# Chapter 1

# Introduction

## Terms of reference

1.1 On 5 April 2001 the Senate asked the Committee to inquire into the management of Australia's urban water, with a reporting date of 1 April 2002. The terms of reference are shown at p iii.

1.2 Several priority matters intervened to prevent the Committee making any progress on a hearings program prior to the federal election held in November 2001. The Senate's reference lapsed with the dissolution of the 39th Parliament. However, on 15 February 2002 the Senate in the 40th Parliament authorised the Committee to resume the inquiry with the same terms of reference, with a new reporting date of 27 June 2002. That reporting date was subsequently extended to 5 December 2002 when it became clear that the scale and complexity of the inquiry required more extensive consideration by the Committee.

## Conduct of the inquiry

1.3 The Committee's inquiry had been advertised in the national press in April 2001 with a request that submissions be provided to the Committee by 15 June, which deadline was subsequently extended to 12 July to allow several major groups to finalise their submissions. Prior to the calling of the election, some 57 submissions had been received.

1.4 The renewal of the Committee's inquiry in February 2002 was not the subject of another round of national advertising. Rather the Chair issued a media release to invite interested individuals or organisations to consider lodging submissions by 15 March 2002 and the secretariat made contact with the authors of the 57 submissions to invite them to consider updating their contributions.

1.5 The Committee finally received submissions from 82 submitters, some of whom provided several submissions. Details are given in Appendix 1.

1.6 The Committee then conducted a series of eight public hearings over the period from March to May 2002. Hearings were held in Canberra on two occasions, and in Townsville, Brisbane, Sydney, Melbourne, Perth and Adelaide, details of which are given in Appendix 2. Witnesses at the hearings presented the Committee with a wealth of background material. A schedule of these exhibits is given in Appendix 3.

1.7 The Committee took the view that its understanding of the issues in relation to urban water management would be assisted by the undertaking of a program of site visits in conjunction with its hearings program. The Committee undertook site visits in each of the cities in which it held hearings, as well as visiting the city of Bendigo in regional Victoria. Details of the site visits are given in Appendix 5. The Committee's program of site visits took it to a range of localities around Australia that are subject to very different climatic and geo-morphological conditions, leading to very regionalised urban water problems. It was able to study at first hand water management in urban areas in the tropics, in both a major inland centre and a provincial inland regional centre, and in several capital cities in coastal locations. The range of challenges was impressive, as was the initiative being shown in meeting them.

1.8 Some members of the Committee also took part in a delegation to the New Zealand Parliament from 15 to 17 April 2002. As part of its program, some of the delegation were briefed by the Wellington Regional Council about its approach to water management and visited the Te Marua Water Treatment Plant and the Moa Point Sewage Treatment Plant. While that delegation is the subject of a separate report to the Senate, its findings have informed the Committee's deliberations in this report.

1.9 Under term of reference (a)(i) the Committee was requested by the Senate to undertake a review of existing reports on the management of water, predominantly in urban areas. To assist that review the Committee compiled a schedule of several key reports, including detailing their backgrounds and outcomes. That schedule is included as Appendix 7.

## Acknowledgments

1.10 The Committee notes that, while responsibility for land and water management in Australia rests primarily with the governments of the States and Territories, and also with local government under authority delegated by the State governments, it received nothing but the full cooperation of representatives of all three tiers of government during the course of this inquiry. There seemed to be a general recognition that the Commonwealth Government can play an important role in the process of urban water management, not only in showing national leadership in an otherwise fragmented sector, but also in ensuring that Australia's international obligations are met.

1.11 The Committee wishes to express its appreciation to all parties who contributed to the conduct of this inquiry, whether by making a written submission, by personal attendance at a hearing or, in many cases, by both written and oral submissions. Many witnesses gave of their time and expertise – and their obvious passion for the subject – to ensure that the Committee's inquiry process was a comprehensive and rewarding one.

1.12 The Committee also wishes to thank the several councillors, council officers, and representatives from other public bodies and from the private sector who went to great lengths to ensure that the Committee's inspections and site visits program was fully beneficial.

1.13 The Committee trusts that the quality of this report justifies their investment in the inquiry process and that their contributions will have been of benefit to the identification of normative approaches to the sustainable use of urban water.

1.14 Finally, the Committee wishes to recognise the efforts of the officers of the secretariat who assisted it with the conduct of the inquiry and the drafting of this report.

## The report

1.15 The report addresses each of the Committee's terms of reference and was written with two major factors in mind. First, the report aims to take a solutions based approach to urban water management, rather than simply recounting a list of problems. Second, the Committee is mindful of the fact that urban water management is a shared responsibility of all three levels of government in Australia, which ensures a degree of jurisdictional complexity. The report considers the roles of all three levels, but ultimately focuses its recommendations on matters that are the responsibility of the Commonwealth.

1.16 In this context, the report is structured as follows:

1.17 Chapter 2 examines the water supply and gives an overview of the environmental, health and economic implications of related problems. This sets the scene for addressing the imperatives to achieving ecologically sustainable water management. [Terms of Reference a(ii)]

1.18 Chapter 3 then addresses the general options available to achieve this sustainability, including demand management, water efficiency and recycling. [Terms of Reference d.]

1.19 Chapter 4 covers the issues associated with stormwater management, use and reuse. [Terms of Reference c.]

1.20 Chapter 5 discusses problems associated with effluent and best practice treatment systems.

1.21 In Chapter 6, the Committee evaluates the progress and adequacy of Australia's policies to achieve the solutions raised in Chapter 3, including a discussion of the adequacy of laws, organisational arrangements, and environmental management systems. [Terms of Reference d(iii)].

1.22 The report concludes with Chapter 7's discussion of pricing issues and other economic instruments.

1.23 This chapter sets the scene for the rest of the report by describing the water cycle; the characteristics of Australia's water supply, and the overall patterns of supply and demand for water in Australia's urban centres.

## The water cycle

1.24 Urbanising the landscape has profound effects on the natural water cycle and while all types of land development have hydrological consequences, the impacts of cities and towns create a range of issues distinct from those of other land uses. Impacts on one part of the water cycle can have far reaching effects and despite the fact that urban water use in Australia comprises only about 25-30 per cent of total water use, the consequences, both ecological and economic of that consumption, raise questions about the sustainability of Australia's cities.

1.25 Very little water escapes from the planet because of the earth's atmosphere, and the total amount of water on the earth has remained about the same for many millions of years. Of all water on the earth, only about 2.5 per cent is fresh water and of this, 76 per cent is located in glaciers and ice caps; and 23.5 per cent comprises groundwater. Only 0.5 per cent of global water is in freshwater lakes, rivers, water vapour in the atmosphere, and water stored in animal and plant life, and in the soil.[1]

1.26 Water is stored on the land – in the soil, plants and animals, surface waters and groundwater – in the oceans, and in the atmosphere, and it is transferred between these reservoirs in a continuous cycle driven by the sun. Each year, the average amount of water circulating is less than one per cent of the total volume of water on land and in the oceans.

1.27 The **water cycle** (or hydrological cycle) is the means by which life is sustained. A unique characteristic of water is that it exists in all physical states on the earth – gas, liquid and solid.

1.28 The sun's energy heats water on the surface of the planet, changing it from a liquid into **water vapour**. As the earth's surface warms, rising currents of air carry the vapour upward to where temperatures become cooler and it condenses into tiny drops of liquid, forming clouds. These drops of water combine and grow (it takes one million droplets to form one raindrop) and, under suitable conditions, fall back to the land and oceans as **precipitation** (sleet, rain, snow or hail). Most of the water that falls as precipitation comes from the sea – approximately 85 per cent is evaporated from the oceans and 15 per cent from the land.

1.29 Water returns to the atmosphere through evaporation from soil and water surfaces as well as through transpiration from plants, which is the process through which plants take in water from their roots and expel it as water vapour through their leaves. The total loss of water from a particular area, equal to the sum of the water lost by evaporation from the soil and other surfaces and that lost by transpiration from plants, is referred to as **evapotranspiration**.

1 Smith, David Ingle, *Water in Australia*, pp 2-3.

1.30 Some precipitation may evaporate during its fall towards the earth and some may evaporate after it is intercepted by vegetation and other surfaces. Precipitation, which reaches the ground, can follow one of four courses. It may:

- remain on the surface as pools, puddles or surface soil moisture which is directly evaporated;
- flow over the land into depressions and channels to become surface **runoff** in the form of streams which either recharge **groundwater** via seepage or flow to lakes and the oceans;
- soak a little way into the ground, be absorbed by plant roots and return to the water vapour in the air by transpiration from the leaves; or
- soak deeply into the ground and add to the groundwater, moving slowly along the direction of groundwater flow towards rivers, wetlands or the sea.

1.31 A **water catchment**, or **drainage basin**, is an area of land that collects and transfers all the precipitation that falls on it (with the exception of evapotranspiration and groundwater losses) into a particular watercourse. Divisions between catchments are called watersheds.[2] The catchments of creeks, gullies and streams combined, form the catchments of small rivers, which together form the catchments, or river basins, of major rivers.

## *Water purification*[3]

1.32 Natural processes at work in catchments purify water. Forests, woodlands, wetlands, and grasslands act as sponges to slow the movement of water from where it falls as precipitation to where it enters streams, lakes, and estuaries. This is important to natural purification because many of the processes by which the water is cleaned are biological processes, often performed by microbes such as bacteria and fungi. These processes take time, so the longer it takes for water to move across the landscape, the greater the cleansing that occurs.

1.33 Once runoff water reaches a stream, fallen trees, branches and natural debris (snags) in the water are important to slow it down and allow bacteria, fungi and algae to remove impurities. Wetlands and streamside (**riparian**) vegetation are particularly important for removing fine sediments from runoff. As sediment-laden water moves across and through these ecosystems, 80-90 per cent of the fine particles settle to the bottom or are filtered out. Other pollutants such as organics, metals, and radionuclides (radioactive elements) are often adsorbed[4] by silt particles. Settling of the silt removes these pollutants from the water. Thus sediment deposition provides multiple benefits to downstream water quality.

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2 Although in America, this term is used to refer to the catchment itself.

3 This section is based on the Science NetLinks site, at: http://www.sciencenetlinks.com/lessons.cfm?DocID=275

4 Adsorption is the bonding of substances such as metals and nutrients onto the surfaces of suspended particles by way of physical, chemical and biological processes.

1.34 Healthy microbial assemblages in soil and on surfaces in water change the form (and possibly the toxicity) of pesticides and they also remove heavy metals, such as mercury, that can be harmful to life. Wetlands can remove 20-60 per cent of heavy metals in the waters moving through them, and microbes in ecosystems can also change herbicides so that they are no longer toxic. It is difficult to predict how much and what type of materials and pollutants can be treated within a natural ecosystem without permanently harming it, but factors such as location, size, type of soil and vegetation, water flow (patterns and extremes), and the landscape in which the ecosystem exists all play a part.

## *Soil moisture*

1.35 Besides surface water storages such as rivers, there are two other important stores of water in the catchment — the moisture in the soil and the groundwater. Most of the rain that falls in catchments is stored in the regolith[5] before being transpired by plants, entering the groundwater system or becoming streamflow.

1.36 The soil itself acts as a regulator in the water cycle. Soil moisture occupies the pores between grains and crumbs of soil. When these pores are completely full of water, the soil is saturated and water can drain through fairly easily. The role of the soil as a regulator arises because it retains water and partitions it between the runoff part of the system and evapotranspiration. The extent of this partitioning depends on the soil moisture content – when the soil is dry, drainage and throughflow are slow and most precipitation is retained in the soil and subsequently evaporated. When the soil is initially moist, the addition of further water from precipitation promotes rapid drainage, groundwater recharge and throughflow. The soil organic matter content also has an important influence on the amount of water that soaks into soil.

## *Groundwater*

1.37 The amount of water that infiltrates the soil varies with the degree of land slope, the amount and type of vegetation, soil type and rock type, and whether the soil is already saturated by water. The more openings there are in the surface of the land (cracks, pores, joints), the more infiltration occurs. Water that is not used by plants or evaporated, continues moving downward through empty spaces in the soil, sand or rocks until it reaches a layer of bedrock though which it cannot easily move and that over time becomes saturated. The water fills the empty spaces and cracks above that layer and is referred to as groundwater. Over time the bedrock can become broken and fractured, and some bedrock, for example limestone, is dissolved by water. These processes can lead to vast underground lakes being created.

1.38 The **water table** is the surface of the saturated zone, wherever that occurs below the ground. It is not so clearly defined as the surface of a river since the water level gradually peters out. Surface tension allows 'capillary' forces to penetrate the

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5 The regolith is the layer of loose unconsolidated material, including soils, sediments, and rock fragments, that overlies bedrock and forms the surface of the land.

soil above the water table without saturating it. This zone in the soil is vital for most land plants and biological activity, which require both water and gases for their survival.

1.39 Groundwater is replenished (**recharged**) through infiltration from precipitation and through leakage from the bottom of some rivers and lakes. In some cases it is groundwater which provides the water for wetlands. In general, shallow groundwater flow is towards nearby rivers or springs, where it seeps to the surface to form stream flow, but deeper groundwater may flow beneath catchments to form regional flow systems.

1.40 Groundwater comprises 23.5 per cent of the world's fresh water. This percentage can be compared with the amount of surface water on the planet (in fresh-water lakes, soil moisture and water vapour in the atmosphere) which constitutes only 0.5 per cent of the world's fresh water. However, groundwater can be of varying quality and much is inaccessible to humans with current technology. Human induced pollution issues aside, the chemical components of groundwater depend upon the different types of rock and other matter in which the water is contained and through which it flows.

## Aquifers and aquicludes

1.41 Rocks with moderate to high permeability allow considerable flow of groundwater and are called aquifers ('water-bearers'). Rates of groundwater flow depend on the composition of the rock containing the groundwater (the **aquifer**). Permeable rocks such as sands, gravels and some types of limestone allow rapid water flow but impermeable layers such as clay can limit the flow rate – for example to less than a metre per year. Rocks such as clays, shales, silts and unfractured crystalline rocks are **aquicludes** – their permeability is so low that they form barriers to groundwater movement.

1.42 An **unconfined aquifer** is one where the upper boundary of the groundwater body is the water table and the groundwater is fed by recharge from the unsaturated zone. Alternatively, a **confined aquifer** is one where the aquifer is overlain by an aquiclude and so there is no water table: the water cannot find its own level but is forced to stay below the overlying layer. In this case the water is under greater than atmospheric pressure and, in some cases when a bore is drilled, the internal pressure can be sufficient to propel water to the surface without the aid of a pump. This is an artesian bore.

1.43 If more water is extracted from an aquifer than is recharged, the water table is lowered and subsidence of the land can follow as the previously saturated ground dries and shrinks. On the other hand, when deep-rooted vegetation is removed and/or irrigation is used, the water table can rise and dissolved salts and minerals are brought to the surface and left there when the water evaporates, causing the problem known as **dry land salinity**.

## Disruptions to the natural water cycle by cities and urban centres

1.44 The water cycle continually replenishes water but cities and urban centres change the hydrological characteristics of catchments and affect various elements of the cycle. In addition to changes to hydrological cycles, urbanisation destroys biophysical processes, the energy cycle, the carbon cycle and a variety of ecological cycles and food chains, all of which are connected.[6]

1.45 Urban water extractions and returns to the environment often have a significant and unsustainable impact on the catchments in which they are situated. Impacts on the water cycle arise from changes to the flow regime of rivers, disconnections between parts of the river system (upstream, downstream and the floodplain, for example) and removal of the links between groundwater and surface waters. These changes permeate through the entire cycle, from the headwaters of the catchment to receiving waters.

1.46 Developing the natural landscape alters the amount of water that soaks into the ground, the way it moves across the surface of the land, and what materials it carries with it. The Australian Water Association considers that of all catchment processes, land use has the most profound impact on water quality and the environment.[7] In addition, urban areas divert waters from the environment, prevent groundwater recharge and regulate rivers, all of which affect ecosystems. The extent of a city's influence in this regard can range more widely than its perimeter and is referred to as an **ecological footprint**:[8]

> The natural flow of water down a river to the sea is a part of a healthy system. It is when we prevent this that the river's health is at risk.
>
> Today, we see a link between the amount of water taken by Melbourne and the level of toxic algae in the Gippsland Lakes. The algae flourish on a bank of nutrients caused by land-clearing and agriculture. The nutrients are triggered by low flows in the rivers running into the lakes. The ability of the rivers to cope with their nutrient loads is directly related to their ability to flush themselves naturally.
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> The landscape, its plants and animals have evolved to cope with episodic flooding. By taking out the water and preventing floods, we need to be aware we are also destroying that landscape.[9]

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6 Mr Daniell, *Proof Committee Hansard*, Adelaide, 30 April 2002, p 498.

7 Australian Water Association (AWA), *Submission 41*, p 8.

8 The ecological footprint is the geographical area affected by a city. It includes directly and indirectly affected resources used by the city as well as areas affected by the wastes the city generates. An individual's ecological footprint is the area of land required to sustain that person's lifestyle.

9 John Williams, *A landscape dammed by dreams*, by Kim Mahood, Sunday Age, 9 December 2001, p 15.

1.47 To ensure a ready supply of water for communities, engineering systems modify the natural regimes and disturb what were previously, stable ecosystems. Withdrawing increasing volumes of water from surface flows significantly adds to the stresses on the ecological systems from which the water is sequestered, affecting the lifecycles of fish and other animals (discussed in Chapter 2). These changes in river systems can then have further flow-on effects in other ecosystems, such as wetlands and floodplains, reducing biological diversity and ecological integrity.

1.48 The Centre for Cooperative Research for Catchment Hydrology lists some effects of changes in catchment hydrology as a consequence of urbanisation as follows:[10]

- increased frequency of high velocity flows;
- increased frequency of disturbance to the streambed (and hence the habitats of many aquatic fauna);
- increased sediment supply and sediment transport rates;
- long term changes to streambed particle size range due to the removal of the more easily eroded and supply limited materials;
- increased rates of streambed erosion and upstream movement of erosion fronts.

1.49 These changes lead to a reduction in in-stream physical diversity and, as a consequence, reduce aquatic ecosystem health.

### *Changing water levels*[11]

1.50 Development though drainage, clearing, drawing water for water supplies, and construction can affect the local water balance in complex ways. For example, the following activities raise the water table, raise wetland levels, and cause normally seasonal wetlands to be often or permanently flooded:

- constructing **impervious surfaces** such as roads, roofs, footpaths and car parks, reduces groundwater recharge and increases runoff;
- **channelling water** away in drains may raise wetland levels in other places; and
- **clearing vegetation** and removing trees reduces the amount of water drawn up through roots, which can allow the water table to rise.

1.51 In some areas, the rising water table brings dissolved salts to the surface, causing **salinity** problems.

10 Cooperative Research Centre for Catchment Hydrology, *Submission 25*, p 2.

11 This section is based on information from the Water and Rivers Commission site, *Water facts7*, at: www.wrc.wa.gov.au/public/waterfacts/7_water_cycle/impact.html

1.52 Conversely, the following activities can lower the water table and dry out wetlands:

- draining wet, low-lying land for housing or agriculture destroys wetlands and moves water from one place to another, for example to drainage sumps, other wetlands or rivers; and
- excessive use of shallow groundwater can lower the watertable and dry out wetlands some distance away from the bores.

1.53 Lowered water tables can damage native vegetation and wetland ecology.

## *Pollution*

1.54 Probably the most obvious effect of urban centres is the pollution of water courses, oceans and groundwater from contaminated water entering the environment, either from direct discharge from **point** or **non-point sources**,[12] or from the seepage of water from contaminated sites into aquifers and other water courses. According to Dr Fleming:

> There are many sources of water pollution, and most are related in some way to the way that land is developed, used and managed. Sources of pollution are well known and include industrial sites, waste depots, rail yards, sewage disposal facilities, contaminated sites (such as leaking tanks at fuel stations), inappropriately designed landfills, and sites of intensive animal keeping (such as stock sale yards).[13]

1.55 The types and consequences of pollution from these various sources is discussed in later chapters.

## *Interactions between various parts of the urban water system*

1.56 In general, urban water authorities focus on a once-through use-and-dispose approach to water. This involves harnessing a water source, filtering and disinfecting the water, storing it, and delivering it to users through a system of pipes. Following its use, in sewered areas water is sent through a system of **sewerage**[14] pipes to the wastewater treatment facility (**sewage plant**) where it is treated. The resulting **effluent**[15] is then discharged, usually to the ocean.

1.57 Current water treatment technologies allow water to be cleansed and made available for more than one use. Rainwater, greywater and effluent can all be captured, treated and made suitable for a variety of uses, thus reducing requirements

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12 Point sources are identified sources of pollution such as discharge pipes. Non-point sources are diffuse sources of pollution such as agricultural runoff and stormwater runoff.

13 Dr Nicholas Fleming, *Submission 8*, p 4.

14 Sewage refers to wastewater and refuse, and the sewerage system is the pipes and fittings which convey the sewage.

15 Effluent is the liquid waste matter that results from sewage treatment or industrial processing.

for increasing amounts of water being diverted from catchments for the consumption of cities.

1.58 Many submissions emphasised the importance of an holistic approach to water management, that considers the total water supply rather than dissecting it into segments – potable water, greywater, blackwater, stormwater, groundwater, natural river water and recycled water. These are all interrelated and changes in one area will have impacts on the dynamics in the rest of the system.

1.59 Ultimately there is a finite quantity of water in the system, and this total water resource supports the biodiversity of life and environment in the catchment, including the urban communities who live in, take and dispose of their water.[16] Just as the various components of the water cycle are linked, so too are the various components of the urban water system and each can influence the other. Significantly changing the method of storage, the volume, the pollution and the discharge of any or all the types of water (potable, grey, black, stormwater etc), would need to be carefully analysed and the benefits and costs identified as they affect the whole system.

1.60 For example, if the need (demand) for potable water is significantly reduced by using stormwater and recycled greywater, then less potable water requires storage, transport and treatment, less effluent requires disposal (large quantities would be taken by water recyclers) and the volume of flows in stormwater drains would fall, reducing localised flooding. Use of stormwater can mitigate peak flows from drainage systems (which are magnified in urban areas due to the prevalence of hard surfaces). However, stormwater use may reduce the market for wastewater reuse.[17]

1.61 For this reason the system ought to be considered as a whole within, and as a part of, the water cycle, and be holistically managed.

## Defining ecologically sustainable water use

1.62 The COAG water reforms of the 1990s were instigated in recognition that Australia was not managing its water resources sustainably and the consequences, in addition to a degraded environment, would be felt on economic activity. Many submissions to the Committee's inquiry were able to identify activity that was not ecologically sustainable, but few could say precisely what constitutes sustainability:

> I believe it is false to suggest that anyone knows what constitutes a sustainable urban water system. Certainly, there are many people developing and applying technologies to use water more efficiently and to make better use of municipal effluent and stormwater, and it is likely that these activities are important in pursuing sustainability. However, the challenge and complication arises in integrating these technologies into

16 Stormwater Industry Association, *Submission 37,* p 3.

17 CSIRO, *Submission 47*, p 14.

> water systems where traditional technologies and traditional thinking dominates.[18]

1.63 It is generally agreed that current urban water use is not sustainable. Although the urban water system is often referred to as a ‘cycle’, it is actually more of a linear flow of water. In an environment of ever increasing city sizes, urban developments exceed the capacity of natural systems to absorb the effects of urban water use.

1.64 The key to achieving ecological sustainability therefore revolves around returning this linear pattern to its natural cycle, and not creating impacts on the environment greater than can be assimilated within the natural ecosystem. In practice, this means changing the human tendency to ‘solve’ problems by displacing them.

1.65 In doing this in cities, each component of the urban water management system cannot be viewed in isolation from other parts of the system and it must be integrated with the management of other urban infrastructure:

> The reality is that the most effective and enduring solutions require a multi-disciplinary and holistic approach to living with the capacity of natural systems.[19]

1.66 The CSIRO recommends more self-sufficient systems for the provision of water to urban areas:

> If the environmental impact of providing urban water services is to be reduced, a movement towards more self-sufficient systems is required rather than the once-through systems that presently dominate. This should not be taken to suggest that existing systems should necessarily be dismantled, as this may not be required to satisfy sustainability criteria. Rather, it suggests that continuous development of new linear systems is unlikely to be sustainable: we must seek systems that reduce dependence on new natural resources as sources of supply and waste sinks. The form of urban development will significantly affect our ability to reduce dependence on imported water and the use of the environment as a waste sink.[20]

1.67 The United Nations Commission on Environment and Development 1987 report, *Our Common Future* (the Brundtland Report) defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their needs.[21] Needs are culturally and socially determined; nevertheless sustainable development should promote consumption levels that are supported ecologically and that can be realised by all. At a minimum,

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18 Dr Nicholas Fleming, *Submission 8*, p 4.

19 Dr Nicholas Fleming, *Submission 8*, p 10.

20 CSIRO, *Submission 47*, p 34.

21 CSIRO, *Submission 47*, p 13.

sustainable development must not endanger the natural systems that support life on Earth: the atmosphere, the waters, the soils and the living beings.

1.68 The ability to ‘meet the needs of the present without compromising the needs of the future’ is an aspiration that will be difficult, if not impossible, to satisfy. However, the underlying principle provides a yardstick against which development objectives should be measured.

1.69 Sustainability, of course, requires the integration of social, environmental and economic considerations and as such, is not a fixed condition. It will be difficult to determine the ‘state’ that represents sustainability, albeit particular requirements might be identified (for example the amount of water that should be made available for environmental flow in a particular river system). Consequently, it will often be more valuable to work toward a reduction in unsustainability than to decree something as sustainable and posit that as an immutable goal.

1.70 This view of reducing unsustainability is echoed by Professors Troy and White:

> The notion of sustainability means different things to different people, and the policies aimed at enhancing the sustainability of cities will differ between regions and countries. While sustainability is seen by some as problematic and by others as unattainable, the reality is that Australia must adopt the strategy of a transition to sustainability by attempting to systematically reduce environmental stress. Nowhere is this strategy more important than in the city given its central role as a major source and location of environmental stress. An integral part of contemporary strategies and initiatives has been to make our cities less unsustainable.[22]

1.71 Several witnesses suggest that sustainability is about a process or a journey rather than a destination.[23] This journey involves continuous learning, adaptation and improvement to sustain environmental, social and economic systems. According to the Australian Water Association:

> The complexity of linking systems and processes is so great that the process can only be tackled on an evolutionary basis and may never be achieved completely. A useful concept here is adaptive environmental management, which means making the best decisions we can now, but revisiting them as new, better information comes to hand. Taking the ecologically sustainable water use journey will thus mean starting with the best we know now and improving it as we learn more, by experience and from research.[24]

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22 Centre for Resource and Environmental Studies, *Submission 50A*, p 1.

23 Dr Nicholas Fleming, *Submission 8*, p 4; Australian Water Association, *Submission 41*, p 7; and Mr Daniell, *Proof Committee Hansard*, Adelaide, 30 April 2002, pp 505-506.

24 Australian Water Association, *Submission 41*, p 7.

1.72 Additionally, sustainability depends on the integration of the economics, the environment and the social consequences of the planning and implementation cycle.[25] The CSIRO notes that the most important benefit of an integrated approach to urban water systems is the potential to increase the range of opportunities available in order to be able to develop more sustainable systems:

> In as much as the robustness of ecological systems is increased through diversity, so too will the sustainability of urban water systems be improved if an increased range of options are made available enabling solutions to be tailored to local circumstances.[26]

1.73 Melbourne Water points out that the broad principles of sustainable water use involve understanding the complex relationships and interconnections between all the elements in the environment so that decisions are made in an holistic context; for example the sequential relationship between well managed catchments and healthy waterways and bays.[27] Given that there is no universally acceptable definition of sustainability, practitioners have defaulted to using a set of guiding principles to deliver outcomes that are consistent with ecologically sustainable water use. These are:

- decision making processes should incorporate economic, environmental and social equity considerations;
- global dimensions of environmental impacts need to be recognised and considered when protecting biodiversity;
- when there is a lack of scientific certainty about the extent of risk, the precautionary principle should apply;
- flexible policies such as improved valuation of all costs, pricing and incentive mechanisms should be adopted; and
- decisions should provide for broad community involvement on issues that affect it.[28]

1.74 Sustainable water use will vary from site to site, and even within sites and it needs to be viewed within the context of all social, environmental and economic considerations. For example, sustainability might not be achieved by arbitrarily decreeing a reduction in water use, if achievement of the goal requires additional energy use and where water abstractions do not lead to an appreciable diminution of ecosystem function. In other circumstances, such as those in which a minimum environmental flow requirement has been mandated, setting a target for reducing water use to meet human needs may be an entirely appropriate strategy. Similarly, at a site where water use appears sustainable, but wastewater discharge is clearly not, the

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25 Mr Daniell, *Proof Committee Hansard*, Adelaide, 30 April 2002, p 499.

26 CSIRO, *Submission 47,* p 34.

27 Melbourne Water, *Submission 46,* pp 3-4.

28 Melbourne Water, *Submission 46*, p 4.

solution to the discharge problem – such as greater reuse – will affect the amount of water used, even though the current demand would appear to be sustainable.[29]

1.75 The Australian Water Association makes the point that ecologically sustainable water use means creating a sustainable system in each catchment or coherent management unit (bioregion or groundwater region), which allows communities today to maintain their quality of life, without compromising either the environment or future generations' ability to enjoy at least the same quality of life.

1.76 As populations grow, generally and in particular locations, increasing pressures will be put on water resources. Traditionally, increasing demand has been met by harnessing new supplies to meet that demand, but the environmental, social and economic costs of such an approach are high and increasingly recognised as unacceptable, in both environmental and economic terms. Where such constraints are emerging, planning effort needs to be directed to determining the most appropriate way of meeting human needs from the host of options that have emerged over the past two decades or more.

## *Indicators of sustainability*

1.77 Despite some difficulties in defining sustainability, the CSIRO suggests that there is considerable value in measuring systems performance against a range of criteria to determine progress towards an objective relevant to particular aspects of the system or its impact.[30] Mr Davis from the Australian Water Association echoed this approach:

> We are trying to wrestle with the idea of how you measure sustainability. The only thing we can do is to try to come up with a lot of surrogates for sustainability and to try to measure them and look at best practice.[31]

1.78 The CSIRO suggests that relevant objectives would include those related to systems performance, environmental outcomes, economic and social impacts and regulatory issues.[32] A list would include:

- water availability – which reports on the source and extent of supply;
- water usage – which provides a measure of water usage within and across urban sectors;
- supply water quality – which reports on the quality of the water reaching the public;
- water disposal – including both stormwater and wastewater discharges to receiving environments and the contaminants they carry;

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29 CSIRO, *Submission 47*, p 13.

30 CSIRO, *Submission 47*, p 14.

31 Mr Davis, *Proof Committee Hansard*, Sydney, 18 April 2002, p 231.

32 CSIRO, *Submission 47*, pp 14-15.

- receiving water quality – which provides a measure of the extent to which receiving marine and inland water environments are affected by stormwater and wastewater discharges;
- flow implications – which measures the extent to which abstraction for supply purposes alters flow regimes and natural environments;
- economic and institutional implications – which measures the expenditure or investment in conventional stormwater, groundwater and wastewater practices, as well as ‘greener’ initiatives;
- political and social objectives – which reports on the ability of urban water systems to satisfy community needs; and
- promotion of reuse, recycling and sustainable water use – which identifies and measures the extent to which alternative, environmentally friendly technologies are being implemented. It also reports on the extent to which the community is involved in these activities.

1.79 An alternative grouping of these issues would be the following broader objectives:

- conservation and enhancement of public health;
- conservation and enhancement of aquatic ecosystems and associated environments (water quality);
- conservation and management of water resources (flow control);
- satisfaction of economic and institutional constraints;
- meeting of political and social constraints; and
- promotion of reuse, recycling and sustainable water use.[33]

1.80 The following table lists a selected range of possible indicators of urban water system sustainability, and matches them against the issues and objectives that they are attempting to satisfy:[34]

*Table 1*

| **Possible Indicators of Urban Water Sustainability** | |
|---|---|
| **Objective/Issue** | **Indicator** |
| **1. Water availability** | • proportion and volume of water derived from groundwater, surface water and reclaimed water resources; and<br>• frequency and duration of water shortages. |

33 CSIRO, *Submission 47*, p 15.

34 CSIRO, *Submission 47*, p 15.

| | |
|---|---|
| **2. Water usage** | • daily and total municipal water usage by sector;<br>• municipal household water consumption patterns;<br>• authorised versus actual groundwater abstraction; and<br>• number of water trading licences issued, and volume of water traded. |
| **3. Supply water quality: conserve and enhance public health** | • human health criteria exceedances. |
| **4. Water disposal** | • proportion of municipal population served by treated wastewater;<br>• percentage and amount of effluent disinfected - by method;<br>• disposal and reuse of treated wastewater;<br>• volume of sludge from wastewater treatment plant disposed or reused; and<br>• volume of stormwater treated and discharged to receiving waters or reused. |
| **5. Receiving water quality: conserve and enhance aquatic ecosystems and associated environments** | • guideline trigger levels reached in inland waters; and<br>• pollutant loadings to marine environments from stormwater and wastewater pipes and drains, which exceed environmental health regulations. |
| **6. Flow implications: Conserve and manage water resources** | • ratio of groundwater abstraction to groundwater recharge; and<br>• river discontinuity. |
| **7. Satisfy economic and institutional constraints** | • expenditure on water supply;<br>• expenditure on wastewater treatment and disposal;<br>• cost of water supply and disposal under conventional versus 'greener' urban water systems; and<br>• investment ratio in 'greener' wastewater, stormwater and groundwater management practices, as a proportion of total wastewater, stormwater and groundwater expenditure. |
| **8. Social and political expectations** | • already listed within indicators 1-7, and indicator 9. |
| **9. Promote reuse, recycling and sustainable water use** | • proportion of greywater, stormwater and blackwater recycled/ reused;<br>• proportion of wastewater reused (before/after) |

| | |
|---|---|
| | reaching wastewater treatment plant;<br><br>• composite indicator: management effort; and<br><br>• number of people involved in community water monitoring programs. |

1.81 The Committee also took evidence on the value of triple bottom line reporting as a way to encourage best practice.[35] This idea ties in with the concept mentioned previously of sustainability being about a process. The notion of reporting against the three components (or 'bottom lines') of economic, environmental, and social performance is directly tied to the concept and goal of sustainable development. The perspective taken is that for an organisation (or a community) to be sustainable (a long run perspective) it must be financially secure (as evidenced through such measures as profitability); it must minimise (or ideally eliminate) its negative environmental impacts; and, it must act in conformity with societal expectations. These three factors are obviously highly interrelated.

1.82 The Department of Land and Water Conservation is planning for balanced outcomes by taking triple bottom line goals into account when considering various options for managing the urban water cycle.[36] The Balanced Outcomes Planning (BOP) approach involves the economic evaluation of different options or bundles of options to achieve a stated goal at least cost. This approach makes some attempt to include external costs in the analysis.

1.83 Foley and Daniell conclude in their paper, that governments need to be committed and have a sustainability model in place that is not static and allows targets and goals to be reviewed on a regular basis. The model must recognise that sustainability is location and resource dependent and that decision support systems are required to assess the merits of proposed projects in relation to economic, social and environmental issues independently of political considerations.[37]

1.84 This issue of political considerations is an important point. Decisions made in the timeframe of the electoral cycle do not sit well within the context of a long-run, sustainable approach:

> There is certainly a time frame issue there and, with all respect, I think that it partly has to do with the political process. When you have people making decisions who have a horizon of two years, or six years if they are in the upper house, then the ability to look at planning horizons for something like

35 Dr Essery, *Proof Committee Hansard*, Sydney, 18 April 2002, pp 186 and 187.

36 Department of Land and Water Conservation, *Submission 36*, p 2.

37 Centre for Applied Modelling in Water Engineering, *Submission 30*, Attachment, p 10.

> water, which should be looked at 20 or 50 or 100 years ahead, becomes difficult.[38]

## Australia's water resources

1.85 One of the worst Australian clichés is that this is the 'driest continent on Earth'. Leaving aside that the statement is technically untrue (Antarctica is drier) it masks significant regional variation that *must* be taken into account in any assessment of the adequacy of water supplies or the extent to which our total water stocks are utilised.[39]

1.86 Australia's large size as an island continent that stretches from an equatorial zone in the north to a temperate zone in the south, means that it has a wide range of climatic regions. These vary from tropical regions in the north, dominated by the monsoonal seasonal extremes of 'wet' and 'dry', through the arid expanses of the interior and west representing about 50 per cent of the land mass, to temperate regions in the south that reflect Mediterranean-type climates with winter rains and hot dry summers. Only Tasmania and parts of the eastern coast including the adjacent ranges and slopes, experience a more temperate climate with relatively uniform rainfall on average.[40]

1.87 In addition to the differences in climate across the Australian landmass, there are significant year-to-year variations in rainfall, so that areas with reasonably high annual rainfall averages can also experience regular drought episodes interspersed with severe flooding (for example Sydney and Brisbane). The explanation for this large annual variability is the influence of the **Southern Oscillation**, which is the variation in the atmospheric circulation and is the driving force for the El Niño Southern Oscillation (ENSO) effect. Australia is one of the most affected continents, experiencing major droughts interspersed with extensive wet periods. The frequency of tropical cyclones, heat waves, bushfires and frosts is also linked to the Southern Oscillation.

1.88 In general, annual rainfall variability is inversely related to annual precipitation – that is, arid regions not only receive less rain on average but the rain that they do receive is more episodic. A statistical measure, the coefficient of variation,[41] is used as an indication of this variability – the larger the coefficient, the greater the variability. Australia has greater variability of rainfall and runoff than any other continental region and its coefficients of variation are 2 to 4 times those of North America and Europe.[42] It is for this reason that Australia's adoption of European

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38 Mr McRae, *Proof Committee Hansard*, Sydney, 18 April 2002, p 232.

39 CSIRO, *Submission 47*, p 27.

40 *The Australian Water Directory 2001*, Australian Water Association, p 10.

41 The coefficient of variation is the standard deviation divided by the mean.

42 Water Services Association of Australia, *Submission 55*, p 2.

methods of farming, which are based on regular patterns of rainfall, has such a devastating effect on the land.

1.89 Ecosystems in Australia have adapted to this variability and depend on it for their survival. For example, some wetland species are reliant not only on major floods, but on smaller flood episodes, which, with the construction of dams, no longer occur. The imposition of regularity on water flows which is so vital for agricultural, is having a damaging effect on native lifeforms.[43]

1.90 Dr Fisher made the following point:

> In terms of the discharge, it is often thought that if water runs past you then it is wasted. There are views that all that water running out to sea after floods is wasted and should be dammed, and perhaps piped to other areas where there are water shortages. But that is a part of the ecology of the inshore marine waters. For example, in the Snowy River system, research has been done showing that the lack of flow from the Snowy into the Pacific Ocean has stopped the Snowy River from being a location for eels, because they actually sense the water gradient as they swim up the coast. So we do not fully understand these issues about flooding, but floods are part of the marine ecology, as indeed they are of the river ecology.[44]

1.91 Overall, Australia is relatively arid, with 80 per cent of the country receiving less than 600 mm of rain per year and about 50 per cent receiving less than 300 mm. Australia's rainfall is the lowest of the five continents (excluding Antarctica). The discharge of Australia's rivers into the sea is by far the lowest of any of the continents.

1.92 In addition to the extreme variability of the rainfall, Australia has high evapotranspiration rates. The driving force for direct evaporation is incoming solar radiation, and the highest values in Australia are recorded in the central areas of the country which have exceptionally long hours of sunlight.[45] Runoff is the difference between precipitation and evaporation and is the amount of water available for lakes, streams and other land reserves. Evaporation losses greatly reduce the water available as runoff. Worldwide, on average, runoff and groundwater recharge is about 12 per cent of average rainfall – but for three-quarters of the land area of Australia, evapotranspiration limits the runoff to less than 5 per cent of the rainfall. Australia has approximately 5 per cent of the world's land area, but produces only 1 per cent of global river runoff. This contrasts with 31 per cent produced by Asia, 10 per cent by Africa and 7 per cent by Europe.

1.93 Low rainfall, combined with high evaporation rates, results in low surface water flows and many intermittent river systems. In turn, these factors contribute to problems with salinity and algal blooms as rivers do not have sufficient volumes of water to flush through – for example the largest river system in Australia is the

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43 Ticky Fullerton, *Watershed: Deciding our water future*, ABC Books, 2001, pp 234-236.

44 Dr Fisher, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 364.

45 Smith, David Ingle, *Water in Australia*, pp 10-11.

Murray-Darling, but in less than one day the Amazon River in South America carries the equivalent of the Murray's entire annual flow. The hydrological cycle itself is most vigorous in South America and least so in Australia.

1.94 However, Australian's relationship with water is modified by two characteristics. First, it is highly urbanised with 64 per cent of Australia's 19.2 million people living in capital cities,[46] which, with the exception of Perth, are located in quite well-watered regions.[47] Moreover, most of the Australian population is in five cities with populations in excess of one million, of which two, Melbourne and Sydney, have more than three million. This contrasts with the typical population of a European or North American mid-sized city which is around 50,000 people.

1.95 Second, Australia's population is concentrated within 100 km of the Australian coast – far from the arid centre (80 per cent of the population lives within 30 kilometres of the coast, and that number is rapidly increasing). The availability of water has been a significant force behind patterns of urban settlement, with the majority of Australia's urbanised areas lying adjacent to the coasts where water supplies are more secure. As a consequence of these factors, and its low population, the amount of water available per person, ranks among the most favourable on Earth.[48]

1.96 However, there is a mismatch in that Australia's major water resources are in northern Australia and Tasmania (as shown in the following table), whereas most of its agriculture and people are in the south-eastern mainland.

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46 Sydney Morning Herald, *A country practice: pack up, move on and leave a small town to die,* 15 January 2001, p 1.

47 Australian Water Association, *Submission 41,* p 9.

48 Smith, David Ingle, *Water in Australia*, p 16.

*Table 2*

**Australia's divertible and developed water resources in 1995/96**[49]

| Spatial unit | Divertible fresh water resources (gigalitres) | | | Volume used | Proportion utilised (%) |
|---|---|---|---|---|---|
| | Surface water | Groundwater | Total | | |
| Queensland coast | 6000 | 1220 | 7220 | 2740 | 38 |
| Queensland part of Lake Eyre Drainage Basin | 160 | 170 | 330 | 80 | 24 |
| Queensland Carpentaria and Cape York | 20130 | 620 | 20750 | 400 | 2 |
| New South Wales coast | 11160 | 820 | 11980 | 1460 | 12 |
| Victorian coast | 3830 | 380 | 4210 | 1030 | 24 |
| Tasmania | 10860 | 180 | 11040 | 560 | 5 |
| New South Wales part of Murray-Darling Basin | 5140 | 710 | 5850 | 6750 | 115 |
| Victorian part of Murray-Darling Basin | 6530 | 60 | 6590 | 3790 | 58 |
| Queensland part of Murray-Darling Basin | 720 | 230 | 950 | 370 | 39 |
| South Australian part of Murray-Darling Basin | 20 | 0 | 20 | 500 | 2500 |
| South-east coast of South Australia | 80 | 1090 | 1170 | 490 | 42 |
| Adelaide and hinterland | 150 | 230 | 380 | 290 | 76 |
| South Australia Eyre Peninsula and North | 10 | 320 | 330 | 80 | 24 |
| South-west of Western Australia | 1390 | 730 | 2120 | 980 | 46 |
| Goldfields and Esperance | 10 | 50 | 60 | 30 | 50 |
| Gascoyne and Pilbara | 300 | 90 | 390 | 150 | 38 |
| Kimberley | 8660 | 490 | 9150 | 130 | 1 |
| Northern Territory | 17320 | 2420 | 19740 | 120 | 1 |
| **Total** | **92470** | **9810** | **102280** | **19950** | **20** |

## Overview of Australia's urban water supplies

1.97 Australian towns and cities source their water from either surface water, flowing in streams and rivers and stored in dams, or groundwater, extracted from aquifers.

1.98 All State and Territory capital cities are built on major waterways, however the geographical differences in rainfall patterns across Australia means each region has found its own solutions to water supply. Some areas, such as Melbourne and Sydney, rely solely on surface water, while others like Alice Springs, rely on groundwater. Perth, Newcastle and Geelong, use a mixture of surface and groundwater reservoirs. The following gives a brief overview of the various water supply arrangements for cities across the country.[50]

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49 CSIRO, *Submission 47*, p 28.

50 The following analysis includes only capital cities, both for reasons of brevity, and because detailed information is not available on all regional centres.

## *Australian Capital Territory - Canberra*

1.99 The Australian Capital Territory is the largest inland urban centre in Australia and is located in the Murray Darling Basin. The ACT draws its water supply from two separate catchment systems. The principal supply is the Cotter system based on the Cotter River catchment containing the Corin, Bendora and Cotter Dams. These catchment areas are well protected and forested and water is of a high quality requiring little treatment.

1.100 The secondary supply is the Googong Dam collecting water from the Queanbeyan River. This is collected from a rural environment and requires full treatment, and consequently, is ten times as expensive to treat as water from the Cotter.[51] Most of the water required to meet present demands is drawn from the Cotter system, with water from Googong being drawn to meet peaks in demand during the summer or extensive dry periods.

## *New South Wales – Sydney*

1.101 Sydney's bulk drinking water supply is largely drawn from catchments on four main river systems which occupy more than 1.6 million hectares (16,000 square kilometres[52]) in eastern New South Wales. The catchment stretches from the Coxs River near Lithgow in the Blue Mountains, to Goulburn and the Mulwaree and down to the headwaters[53] of the Shoalhaven River near Cooma. The main reservoir supplying about 80 per cent of Sydney's water is the Warragamba Dam (which alone has a catchment area 9,050 square kilometres). Eleven treatment plants and 20,000 kilometres of pipes are required to deliver water to Sydney consumers.

1.102 According to the 2001 audit of the Sydney water supply catchments, 70 per cent of the catchment was in less than excellent condition and was exposed to threats and pressures from continuing urban, rural and industrial development.[54] The report also found that farm animals could access 38 per cent of all rivers in the catchment, resulting in the *cryptosporidium* and *giardia* organisms at the centre of Sydney's 1998 water crisis.[55]

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51 *ACT future water supply strategy*, ACTEW, June 1994, p. 36.

52 Ticky Fullerton, *Watershed: Deciding our water future*, ABC Books, 2001, p 22.

53 Headwaters are the waters upstream from a dam or other such structure.

54 CSIRO, *Audit of the Sydney Drinking Water Supply Catchments managed by the Sydney Catchment Authority*, Interim Report to the Minister for the Environment, NSW State Government, December 2001.

55 Sydney Morning Herald, *Dangerous bugs still lurking in city's water*, 20 December 2001, p 3.

## *Northern Territory – Darwin* [56]

1.103 Around 58 per cent of drinking water in the Northern Territory is sourced from surface water stored in dams and weirs on the Darwin and Katherine Rivers. The remaining 42 per cent is sourced from groundwater.

1.104 Darwin relies on water from the Darwin River Dam, Manton Dam, and the McMinns' Borefield. The other urban centres of Alice Springs, Tennant Creek and Yulara use groundwater.

## *Queensland – Brisbane*

1.105 Brisbane uses surface water stored in four dams – Somerset, Wivenhoe and North Pine. Queensland's State of the Environment report 1999, warns that half of Brisbane's water catchment area is used for grazing, with forests and plantations accounting for another 35 per cent.

## *South Australia – Adelaide*

1.106 Adelaide's reticulated water is sourced from the Murray River, which provides around 40 per cent, with the remaining 60 per cent coming from catchments in the Mount Lofty Ranges. These catchments cover more than 4,000 square kilometres and are in quite poor condition – only 8 per cent of native vegetation remains; 80 per cent of the land is used for primary production, and only 1 per cent of the stream network of the Adelaide Hills has riparian vegetation that is described as being in a healthy condition.[57]

1.107 Adelaide's reliance on the Murray River increases significantly in drought periods, accounting for up to 90 per cent of supply[58] (although Adelaide's withdrawals generally only amount to less than one per cent of the overall Murray-Darling Basin flow[59]). However, it is estimated that by 2020 water supplied to Adelaide from the Murray will fail the World Health Organization standards for drinking water 20 per cent of the time by 2050.[60] The poor quality and poor taste of both the Murray River and Adelaide Hills water is probably the primary reason that 20 per cent of Adelaide home owners use rainwater as their primary source of drinking water.[61]

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56 No evidence to the inquiry was received from the Northern Territory Government.

57 South Australian Government, Environment Protection Agency, *The State of Health of the Mounty Lofty Ranges Catchments from a water quality perspective*, p. 5.

58 CSIRO, *Submission 47*, p 31.

59 Ms Howe, *Proof Committee Hansard*, Sydney, 18 April 2002, p 469.

60 CSIRO, Submission 47, p 31.

61 Mr Allen, *Proof Committee Hansard*, Adelaide, 30 April 2002, p 455.

## *Tasmania – Hobart* [62]

1.108 Hobart uses surface water from three catchments: River Derwent (60 per cent); Mount Field National Park (20 per cent); and Mount Wellington (20 per cent).

## *Victoria – Melbourne*

1.109 Around 90 per cent of Melbourne's water supply comes from uninhabited catchments amounting to 140,000 hectares, which include the Yarra Ranges and Kinglake National Parks.[63] Most of the water from these catchments is of sufficiently high quality that it does not require filtration.

1.110 These areas include nine major storage reservoirs with maximum gross storage of 1,773,000 megalitres. The largest of these reservoirs is the Thomson Dam in the Gippsland district, which supplies 60 per cent of the city's water.

## *Western Australia – Perth*

1.111 Drinking water in Perth is sourced from protected catchments and freshwater underground reserves. Groundwater provides 50 per cent of the total public water supply requirements. About half of the groundwater is pumped from the unconfined superficial aquifer (a major unconfined aquifer extending throughout the coastal plain west of the Gingin and Darling Scarps) with the balance drawn from the confined aquifers that underlie the Perth Region.[64]

1.112 About 25 per cent (or 150,000) of Perth's houses also have private wells which access groundwater for outdoor use.[65]

# Extent of water use

1.113 A gigalitre (GL) of water is equivalent to one billion litres.[66] According to the Australian Bureau of Statistics (ABS)[67] an estimated total of 68,703 gigalitres of surface water and groundwater was extracted from the environment for 1996-97. 11,525 GL was distributed for use via mains infrastructure and 49,480 GL was

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62 No evidence to the inquiry was received from the Tasmanian Government.

63 Melbourne Water site, The water source, information sheet, at: www.melbournewater.com.au

64 Water Corporation of Western Australia, *Submission 49*, pp 25-26.

65 Dr Leybourne, *Proof Committee Hansard*, Perth, 29 April 2002, p 399; Dr Humphries, *Proof Committee Hansard*, Perth, 29 April 2002, p 416.

66 1 kilolitre (kL) = 1,000 litres (L)
1 megalitre (ML) = 1 million litres
1 gigalitre (GL) = 1,000 megalitres or 1 thousand million litres

67 Australian Bureau of Statistics, *4610.0 Water Account for Australia 1993-94 to 1996-97*, Main features, at: http://www.abs.gov.au/ausstats/abs%40.nsf/b06660592430724fca2568b5007b8619/a7f8ae8188119911ca2568d40004eaf7!OpenDocument

discharged back to the environment directly to surface waters (46,509 GL of which was utilised in-stream by hydro-electric power generation schemes). Net water consumption,[68] which is the amount of water used and not discharged back to existing water bodies, was 22,186 GL and this is a 19 per cent increase over four years from 1993/94.

1.114 In 1996-97, the agricultural sector accounted for the bulk of net water consumption in Australia. At 15,522 GL this comprised 70 per cent of the total; the industry and manufacturing sectors consumed 4,312 GL, of water which was 20 per cent of the total; and the household sector accounted for 1,829 GL or 8 per cent. In the context of the Committee's terms of reference, the Australian urban water industry provides water and wastewater services to 13 million people and the water supplied accounts for less than 10 per cent of all water used in Australia.[69]

## *Nexus between agricultural water use and cities*

1.115 The amount of water used in the agricultural sector is far greater than that used in urban areas and examples of inefficient and wasteful water use abound in agriculture as they do in cities and towns. In relation to this point, several submissions note that an inquiry into water that does not take into account agricultural use, will be deficient.

1.116 Dr Fleming notes that the growth in urban populations is relatively small in an historical context and water use on a per capita basis is relatively static and in some areas declining:

> Growth in overall urban water demand and the capacity to meet that demand is therefore not the principal concern or constraint to development. Increasing water demand in the rural sector, principally for irrigation, is the major issue in relation to water quantity.[70]

1.117 The Australian Water Association suggests that any serious attempt to address sustainable use of water in Australia must include consideration of rural water use:

> Common sense dictates that the most cost effective gains can typically be secured by focusing first on the biggest part of the pie. A 1% savings in the rural sector requires 4% savings in the urban sector to yield the same quantity of water.[71]

1.118 Further, the Association notes that:

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68 This is calculated as self extracted use + mains use – mains supply – in-stream discharge.

69 Water Services Association of Australia, *Submission 55*, p i.

70 Dr Nicholas Fleming, *Submission 8*, p 4.

71 Australian Water Association, *Submission 41*, p 2.

> The bottom line in water utilisation, therefore, is that the key issue for water demand management is not associated with urban water but rather with rural water …[72]

1.119 The CSIRO however argues that:

> Urban water use constitutes only about 28% of total water use in Australia. Strong arguments are often put that such use should be considered in the total Australian context and that if this were done, the focus would naturally fall on water consumption outside urban areas. While this argument has legitimacy in many circumstances, urban water extractions and returns to the environment often have a significant and unsustainable impact on the catchments in which they are situated. In this sense, the Committee should not be misled by arguments suggesting that urban water management should not be the focus of the Committee's work.[73]

1.120 Whilst the agricultural sector is the largest water user in the country, the Committee recognises that much of its products sustain urban populations. Therefore, there is a connection between the demands of the cities and the amount of water used by the rural sector. In terms of the ecological footprint referred to previously, it takes 4.5 hectares of arable land to sustain one person in an Australian city. This point was emphasised by Councillor Johnstone from the City of Port Phillip in Melbourne:

> I think there is little understanding of water consumption in Victoria. Indeed, people say, 'The city only uses 10 or 20 per cent.' They fail to remember that 75 per cent of the water consumed in the state is principally in agriculture to support those urban lifestyles. The water consumption would not be happening in regional Victoria if it was not supporting export production and consumption in cities. So, to me, there is a big gulf in understanding and, if we are going to get those behavioural changes, people need to better understand the ecological footprint of their current way of life.[74]

1.121 Mr Alan Pears from Sustainable Solutions Pty Ltd provided an example of the connection between rural and urban Victoria:

> Regarding the rural water use, data in the Melbourne water resources review showed that 77% of Victoria's water is used for irrigation, and only about 8% is used by Melbourne people directly. The simple point is that even if only 10% of food and fibre produced in Victorian rural areas is consumed by Melbourne people (and Melbourne holds over ¾ of Victoria's total population) this would mean our indirect water consumption was greater than our direct consumption. So Melbourne dwellers are really importing water from rural Victoria 'embodied' in the food and fibre they consume. In reality, Melbourne people actually use a relatively large proportion of

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72 Water Services Association of Australia, *Submission 55*, p 4.

73 CSIRO, *Submission 47*, p 14.

74 Councillor Johnstone, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 354.

> Victorian-produced food, in which case they are indirectly using much more water than they are directly.[75]

1.122 It may be that people in cities have an obligation to assist the rural sector to use water more sustainably, whether by paying an additional charge for water to be used to improve rural practices, or by some other means.

1.123 The Australian Water Association notes that any measures to reduce urban water use adopted in the urban context needs to be compared on a least cost basis with achieving equivalent outcomes in the rural setting.[76] The AWA provided an example from California where an urban utility funded the lining of irrigation canals and then made use of the water saved. This provided a cheaper and more acceptable alternative to building a new dam.

1.124 Rather than allocating resources to achieve a reduction in urban water use, the same amount of resources could potentially reduce rural water use by a greater amount.[77] In general terms therefore, this rural/urban nexus reinforces the point that sustainability is about the interrelation between all water uses and that cities must look beyond their own immediate impacts. However, as the issue is outside of the Committee's terms of reference, it will not be discussed further in this report.

## *Trend in water use*

1.125 On average, water usage in Australia is increasing. Between 1983/84 and 1996/97 it increased by 65 per cent.[78] This was mostly due to increases in irrigated agriculture that consumed an additional 5,000 GL over the period. This increase alone is more than 2½ times the level of water consumed by Australian households in 1996/97.[79]

1.126 Mr Davis from the Australian Water Association told the Committee that overall, Australia uses about 3,300 litres per person per day, which is high:

> It is not nearly as high as the United States, it is not as high as Canada, but it is a lot higher than Europe and anywhere else in the world. If you look at the domestic scene, we use about 350 litres per person per day in the household.[80]

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75 City of Port Phillip, *Submission 71*, Attachment.

76 Australian Water Association, *Submission 41*, p 9.

77 Australian Water Association, *Submission 41*, p 2.

78 National Land and Water Resources Audit site, Australian Water Resources Assessment 2000, Australian Natural Resources Atlas: Water - Water Resources - Australia, at: http://audit.ea.gov.au/ANRA/water/docs/national/Water_Use.html

79 Water Services Association of Australia, *Submission 55*, p 3.

80 Mr Davis, *Proof Committee Hansard*, Sydney, 18 April 2002, p 231.

## Urban water consumption

1.127 The following table shows the amount of water supplied to urban areas:

*Table 3*

**Urban Water Supplied: 1995/96 to 1999/00**[81]

| Financial Year | Water Supplied (ML) |
|---|---|
| 1995/96 | 2,002,854 |
| 1996/97 | 2,159,197 |
| 1997/98 | 2,230,413 |
| 1998/99 | 2,172,868 |
| 1999/00 | 2,217,751 |
| 2000/01 | 2,377,598 |

1.128 While urban water use was variable across State capitals, in some cities it declined during the 1990s. The following table shows the amount of water used in various Australian cities, for the years 1983/84 and 1996/97:

*Table 4*

**Urban Water Use in Some Australian Cities, 1983-84 and 1996-97**[82]

| City | Use in 1983-84 (ML[83]/yr) | Use in 1996-97 (ML/yr) | % change |
|---|---|---|---|
| Adelaide | 182,800 | 214,650 | 17 |
| Brisbane | 144,900 | 183,900 | 27 |
| Canberra | 67,500 | 50,700 | -25 |

81 The Australian Urban Water Industry, 2001 WSAA*facts*, Water Services Association of Australia, pp 21-23.

82 National Land and Water Resources Audit, Australian Water Resources Assessment 2000, Australian Natural Resources Atlas: Water - Water Resources – Australia.

83 ML = megalitre. Refer to footnote 66 for water volumes.

**Urban Water Use in Some Australian Cities, 1983-84 and 1996-97**[82]

| | | | |
|---|---|---|---|
| Darwin | 21,890 | 37,400 | 71 |
| Geelong | 29,600 | 34,900 | 18 |
| Hobart | 19,860 | 36,600 | 84 |
| Melbourne | 406,600 | 500,000 | 23 |
| Newcastle | 55,400 | 60,800 | 10 |
| Perth | 322,000 | 314,600 | -3 |
| Sydney | 473,000 | 480,900 | 2 |

1.129 The CSIRO concludes that in the absence of more extensive data, total water consumption is increasing only marginally in urban areas.

1.130 There has been a significant reduction over 22 years in per capita consumption of water in major urban centres in Australia. However, despite these reductions, population growth is producing an increase in total demand, particularly in developing areas.

1.131 The introduction of user-pays pricing, universal water metering, and various demand management policies and educational campaigns has had a significant impact on the per capita consumption of water, allowing exploitation of new water resources to be deferred for many years. These reductions have meant that total water use has not increased, or has only marginally increased, despite significant population increases. As an example, the following table shows changes in water use in Sydney, Melbourne and Newcastle:

*Table 5*

**Changes in Water Use**[84]

| | Total Water Used | | | Water Used Per Capita | | |
|---|---|---|---|---|---|---|
| | **1970 to 1980** | **1980 to 1990** | **1990 to 2000** | **1970 to 1980** | **1980 to 1990** | **1990 to 2000** |
| **Sydney** | +30% | -6% | +2% | +15% | -16% | -7% |
| **Melbourne** | +50% | +13% | -1% | +38% | -6% | -12% |
| **Newcastle** | +37% | -16% | -2% | +27% | -23% | -14% |

84 Water Services Association of Australia, *Submission 55*, p ii.

1.132 Despite these achievements, there is concern that total water consumption (and possibly per capita water consumption) is now trending upward, although the influence of climate variability is a confounding factor over the short term. If the upward trend is confirmed, pressure will be put on water resources in many jurisdictions, where it does not presently exist. Some high growth areas are already subject to such pressures.[85]

## Increasing populations

1.133 It can generally be said that water use in each sector has declined (or in the case of industrial water use, remained steady) over 19 years. However, even with very aggressive demand management there remains the risk that population increases will eventually overcome any achievement made, even if this has not yet occurred. It also cannot be said that the reduction in water consumption achieved to date is sufficient to mitigate or prevent unsustainable conditions at various locations. Nevertheless, the CSIRO's analysis suggests that the demand management gains made to date have forestalled increases in total urban water consumption.

1.134 Whilst there is a suggestion that total water consumption is increasing only marginally in urban areas, demand for water for urban use is growing in a number of locations, such as the 'sun-belt' regions of Western Australian and south-east Queensland. Add to this, the uncertainty associated with climate change and the potential for decreased yield from existing water supply catchments and growing community resistance to the building of dams because of their effects on the natural environmental, and there is considerable potential for conflict over supplying increased urban water demands.

## Annual total per capita water use

1.135 In conjunction with the Water Services Association of Australia (WSAA), the CSIRO conducted a review of all the major urban water supply authorities in Australia for the period 1990-91 to 1997-98.[86] The review was confined to large urban communities centred on the major cities in Australia and because it was a similar format to previous CSIRO reviews, it has enabled trends in water use to be established. Major findings from the review are reproduced below.

1.136 Average total water use ranges from 316 litres per capita per day (lpcpd) in Melbourne to 1,212 lpcpd in Darwin. The usage in most cities ranges from 348 lpcpd to 479 lpcpd. Total water consumption varies with the seasons with peak consumption in summer. The exception to this is Darwin which experiences peak consumption during its dry winter period.

1.137 The annual total water use per capita including unmetered use (ie losses) shows a downward trend over the last 22 years for all cities except Darwin. Levels of

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85 CSIRO, *Submission 47*, pp 17 and 18.

86 CSIRO, *Submission 47*, pp 19-26.

average annual use fell from 640 lpcpd in 1977, to 622 lpcpd in 1983/84, and, following the implementation of various demand management strategies, to about 500 lpcpd in 1998. This represents a reduction of 21 per cent overall or 0.9 per cent per annum from 1977 to 1998 in per capita water consumption.[87] However, despite these gains, rising populations are forcing up total demand for urban water.

## Categories of urban users

1.138 Users of water can be divided into the categories as shown in the table below. The proportion of total use that each category comprises is also given:

*Table 6*

**Categories of urban water user[88]**

| Category of use | Description | Average percentage of total use |
|---|---|---|
| Domestic | water consumed in private residences | 59 |
| Non-domestic | includes all categories except domestic and unmetered use | 28 |
| Industrial | water consumed in industrial processes (eg manufacturing, cooling water, washdown water etc) | 13 |
| Commercial | water consumed in commercial (non-industrial) premises (eg restaurants, shops, office buildings) | 10 |
| Unmetered water/non-revenue water/unaccounted-for-water | water lost to the system due to leakage, maintenance, theft, evaporation, firefighting | 2 |
| Institutional | water used in premises such as schools, public swimming pools etc | 6 |
| Parks and gardens water | used for irrigation of public spaces | 13 |

1.139 The following table gives an indication of how much water is used each day by the different categories. It shows the range of water use across user categories for

87 CSIRO, *Submission 47*, p 20.

88 CSIRO, *Submission 47*, pp 17-18.

large urban communities centred on the major cities in Australia and, where data is available, the average range in most cities:[89]

*Table 7*

| Water use across Australian cities | | |
|---|---|---|
| **Category of user** | **Range of water use (litres/capita/day)** | **Average range in most cities (litres/capita/day)** |
| **Domestic** | 206 to 461 | 233 to 288 |
| **Non-domestic** | 35 to 595 | 102 to 216 |
| **Industrial** | 17 to 100 | — |
| **Commercial** | 24 to 91 | — |
| **Parks and gardens** | 1.2 to21 | — |
| **Institutional** | 11.6 to 47.3 | — |
| **Unmetered (Non-revenue)** | — | 35 to 69 |
| **Annual total** | **316 to 1,212** | **348 to 479** |

1.140 An example of a breakdown of some of these market segments as well as changes in the sectors between 1975/76 to 1998/99 are given for Sydney below:[90]

*Table 8*

**Changes in Market Sector Use for Sydney Water from 1975/76 to 1998/99**

| **1975/76 Water Use** | | **1998/99 Water Use** | |
|---|---|---|---|
| Houses | 41% | Houses | 52% |
| Flats & Units | 8% | Flats & Units | 15% |
| Industry | 23% | Industry | 13% |

89 CSIRO, *Submission 47*, pp 19-25.

90 Sydney Water, *Submission 45*, Appendix 1, Demand Management Strategy, December 1999, p 5.

**Changes in Market Sector Use for Sydney Water from 1975/76 to 1998/99**

| 1975/76 Water Use | | 1998/99 Water Use | |
|---|---|---|---|
| Commercial | 14% | Commercial | 10% |
| Govt/Exempt | 9% | Govt/Exempt | 6% |
| Other | 5% | Other | 4% |

1.141 As can be seen, the relative water use by the major customer sectors has changed over time. Continuing population growth and the construction of new housing in the Sydney basin has resulted in increasing demands from the residential sector which grew from 49 per cent of total consumption in 1975/76 to 67 per cent of consumption in 1998/99.

1.142 Commercial consumption has remained reasonably stable although the number of commercial properties has increased. Commercial properties (and all other non-residential customers) pay by volume for both water use and sewage discharges, as well as incurring trade waste charges where applicable. Because of these factors, the price incentives and monetary savings from conservation are much stronger for commercial and other non-residential customers than for residential customers.

1.143 Industrial water use has been declining due to a general shift in Sydney's economic base away from heavy industry toward commercial and institutional activity. Water saving technology has also been developed and implemented more rapidly by industry, relative to the other non-residential water users.[91]

## *Domestic*

1.144 Domestic or residential water use can be subdivided into categories of use as is shown for Sydney households below. Around 69 per cent of current metered water use in Sydney is domestic and this comprises use from houses, strata units and flats.[92]

*Table 9*

**Domestic Water Use, Sydney**

| | |
|---|---|
| Toilet | 20% |
| Shower | 23% |

91 Sydney Water, *Submission 45*, Appendix 1, Demand Management Strategy, December 1999, pp 5-6.

92 Sydney Water, *Submission 45*, Appendix 1, Demand Management Strategy, December 1999, p 6.

| | |
|---|---|
| Bath and basin | 4% |
| Washing machine | 17% |
| Laundry trough | 3% |
| Dishwasher | 1% |
| Sink | 5% |
| Waste disposal | 0.04% |
| Garden and lawn | 23% |

## Outdoor use

1.145 The volume of water used outside of the house is variable and dependent on the size and type of garden, suburb, pricing policies and seasonal influences. Although climate, in terms of rainfall, temperature and relative humidity, is one factor in explaining domestic demand and the differences in daily use for the major cities, Smith suggests that it is not the only factor, and there are various reasons for the differences. One of these is the perceived need to water lawns and gardens.[93] Outdoor water use is the largest component of household water use and can be as much as 60 per cent of the total, but varies greatly in response to the weather. Additionally, the style of housing will greatly influence water use, for example Canberra has a 'garden city' reputation and the dominant housing subdivisions are quarter acre blocks. As a consequence it has a higher demand for garden watering than does Sydney in which a large proportion of the population lives in multi-occupancy residences.[94]

1.146 The Water Services Association of Australia notes that Australia's urban development is similar to that of urban sprawls in the USA and with this kind of development comes significant water use to maintain suburban gardens and other outdoor water uses.[95] The Association compares the outdoor water use in Perth of more than 50 per cent, with that in the United Kingdom which is only 3 per cent of total residential consumption.

1.147 Increased affluence in Australia has added to residential outdoor water use by the growing incidence of private swimming pools and the introduction of automatic garden watering systems that have the potential to increase peak usage.[96] Offsetting

93 Smith, David Ingle, *Water in Australia*, p 109.

94 Smith, David Ingle, *Water in Australia*, p 109.

95 Water Services Association of Australia, *Submission 55*, p 6.

96 Water Services Association of Australia, *Submission 55*, p 9.

the trends in increased usage are the moves towards greater urban infill and the greater use of outdoor paving that requires negligible outdoor residential water consumption.

1.148 Recent figures for Melbourne show that the average suburban household with a garden uses up to 65 per cent of water indoors and the remaining 35 per cent externally - predominantly on the garden.[97] The outdoor component of household consumption can fluctuate by plus or minus 8 per cent depending on the weather. A breakdown of residential water use for Melbourne shows where, on average, water is used in households:

*Table 10*

| **Estimated average residential potable water use[98]** | |
|---|---|
| Garden | 35% |
| Bathroom | 26% |
| Toilet | 19% |
| Laundry | 15% |
| Kitchen | 5% |

1.149 The relationship between rainfall and water consumption is a very significant issue. The demand for water increases during periods of low rainfall and the main reason for this is that the majority of water is going to garden usage.[99]

## Indoor use

1.150 50 litres per person per day has been determined as the basic water requirement for drinking, sanitation, bathing and cooking. According to the National Land and Water Audit, people in Asia, Africa and Latin America use 50-100 litres per day; and people in America use 400-500 litres per day.[100]

1.151 According to Foley and Daniell, it is the in-house proportion of water usage that is considered a basic requirement. However, this does not mean that indoor use is

97 Water Resources Strategy Committee for the Melbourne Area, *Discussion Starter: Stage I in developing a Water Resources Strategy for the Greater Melbourne area*, June 2001, p 17.

98 Water Resources Strategy Committee for the Melbourne Area, *Discussion Starter: Stage I in developing a Water Resources Strategy for the Greater Melbourne area*, June 2001, p 14.

99 Mr Harvey, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 280.

100 National Land and Water Resources Audit site, Australian Water Resources Assessment 2000, Australian Natural Resources Atlas: Water - Water Resources - Australia, at: http://audit.ea.gov.au/ANRA/water/docs/national/Water_Use.html

static and cannot be altered. Changes in the efficiency of appliances such as low flush toilets, water efficient showerheads, washing machines and dishwashers will over time lead to reduced water use inside the home.

1.152 Annual domestic water use has shown a downward trend over the last 22 years for all cities. Levels of average annual use fell from 424 lpcpd in 1977 to 384 lpcpd in 1983/84. Since 1983/84, the implementation of demand management measures aimed mainly at domestic users has brought the average water use down to about 277 lpcpd. This represents a reduction of 34 per cent overall or 1.3 per cent per annum from 1977 to 1998. The reduction from 1983/84 to 1998 is 39 per cent or 2.2 per cent annum.

1.153 For most major cities in Australia, domestic use peaks in summer, except for Darwin, where peak use coincides with the dry winter period.

## *Non-domestic*

1.154 Non-domestic water use includes all categories of use except domestic and unmetered uses. It has also shown a small downward trend over the last 15 years for all cities. Levels of average annual use fell from 199 lpcpd in 1983/84 to 176 lpcpd in 1997/98. This represents a reduction of 12 per cent overall or 0.8 per cent per annum from 1983/84 to 1998.

1.155 Seasonal non-domestic water consumption also exhibits significant variability for most authorities and peaks in summer, except for Darwin, where peak use coincides with the dry winter period.

## *Industrial*

1.156 Water has a wide range of uses in industrial processes. It may be incorporated into a product such as food and drinks; used for heating, cooling, steam generation; in mining to form slurry, for washdown, concrete batch mixing; and a variety of other purposes. Many industries use potable water when lower quality water would be adequate for their purposes. Some industries use recycled water from their own site or treated effluent from the sewage treatment plant, in their manufacturing processes, but currently this is only a minor component of total industrial use.

1.157 Industrial water use varies significantly from city to city. Levels of average annual use rose from 51 lpcpd in 1977 to 75 lpcpd in 1983/84 and have since fallen to about 56 lpcpd.

1.158 From the limited data available, industrial consumption exhibits low seasonal variability.

1.159 The Australian Water Association suggests that the introduction of water and wastewater tariffs over the last 20 years has led to industries dramatically cutting their unit of production consumption rates.[101]

1.160 During its water efficiency audits of various industrial companies, Sydney Water found that some industrial end uses show the greatest opportunities to improve water management, including cooling towers, steam systems and on-site reuse of rinse water and other process effluent streams.[102]

1.161 Between 1990/91 and 1998/99, Sydney's industrial water use declined from 80,600 to 60,000 ML per year. Since 1991 average water use per property has fallen from 5,200 kL per year to current levels of 3,180 kL per year. Lower water use by new industries is contributing to the lower average figures for the sector.[103]

1.162 Sydney Water has considerable experience in terms of its demand management program in dealing with major commercial industrial customers and it undertakes water audits of various businesses:

> I know we recently signed up Sydney's largest or very major laundry service. We go in and inspect their operations. We hire experts that understand the processes, especially things like clean production. They say, 'If you can do this or that you can actually increase your cycle frequency for the usage of this water and you can cut consumption down by 10 per cent.' We have done that with a number of customers.[104]

1.163 Brisbane City Council encourages lower industrial water use by offering two price tariffs to its top 42 industrial water users. Users will be eligible for the lower tariff if they introduce water management plans.[105]

## *Commercial*

1.164 Commercial water use varies significantly from city to city. Levels of average annual use have fallen from 105 lpcpd in 1977 to 81 lpcpd in 1983/84 and have since fallen to about 45 lpcpd.

1.165 From the limited data available, commercial consumption exhibits low seasonal variability.

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101 Australian Water Association, *Submission 41*, p 8.

102 Sydney Water Corporation, *Submission 45*, Additional Attachment, *Water Conservation and Recycling Implementation Report*, August 2000, p 14.

103 Sydney Water, *Submission 45*, Appendix 1, Demand Management Strategy, December 1999.

104 Mr Gellibrand, *Proof Committee Hansard*, Sydney, 18 April 2002, p 183.

105 Mr Woolley, *Committee Hansard*, 4 April 2002, p 611.

### *Parks and gardens*

1.166 Parks and gardens water use varies significantly from city to city. Levels of average annual use have fallen from 43 lpcpd in 1983/84 to about 10 lpcpd in 1990/98.

1.167 Municipal parks and gardens water use is essentially a response to irrigation needs and therefore in general tends to vary seasonally with peaks in the dry seasons.

### *Institutional*

1.168 Institutional water use varies widely from city to city. Levels of institutional use were not assessed in previous CSIRO reviews and so trend data is not available. Institutional water use exhibits significant seasonal variability which indicates that it is driven partly by irrigation needs with peaks in the dry seasons for the southern cities although more data is needed to confirm this inference.

### *Unmetered (Non-revenue water)*

1.169 Unmetered water use has shown a small increase over the last 15 years. Levels of average annual use have risen from 58 lpcpd in 1983/84 to 65 lpcpd in 1990/98. Authority estimates of unmetered use suggest an average value of 77 lpcpd.

1.170 Leakage loss is expected to be reasonably constant throughout the year, as it is dependent on the water-tightness of the distribution and service pipe system. Leakage is a function of operating pressures and not a function of total use. A peak in unmetered use would result from system maintenance, fires or pipe bursts being concentrated in a particular season of the year. Variability in unmetered use does occur in some cities.

## Water quality standards

1.171 Standards for water quality in Australia are the shared responsibility of the Commonwealth and the States and Territories. The Commonwealth takes a leadership role in the production of the Australian Drinking Water Guidelines (ADWG), which set out benchmarks for safe drinking water. Water suppliers are expected to achieve water quality that meets this standard, however local conditions may lead to lesser standards being adopted. Legal standards for water quality are the responsibility of the State and Territory health authorities, based on the ADWG.

1.172 The quality of natural waters is covered by the Australian Water Quality Guidelines for Fresh and Marine Waters, which were revised in 2000.

1.173 The other general source of standards for water management is the National Water Quality Management Strategy (NWQMS) which has been evolving since 1992.

The strategy is discussed in detail in the AFFA/EA submission, and so far, nineteen of the projected twenty-one of the guidelines have been published.[106]

## Conclusions

1.174 Achieving an ecologically sustainable pattern of water management in Australia, and measuring our current practices against this goal, must ultimately be based on an understanding of the natural water cycle, however much many city dwellers may prefer to believe otherwise. The various solutions taken around Australia to provide safe water supplies, reflect the diversity of the water cycle, climate and rainfall patterns in different parts of the continent.

1.175 As this chapter has shown, urban water use comprises a relatively modest component of overall water use, and the battle to achieve ecologically sustainable water use will ultimately be won or lost in the rural sector. But this is not to suggest that urban water can be ignored. Australian cities maintain high, rising and unsustainable levels of water usage, based on inefficiencies, inappropriate garden styles, and sheer wastage. All of this creates an ecological 'footprint' that extends well beyond the borders of cities themselves, and places stress on natural ecosystems that are already stretched by other demands.

> The technology is there, and there are certainly far more efficient ways of using water, but the social challenge of getting people out of inappropriate places and inappropriate practices is huge. It is not a technical issue; it is a human issue and a political one.[107]

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106 Department of Agriculture, Fisheries and Forestry – Australia, and Environment Australia, *Submission 54*, p 13. For a more detailed discussion of policies and standards, see Chapter 6.

107 Department of Agriculture, Fisheries and Forestry – Australia, and Environment Australia, *Submission 54*, p 13.