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Water for a Healthy Country

UNCHARTED WATERS

Influences on the Australian urban water sector

CSIRO

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Abbreviations

AGO	Australian Greenhouse Office
BCA	Business Council of Australia
CoAg	Council of Australian Governments
GBE	Global Business Environment
GHD	Gutteridge, Haskins & Davey
NGO	non-government organisation
NIC	National Intelligence Council
NLWRA	National Land and Water Resources Audit
OECD	Organization for Economic Co-Operation and Development
SARS	severe acute respiratory syndrome
UK	United Kingdom
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
US	United States
WSAA	Water Services Association of Australia

Executive summary

Developing sustainable water management options requires thinking about the future, thinking about:

- how community needs and industry operating conditions may change;
- the best strategies for catching the opportunities and managing the threats; and
- where to invest.

This is particularly important since until recently the water sector has been relatively insulated from many of the dramatic changes occurring in other sectors within the Australian community.

Stakeholders in the water sector are now making decisions that have long-term impacts in increasingly volatile conditions.

We view the future as one of opportunities that bring uncertainty and challenges for urban water management.

> *We are in the midst of a worldwide, revolutionary change, with an uncertain outcome. Part of the uncertainty has to do not just with events but with human attitudes and reactions towards those events. People can react with hope and seize the opportunities … or they can react with fear and try and erect barriers to liberalisation to protect what they value.*
>
> GBE 2002

Most importantly, we recognise that the urban water sector is an integral part of the wider Australian community, and therefore interconnected with the global community.

SCENARIO PLANNING

Scenarios are not a prediction about the future but tools for thinking about the future. Unlike forecasts which impose patterns extrapolated from the present they explore wider possibilities. Scenarios are not prophecies. They incorporate a spectrum of ideas to create coherent and credible alternative stories about the future. Scenario planning is a tool designed to assist us to challenge assumptions, focus on key uncertainties, understand the key influencers, and test strategies and plans. Scenarios are not about selecting the right 'forecast' but about accepting uncertainties and making it part of our thinking.

POSSIBLE FUTURES

We face an infinite number of possible futures. This paper is a snapshot, a summation building on the work that others have done. It discusses the key influencers—the 'big ticket items'—that are likely to shape urban water management over the next **20 years**. These influencers will impact on how systems work and will cause important events and trends to occur.

Selection of the influencers and their specific factors is based on:

- a review of scenarios undertaken by a range of organisations;
- a literature search, scanning 20-year plans undertaken by the states/territories and authorities for the water sector; and
- input from researchers and people directly involved in the water and allied sectors.

Selection was made in the realisation of a need to look outside the industry itself and pick up those big picture events that may change the water sector's present direction.

The purpose of this paper is to provide a basis for scenario planning, a collaborative process, that involves a high level of stakeholder engagement. It aims to stimulate debate among urban water managers and decision makers on the nature of the world in 2024 and how it will effect planning.

Scenario development provides a mechanism to explore the interaction of the influencers and how they may roll out over time. To illustrate how this can take shape a selection of scenarios have been included in *Appendix A: scenarios.*

This paper also includes a series of 'What if …' pictures of possible futures that may be driven by a particular influencer. You are encouraged to develop your own views of how the influencers and their interactions may create a different future. You are also encouraged to consider whether there are other influencers that will cause major discontinuities.

All decisions are taken against an uncertain future. These decisions can be difficult, as we are often trapped by the values and experiences that influence our views on what the future may be like. Water authorities both public and private, regulators, and governments need to choose those strategies that are of the most benefit even in different futures. This can be made easier by assessing the options against possible scenarios.

UNCHARTED WATERS

By 2024 the urban water sector will have been shaped by significant events. How those events shape the future will be determined by the Australian community's social values and its system of governance. These factors will also be influenced by events.

It will be a bumpy ride to 2024, with many twists and turns, and there are no road maps. Globalisation, liberalisation and information technology, will make the journey one of breakneck speed.

- The global community will need to deal with significant climate and environmental changes. These changes will dominate initiatives in both urban water and energy sectors.
- Science and new technologies will offer us new choices and opportunities especially in the areas of biotechnology and information technology.
- We will face more pressure to change our institutions and by 2024 the shape of government and business, and the way they operate will be quite different.
- Australians will be older and there will be more of us. We can speculate how this may influence our values and willingness to engage in the new world.

KEY INFLUENCERS

The seven key influencers for the urban water sector look at different possible developments, and consequently new risks and opportunities that the water sector might face. They have been identified as:

- globalisation and liberalisation;
- people and institutions;
- population;
- climate and environmental change;
- energy and greenhouse gas;
- science and technology; and
- water use and management.

These influencers emphasise the 'uncertainties' rather that the predetermined elements.

Influencer 1 – Globalisation and liberalisation

The primary shapers of Australia's future—globalisation, liberalisation and the uptake of new technology—are unstoppable. We will be more interdependent on the global community, and will experience a period of rapid change and uncertainty.

Water sector: In 20 years the water sector's operating environment will be founded on global events. Industry direction will increasingly be determined from 'outside' by, for example, non-government organisations, commercial interests or the US. The water industry will need to be globally competitive and adaptable.

Influencer 2 – People and institutions

The relative importance of all the change influencers will be determined by the community's willingness to embrace change and government structures, together with the way in which they interact.

Water sector: If the Australian Government pursues market liberalisation, as a result of the Council of Australian Governments (CoAG) reforms and international competition, can the sector make the necessary changes to its systems and culture? The risks are:

- the entry of global competitors and the 'cherry picking' of services;
- elimination of cross subsidies; and
- stranding of assets.

There may be opportunities to re-position or converge to form multi-utilities, or the industry may move towards multiple participants with a distributed infrastructure network.

Influencer 3 – Population

Australia's population will increase and age. At the same time, populations in the underdeveloped countries will grow faster and be younger. The combination of population growth and urbanisation will foster instability in neighbouring countries. Australia is at risk of a 'brain drain' with young people moving oversees.

Water sector: There is likely to be a growth and change in demand for urban water services, particularly along the east coast. The industry is likely to suffer a shortfall of skills during a period of rapid change.

Influencer 4 – Climate and environmental change

Exact impacts of global warming are uncertain—Australia is likely to be hotter and dryer, with more extreme weather conditions.

Water sector: There will be an increased demand for water, reduced yields and increased variability.

Influencer 5 – Energy and greenhouse gas emissions

Australia will have sufficient energy to meet demands for population and economic growth. However, environmental considerations will dominate the energy sector's initiatives. Advances are being made to increase efficiency in energy production, and to develop sustainable alternative energy sources. We could become a hydrogen society.

Water sector: The water sector is likely to experience some increases in prices for energy, but prices may become volatile. The industry will be accountable for its greenhouse gas emissions.

Influencer 6 – Science and technology

The next 20 years will see a further spread of information technology and the application of new bio-technologies. Nano-technology, sensor technologies and bio-markers offer an extraordinary range of applications and benefits.

Water sector: The use of bio-technology to influence landscape-scale ecological process, improved efficiencies in water use, breakthroughs in membrane technology, solutions for local retention of stormwater and sewage disposal, will create new ways of delivering water services.

Influencer 7 – Water use and management

A shift to higher value use of water is likely in response to the recognition of the need for sustainable use, increasing prices, changes in institutional structures and recognition of the value of water.

Water sector: Over the next 20 years the urban sector is likely to have wrestled with the sustainability issues and come to grips with managing demand, pricing and value.

The next **20 years** will be a period of increased instability for the urban water sector. This will create new risks but also opportunities. Analysing how these influences interact and roll out over this period of time is a function of the scenario planning process.

A BETTER WORLD?

Since 1980 there have been increases in 'world development' indicators:

- life expectancy—increased from 61 to 68 years; in developing countries it increased from 58 to 65 years
- adult literacy—increased from 63% to 75%
- primary school enrolment—increased from 81% to 90%
- secondary school enrolment—increased from 60% to 68%; for the poorest counties it increased from 49% to 59%
- percentage of women of childbearing age in the poorest countries with access to contraception—increased from 4% to 35%
- cereal production per hectare increased by 20%
- infant mortality fell from 8% to 5.4%; in the poorest countries it fell from 9.7% to 6.8%.

Income inequity is rising, but the gap in human development is falling.

World Development Indicators, Shell

1. Introduction

This paper discusses the key influencers or 'big ticket items' that are likely to shape urban water management over the next 20 years.

1.1 AIM

We all need to plan for the future. The urban water sector faces many uncertainties and possible different futures—it may be transformed by issues that are both conceivable and inconceivable at this present point in time. Water authorities, businesses, regulators and governments need to select strategies that can create benefits even in very different futures.

The aim of this discussion paper is to stimulate debate among urban water managers and decision makers on the nature of the world in 2024 and how it will effect planning.

It identifies the influencers—the processes that have a high influence on how systems work, and that cause important events and trends to occur. Almost all processes are both influenced and influence other processes. They are the forces that will shape the environment. Those that will persist and can be forecasted, and how change may occur is unknown.

1.2 APPROACH TO DEVELOPING THE PAPER

We face an infinite number of possible futures. This paper is a snapshot, a summation building on the work that others have done. Selection of the influencers and their specific factors included in this paper emerged from:

- a review of scenarios undertaken by a number of water and other organisations (national and international);
- a review of studies on trends;
- literature research;
- scanning of 20-year plans undertaken by the states/territories and authorities for the water sector; and
- input from researchers and people directly involved in the water and allied sectors.

Selection of the influencers was made in the context of a recognition of a need to look outside the water sector and pick up those big picture events that may change the industry's view of the direction of the sector. Trends and predetermined events that are well understood by the water industry and have been already been incorporated in their long-range plans were not included.

From the outset, the research sought to identify:

- those issues about the future that could turn the water sector upside down;
- what is making people feel enthusiastic and optimistic; and
- what is keeping them awake at night.

The selection was also made with the view that it is more productive to focus on a smaller range of key influencers.

Some of the predicted key influencers are also based on trends that have an important degree of uncertainty. In contrast, judgements about the environment, climate, governance, and community attitudes represent a distillation of views of experts from inside and outside CSIRO. These are matters for speculation as they are contingent on the decisions that societies and governments will make.

Scenario planning is a collaborative process and one that involves a high level of stakeholder engagement. The purpose of this paper is to provide a basis for that process. It is suggested that next steps towards developing scenarios should be:

1. agreement through consensus on the selection of the factors grouped within influencers;
2. development of exploratory first generation scenarios to give insight into the system, to identify predetermined elements, and to understand the connection between various forces and events influencing the system;
3. detailed research (with a focus on gaining insights) on some of the influencers and their uncertainties to gain a better understanding of the forces that will eventually compel an outcome and their interplay; and
4. next generation scenarios or construction of decision scenarios so that decision makers question their own views of reality.

1.3 STRUCTURE

The structure of this paper is based on the seven-key influencers, with a section for each influencer. Each section explores the 'big ticket items' the main factors that relate to the influencers, and asks questions about how these factors may change the urban water sector or its strategies.

Hypothetical 'What if …' pictures of possible futures that may be driven by a particular influencer are included at the end of each section. Readers are encouraged to develop their own views of how the influencers and their interactions may create a different future. They are also encouraged to consider whether other influencers or factors may cause major discontinuities.

Appendix A Scenarios provides summaries of some scenarios to illustrate how the various influencers could play out in the future.

1.4 THE KEY INFLUENCERS

By 2024, water management in Australia is likely to be shaped by seven main influencers (see Figure 1):

- globalisation and liberalisation;
- people and institutions;
- population;
- climate and environmental change;
- science and technology;
- energy; and
- water use and management.

These influencers are interdependent and are plausible drivers. They are as much about opportunities that, if captured, will transform the water sector, as about over-the-horizon problems.

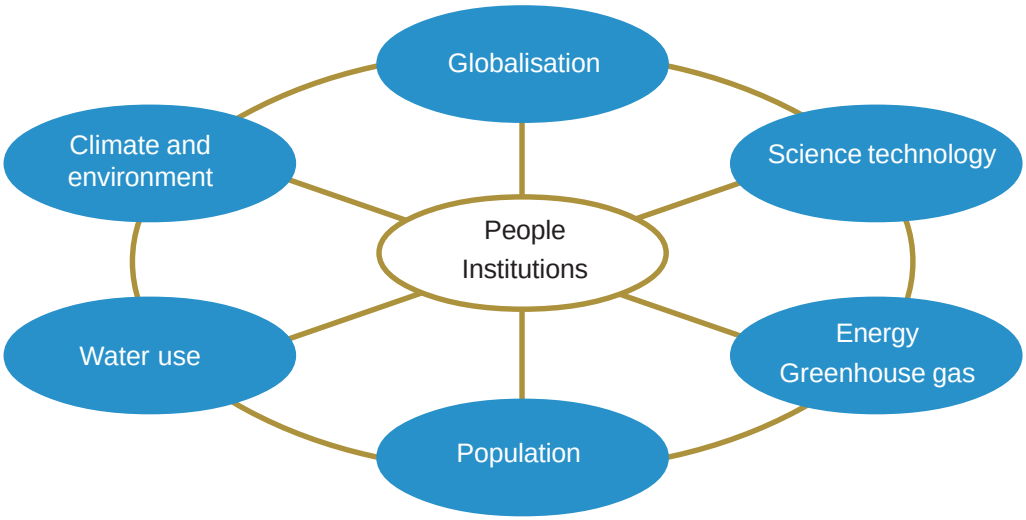
1.4.1 What could our alternative futures be?

When considering these influencers, we can ask the following questions.

- What new opportunities and challenges will arise?
- What shape could they take for Australia?
- What will be our community's likely response?
- What new institutions will arise?
- What bearing could they have on the management of urban water and its institutions?
- What are the sector's likely responses?

between the idea and the reality
between the motion and the act
falls the shadow
TS Elliot

Figure 1. The seven key influencers.



2. Globalisation and liberalisation

The future's primary influencer—globalisation, liberalisation (political, economic and social) and uptake of new technology—appears unstoppable. We are entering a period of rapid change. The networking and integration of the global community and markets, together with information technology, will speed up the cycle of change and adjustment pressures.

The key questions for urban water are:

- How will the Australian community be positioned in this new world?
- What opportunities and risks will it bring?
- How will globalisation and liberalisation influence community values?
- How will they influence business direction and operations?

2.1 A WELL-CONNECTED WORLD

We are connecting more closely and in more ways to the global community as our communication infrastructure develops and as our economic systems become more inter-dependent. This means that occurrences in any one area have the potential to effect many other occurrences and areas.

2.1.1 Dominant players

In this connected world there are dominant players with shifts in the balance of power and control.

New participants and a greater role for global corporations and non-government organisations (NGOs): An increasing number of new players are participating at a global level:

- countries entering the global trading regime;
- new businesses;
- new partnerships among established businesses; and
- NGOs that are assuming a greater role in public debate and decision making.

United States (US), a major power: The US will continue to be a major global force. US global economic, technical, military and diplomatic influence will be unparallelled among nations as well as in regional and national organisations. This power will not only ensure America's pre-eminence, but also casts it as the key driver of the international system (GBE 2002; NIC 2000). It will be a major proponent of globalisation, and its actions will have an increasing global impact because of the tighter integration of global markets.

ECONOMIC LIBERALISATION

The term 'Washington Consensus' describes the key reforms most neo-liberal economists believe should be universally applied:

- fiscal discipline
- public monies for primary health care, primary education, and infrastructure
- tax reform to lower marginal rates and broaden the tax base
- interest rate liberalisation
- a competitive exchange rate
- trade liberalisation
- liberalisation of direct foreign investment
- privatisation
- removal of barriers to market entry and exit
- secure property rights

GBE 2002

South-east Asia's growth and stability: Emerging Asia will be the fastest growing region, led by China and India, whose economies already comprise roughly one-sixth of global GDP (NIC 2000). How stable is our region? Potentially it provides unimaginable economic growth opportunities, and the stability and nature of the relationships will be of great importance.

Governments: Governments will have less control over flows of information, technology, migrants, arms and financial transactions, whether licit or illicit across their borders. The quality of governance nationally and internationally will substantially determine how well states and societies cope with the global forces (NIC 2000).

2.1.2 Pandemic disease

A well-connected world will further open trade and increase movement of people. Global cooperation has shown to be effective in controlling outbreaks of disease such as severe acute respiratory syndrome (SARS), although an increase in movement of people was part of the reason for the threat and could also introduce new pests and diseases to humans, livestock and plants to Australia. In developing countries, the exposure of people to ecosystems previously isolated from humans, together with human cohabitation with stock and captive wild animals, increase the risk of new diseases.

2.2 GLOBAL TRENDS

Possibly the most significant anticipated trends for the urban water sector are water scarcity and economic growth.

At least 1.1 billion people lack access to safe water, and 2.4 billion lack access to basic sanitation, a silent humanitarian crisis that each day takes thousand of lives, robs the poor of their health, thwarts progress toward gender equality, and hamstrings economic development, particularly in Africa and Asia.

UN Millennium Project 2004

Water scarcity: Globally, the withdrawal of water supplies is projected to increase by at least 50 percent by 2025 (UN 2004). By 2015, nearly half of the world's population, will live in water-stressed countries (i.e. no more than 1.7 ML of water per person per year) mostly in Africa, the Middle East, South Asia, and Northern China (NIC 2000). The United Nations advised:

> *... faced with inertia at the leadership level the global water crisis will reach unprecedented levels in years ahead with growing per capita scarcity of water in many parts of the developing world … water resources will steadily decline because of growth, pollution and expected climate change.*
>
> UNESCO 2003

Economic growth: It is predicted that overall the global economy will return to the high growth levels of the 1960s and early 1970s. Political pressures for higher living standards, improved economic policies, rising foreign trade and investment, diffusion of information technologies, and an increasingly dynamic private sector will drive this change. Brakes on the economy, such as a substantial financial crisis or prolonged

MILLENNIUM DEVELOPMENT GOALS

Goal 7 Target 9: Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources.

Goal 7 Target 10: By 2015 to halve the proportion of people without sustainable access to safe drinking water and basic sanitation.

UN Millennium Project 2005

disruption of energy supplies, may undo this projection. Regions, countries and groups left behind will face stagnation, political instability and cultural alienation. The gulf between the haves and have-nots will widen. This will foster political, ethnic, ideological and religious extremism, along with the violence that often accompanies it (NIC 2000).

2.3 URBAN WATER INDUSTRY GLOBAL LIBERALISATION AND COMPETITION

The water sector is actively involved in the globalisation and liberalisation processes. Over the past two decades, there has been a dramatic growth in the privatisation of water infrastructure. By 2000 an estimated 93 countries had privatised water or wastewater services, or were in the process of doing so. This included countries in North and Latin America, the Caribbean, Europe, Africa, and the Middle and Far East (Friend et al. 2003b).

The focus of major international water companies is expansion and growth. This is driven by the investment appeal of the water industry with its positive profit performance, and the need for infrastructure development in many third world countries (Friend et al. 2003b).

> *The industry provides significant profits to the three key players in the world market namely Vivendi Universal, Suez and RWE. Each is among the top 100 corporations. Their revenues are estimated to grow by ten percent per year...*
>
> Friend et al. 2003b

There is a growth in alliances and involvement in public-private partnership. Competitiveness and acquisitions are also features. As an example, it appears that E.On and RWL are aggressively competing for leader status in Germany. In the United Kingdom (UK), it is evident that water companies are responding to the regulated water industry with a growing interest in non-regulated ventures. Multi-utilities are emerging (Friend et al. 2003b).

Within this context there will be increasing external pressure on Australia to pursue the CoAG water reforms, creating opportunities for new market entrants.

In 2003, profitability was a problem for 50 percent of major Australian water companies despite increased revenues for most. The ongoing drought is unlikely to help as reduced water supply and restrictions impact on revenue (Friend et al. 2003b). This can make them vulnerable in the longer term.

Increased liberalisation and competition means that organisations not only need to implement best practice, but also need to operate in a strategic and commercial manner to sustain profitability and market share. Those that cannot adapt quickly will 'go under'.

How many of you believe that you will be bought, sold, merged or affiliated with a public or private organisation within the next 15 years? You realize up until three months ago there were four mega firms, each with a goal of owning or controlling 30 percent of the world's water and waste water infrastructure within one or two decades? Now there are only three. One bought up the fourth.

Steve Gordon AWWA President, AWWA Mainstream, July 1999

BUT WHAT IF …?

Imagine alternative futures where:

- Australia becomes a world-leading nation;
- Australia hands over its sovereignty;
- Australia disconnects from the rest of the world;
- the rest of the world disconnects from Australia;
- international scarcity of potable water results in the creation of an international trading market;
- the Australian water sector becomes a world leader; or
- the water sector operates in a hostile environment.

Australia's international position

Australia becomes a world leading nation: What if Australia's international status increases and it becomes the second most powerful nation (after the US). This is achieved through its agility in adapting to global events, speed in applying new technology and its 'national competitiveness' (its dynamic institutions, state-of-the-art environmental management practices and robust physical infrastructure). In addition Australia leverages its other strengths—excellence in education, science and technology, cultural diversity, and abundant 'clean' natural resources. It sets the global environmental and water management agenda, and provides technological leadership.

Australia hands over its sovereignty: Imagine that Australia becomes the fifty-first state of the United States or, because of its geographical position and high proportion of Asian born residents (following an increase in immigration), Australia becomes a member of a powerful Asian federation. The federation controls trade, security, international policy, and environmental sustainability.

Australia disconnects from the world: What if Australia withdraws from the global community as a 'revolt' against the externally imposed rate and direction of change. As the gap between the 'haves and have-nots' widens, with few benefiting from the global connections. Australians attempt to re-create the 'good old days'. We retreat within our borders, restricting the movement of people, produce, finance and communications. Government is concerned about losing control and centralises its decision making. Australia fails to adapt and keep up. Our economic wealth falls.

The world disconnects from Australia. Imagine that relationships between nations breaks down. War spreads beyond the Middle East and splits the community into two opposing sides, creating a 'Korea-type relationship' on a global scale. Trade and communications between the sides cease. Countries try to check US dominance. The US assumes a less benign control of power, pursuing their interests at the expense of all.

The water sector

International scarcity of potable water: What if water scarcity results in the creation of an international trading market with water traded as either a bulk commodity or embodied in high input products such as rice or milk. The value of the traded goods would reflect their embodied water content. Demand for irrigation would increase with an increase in the production of the high water content produce.

Australian water sector becomes a world leader: Imagine that the Australian water industry develops a leading position in sustainable, integrated water management, energy use and infrastructure design. The sustainable delivery of low cost, reliable water underpins Australia's economic and social growth. The water industry too enters the international market making a significant contribution to Australia's wealth.

Water sector operates in a hostile environment: Imagine that with rising international conflict Australia becomes more vulnerable to terrorism requiring additional defence expenditure. Funding for capital investment, science and technology becomes scarce. There is a decline in water quality and concerns about its security, and services become unreliable.

3. People and institutions

Australia's people and institutions will shape its future. They will determine the relative importance of the influencers through their capacity and willingness to embrace change, together with the way in which they interact.

Can Australia's national culture and current system of government and public policy development seize the opportunities and cope with the challenges ahead? If not, are Australians capable of making fundamental changes that will work to both culture and structure (Wayne Goss cited in BCA 2004)?

The key questions for urban water are:

- What will the community expect of water institutions and services?
- How far will governments pursue the reform agenda?
- How will stakeholders respond?
- What business enterprises will enter the marketplace?

3.1 CULTURAL VALUES

How will people respond to future opportunities or challenges?

Most Australians have an optimistic outlook on our capacity to respond to challenges. But are we looking through rose coloured glasses?

> *... people often do not act in the rational, self interested way they are 'supposed to' in economic theory ... People have a way of upsetting the status quo, especially if they act together under the force of deeply held values galvanised by a new ideal or by new circumstances – or when they feel threatened.*
>
> GBE 2002

3.1.1 How do we view water and the environment—as commodities or as social goods?

Water is not 'respected' or valued by the Australian community generally. While water and the environment are regarded as important, will policy be more pragmatic than idealistic? Or, will the impending international water scarcity or global warming change our views on its management and use?

Since a considerable amount of urban water is used for recreational purposes, such as gardening and community parks, there is a view that water demand needs to be considered a social issue.

> *Water should be treated as a social and cultural good, and not primarily as an economic commodity. This presents a different view from decisions taken at several international forums in the 1990s,*

The rate of change is so rapid it is just about the only certainty remaining; that there will be change and there will be further change ... as Islam is demonstrating, human beings aren't always happy with change and may revolt against it, even preferring a lower standard of living for the certainty of not changing any more. Change is exhausting.

Pru Goward Federal Sex Discrimination Commissioner

in which water was judged to be an economic commodity, reflecting a shift towards market-based policies that reflect the true cost of water, reduced subsidies and possibly engage the private sector in water supplies.

United Nations 2003

There is a view that water should flow to the higher value use. However, tension exists between the demand for irrigation, for environmental flows and for urban supply. Increasingly urban and environmental use may be considered to have the 'higher value'. What would be the implications be for primary producers? Alternatively, how willing will the community be to embrace further restrictions or changes in water quality?

3.2 GOVERNANCE

The willingness and capacity of governments and its institutions to undertake a concerted effort to sort out longer-term problems is a key influencer.

Do Australians accept that their future will be profoundly influenced by factors such as our ageing population, globalisation, security issues and the strength of our economy? .Of course we have to add unpredictable events such as the world experiencing SARS and the September 11 manifestation of asymmetric warfare. Australia cannot prevent such events. The question is what will be the quality of response from our system of governance and politics? The answer comes back to the leadership of the Australian nation—not only political but also business, media and the community?

Wayne Goss cited in BCA 2004

3.2.1 Institutional and structural change fatigue

Australia's structural reform over the last 30 years has covered almost every aspect of economic activity. Key areas of reform include the labour market, tariff reductions, the exchange rate and financial sector, corporate governance, taxation, national competition policy, the public sector, and frameworks for monetary and fiscal policy (BCA 2004).

The reform dividend is evident in the high rates of productivity and economic growth achieved, especially relative to experiences of many other countries. This success was neither guaranteed nor was it a result of luck.

A considerable amount of reform remains to be undertaken, and new issues are continually arising.

However, there is an increasing level of reform fatigue in the community, and evidence of some leaders stepping back from further reform. While some Australians welcome reform relief, ultimately Australia's future will be diminished if it steps back.

Wayne Goss cited in BCA 2004

3.2.2 Quality of Australia's institutions

Countries with competent governance will reshape traditional government structures to better engage a more complex and interconnected world. States with ineffective and incompetent governance will not only fail to benefit from globalisation but in some instances will spawn conflicts at home and abroad, ensuring an even wider gap between regional winners and losers than exist today (GBE 2002).

Effective governance will increasingly be determined by:

- the ability and agility to form partnerships to exploit increased information flow;
- new technologies;
- migration; and
- the influence of non-state actors (GBE 2002).

Responsibilities of semi-autonomous government agencies will increasingly intersect because of the transnational nature of priorities and requirements for interdisciplinary policy responses.

3.2.3 Capacity of Australia's institutions

Governance of democracies can only become more difficult.

> *Globalisation will increase transparency of government decision making … complicating the traditional deliberative processes of democracies. Social decisions are mediated by institutions that were designed for a slower, more methodical approach to solving problems, and these problems were assumed to come one by one.*
>
> *The short-term nature of electoral cycles, inevitably bestows upon governments a short-term outlook, now strongly reinforced by the media's rapid news cycle and community expectations that problems can be fixed immediately. Prevention for example is not sexy in politics.*
>
> Goward 2003

Can the three tiers of government work together for the benefit of the nation? Will inefficiencies and duplication between governments threaten Australia's capacity for growth and social well being?

> *Many of Australia's current environmental problem, have as acutely exacerbating features the overlapping responsibilities of Local, State and Federal Governments. Land clearing deteriorating condition of the Murray–Daring Basin are good examples of problems that cry out for the resolution of overlapping responsibilities for services and the uncoordinated approaches to regulation and standards setting.*
>
> Michael Rae cited in BCA 2004

Environmental problems, especially water allocation and greenhouse gas emissions are adressed on a piecemeal basis. The governments each put money into water and energy-related issues without a coordinated effort to sort out the longer-term problems.

3.2.4 Regulation and control

People want the efficiencies that market liberalisation brings. They also want appropriate government regulation. Many of the traditional approaches to regulating the economy and institutions will become increasingly difficult to preform. The rate of change and its unpredictability in a global economy requires a new way of 'running the shop', with new rules to manage the unwanted consequences of change.

3.3 URBAN WATER SECTOR INSTITUTIONAL LIBERALISATION

In 1994, CoAG recognised the need for water management reform and agreed to implement a reform framework (Reform Framework). Still in its early days, the focus has been on getting the Reform Framework into place and cost reductions. Most of the real implications of these reforms are yet to be played out. Far reaching changes are predicted for the urban water sector for example:

Pricing of services: Full cost pricing of all water and wastewater services (including a provision for environmental cost), as well as an unwinding of cross-subsidies (e.g. customers could pay different prices based on their specific service delivery costs, time of use and water quality) may be introduced.

Consumers will have come to terms with the fact that the days of cheap subsidised water are coming to a close.

Prof Alan Fels, Chairman Australian Competition Commission

Marketisation of the sector: It is anticipated that:

- there will be new entrants under the 'new access regime' with competitors accessing existing facilities;
- customers may have a choice of service providers;
- full privatisation may occur;
- a further carving-up of businesses based perhaps on geography, integrating the water cycle elements, or infrastructure will occur.

Increasingly water authorities may not want to retain control of all aspects of water management or may want to expand their portfolios (e.g. they may re-position themselves as public health authorities).

Competition in other infrastructure industries is driving convergence towards the provision of multi-utility services.

In whichever direction the sector goes, it is likely that there be more providers, an increased sophistication and a simplification of the business.

Innovation and technical change: Liberalisation creates opportunities for innovation and technical change—old constraints may be freed to create more diverse ways to deliver customer services. Changes in water delivery are expected and it is speculated that there will be greater local control, management and service delivery to reduce risks and costs, and improve sustainability.

It is clear that whatever the water industry does, there will be rapid change with a move toward a very different approach to service delivery. The Reform Framework will create new dynamics for policy makers and regulators and will increase business risk and, in particular, the risks of assets being stranded and the 'cherry picking of customers'.

While significant progress has been made, the Reform Framework is unlikely to meet its implementation target date of 2005. Rural water management reform is especially lagging.

In Services Sydney Pty Ltd's application to the National Competition Council for a recommendation to declare Sydney Water Corporation's transmission of sewage services and a service for connection of new truck main service, it proposes to:

- establish a new state-of-the-art water reclamation plant; and
- construct water conduits to return tertiary treated water for other uses.

The company will compete for customers principally on the basis that its effluent treatment would be more environmentally friendly than the ocean outfall system used by Sydney Water. Its pricing structure is expected to be similar.

<www.ncc.gov.au>

BUT WHAT IF …?

Imagine alternative futures where:

- no change occurs;
- Australia's institutions change;
- a MacWater takes over the Australian urban water market; or
- the international market is dominated by oligopolies.

Australia's response to change

No change: Imagine if Australia's governments have not been able to embrace the change and where we are unable to achieve agreement on problems or the way forward, different levels of government are blaming each other (BCA 2004). There is a lack of trust between the people and government and social unrest. Short-term attitudes flourish with no concerted effort by government to pursue long-term opportunities or sort out the longer-term problems.

Australia's institutions change: What if Australia has a stronger and more centralised national government; state/territory governments are abolished? Alternatively, Western Australia and Queensland cede from the Australian federation.

Water sector

A MacWater takes over the Australian urban water market: An international water company experiences flat profits in its primary market and decides to expand into other enterprises. 'MacWater' diversifies into land development. A major breakthrough in water treatment technology allows MacWater to offer a better and cheaper service, with franchised management of development sites including local water service provision. Its real competitive advantage is its leadership in customer knowledge, managing the environmental impact of its operations and cost efficiency. It is very successful and eventually takes over the urban water industry. Governments subsequently have a very small role in the delivery of essential services and the industry becomes self-regulating.

International market dominated by oligopolies: Globally the entire water market is cornered by a few mega-corporations, which collude and act as aggressive oligopolies excluding new entrants, and manipulating supply and prices. Australia's water utilities adopt a 'head in the sand' approach. A corporation enters the Australian market 'cherry picking' the services it provides. The expensive less profitable services are left in the public domain. Their costs climb or the authorities become unviable, as their fixed overhead costs are covered by a smaller customer base. Governments are forced to heavily subsidise the water industry to ensure equity and basic service provision to all citizens. The corporation subsequently provides small local treatment plants, further stranding the larger centralised infrastructure system.

4. POPULATION

Australia's future will be shaped by changes to local and global populations. Population changes:

- trigger changes to social values and community needs;
- trigger demand for goods, services and resources; and
- have environmental impacts.

Our demographic profile relative to those of our neighbours influences our relationships, and has economic and social implications.

The Australian Bureau of Statistics advised that:

> *The growth of the world's human populations and its increasing demand for limited global resources is a key issue for citizens and governments throughout the world. This is coupled with evidence that many of the life support systems that make-up our natural environment is being degraded by human activity and continued population growth will add to the pressure experienced by these systems.*
>
> ABS 2001

The key questions for urban water are:

- How can we provide for urban growth and meet higher environmental and public health standards?
- How will businesses manage a skills shortage at a time when they need to draw upon a solid skills and knowledge base to meet the challenges?

4.1 POPULATION SIZE AND GROWTH

The world's demographic balance is changing: in the future there will be more people and in the developed countries those people will be older.

4.1.1 Global population

Global population will increase from today's 6.4 billion to 7.8 billion in 2024 (U.S. Census Bureau 2004). Ninety-five percent of the increase will be in developing countries—mainly in rapidly expanding urban areas—where political systems are brittle. The combination of population growth and urbanisation will foster instability (NIC 2000).

In developed countries, growth seems to have settled at virtually zero. According to the United Nations 2003 projections, the average fertility rate in the more developed countries is 1.6 (Australia's is 1.7), while the rate in the less developed countries is 2.9, the world average is 2.7 (ABS 2003b).

4.1.2 Australia's population

Population growth: Concerns have been expressed about the optimal population size. Estimates of Australia's carrying capacity vary considerably, ranging from hundreds of millions to less than the current number of people (ABS 2001). This issue remains unresolved.

Australia's June 2002 population of 19.7 million is projected to grow to between 22.3 to 24.6 million by June 2021. Fertility and migration have the greatest impact on this growth. Immigration is a more significant driver as large changes in birth rates would be needed to impact on total births (ABS 2003b).

Ageing population: Over the next 20 years ageing and retiring baby boomers presents a challenge. The additional pressure on the tax and welfare systems will be supported by fewer taxpayers and this will slow down economic growth. In 2002, 13 percent of the population was aged 65 years and over; by 2021, it is projected that they will represent 19 to 20 percent (ABS 2003b). The elderly dependency ratio increased from 18 percent to 19 percent between 1954 and 1981, then to 21 percent by 1996. By 2031 it may reach 31 percent. The net effect of a likely life expectancy increase of over the next 10 years would be further increases in the proportion of over-sixty–fives.

Where we will live: There will be an overall movement of the population to the coast and cities. Predictions are for a coastal community that spreads along most of eastern Australia. The drift will have a significant impact on our capacity to manage water, infrastructure investment and environmental sustainability.

Further concentrations in capital cities will be due to larger growth rates relative to the rest of their state/territory. Melbourne is likely to increase by 19 percent to 4.2 million in 2021 (estimated range is between 4.1 and 4.3 million); Sydney by 18 percent to 4.9 million in 2021 (estimated range is between 4.7 and 5.1 million); Brisbane by 35 percent to 2.3 million (estimated range is between 2.1 and 2.5 million). Brisbane and the Gold Coast will merge into a new megacity. They will remain Australia's three most populous cities (ABS 2003b).

How we will live: Households numbers are set to increase sharply, with a decline in the number of people per household. In 1947, the average Australian household size was 3.8 persons. From 1981 to 1996 the number fell from 2.92 to 2.72. It is expected there will be 2.3 persons per household in 2021. The

smaller households result from an ageing population, family breakdown, smaller families and lifestyle choices. It is forecast that 500 000 new homes will be built in Sydney over the next 20 to 30 years (Executive Intelligence). The percentage of multi-unit dwellings has increased.

Population make-up: Australian has one of the worlds' most diverse populations: in 2001, 23 percent were born overseas (ABS 2003b), compared to, for example, 8 percent in both the US and New Zealand. Increasingly, Australians are dispersing and living elsewhere in the world on a temporary or permanent basis (1.7 percent of the population in 2001).

Our population diversity and its connection with the global community increases our adaptability and capacity to innovate.

4.2 SKILLED WORKFORCE

A critical assumption is that Australia will be able to draw on a pool of skills to support its transition and growth. However, this may be unrealistic due to the combination of the baby boomers retiring and a brain drain.

Baby boomers retire: Australia's workforce has a disproportionably high number of people close to retirement, and fewer younger workers. In the next few decades a shortfall in the number of young people entering the workforce could limit industry's ability to conduct business and lead to higher wages.

European and Japanese populations are also rapidly ageing, requiring more than 110 million new workers by 2015 to maintain the current working population to retirees dependency ratios (GBE 2002).

Brain drain: Increasingly, young Australians are seeking opportunities overseas.

> *A key issue … is where we will come out in terms of net brain gain or drain – that is, will Australia be able to attract more skilled individuals on a relatively permanent basis than we lose? Australia's capacity to continue to benefit from 'brain gain' will be determined not only by domestic circumstances—including the availability of competitive employment opportunities and policies to support skilled migration and return of ex-patriots—but also by the equivalent circumstances globally. Australia is already facing competition for skilled labour from other developed countries. This will intensify as population ageing advances. At the same time, permanent and long-term departures by young, skilled Australians have trended up (BCA 2004).*
>
> Melinda Cilento cited in BCA 2004

Water industry: A shortage of people entering and remaining in the water treatment industry—in design, construction and management—could lead to significant problems in 10 to 20 years (GHD 2004).

BUT WHAT IF…?

Imagine alternative futures where:

- we experience a rising tide of refugees; or
- our population decreases.

An overwhelming population increase

A rising tide of refugees: Imagine if legal and illegal refugees cause a significant increase in our population due to:

- *population pressures* from growth in the least developed countries that are least able to support it—unless a significant improvement in these countries' economic prospects occurs, it is likely outward migration will grow;
- *regional instability* due to high population growth, urbanisation and a widening disparity of wealth;
- *natural disasters* (e.g. 30 of the world's largest cities lie near coasts: a metre rise in the oceans … would put an estimated 300 million people directly at risk [Linden cited in Hawken, Lovins & Hunter Lovins 2000]);
- *relative economic position*—our relatively strong economic fortune creates strong pull factors;
- *a shift in Australia's social or economic values* where immigration policies that are based on views on appropriate numbers, an obligation to accept refugees and the need to control inflow, could change as views change; movement of people could also be deregulated in the same way that we are seeing economic and political liberalisation; or
- *loss of border control*, where Australia loses its ability to control the inflow of illegal migrants.

East coast growths:The current population increase is occurring mainly on the east coast of Australia. What if water authorities are unable to meet the demand for water services: demand exceeds available supply and our ability to dispose of the effluent and the capacity of infrastructure.

Population decrease

Population decrease: Imagine if a real population decrease occurs as it becomes evident that Australia has exceeded its human carrying capacity or, a pandemic disease dramatically reduces our population and immigration inflow. The water industry's costs increase dramatically and revenue raising capacity falls as:

- in anticipation of a population increase, industry has over-invested in capital infrastructure, with significant under-utilisation and high operating costs;
- more resources are allocated for environmental sustainability and to undertake remedial work; or
- the population's increased dependency ratios limits the industry's capacity to generate the required revenue.

More than 6 million new settlers have arrived in Australia since the end of World War II.

ABS 2004c

5. Climate and enviromental change

We are at a new moment in human history. For the first time, we are widely aware that our day-to-day decisions have the power to destroy our own habitat. Water is integrally linked to the environment's health. Water is vital to the survival of ecosystems, and in turn ecosystems help regulate the quality and quantity of water (Rosegrant, Cai & Cline 2002).

For much of Australia, climate change predictions forecast that with rising temperatures, there will be an increased demand for water, reduced yields and increasing yield variability.

The key questions for urban water are:

- What provisions can be made to manage reduced yield in general, and increased yield variability, combined with population and economic growth?
- What will be done to mitigate the risks arising from climate change and environmental degradation?
- How significant are those risks?

5.1 THE ENVIRONMENTAL TRENDS

> *Contemporary* (global) *environmental problems will persist and in many instances grow over the next 15 years. With increasingly intensive land use, significant degradation of arable land will continue as will the loss of tropical forests. Given the promising global economic outlook greenhouse gas emissions will increase substantially. The depletion of tropical forests, other specie-rich habitats, such as wetlands and coral reefs, will exacerbate the historically large losses of biological species now occurring.*
>
> NIC 2000

Australia's arable land and fresh water are also predicted to continue to decline both in quantity and quality as is our biodiversity (Michael Rae cited in BCA 2004).

5.2 WATER USE AND ITS ENVIRONMENTAL IMPACT

Approximately 73 percent of water used in Australia (~24 000 GL) is supplied by rivers, 21 percent by groundwater aquifers, and the remaining 9 percent by harvest of overland flows. Surface water predominates in all states and territories except Western Australia and the Northern Territory (NLWRA 2001a).

The National Land and Water Resources Audit showed that, in 2002, twenty-six percent of the 325 surface water management areas units were either close to or already overused when compared with sustainable flow regime requirements. These account for 55 percent of total water use in Australia. Thirty-one percent of the 538 ground water management units are also fully or over-allocated (NLWRA 2001b).

We learn geology the day after the earthquake.

Ralph Waldo Emerson

Water quality data are limited with only between 67 and 75 out of Australia's 246 river basins (about 28 percent) able to be assessed for any of the key variables—turbidity, nutrients or salinity. Sixty-five basins had major exceedances of guidelines (NLWRA 2000).

5.3 VARIABILITY IN ANNUAL RAINFALL

In all parts of Australia there is great variability in annual rainfall:

- along the east coast it can vary by a factor of two or three to one between consecutive years; and
- in arid areas annual rainfall in consecutive years can vary by a factor of 10 or higher.

Also, both long- and short-term cycles of wet and dry weather can be identified and these can be Australia wide or regional. Long-term weather cycles of 40–50 years have been identified (GHD 2004). These can have a significant impact on the reliability of existing supplies.

Many of Australia's rivers have highly variable flows. Droughts and floods are common, and hence rivers and groundwater resources have been developed extensively for irrigated agriculture and domestic water supplies.

The variable climate and water cycle flows suggest that the use of the system to support the service needs of the community and the economy also needs to vary. The move towards integrated water cycle management will require sensitivity to this volatility. Further, if we learn to live with climate variability we will be better equipped to deal with climate change.

5.4 GLOBAL WARMING AND SEA-LEVEL RISE

For many, global warming looms as one of the planet's biggest threats. Over the past 20 years researchers have gathered evidence that burning fossil fuel is causing temperatures to rise. The exact pace of global warming, as well as mankind's contribution, is uncertain (Cline 2004).

Rising temperatures can cause considerable harm depending on how big the future rises are and how quickly they happen, and the impacts on regional environments.

Predictions are that the Earth's average temperature is likely to rise by 1.4 to 5.8°C by the year 2100 relative to 1990, a warming rate of 0.1 to 0.5°C per decade. With this will be a rise in sea level of 9 to 88 cm by 2100, or 0.8 to 8.0 cm per decade (CSIRO 2001b).

Given the promising global economic outlook, greenhouse gas emissions will increase substantially. But the pressures on the environment as a result of economic growth will decrease as a result of less energy-intensive economic development, technological advances and the shift towards less polluting fuels such as natural gas (NIC 2000).

There are many uncertainties. Forecasts on greenhouse gas emissions are subject to:

- population growth;
- technological change;
- social and political behaviour; and
- the validity of the climate modelling.

The climates too are influenced by the normal climatic cycles and other unpredictable factors such as solar radiation and chaotic variations in the climate system.

Many people's intuition that weather is shifting and is becoming more volatile is confirmed by meteorological measurements. Spring in the Northern Hemisphere is coming a week earlier: the altitude at which the atmosphere chills to freezing is rising by nearly 15 feet a year; glaciers are retreating almost everywhere.

5.5 AUSTRALIA'S CLIMATE CHANGE

Australia's temperature, rainfall patterns and availability of water will change relative to 1990.

Rising temperatures: By 2030, Australia's annual average temperatures will probably be between 0.4 and 2.0°C higher, with slightly less warming in some coastal areas and Tasmania, and greater warming in the north-west. The greatest amount of warming will occur in spring; the least amount will be in winter. In the north-west, the greatest potential warming will be in summer. These increases may lead to large changes in occurrence of extremely hot or cold days (CSIRO 2001a).

Changes to average rainfall, rainfall pattern and intensity of rainfall events: Average annual rainfall could increase or decrease. Changes vary from -10 percent to +10 percent by 2030 and -35 percent to +35 percent by 2070, relative to 1990. Decreases will be most pronounced in winter and spring. There will be a bias towards decreases in the south-west, parts of the south-east and Queensland. Some inland and eastern coastal areas may become wetter in summer, and some inland areas may become wetter in autumn (CSIRO 2001a).

Where average rainfall increases we could have more extremely wet years, and where it decreases, more dry spells. An increase in extreme daily rainfall leading to more frequent heavy rainfall events and flooding, is likely (CSIRO 2001b).

It will be drier, as higher temperatures increase evaporation, and this will tend to be greater where there is a corresponding decrease in rainfall (CSIRO 2001b).

If the world's nations wanted to stabilise the atmosphere in its present disrupted state, they would need to cut CO_2 emissions immediately by about three-fifths.

Hawken, Lovins & Hunter Lovins 2000

5.5.1 Implications of a climate change

Climate change will have social, economic and ecological impacts. All our natural ecosystems are vulnerable. Water resources, cities and towns, the energy sector and industry are likely to be sensitive to climate change, although the net effects are difficult to predict (CSIRO 2001a). The likely implications for urban water include water shortages, extreme weather events and environmental impacts.

Water shortage: Shortages are likely to occur particularly in winter-rain–fed systems already under stress. This will lead to a sharpening of competition between different water users, especially where large diversions from river systems are made for industry and irrigation. The trends will be:

- increased water stress with increases in stream flow in northern Australia and decreases for southern Australia;
- warmer conditions, accompanied by rainfall decrease in key agricultural regions particularly in winter and spring; and
- a decrease in water available for irrigation, domestic and industrial uses; environmental flows; and crop and pasture growth.

Extreme weather events: More frequent extreme events such as bushfires, floods, storms and drought are likely to occur.

Environmental impacts: A substantial reduction in biodiversity is likely to occur as many natural systems will have difficulty adapting to climate changes. The range of tropical diseases, disease vectors and toxic algal blooms are likely to be expanded (CSIRO 2001a).

5.5.2 Community response to climate change

Planning and adaptation strategies can help to minimise the adverse impacts and optimise benefits. However, climate change is not well understood and is poorly accepted by decision makers and the public.

> *Global warming will challenge the international community as indications of a warming climate … occur. The Kyoto Protocol on Climate Change, which mandates emission reductions targets for developed countries, is unlikely to come in force soon or without substantial modification. Even in the absence of a formal treaty, however, some incremental progress will be made in reducing the growth in greenhouse gas emissions.*
>
> Cline 2004

Economist and columnist Robert J Samuelson in Newsweek expressed the view that:

> *It would be political suicide to do anything serious about [climate] … So shrewd politicians are learning to dance around the dilemma' … Without a breakthrough in alternative energy – nuclear or something – no one knows how to lower emissions adequately without crushing the econom …*
>
> Samuelson cited in Hawken, Lovins & Hunter Lovins 2000

A contrary view is that:

> *Samuelson, like many business people, believes climate protection is costly because the best publicised (though not the most broadly accepted) economic computer models say it is. …those models find carbon abatement costly* because that's what they assume. *The menu of climate-protecting opportunities is so large that over-time, they can overtake and even surpass the pace of economic growth… These steady long-term improvements are profitable and already underway.*
>
> Hawken, Lovins & Hunter Lovins 2000

BUT WHAT IF …?

Imagine alternative futures where:

- large and sudden climatic changes occur;
- environmental decline triggers extinction; or
- existing production patterns intensify.

A climate catastrophe

Large and sudden climatic changes: Many scientist suspect that relatively small changes in certain forces that drive the climate—notably CO_2 concentrations, especially if they happen fast enough—may trigger large and sudden changes in the world's weather (e.g. the shifting of ocean currents). Such changes could lead to the onset of an ice age in just decades—this must be possible since ices ages appear to have occurred this abruptly in the past (Hawken, Lovins & Hunter Lovins 2000).

Well that's that: Environmental decline could trigger the sixth extinction? Maybe in the far, far distant future a new species will feature a television or other program 'Walking with Humans'?

There is no change in land use

Existing production patterns intensify: Imagine if Australia's climate becomes significantly dryer in the Murray–Darling Basin which currently accounts for 45 percent of Australia's agricultural produce. The type of produce remains unchanged. Internationally prices increase in accordance with their water content due to global water shortages and increase in cost of water. Responding to the higher prices, producers seek to increase production levels, irrigation increases significantly and the river is drained.

6. Energy and greenhouse gas

Water and energy are closely connected. Energy is used to clean, transport and heat water, and water is used to produce energy. The water sector's use of energy and its emission of greenhouse gases to deliver water services are significant.

The key questions for urban water are:

- Will the urban water sector initiate effective energy efficiency measures?
- What should be done by the sector to reduce its greenhouse gas emissions?

6.1 AUSTRALIA'S GREENHOUSE GAS EMISSIONS

Combustion of fossil fuels is the major contributor to Australia's greenhouse gas emissions (about 73 percent of net emissions, excluding land clearing) (ABS 2003a).

Australia's per capita carbon dioxide emissions, total primary energy supply and electricity consumption, are higher than average for all major world regions, with the exception of North America. Australia's per capita carbon dioxide emissions are more than four times the world average and nearly 50 percent greater than the average for OECD countries (ABS 2003a).

I am a Green and I entreat my friends in the movement to drop their wrongheaded objection to nuclear energy. Every year that we continue burning carbon makes it worse for our descendants and for civilisation. The Green lobbies, which should have given priority to global warming, seem more concerned about threats to people than threats to Earth.

James Lovelock – renowned British scientist who postulated that earth is a single living organism

6.2 ENERGY SUPPLY AND PRICE

Sustained economic growth, along with population increases, will drive a nearly 50 percent increase in global demand for energy over the 15 years (to 2015). Meeting this demand will not pose a major supply challenge. Despite the increase, global energy resources will be sufficient to meet demand. Estimates suggest that 80 percent of the world's available oil and 95 percent of its gas remains underground (NIC 2000).

Globally, renewable energy will gain increasing importance. Non-hydro renewables—mainly wind and bio-mass—are expected to account for a fast-growing share of electricity production, even although they are starting from a small base. It is anticipated that the per annum growth for wind power's share should be by 10 percent, bio-mass by 4.2 percent, solar power by 16 percent and geothermal power by 4.3 percent. With these growth rates substantial falls in capital costs are expected (IEA 2002).

Natural gas use will increase more rapidly than any other energy source. However, fossil fuels will remain the dominate form of energy (GBE 2002).

There is some debate about whether with the increase in demand significant real price increases will also occur:

> *... it is expected that energy prices are likely to become more unstable in the next 15 years period as price hikes are followed by price collapse.*
>
> GBE 2002

6.2.1 Australia's future demand and availability of energy resources

By 2015 Australia's total energy production is projected to increase by 55 percent over 1998 levels. Black coal and uranium are expected to be the dominant energy resources. Australia is facing a decline in crude oil production. Geoscience Australia predicts that without any discoveries liquid fuel self sufficiency will decline from 85 percent in 2001, to less than 40 percent in 2010.

Australia's known and prospective energy resources, other than oil (which can be imported or substituted through liquefaction of natural gas and coal), are sufficient to meet projected demand.

In Australia, renewable energy (mainly hydro, biomass, solar and wind energy) represented 4 percent of total energy used for electricity generation, and 5 percent of end use consumption in 2001/2002 (2004a).

The Australian Bureau of Statistics advised that although Australia has a favourable climate for solar energy applications, its use is far below its potential. With the exceptions of hydro-power, other forms of renewable energy are still relatively insignificant. The abundance of cheap fossil fuel may be one factor influencing the rate of development of alternative energy, it is probable that non-renewable energy sources will dominate Australia's future for some time (ABS 2004b).

6.2.2 Reduction in energy use and management in greenhouse gas emission

The continuing growth in energy use and greenhouse gas emissions are likely to be capped by government and commercial initiatives. The introduction of legislation around the world and in Australia has spurred sustainable developments and new business opportunities while achieving the objective of reducing environmental impacts. To illustrate:

- Significant global developments include the emerging emission trading schemes to achieve effective reductions in greenhouse gas emissions. A global greenhouse gas emissions market is starting to appear despite non-sanctification by the US government. However, in the UK there are some doubts about its effectiveness.
- The Australian *Renewable Energy (Electricity) Act 2000* (Cwlth) requires that wholesale purchasers of electricity proportionally contribute towards the generation of an additional 9500 gigawatt hours (GWh) of renewable energy annually by 2010 (the Mandatory Renewable Energy Target), equivalent to more than twice the output of the Snowy Mountains Scheme. A recent review recommended that the targets be increased beyond 2010, to 20 000 GWh in 2020.
- Accounting guidelines have been provided jointly by the Institute of Chartered Accountants in Australia and Environment Australia to assist the reporting of environmental costs. They are designed to help management identify environmental performance.
- Corporations around the globe are viewing sustainability as a core business strategy that contributes to business success (Friend & Briggs 2003b).

Environmental considerations are the major driver of new energy supply technology. The global economy will continue to become more energy efficient through 2015. Advances are being made for example in:

- establishing the role of hydrogen in energy supply by 2025;
- developing low-emission energy technologies and systems, and reducing the losses in end use processes;
- reducing the intensity of current fossil fuel electricity generation;
- increasing efficiency of distributed generation through cost-effective use of the waste heat;
- developing vehicle technologies and traffic management systems that will reduce greenhouse gas emissions; and
- developing distributed networks with locally generated power systems (micro turbines) to reduce the community's reliance on large, lengthy transmission networks.

The Business Council of Australia asks:

> *Can advanced nuclear generation systems, and improved waste disposal technologies, be developed to the extent that community opposition to nuclear energy is lessened or overcome? Will nascent solar photovoltaic industry take-off over the next 20 years as wind energy has done in the past quarter of a century?*
>
> Keith Orchison cited in BCA 2004

Carbon geo-sequestration technologies have been developed to store greenhouse gas emissions from coal in the ground—critical to the pursuit of zero emissions from coal use. It has the potential to change the world's view of greenhouse strategy and renewable energy. The product gas in this scheme is hydrogen which can be used to accelerate the long-term change to a hydrogen economy.

To halve greenhouse gas emissions and double the efficiency of the nations new energy generation, supply and end use, and to position Australia for a future hydrogen economy.

Mission CSIRO Energy Transformed Flagship

6.2.3 Energy use and greenhouse gas emissions by the water sector

While it is likely that the water sector will experience real price rises for energy, the key influencer will be increased accountability for energy use and greenhouse gas emissions, pushed by global and community expectations, climate change and population growth.

Greenhouse gas emissions are generated by water utilities, directly and indirectly, through all their operations(see Table 1).

Table 1. Urban water utility net greenhouse gas emissions for 2002 – 2003 allowing for sequestration. The figures include emissions from energy consumption and during sewage treatment process, but not the embedded energy in materials such as pipes.

ACTEW Corporation	37 171
Brisbane Water	203 275
Central Gippsland Region Water Authority	36 137
City West Water	7 006
Gold Coast Water	107 794
Goulburn Valley Water (for 2001–2002)	90 284
Hunter Water Corporation	74 073
Melbourne Water	462 200
Power & Water Corporation	8 134
South Australian Water	443 973
South East Water	25 269
Sydney Catchment Authority	59 246
Sydney Water	394 420
Water Corporation	148 787
Yarra Valley Water	23 421

Source: WSAA 2003

Water heating accounts for 24.6% of household energy uses. Water heating accounts for 5.6% of the total greenhouse gas emissions for major end users.

AGO 2002

Significant inroads are being made to reduce greenhouse gas in the sectors with the highest level (energy sector, transport, households, manufacturing—iron, steel and basic non-ferrous metal and products) by managing both the demand and efficiency of use.

Increasingly the water sector will need to enhance energy efficiency and reduce greenhouse gas emissions through research, creative technologies, changes in processes, and re-design of its infrastructure. It will also be expected to assist in the integration of energy and environmental policies.

BUT WHAT IF …?

Imagine alternative futures where:

- cheap alternative energy becomes readily available and used;
- energy supplies are disrupted;
- the urban water sector does not adequately address its energy use; or
- the Australian water sector is a global leader in the research and application of energy efficient processes.

Change in global energy demand and supply

Alternative energy: Imagine the situation if a very cheap alternative energy source that is environmentally sustainable takes over oil. Alternatively, Australia becomes a hydrogen society within the next 20 years.

Disruption in energy supplies: Imagine if global energy supplies suffer a major disruption. Turbulence in global energy supplies has a devastating effect. It is driven by conflict among key energy-producing states, sustained internal instability in two or more energy producing states, or major terrorist actions (GBE 2002).

Water industry energy use

The urban water sector does not adequately address its energy use: Imagine the situation if the water industry lost public support through its tardiness in reducing its greenhouse gas emissions. The industry is further penalised as a result of the establishment of a trading market where costs proved to be prohibitive. At the same time with increased desalination and recycling processes, there is a dramatic increase in energy use. This situation would be compounded by the cost and lead-time to develop and implement energy-efficient technologies and processes.

Australian water sector is a global leader in the research and application of energy efficient processes: The Australian water industry could develop an international competitive advantage through its application of energy-efficient processes and thereby enter the international market.

7. Science and technology

Positive outcomes from technological choices, be they in economic growth, social equity or environmental quality, rely more on the effectiveness of their integration rather the brilliance or efficiency of a technology or idea (Barney Foran cited in BCA 2004).

The key questions for urban water are:

- What current technological innovation will impact on the services that water currently provides?
- How will information technology, sensors, nano- and other technologies be incorporated into water management?
- What further advances can urban water make to increase water efficiency at each of the steps within the water cycle?

7.1 NEW TECHNOLOGY

Over the next two decades the continued diffusion of information technology, developments in nano-technology, sensors, and bio-markers together with new applications for bio-technology, will be at the forefront of development. They will be the major building blocks for international trade and empower non-state actors.

The continuing revolutions and the integration of information technology, biotechnology, materials science, and nanotechnology will generate a dramatic increase in investment in technology, which will further stimulate innovation.

7.1.1 Information technology

The information technology revolution represents the most significant global transformation since the industrial revolution. The revolution, a driver of what is often called the 'fifth wave' of technology, is only in its very beginnings. Few predicted its profound impact twenty years ago. Looking ahead another 20 years, the world will encounter more quantum leaps in information technology.

7.1.2 Nano-technology

Nano-technology, the design, fabrication, and characterisation of functional objects having dimensions at the nanometer (one billionth of a metre) scale, will impact on our lives in ways we can only begin to imagine. Nano-technology promises more for less: devices are smaller, cheaper, lighter and faster, they have greater functionality and added value, consume less raw materials and energy. Examples of nano-technology research include:

- molecular electronics to revolutionise information technology;
- multifunctional windows (self-cleaning, solar control, switchable, photovoltaic) in one small package;
- paint additives that mean dark surfaces stay relatively cool and light surfaces can absorb heat;
- embedded, distributed sensing systems that involve implanting tiny sensors (temperature, air quality, stress) in building materials—using such systems we obtain 'smart spaces' that employ technology that can sense and act, communicate, reason, and interact with us to make our living and working environment better; and
- biosensors for diagnostics that might one day be found in the medicine cabinet.

7.1.3 Sensor technology

Sensor networks and associated processors are being designed as self-organising systems that are aware of data and able to form responses without human intervention (rather than using passive instruments for data collection). These autonomous systems are capable of performing advanced tasks in changing environments. They comprise sensors intelligently linked to control and actuation, and may communicate and cooperate to achieve complex tasks. They can perform tasks that humans do not wish to do, or that they cannot do safely or well.

Sensor technology has many applications and potential benefits are great.

7.1.4 Biomarkers

Biomarkers are being used for natural resource management. They are organic compounds that are characteristic of pollutants; their presence indicates not only that the pollutant is in the water or sediments, but also its source. They are, in effect, 'fingerprints' of the pollutant.

The ability to trace sources of hydrocarbons and distinguish between sources is an invaluable tool for improving management of stormwater systems and controlling the amount and type of hydrocarbons entering the marine system. It provides a base for understanding the toxicology of hydrocarbons in the systems.

7.1.5 Other innovations

Other innovations that are anticipated by 2024 include:

- Biotechnology could drive medical breakthroughs enabling the world's wealthy to improve their health and dramatically increase their longevity. At the same time, genetically modified crops could offer the potential to improve nutrition among the world's one billion malnourished people.
- Breakthroughs in materials technology could generate widely available products that are multi-functional, environmentally safe, longer lasting and easily adaptable to particular consumer requirements (NIC 2000).
- Houses could supply their own power needs through use of fuel cells combined with photovoltaic generation of electricity ending the need for large remote power stations.
- Micro-turbines could be used in residences.

7.2 WATER MANAGEMENT – WHAT IS POSSIBLE

Technical innovation, including mimicry of natural solutions, will continue to be a key to sustainable development and smarter use of water resources. The call for more efficient use of water resources is also providing some impetus to innovations in water use and recycling technologies. In the urban context managing scarcity and quality of water supply, reducing stormwater pollutant impacts, and the re-use of wastewater are among key drivers for technical innovation. Technical applications directed towards achieving efficiencies in operations, control systems and cost reductions are also apparent (Friend & Briggs 2003a). Examples of developments anticipated by 2024 in the water sector follow.

Waterways and ecological processes

- A better understanding of interactions with biological processes and increasing power to influence landscape-scale ecological processes, together with better measures of river health.
- Eco-technologies for environmental mitigation and management that mimic natural solutions.
- Environmental problems overcome (e.g. increasing salinity and the treatment and disposal of wastes).

Effective waters use

- Further efficiencies in residential water use including waterless toilets, improvements to washing machines, dishwashers and garden irrigation.
- More efficient use of water for primary production using precision farming techniques.
- Improved profiling of agricultural production, and plant and animal varieties to determine which are better adapted to local environmental conditions.

Efficient treatment

- Greater emphasis on engineering for efficiency of water and wastewater treatment and transmission including:
  - improved metering and leak detection;
  - improved maintainability of buried infrastructure (particularly the ability to pinpoint when the infrastructure needs replacing);
  - solutions for local retention of stormwater and sewerage disposal; and
  - development of water treatment technology enabling greater water re-use.

New!Stafford®Cotton/Poly PerformanceW/ FDress Shirt

Scotchgard™ Dual Action fabric protector repels stains while releasing dirt and other more stubborn stains in the wash. The technology reduces need for frequent washing.

<www.jcpenney.net>

The new waterless urinal won't block, is free from odour and won't require water ... The new urinal requires the use of one bucket of water a day for cleaning compared to the average of 1500 to 2000 litres for flushable urinals ... It is more effective than flushing at stopping the build-up of uric scale—the part of the urine which sticks to urinal flushpipes and creates unpleasant odours ... Mico-biological cubes are placed in the urinal, which convert urinal scale to a soluble substance.

<www.heraldsun.news.com.au>

Process efficiencies

- Breakthrough in membrane technology for desalination plants resulting in much lower levels of greenhouse gas emissions and processing costs.
- Industry's waste heat used for desalination.
- Systematic implementation of measuring, monitoring and control technology. Sophisticated remote management of any site, and greater precision, real-time biological and chemical detection.
- Multi-utility 'smart meter' in all residences, providing real-time information on water use and quality (or electricity and gas) to customers and utilities. A tool for measuring consumption and managing use.

Risk management

- Tools to detect bio-terrorism activity and improve security arrangements, including algae as an early warning system, and biological and chemical sensors to monitor and provide real-time detection.

BIO-REMEDIATION AND REDEVELOPMENT AT THE SAME TIME

TNO and Tauw have successfully carried out the first scale in situ HCH [pesticide] bioremediation at a Netherlands industrial contaminated site. This was possible through a new approach that allows existing bacteria in the soil, groundwater and wastewater treatment to mineralise all HCH isomer into harmless end products like CO2. This technology is 20-35 percent cheaper than the best alternative containment technology including pump and treat

Friend & Briggs 2003a

BUT WHAT IF …?

Imagine alternative futures where:

- new crop varieties revolutionise water use;
- new water sources are developed;
- efficient water extraction and re-use is a reality;
- water use is efficient;
- innovative consumer technologies are developed; or
- services are fully automated.

General technological breakthroughs

New crop varieties: Significant bio-technology breakthroughs could result in new crop varieties that:

- are salt tolerant and can be grown using salty water or in central Australia;
- require a low level of embodied water and use water efficiently;
- are able to adapt to climate variability and produce good quality protein during stress periods;
- are pest resistant and may be grown in northern Australia; and
- act as bio-filters so that they remove impurities from water and waterways, and can absorb and remove heavy metals from contaminated soils.

Technological breakthroughs within the water industry

A 'new' water source: Imagine the situation if the cost of desalination were reduced to $1 per kilolitre, or that cloud-seeding techniques are developed to enable the 'manufacture' of water and that the clouds could be moved between regions.

Efficient water extraction and re-use: With the introduction of new recycling technologies, using cheap effective micro-desalination plants, advanced biotechnologies and increased processing efficiencies, 90 percent of all water extracted could be re-used (e.g. in-house water treatment systems that are 100 percent reliable, cheap to operate and require no maintenance). Water loss from extraction to delivery could be eliminated and the amount of available water could double.

Image if we had a full understanding of the water cycle based on robust science. Environmental impacts of water source development and extraction could be eliminated.

Efficient water use: We could eliminate the need for many currently intensive water users, in industry and in primary production to use extracted water through research, innovation, manufacturing and process changes, new technology and capital investment.

New consumer technologies: New technologies that are market-driven could emerge. They could include sonic massaging showers, fabrics that don't require washing, grass that stays green and does not grow. New materials could mean that toilets and showers don't need to be cleaned thereby overcoming the cultural bias towards flushing toilets.

Fully automated service: With an integration of sensors, bio-markers, robotics and information technology, the water infrastructure could be a fully automated self-managing system. The systems collect and analyse data and take action.

8. Water use and management

Key industry drivers will be security of water supply, sharing of limited resources and delivery of required water services to customers.

The key questions for the urban water sector are:

- Will the transition to sustainable water use be achieved in time?
- Should allocations shift from rural to urban use?
- Will distributed localised systems replace the current large-scale centralised water network systems?
- How will the industry approach water use and management within a rapidly changing operating environment?

8.1 AVAILABILITY AND RELIABILITY OF SUPPLY

Contrary views on water shortages range from 'yes, there is a shortage for all the uses that we want from water' to 'Australia appears to have sufficient water availability'.

8.1.1 Security of the current water supply

The increasing demand for urban water is causing concern. Many cities are now experiencing moderate water restrictions as a consequence of the seven-year drought showing that we do not have enough water for existing water management practices to remain sustainable (GHD 2004).

A re-assessment of what is an acceptable level of reliability for future urban water supplies is likely to occur. Dam design and the estimation of safe yield are based on historical data. Safe yield describes the quantity of water that can be taken from a water storage. Increasingly yields are being quoted with an associated probability of failure. Traditionally low probabilities of failure (such as 0.5 percent or 1.0 percent) have been accepted (GHD 2004). Economic growth and rising living standards are leading to demands to increase reliability of water availability.

Against this, are the climate change forecasts predicting reduced yield and increased yield variability increasing the probabilities of failure. The degree of risk will become more difficult to predict.

8.1.2 Future water use

Water use expands with economic and population growth. Australia's water use increased from 14 600 GL per year in 1983/84 to 24 000 GL per year in 1996/97, a 65 percent growth (60 percent of this growth was for agricultural use; the balance was for mining, industrial and other uses; domestic use was stable). The growth rate over the last decade was nearly 4 percent per annum, a doubling time of some 20 years (NLWRA 2001a).

> *Taking account of proposals to implement better technologies and institutional arrangements, by 2050 water requirements for urban water will increase from 5,000 to 8,000 GL per year depending on the population. By contrast total annual managed water use could increase from the current level of 24,000 GL to more than 40,000 GL by 2050, due to an anticipated expansion of irrigated agriculture in northern Australia as constraints and availably of quality water are experienced in the south.*
>
> Foran, Poldy & CSIRO Sustainable Ecosystems 2002

8.2 NATIONAL TRANSITION TOWARD A MORE SUSTAINABLE USE OF WATER

The CSIRO Water for a Healthy Country Flagship's mission is to achieve 'tenfold increase in social, economic and environmental benefits from water use by 2025'.

With increased water requirements we will see a shift to higher value water use, significant productivity improvement, and increased use of improved treatment and distribution technologies driven by price rises, regulation and planning controls, and community values.

8.2.1 Australia's current water use

The National Land and Water Audit advises that 24 000 GL (1996/97) of water a year is consumed, 80 percent for irrigation and rural uses and 20 percent for urban and industrial uses (NLWRA 2001a) (see Figure 2a).

Average residential use: In Australia, 34 percent of residential water is used in gardens and 66 percent for domestic purposes (see Figure 2b).

Rural use: Eighty-seven point five percent of rural water use is for agricultural production with 12.5 percent being used in towns and other uses.

Of the water diverted for use, on average only 77 percent reaches the customer with the remainder lost to seepage or evaporation (NLWRA 2001a). Australia exports more water than it imports—an estimated 4000 GL of water is embodied in exported products. This is about the same amount used each year by urban Australia (excluding manufacturing) (Foran, Poldy & CSIRO Sustainable Ecosystems 2002).

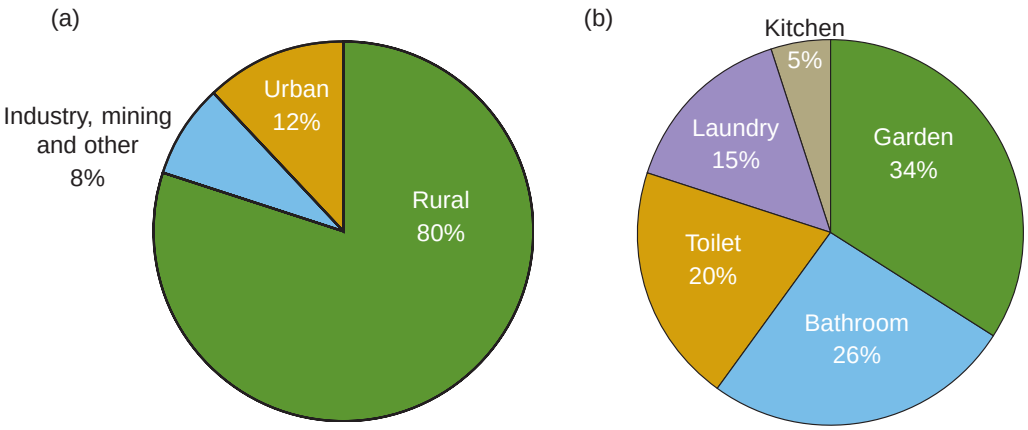
8.2.1 Highest value use

Water is crucial to Australia's economic and natural wealth. We have major opportunities to increase economic activity, and at the same time enhance environmental and social benefits generated by water resources. These opportunities exist through water resource development and efficiencies (NLWRA 2000).

The community has not had a real debate about how to achieve highest value water use and how to balance the environment, the irrigation sector, fisheries, recreation and urban uses. Nor, has it adequately addressed the questions:

- Is the form of primary production suited to the region?
- Are production techniques appropriate?
- Are costs to physical resources too high?

Figure 2. Water use across dsectors (a) (NLWRA 2001a) and within the residential sector (b).



A comparison of embodiment of water for selected production activities is illuminating (see Table 2).

Table 2. Embodiment of water ($Aus) for selected agricultural and mining industries (1994–1995).

Agriculture	
Rice in the husk	7 458
Wheat and grains	245
Beef cattle	812
Dairy cattle/whole milk	1 470
Sugar cane	1 239
Seed cotton	1 600
Vegetable & fruit growing	379
Mining	
Black coal	22
Crude oil	13
Iron ores	23
Bauxite	366
Gold and lead	15

Source: After Lenzen 1999: Lenzen & Foran 2001, cited in Foran, Poldy & CSIRO Sustainable Ecosystems 2002

Agricultural data shows a wide range of water embodiment (ratio of economic output to water input) with some 7500 litres required per dollar output of rice compared to 245 litres for wheat and other grains. This is the input from the managed water resource and does not include green water or soil water that comes from rainfall. In the case of mining, the selected industries each have similar requirements (except bauxite) (Foran, Poldy & CSIRO Sustainable Ecosystems 2002).

In 2000/01, livestock, pasture, grains and other agriculture were the largest user of water in agriculture (33 percent), followed by cotton (17 percent), dairy farming[1] (17 percent) and rice (12 percent) (ABS 2004c).

As the direct water requirement for urban areas is relatively small, consideration of water supply will extend to equitable (and efficient) allocation. With 80 percent of water used by the rural sector the allocation between urban and rural areas is likely to become a central issue—more so given that a significant quantity is used for low value products, and the recent dramatic increase in the rural sector's use.

8.2.2 Integrated water cycle management and demand management

Many current water management initiatives relate to managing water demand. The National Land and Water Resources Audit advised that it is likely that we will see a greater emphasis on water resources development through the effective and efficient extraction of water and its re-use.

Water-sensitive urban design, integrated water cycle management and demand management will reduce urban water demand and discharges into the receiving environment. Most urban authorities have strategies in place to support their widespread introduction.

Water-sensitive urban design: With a shift to the sustainability concept applied to developments we may see regulation for sustainability go from the household level to a local level. This may also include, for example, a requirement for water-intensive industries to co-locate with wastewater treatment plants to access recycled water.

IRRIGATED AGRICULTURE

- Total agriculture: 3% GDP, 22% total exports
- 0.4% irrigated, 99.6% non-irrigated
- Irrigated agriculture: 25% gross value of agriculture

Department of Environment & Heritage

1 Dairy farming includes livestock and irrigated pastures and grains for dairy farming purposes.

Integrated water cycle management: Water supply, wastewater and stormwater are increasingly being considered in an integrated way. The volume of potable water used, and sewage and the stormwater generated are all of the same order of magnitude in the major urban areas. There is a potential to significantly reduce demand for water by recycling sewage and capturing stormwater. Water may be matched to its intended use—for example, recycled water for toilet flushing and watering gardens; water in rain water tanks for laundry, hot water and gardens.

Integrated water cycle management involves an improved understanding of water systems and their impact on the environment, planning, economy, health risks and community.

Demand management: More stringent demand management strategies may be introduced at both residential and industry levels. Several methods are being employed including:

- installation of low flow fixtures and appliances;
- products that use less water; and
- replacement of water with air cooling for industrial processes.

It is likely that a multiplicity of water products will be differentiated by, for example, quality, service level standards, use and source.

8.2.3 Pricing of water services

With a push to sustainability, world water prices are on the increase. By 2025 agricultural water prices will be twice as high in developed countries and three times as high in developing countries. Water prices for connected households will double (Rosegrant, Cai & Cline 2002).

In Australia most water companies are showing price increases in excess of the 2.5 percent consumer price index for 2003. In comparison to water prices in the rest of the world, Australia continues to be ranked fourth lowest in 2002. Australia has been criticised for being the driest inhabited continent while having one of the highest consumptions in the world (Friend et al. 2003a). The Australian Water Association deems that the current water pricing structure is too low to encourage conservation.

There is a significant price differential between regional and urban areas. Can this difference be sustained?

BASIX

The New South Wales BASIX (Building Sustainability Index) a planning tool introduced into the residential development approval process, targets a 40% reduction in both mains supply water use and greenhouse gas emissions by 2006.

NSW Department of Infrastructure, Planning and Natural Resources

8.3 WATER SERVICES INFRASTRUCTURE

Over the next 20 years it is anticipated that investment in infrastructure will change.

Investment decision making: There are long lead times associated with putting into place new water sources and storages, including large (over 100 ML) desalination plants. Decisions for such developments will be made in an environment of uncertainty with regard to climate and competition, adding to business risk.

With the advent of climate change, we are likely to see fundamental changes in planning issues about dam safety and transport systems that can handle the increased variability and frequency of extreme events.

The infrastructure: Currently, water and wastewater systems are separate. With the new integrated water cycle management systems these will come closer together.

The scale of provision too will change. Will we see:

- bigger centralised systems that are cheaper to operate;
- incremental introduction of smaller systems to accommodate the business risk;
- locally distributed systems with multiple service providers, reaching the position where the principal investment is in treatment plants rather than transportation?

With a much greater acceptance of desalination plants, we will need an increasing focus on energy management.

BUT WHAT IF ...?

Imagine alternative futures where:

- we find cheap sustainable water sources;
- water can be treated at point of use;
- prices increase dramatically;
- leakages are reduced;
- new supplies are developed;
- we introduce large inter-basin transfers;
- the capacity of authorities to deliver water safely changes; or
- we see an increased demand for water.

Demand for water from existing sources falls

Cheap sustainable water source: Imagine that new technology enables the extraction of potable water from any source (e.g. raw sewerage or sea water) cheaply and without significant greenhouse gas emissions and the reliable supply of water ceases to be an issue.

Water treatment at point of use: What if authorities deliver untreated water to all customers. Water is purified by small, cheap, energy-efficient filters at point-of-use with low maintenance requirements.

Price increase: We could see a dramatic increase in the price of water in urban and rural areas, reflecting its value to the community and the cost of externalities. Rural and urban prices could become comparable. Investment to eliminate water loss within the system could be increased and a thriving private sector water and biosolid recycling industry could develop. One hundred percent of wastewater and stormwater could be recycled.

Reduced leakages: Technology could be developed to drastically reduce evaporative losses from storage and eliminate most leakage from pipes. Precision maintenance could also reduce leaks.

Changes to water supplies

New supplies: Imagine if in ensuring reliability of supply for urban areas and to meet the needs of additional instream flows to maintain ecological systems (as a result of climate change), additional supplies and storage including new dams are developed.

Large inter-basin transfers: What if urban water use is designated as the 'highest value use', with large transfers from rural to urban use. This, plus a fall in yields due to climate change and a policy to increase environmental flows, reduces water availability for agricultural use by 60 percent (to early 1980s' consumption levels). In response to climate change, an extensive national infrastructure scheme could be developed to transfer water from northern to southern Australia and shifts in where agricultural production takes place could occur. Price increases and higher water yield in northern Australia make this an economically feasible option.

Changes to water infrastructure: Water authorities could lose community trust, due to a significant water quality incident resulting in a number of deaths. A loss in faith in the industry could eventually undermine its service delivery capacity. Concerns about the protection of the water supply from war, terrorism or mishaps that affect human health could result in major changes to water infrastructure.

Increased demand for water: Community water demand could shift dramatically due to, for example, large increases in economic and population growth, and direct and indirect use and consumption (including a growth in the export of goods with a significant amount of embodied water).

9. Conclusion

The aim of this discussion paper is to stimulate debate among urban water managers and decision makers on the nature of the world in 2024 and how it will effect current planning.

Whatever the form of the journey to 2024, we believe that it is likely to be one of opportunity and adventures. These opportunities bring uncertainty and challenges for urban water management.

Most importantly, the urban water sector is an integral part of the wider Australian community and international community. We are in the midst of worldwide, revolutionary change, with an uncertain outcome. The uncertainty does not result just from events but is also associated with human attitudes and reactions towards those events.

In developing sustainable water management options, we need to think about the future:

- how community needs and industry operating conditions may change; and
- the best strategies for catching the opportunities and managing the threats.

In doing so, we also need to decide where to invest our resources:

- in physical infrastructure; and
- in the pursuit of knowledge and innovation.

Water authorities, business, regulators and governments need to select strategies that can create benefits even in very different futures.

KEY INFLUENCERS

The key influencers look at different possible developments, and consequently new risks and opportunities that the water sector might face. Some of these challenges will be broad sweeping changes, those typically covered by global forces, while others may be more of a specific nature.

The seven key influencers of change for urban water were identified as:

- globalisation and liberalisation;
- people and institutions:
- population;
- climate and environmental change;
- energy and greenhouse gas;
- science and technology; and
- water use and management.

They emphasise the 'uncertainties' rather that the predetermined elements.

Although there are an unlimited number of possible futures, the seven key influencers were selected as they were found to be recurrent research themes and are also most likely to cause the greatest discontinuities for the urban water sector.

Influencer 1 – Globalisation and liberalisation

The primary shapers of Australia's future—globalisation, liberalisation and the uptake of new technology—are unstoppable. In the future, we will be more interdependent with and on the global community, and will experience a period of rapid change and uncertainty.

The key questions for urban water are:

- How will the Australian community be positioned in this new world?
- What opportunities and risks will it bring?
- How will globalisation and liberalisation influence community values?
- How will they influence business direction and operations?

Influencer 2 – People and institutions

The relative importance of the influencers will be determined by both the community's willingness to embrace change and government structures, together with the way in which they interact.

The key questions for urban water are:

- What will the community expect of water institutions and services?
- How far will governments pursue the reform agenda?
- How will stakeholders respond?
- What business enterprises will enter the marketplace?

Influencer 3 – Population

Australia's population will increase and age. Globally, populations in underdeveloped countries will grow faster and will be younger.

The key questions for urban water are:

- How can we provide for urban growth and meet higher environmental and public health standards?
- How will businesses manage a skills shortage at a time when they need to draw upon a solid skills and knowledge base to meet the challenges?

Influencer 4 – Climate and environmental change

The exact impact of global warming is uncertain. Australia is likely to be hotter and dryer, with more extreme weather conditions.

The key questions for urban water are:

- What provisions can be made to manage reduced yield in general, and increased yield variability, combined with population and economic growth?
- What will be done to mitigate the risks arising from climate change and environmental degradation?
- How significant are those risks?

Influencer 5 – Energy and greenhouse gas emissions

Environmental considerations will dominate initiatives within the energy sector. Advances are being made to increase efficiency in energy production, and to develop sustainable alternative energy sources.

The key questions for urban water are:

- Will the urban water sector initiate effective energy efficiency measures?
- What should be done by the sector to reduce its greenhouse gas emissions?

Influencer 6 – Science and technology

The next 20 years will see the continued diffusion of information technology and the application of new bio-technology. Nano-technology, sensor technologies and bio-markers offer an extraordinary range of applications and benefits.

The key questions for urban water are:

- What technological innovation is happening that will impact on the services that water currently provides?
- How will information technology, sensors, nano- and other technologies be incorporated into water management?
- What further advances can urban water make to increase water efficiency at each of the steps within the water cycle?

Influencer 7 – Water use and management

A shift to higher value use of water in response to the recognition of the need for sustainable use, increasing prices, changes in intuitional structures and recognition of its value is likely.

The key questions for the urban water sector are:

- Will the transition to sustainable water use be achieved in time?
- Should allocations shift from rural to urban use?
- Will distributed localised systems replace the current large-scale centralised water network systems?
- How will the industry approach water use and management within a rapidly changing operating environment?

In short can we do better?

Appendix A: scenarios

The stories that could be told about the future are unlimited.

> *The scenarios of the 1980s were strongly coloured by the high oil prices and recession of the early part of the decade, and the subsequent oil price collapse, speculation about the longevity of the USSR, and concerns over climate change and sustainable development. All issues were explored within the mental framework of the Cold War World. But by the end of the 1980s, it was clear we had entered a new era. The 1990s explored the new shape of a more integrated world that was subject to powerful forces.*
>
> GBE 2002

The following scenarios have been included to illustrate how others consider possible shapes of the future.

Scenarios do not claim to be, and are not value free. They recognise that we are prisoners of our own mindsets and language, and that understanding can be furthered with a new word or image, especially a new story. We know that our successors will have a richer language to discuss sustainability, and our task is to shine a light in that direction.

Ged Davis, Director, World Business Council for Sustainable Development

SHELL GLOBAL SCENARIOS

The Shell 2002 global scenario (GBE 2002) looking out to 2020 explores the social consequences of globalisation, liberalisation and advancing technology.

Business Class explores a future resulting from when the *connected freedom* of the globally interconnected elite and the only remaining super power—the US—lead the world towards greater economic integration and the dream of economic prosperity for all. We are looking at a world focused on efficiency and individual choice, where cities and other rising sources of power diminish the influence of national governments in a kind of '*new medievalism*', while business pursues cutting-edge strategies to meet the volatile conditions of the time.

Prism questions the monochromatic world of global integration and explores, instead, the persisting power of culture and history—*the connections that matter*—and the pursuit of multiple modernities as they emerge in a new regionalism. It is a world shaped by the interplay of our differences, where countries find their own development path to suit their particular circumstances. In these diverse environments, *the heart of business* is to gain access and trust.

In both scenarios the real determinant of success is the quality of people engaged in an enterprise, how they relate to each other and to others, and how their talents are developed and harnessed.

SYDNEY WATER SCENARIOS

The purpose of the development of the Sydney Water Corporation scenarios was to identify the external influences that should be considered when undertaking a strategic planning process. These scenarios, undertaken in 2002, explore possible ways that the organisation may operate within a business environment created in the context of global forces.

More than welcomed covers the rapid growth in Sydney over the past twenty years as Australia agreed to increase the refugee component of its immigration program. In this scenario, Sydney's population reached six million—far exceeding earlier predictions. As a result, Sydney Water worked closely with customers and the community to meet this demand, taking a lead role in planning development as the need to provide water and sewerage to the increased population became vital.

Alone again naturally details the changes that Sydney Water would undergo in response to increasing global isolation, reduction of international trade and a growing state/territory and national focus on development. A number of water problems occurred in the scenario and anyone who could afford the alternatives to the public water supply did so. This resulted in the amalgamation of state-wide water functions and Sydney Water became the urban water division of the State Water Department.

Utopia – The Global Village postulates periods of intense conflict, which have given way to a new form of international governance. Sydney Water has flourished as a result of high levels of international cooperation and has now become the leader in water management. It provides domestic customers with access to local and on-site integrated systems so that they can now choose service and quality levels. Minimum standards are high and industrial and commercial customers have products that are fit for purpose that meet sustainability protocols. Developed countries generate funds through water customers to raise the standard of service in developing countries.

MacWater – A Retrospective suggests that following a rise in influence of multi-national corporations and a subsequent decline in government influence, the water industry becomes self-regulating. A French multinational water company in the scenario, makes a major breakthrough in water treatment resulting in a better, cheaper service. They enter the Australian market offering cheaper alternatives than was available through Sydney Water.

The international water company experiences flat profits in its primary market and decides to expand into other enterprises. 'MacWater' diversifies into land development. It wins the rights to build a series of new eco-developments with franchised management that includes local water service provision. Its real competitive advantage is its leadership in customer knowledge, managing the environmental impact of its operations and cost efficiency. It is very successful and puts in a bid to buy Sydney Water, which is eventually successful.

ASPIRE AUSTRALIA 2025

The Business Council of Australia (BCA 2004) concluded that there are three key challenges for Australia's future. The first is to deal with with its capacity; the second is its ability to respond to change; and the third is its social cohesion.

Riding the Wave explores the consequence of the breakdown of trust between people and institutions. It is a story about reform fatigue and complacency. A loss of faith in institutions eventually undermines Australia's capacity to grow. A lack of long-term focused investment and reform results in economic decline and social crises, ultimately leading to a re-examination of our political structures. In Riding the Wave, global prosperity is no guarantee for national prosperity. Efficient and effective government, and trust between people and institutions are critical to building national capacity.

Stormy Seas focuses on Australia's international relationships. It explores Australia's policy options in a future where there is a substantial decline in Asia–Pacific stability and security. Regional instability challenges Australia's international and economic relations. Australians become more nationalistic, more cohesive—they are more tolerant towards difference within Australia, but at the same time cocooned in their view of the rest of the world. While it is stressed that this is only one possible story about how these relationships might evolve, the Stormy Seas scenario presents a difficult future for Australia.

Changing the Crew examines the social dimensions of change in Australia—in particular the potential value tensions within and between generations as baby boomers, who have dominated Australia's policies and values, are moving into retirement in unprecedented numbers. A new generation of pioneers create a sharper edge Australia, resulting in friction with other generations. Australians are more strongly connected with the rest of the world than ever before, economically and culturally.

WATER AND SUSTAINABLE DEVELOPMENT, GLOBAL SCENARIOS 2000 – 2050

The World Business Council for Sustainable Development (1997) developed three scenarios to explore possible challenges to sustainable development. Their divergence from each other arises when human actors respond in varying ways to the challenge of sustainable development. They are differentiated from each other not so much through the eco- or social system, but through people.

In **FROG!**, many nations experience a degree of economic success and, for most, economic growth is the major concern, with sustainable development acknowledged to be important, but not pressing. As environmental NGOs demand enforcement of standards set in global summits, those nations who are striving to develop argue that if the developed nations insist on raising environmental standards, they should '**F**irst **R**aise **O**ur **G**rowth**!** People in developed countries respond in uneven ways—sometimes by offering help in improving the environment, and sometimes in raising cries of 'FROG!' themselves.

In the early years, environmental health in many areas improves significantly. This leads to a perception that it is in much better shape than it was in the late 1990s. But at the global level, the picture is less clear. With population and economic growth, greenhouse gases are rising, unnoticed by most. The signals are difficult to read and people disagree about what they mean—good reasons, it is felt, to continue to FROG! But, by 2050 there is evidence that the darkest predictions about global warming are actually nearer to the truth than the more optimistic ones.

In FROG!, the habitual reliance on technology has not been sufficient to solve longer-term environmental or social health problems. Globalisation and liberalisation of

markets along with the pressures of rapid urbanisation have raised the degree of social inequity and unrest to a level that threatens basic survival of both human systems and ecosystems. People react like the frog that when placed in boiling water, it leaps out; but when placed in cold water gradually heats to boiling point. The complacent frog is boiled to death.

GEOpolity begins with a succession of signals in the first two decades—some real, some imagined—that an environmental and social crisis looms. The prevailing 'economic myth' is increasingly viewed as dangerously narrow, particularly in Asia, where rapid economic growth has meant that corners have been cut and traditions lost. Because many institutions, especially governments, lose credibility as problem solvers, people expect something from the new centres of power—the multinationals. But the business sector seems unable or unwilling to respond adequately.

The perceived need for strong and certain responses leads to a new global consensus that welcomes technocratic solutions, sanctions, and more direct control of the market to preserve environmental values and social cohesion. The impetus behind all these movements is the growing consensus that the market has no inherent incentives to protect the commons (publicly owned resources that are freely available to all), social welfare, or any other non-economic values. In the absence of business or governmental leadership, people form new global institutions, such as the Global Ecosystem Organisation (GEO) which has broad powers to design and enforce global standards and measures to protect the environment and preserve society, even if doing so requires economic sacrifice.

In GEOpolity, governments are rejuvenated as focal points of civil society. They seek to work with markets rather than to displace them. But they take the lead in shifting the structure of the economy towards sustainable development in conjunction with institutions such as GEO.

Jazz is a world in which diverse players join in ad hoc alliances to solve social and environmental problems in a pragmatic way. The key note of this scenario is dynamic reciprocity. This is a world of social and technological innovations, experimentation, rapid adaptation, voluntary interconnectedness, and a powerful and ever-changing global market.

Quick learning and subsequent innovation in Jazz is enabled by high transparency—the widespread availability of information about ingredients of products; sources of inputs; company, financial, environmental and social data; governmental decision-making processes; and almost anything consumers want to know.

Many players are involved, partly because the way information technology lowers barriers to entry allows new actors to step onto the economic stage. And that stage itself is characterised by a global free market, sound legal systems and a respect for property rights.

To the extent that government is involved, it is most active at the local level, with ad hoc global institutions arising to solve particular problems. Agreements are reached through mediation in a world in which transparency is required.

Achievement of the new environmental and social standards occurs largely out of self-interest. The public is made aware of transgressions and quickly acts against companies or countries that violate standards. Companies are interested in seeing that disputes do not escalate and indirectly harm them. They closely monitor

relationships with customers and suppliers and quickly drop risky partners. In this highly competitive and interconnected world, businesses see strategic economic advantages in being perceived as environmentally and socially responsible, and many become proactive leaders in responding to the challenges.

Jazz is a world in which NGOs, governments, concerned consumers, and businesses act as partners—or fail. Together, with other players, they learn effective ways of incorporating environmental and social values into market mechanisms.

WATERCOURSE – NAVIGATING YOUR UTILITY'S FUTURE

Major trends being identified by the AWWA Research Foundation (Means 2001) as affecting the future water of water utilities are:

- increased infrastructure replacement costs forcing rates increases;
- water supply sources being managed holistically, along with land use and aquatic habitats;
- new environmental regulations that complicate development of new supplies and require more sophisticated treatment of potable water;
- market pressures that drive water utilities to consolidate, outsource non-core functions and adopt other forms of privatisation;
- rising customer expectations compelling utilities to be more responsive to their needs;
- greater difficulty in recruiting and retaining employees as workers become more independent and entrepreneurial; and
- strategically applied technology that pervade the work place.

Four plausible future water utility scenarios were crafted by the AWWA Research Foundation:

- **Business as usual** looks at a water-short utility with growing technological capabilities;
- **Rise of the Oligopoly** depicts a world dominated by several consolidated multinational utilities;
- **Consumer Rules** portrays as a situation in which consumers had full, virtually real-time access to all utility information; and
- **The Empire Strikes Back** paints an idyllic future scenario in which infrastructure and water quality and quantity concerns have been successfully addressed.

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