

Water Innovation A New Era for Australia®



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PO Box 1136 Lane Cove NSW 1595

T 61 2 9418 6207

F 61 2 9924 0944

E carolen@clcreations.com.au

W www.clcreations.com.au

Publisher

Carolyn Barripp

Editor

Kathleen H Bowmer

Kathleen.Bowmer@bigpond.com

T 0411 041 790

Marketing

Elizabeth York

Design and artwork

Pam Sorenson

Luceight

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Foreword



The challenge of providing, using and looking after water resources in a continent with a highly variable climate has been an important national priority for many years.

Water is a vital and highly valued resource and Australia's economy, the well-being of our population and environment depend on the wise use of our limited resources.

Michael J Taylor

Secretary, Australian Government Department
of Agriculture, Fisheries and Forestry

In 2003, the Council of Australian Governments (COAG), comprising the Prime Minister, Premiers and Chief Ministers and the President of the Australian Local Government Association reaffirmed its commitment to the 1994 COAG *Water Reform Framework* by developing an innovative policy approach – the *National Water Initiative (NWI)*.

The *NWI* builds on the 1994 water reforms and specifically will improve the security of water access entitlements, encourage the expansion of water markets, encourage water conservation in our cities and importantly, ensure ecosystem health by implementing regimes to protect environmental assets.

In Australia, water reform is underpinned by science-based research and supported by on-ground regional programs such as the Prime Minister's *National Action Plan for Salinity and Water Quality* and the *Natural Heritage Trust*. Fundamental to the success of reforms is a partnership approach between government, industry and the community.

Water Innovation: A New Era for Australia describes recent innovations in water policy, promotes Australian products and technology, describes examples of leading edge best practice, and provides a directory of contacts and expertise to build further collaboration in Australia and overseas. There is much that Australian water managers, scientists and industry can add to improve the understanding and management of water.

The Australian Government through the *National Landcare Program* is pleased to be a Platinum sponsor and to provide information on the Australian Government's role in providing innovative leadership in water reform policies and programs.

Introduction



Water is life!

Water Innovation: A New Era for Australia is a snapshot of Australian leadership and achievement in water resource management.

The management of water resources is a major challenge for both industrial and developing nations as the world faces unprecedented demand for water, and uncertainty due to climate change and variability. Australia is a diverse continent, with a wide range of climate and geography, and with people in urban centres, in the bush, and in the remote outback. In managing their own resources, Australians have learned many lessons which are readily transferable to international markets and aid programs.

The book is a showcase of achievements. A selection of case studies illustrates the diversity and ingenuity of Australia's extra-ordinary innovation in water resource management which have been developed to balance the demands of consumptive use and environmental protection. These include multi-jurisdictional water sharing agreements, provision of environmental flows, behavioural change methodologies, public-private partnerships, and methods for better protecting public health.

Australian leadership and achievements include the formulation of policy and new technologies for the management of urban water, rivers and catchments, and irrigation. Innovative approaches are presented in the book for the management of water supply and waste treatment; groundwater and surface water; and for urban, industrial and agricultural water.

Key government departments and agencies, successful water utilities, companies, consultants, scientists, engineers, financiers, economists and sociologists are profiled in the book. Together they demonstrate the richness of Australia's expertise that can be harnessed for international commercial and aid projects.

The book is an independent editorial text, supplemented by sponsored pages. The publisher, editor and authors, assisted by an eminent advisory panel, have sought to achieve appropriate breadth and depth in this complex issue of water resource management and to fairly present the diverse views of stakeholders.

I am privileged to commend the book **Water Innovation: A New Era for Australia**.

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Chairman, Editorial Committee

Chairman

Mr Paul J. Perkins
Chairman, The Barton Group

Committee Members

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CEO, CRC for Water Quality and Treatment

Mr Colin Creighton
Director, Water for a Healthy Country, CSIRO

Professor Peter Cullen AO
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Professor Michael Dureau
Executive Director, The Warren Centre for Advanced Engineering

Dr David Garman
Executive Director, Environmental Biotechnology CRC



Advisory

Professor Paul Greenfield

Senior Deputy Vice-Chancellor, The University of Queensland

Dr Graham Harris

Special Advisor
CSIRO Fellow

Ms Anne Howe

Chief Executive, SA Water

Ms Carol Howe

Director, Urban Water Program
CSIRO Manufacturing and Infrastructure Technology

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Opposite page: Herbert river. Image courtesy of ©CSIRO Land and Water
Previous pages: Early morning before sunrise at Lake Joondalup, Wanneroo, Western Australia.
Image courtesy of ©CSIRO Land and Water

12 Managing Australia's water for the future

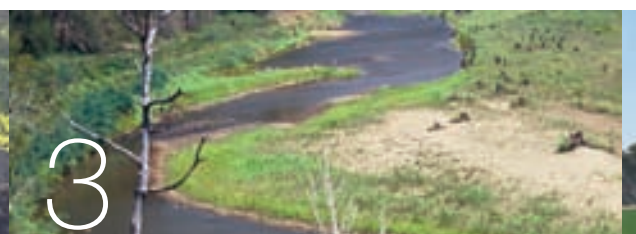
- 14 **Water Innovation: A New Era for Australia**
 - 14 The international consensus
 - 14 Australian water reforms
- 15 **Australian Government**
 - 15 Prime Minister and Cabinet
 - 15 Natural Resource Management Ministerial Council
 - 15 Council of Australian Governments
 - 16 Australian Government Department of Agriculture, Fisheries and Forestry
 - 16 Australian Government Department of the Environment and Heritage
 - 16 Australian Government Department of Industry Tourism and Resources
 - 17 AusIndustry: Helping innovate Australian companies
 - 18 Department of Agriculture, Fisheries and Forestry (DAFF): National policy innovation and practice
 - 26 Coastal water quality programs
 - 27 Department of the Environment and Heritage: Urban water reform
- 28 **Australian and state governments initiatives**
 - 28 National Action Plan for Salinity and Water Quality
 - 28 Natural Heritage Trust
 - 28 Murray-Darling Basin Commission and Ministerial Council
- 29 **State and territory governments**
 - 29 Australian Capital Territory
 - 30 Western Australia
 - 30 Victoria
 - 31 Government of Western Australia: A paradigm shift in Western Australia
 - 32 New South Wales
 - 32 Tasmania
 - 33 Queensland
 - 33 South Australia
- 34 **Regional and local decision making**
- 35 **Research, education and partnerships**
 - 35 Bureau of Rural Sciences (BRS)
 - 35 Australian Bureau of Agriculture and Resource Economics (ABARE)
 - 35 Research and development corporations
 - 35 Predicting global warming and climate change
 - 36 Australian Bureau of Meteorology
 - 36 Environmental Research Institute of the Supervising Scientist (ERISS)
 - 36 Cooperative Research Centres (CRCs)
 - 36 Australian Research Council (ARC)
 - 37 CRCs Water Forum: Researchers putting the water industry in front
 - 38 Australian Government Department of Education, Science and Training (DEST)
 - 38 The International Centre of Excellence
 - 38 Universities
 - 38 CSIRO
 - 39 Water for a Healthy Country
 - 40 Strengths in university research
 - 42 Other research groups
 - 42 International aid
 - 42 Professional associations and networks

44 Sustainable urban water systems

- 46 **Australia's urban water industry**
- 46 **Managing water systems**
 - 46 Regulatory reform
 - 46 Improving performance
 - 47 Water Services Association of Australia (WSAA): The peak national urban water industry body
 - 48 Industry reform – public-private partnerships
 - 49 SA Water: Reputation for innovation
 - 50 Infrastructure renewal and investment
 - 50 Bega Valley sewerage program
 - 51 Woodman Point, Western Australia
 - 52 Smart wastewater treatment solutions
 - 53 Brisbane Water: World-class design innovation, expertise, vision
 - 54 'Aqua 2000' advanced water treatment
 - 55 Advanced treatment and public-private alliance partnering
 - 56 Supermain pipes
 - 57 Vinidex: Continual innovation in manufacturing
 - 58 Government of the Australian Capital Territory (ACT) and ACTEW Corporation: Long-term commitment and successes
- 60 **Research and commercialisation**
 - 61 CSIRO – Urban waterscapes: Creating Australia's water-smart cities of tomorrow
 - 62 Rainfall forecasting
 - 63 University of Western Sydney: Water Futures Institute
- 64 **Mapping and monitoring**
 - 64 ACT water resource planning – A whole-of-government challenge
 - 65 Monitoring with ResMan
 - 65 Cotter catchment digital bibliography
- 66 **Valuing water**
 - 66 Approaches to best practice
 - 66 Using less drinking water
 - 66 Water-sensitive urban design
 - 67 Saving water in commercial premises and industries
 - 67 Education and economic incentives
- 68 **Water sources and solutions**
 - 69 Australian Water Services: Added value from outsourcing the operation and maintenance of water treatment plants
- 70 **Delivering potable water**
 - 70 A framework for sustainable management
 - 70 Treatment technologies
 - 70 Distribution and delivery
 - 71 Delivering drinking water quality
- 72 **Renewing and reusing water**
 - 72 A top score for Music®
 - 73 Desalination on Kangaroo Island
 - 73 Veolia Water: Managing existing resources more efficiently
 - 74 Sydney Olympic Park: Technological innovation
- 76 **Harvesting water**
 - 76 Catchment management
 - 76 Leaders in wastewater reuse
 - 77 Protecting and harnessing natural systems
 - 78 Engineered solutions
 - 78 Micro-organisms and water

80 Healthy rivers and catchments

- 82 **What drives innovation in Australia**
 - 82 A landscape that is unique
 - 82 Landscapes and rivers are damaged and need repair
 - 82 Current dryland agriculture is not sustainable
 - 83 CSIRO Land and Water: Working with communities towards healthy rivers and catchments
- 84 **Innovation 1: Whole-of-system-thinking**
 - 84 The water cycle
 - 85 Australian Bureau of Meteorology: Improved weather forecasting
 - 86 Integrated catchment management
 - 86 Setting targets
- 87 **Innovation 2: Farming without harming**
 - 87 Landcare – a 'true blue' response
 - 88 National Action Plan for Salinity and Water Quality
 - 88 Natural Heritage Trust
 - 88 New land uses
 - 89 Sydney Catchment Authority: Protecting the largest urban water supply in Australia
- 90 **Innovation 3: Salinity management**
 - 91 National Dryland Salinity Program
- 92 **Innovation 4: Catchment management**
 - 92 Heartlands
 - 92 Blackwood Basin
 - 92 Torbay
 - 92 Focus catchments
 - 92 Estuaries and shore-line
 - 93 Land use planning – the Heartlands initiative
 - 94 Regional partnerships
- 95 **Innovation 5: Water reform**
 - 95 Blueprint for a National Water Plan
 - 95 River classification
 - 96 Water-sharing in New South Wales
 - 97 Water-sharing in the Murrumbidgee
 - 98 Innovative approaches in large-scale river management
 - 99 Ecology of rivers
 - 99 Fitzroy river study
- 100 **Innovation 6: Ways of sharing the cost**
 - 100 Catchment care principle
 - 100 Ecosystem services and stewardship
 - 101 Providing innovative tools to support resource management decisions
 - 101 Consultants
 - 102 Market-based instruments and investment leverage
- 102 **Innovation 7: Aids for better decision making**
 - 102 Weather forecasting
 - 102 Predictive models and decision support systems
 - 103 Tracer methods
 - 103 Mapping technologies



104 Sustainable
irrigation

- 106 Irrigation in Australia
 - 106 Water suppliers
 - 107 CSIRO Land and Water: A move to sustainable irrigation
- 108 Innovation 1: Principles and policy
- 109 Innovation 2: Combined use of surface and groundwater
- 110 Innovation 3: Reusing water
 - 110 Groundwater and aquifer storage
 - 110 Reuse of urban effluent
 - 110 Reuse for environmental protection
 - 110 Intensive rural industries
 - 111 Philmac: Driving water efficiency
- 112 Innovation 4: Salt management and interception
 - 112 Intercepting salt
 - 112 Sequential biological concentration
 - 112 Tools to aid decision making
 - 113 World's best practice
- 114 Innovation 5: Managing catchments to maintain water supplies
 - 114 Salinity and run-off
 - 114 Loddon demonstration
- 115 Innovation 6: Minimising losses of water
 - 115 Improved supply infrastructure
 - 116 Modernising an irrigation system in the Murray of South Australia
 - 116 Goulburn-Murray Water
 - 117 Laser levelling and layout design
 - 117 Optimatics
 - 117 Angas Bremer
- 119 Innovation 7: More crop with less water
 - 119 Industries using water wisely
 - 120 Weather data and water use estimates
 - 120 Soil water monitoring and linked systems
 - 120 Understanding the hydraulics of surface irrigation
 - 121 Controlling plant water status
 - 121 Precision farming
 - 122 Southcorp EM survey
 - 122 Improving water-use efficiency in rural Queensland
 - 123 More pecans with less water
- 123 Professional associations and networks
 - 124 Extension and outreach
 - 124 Universities and research
 - 124 National Program for Sustainable Irrigation
 - 124 Cooperative Research Centre for Irrigation Futures
 - 125 International connections

126 Fostering an
internationally competitive
water industry

- 128 The global market
- 128 Australian capacity and expertise
 - 128 Water policy
 - 129 CSIRO Land and Water: Fostering an internationally competitive water industry
 - 130 Legal services
 - 130 Entrepreneurial and business investment
 - 130 Government initiatives
 - 131 Commonwealth Bank: Institutional Banking
 - 132 AusIndustry: Providing financial support
- 133 Exporting and international networks
 - 133 Governance and public-private partnerships
 - 133 Aid and development
 - 134 Flood control in China
 - 135 Regional impacts of vegetation on water resources
 - 136 Consultants and project managers
 - 137 Technology adoption
 - 137 Sustainable irrigation in Argentina
 - 138 South Eastern Anatolia project
 - 138 Technologies
 - 139 System design and management
 - 139 Information gateways
 - 139 Showcasing and conferencing
 - 140 Reducing flood damage in the Mekong Delta
 - 141 Bringing power to remote communities
 - 142 Water measurement systems for Florida's citrus industry

Appendix

- 144 Collaboration section
- 154 Directory of organisations
- 163 Information portals
- 163 Reports, guidelines, plans, strategies and legislation
- 164 Decision support systems, tools and models
- 165 Programs
- 166 Further reading
- 168 Index
- 172 About the publisher
- 173 About the editor
- 174 About the authors





Managing Australia's **water for the future**

Kathleen H Bowmer and Richard Davis



Water Innovation: A New Era for Australia

This chapter describes:

- The international challenges for water management
- COAG's water reform policy
- The role of governments, industries and communities in developing smarter approaches to water management across the nation
- Australian capacity in research and education
- Highlights of achievements in the urban, rural and irrigation sectors, which are further developed through case studies in the following chapters

The international consensus

A series of major international meetings, including the 1992 Rio Environment Summit, the 1992 Dublin International Conference on Water and the Environment, and the 2003 Johannesburg World Summit on Sustainable Development, endorsed the following objectives for improving water management:

- Devolution of responsibility from central government to regions
- Inclusion of stakeholder groups in decisions
- Adoption of a multi-sectoral and whole-of-catchment approach
- A trans-boundary approach where there are shared water resources
- Transfer of operational responsibility as far as possible to the private sector
- Pricing of water at the true value and the enforcement of pollution charges
- The use of markets to set water prices and to promote efficient water use

- Provision of a minimum water supply for basic human needs
- Reservation of sufficient ground and surface water for environmental health

The respected Washington think tank, the International Food Policy Research Institute, concluded that such an approach would lead to the consumption of 20 percent less water than if present trends continued, while still producing adequate food for the world, universal water supply for the world's urban population, and improved aquatic environments.

Australian water reforms

Reflecting the international consensus, water management in Australia has been transformed over the past decade. A supply-based, subsidised, environmentally insensitive approach is being changed to one that is devolved, community-aware, market-based, cost-sensitive, environmentally conscious and, overall, more efficient.

Water management became a national imperative following a 1994 decision by COAG to undertake a far-reaching, nationwide reform of urban and rural water management. Much was achieved during the following eight years in devolving responsibility from government institutions, pricing water at its true value, opening up water markets so water could be moved to higher-value uses, and protecting aquatic environments. In the urban water industry compliance with COAG recommendations was

substantially achieved with improved customer service, improved financial performance and increased dividends to shareholders.

The reforms were given new impetus in mid 2003 through the *National Water Initiative*, which foreshadowed expanded water trading across state borders, made water titles more secure for property owners, and introduced new arrangements for environmental flows.

The reforms are most advanced within the Murray-Darling Basin, where an environmental manager will be empowered and funded to buy and sell water in the market on behalf of the environment. This market approach to providing environmental water promises to be more flexible and efficient than the traditional approach of assigning pre-determined quantities of water for the environment.

Water trading is a critical feature of the *National Water Initiative*. Water and property titles are being separated in Australia as a pre-requisite for developing water markets. Some of the barriers to water trading will be removed by providing compensation for water title holders if government policy should change, so providing greater security for banks and investors.

It has been a challenge to bring these far-reaching reforms about, given the national structure of government in Australia in which the states retain responsibility for water resource management. Nevertheless, the Australian, state and territory governments have agreed to a series of joint programs that have been remarkably successful.

Lock and Weir no.2 in the River Murray near Waikerie, South Australia. Image courtesy of River Murray Catchment Water Management Board. Photograph by Peter Waanders



Australian Government



Vineyard irrigation at Mitchelton. Image courtesy New South Wales Department of Infrastructure, Planning and Natural Resources. Photograph by Bruce Cooper

Prime Minister and Cabinet

Backing Australia's Ability is an Australian Government initiative to promote science and innovation. The initiative (\$AU3 billion over five years) is overseen by the Prime Minister's Science, Engineering and Innovation Council, chaired by the Prime Minister. Commercialisation initiatives include:

- An expanded Cooperative Research Centre program to bring together research and industry and promote commercialisation
- A range of initiatives to encourage commercialisation, including the *Commercialising Emerging Technologies Program (COMET)*; the *Innovation Access Program*; the *Pre-Seed Fund for Universities and Public Sector Agencies* to develop discoveries and business opportunities; and the *New Industries Development Program*

The government has recently focused its research investment in four priority areas, one of which is an environmentally sustainable Australia. This research area has seven priorities, including water – a critical resource, transforming existing industries, overcoming soil loss and acidity, and sustainable use of Australia's biodiversity.

Alarming declines in biodiversity have been measured worldwide in both dryland landscapes and in freshwater ecosystems. Clearing of forests and change from deep-rooted vegetation to annual cropping has had a devastating effect on the water cycle, creating changes in underground water levels and sterilising land by concentrating salt at the soil surface.

These issues have been raised at the highest levels through the Prime Minister's Science, Engineering and Innovation Council.

Reports commissioned by the Council include *Dryland Salinity and its Impacts on Rural Industries* (January 1999), *Moving Forward in Natural Resource Management* (September 1999) and *Setting Biodiversity Protection* (May 2002). Key findings are that it is more economic to protect ecosystems than to restore damage and that the services provided by ecosystems should be valued explicitly. Pilot programs on environment management services (EMS) and market-based instruments (MBI), administered by the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF), will explore how these services can be valued and traded or auctioned.

Natural Resource Management Ministerial Council

The NRMMC includes Australian Government and state ministers for natural resource management. Council develops integrated and sustainable natural resource management policies with advice from the chief executives of the relevant Australian Government, state and territory agencies.

Council of Australian Governments

COAG comprises the Prime Minister, state premiers, chief ministers and the president of the Local Government Association. COAG *Water Reforms*, negotiated in 1994 and subsequently have influenced Australian Government and state policies and had a significant impact on agriculture in the Murray-Darling Basin and on water use in cities throughout Australia.

Australian Government Department of Agriculture, Fisheries and Forestry (DAFF)

National policy innovation and practice

Water availability has always been important in Australian life in determining areas of settlement. Today, regional prosperity is still strongly associated with the accessibility of water. The highly variable climate seriously affects water availability. Management of water resources in Australia is therefore extremely challenging.

The 1990s saw a significant shift in Australian attitudes towards water resource management. Declining water quality, increasing salinity, toxic algae outbreaks and loss of biodiversity were widely recognised. Irrigators faced reduced security of supply in relation to their water allocations whilst demand was on the increase. This, coupled with a change in public values and economic and environmental imperatives, led to the *Council of Australian Governments (COAG) Water Reform Framework* in 1994.

The reforms have been implemented over the past decade. However the dynamics of Australia's water resources are complex, and while much has been achieved there is a need to continue with the reforms to ensure that economic, environmental and social imperatives are balanced. In particular a key issue for ongoing water reform is to effectively balance the needs of the environment and of water users for certainty of access to resources.

In August 2003, COAG agreed to develop a *National Water Initiative (NWI)* to build on the achievements of the 1994 *COAG Water Reform* agenda and to ensure a national approach. The primary objectives of the *NWI* are to increase the productivity and efficiency of water use, sustain rural and urban communities and ensure the health of river and groundwater systems. In particular, the *NWI*

focuses on improving the security of water access entitlements for users by establishing clear, robust and bankable rights. Critical to reducing uncertainty for investors is a clear assignment of risk between governments and water users where water allocations may be reduced in the future.

Most important is the need to define the roles and responsibilities of all those with interests in our water resources. The following pages provide an insight into the changing nature of water resource management in Australia.

Below: Grain harvesting with rice crop in foreground, Coonong Station near Jerilderie, New South Wales. Image courtesy of MDBC. Photograph by Arthur Mostead

Opposite page top: Centre pivot irrigation, southern New South Wales. Image courtesy of MDBC. Photograph by Arthur Mostead

Opposite page below: Dryland salinity near Mildura, North West Victoria. Image courtesy of MDBC. Photograph by Arthur Mostead





1994 COAG Water Reform Framework

1994 was a significant year for water management with COAG agreeing to a *National Water Reform Framework*. This national agreement was set against a background of considerable concern about the state of many of Australia's water resources and recognition that the solution required significant policy and institutional change.

The 1994 *COAG Water Reform Framework* explicitly linked, for the first time, economic and environmental issues within a coherent and integrated package of reform measures. The agreement established water allocations and entitlements, separated from land and backed by secure access rights to water. It also provided for trading in water entitlements, making water available for ecosystems, as well as institutional reform, public consultation and education, and research.

There have been substantial achievements across all jurisdictions since then, including:

- Urban pricing reforms aimed at ensuring full cost recovery and consumption-based pricing, and independent regulation of government water businesses
- Development of water management arrangements to account for the range of water uses – extractive uses, environmental needs, and the needs of stressed and over-allocated river systems
- An expansion in water trading, particularly in the temporary water trading market, with water moving to higher value uses. A critical element was the development of administrative arrangements and institutions to further encourage water trading
- Better arrangements for examining proposals for new rural water infrastructure against the twin tests of economic viability and ecological sustainability
- The introduction of new and refined water industry legislation to underpin the reforms
- Greater levels of accountability, transparency and reporting, and improved stakeholder consultation and community engagement

The 1994 reforms were complemented by the development of integrated catchment management frameworks and progress towards implementing on-ground regional programs supported through the *Natural Heritage Trust* and the *National Action Plan for Salinity and Water Quality*.

Further significant progress was made in 1997 when the southern Murray-Darling Basin jurisdictions instituted a 'Cap' on diversions of surface water within the Murray-Darling Basin, effectively creating a market value for water and the impetus for further far reaching reforms.

Two major achievements made possible by the 'Cap', have been:

- The enhancement of water trading, as a result of the separation of water rights from land title, allowing for water to be traded between different properties and water uses
- Recognition of the environment as a legitimate user of water, contributing to the convergence of interests between the irrigation industry and environmental groups

In 1995 COAG agreed to include water reforms under the umbrella of *National Competition Policy*. Since 1995 all jurisdictions have been assessed by the National Competition Council to determine if reforms to major sectors including the water sector have been carried out. Over \$AU4 billion in payments for undertaking reforms has been provided across all Australian jurisdictions.



National Water Initiative (NWI)

While much has been achieved as a result of the 1994 *COAG Water Reform Framework*, the Australian, State and Territory Governments recognise that there is still a lot more to be done. In August 2003, COAG agreed to develop a *National Water Initiative (NWI)* to consolidate and refresh its 1994 water reform agenda. The *NWI* provides a framework of roles and responsibilities for jurisdictions in progressing reforms in water management. The reforms will focus on:

Improving security of water access entitlements

This involves the establishment of a robust nationally-compatible framework for water access entitlements aimed at encouraging investment and maximising the economic value created from water use. At the same time, it will ensure that sufficient water is available to maintain healthy rivers and aquifers. Key elements of the framework include:

- Transparent processes for returning over allocated surface and groundwater systems to environmentally sustainable levels of extraction
- Perpetual access to a share of the water resource available for consumption
- Clear assignment of risks between governments and water users over possible future reductions in water availability



Establishing and enhancing water markets

The objective is to achieve an efficient water market structure and expand markets to their widest practical geographic scope. An expanded water market, particularly in the permanent water trading market, will enable greater returns on investment with water moving to higher value uses and higher value businesses.

Best practice water pricing

A key objective is the establishment of best practice water pricing through the principles of user pays and full cost recovery, including the cost of delivery, planning and environmental impact.

Integrated management of environmental water

The *NWI* will ensure the management of water at a basin, aquifer and catchment scale to deliver agreed environmental outcomes. Water will

be provided for the environment through targeted public and private investment in engineering works to improve 'leaky' infrastructure, and both on and off farm works to improve water use efficiency based on rigorous investment criteria.

Measuring, monitoring and information

The *NWI* will establish a transparent regulatory framework for measuring, monitoring and reporting progress against the new water management system. A new water accounting framework will enable better management of the increasing competition for water resources. The new system will depend on secure entitlements, market approaches, efficient water recovery and environmental flow management.

Urban water reform

Much progress was made in urban water reform under the 1994 *COAG Water Reform Framework*. The *NWI* reinforces the need for more efficient urban water use, for example by promoting water reuse and recycling, the adoption of more efficient technologies and through review of the effectiveness of pricing policies.



Above: Yarrawonga Weir and Lake Mulwala, River Murray, on the New South Wales and Victorian Border. Image courtesy of MDBC. Photograph by Michael Bell

Left: River Murray near Cobram, Victoria. Image courtesy of MDBC. Photograph by Arthur Mostead

Murray-Darling Basin

The health of the Murray and Darling Rivers is vital to all Australians for many reasons. It is an important part of our natural environment and a key river system in Australia's most productive agricultural region, with the future of many communities dependent upon its health. In recognition of this, steps have been taken to ensure the health of these river systems.

The Murray-Darling Basin Commission replaced the former River Murray Commission in 1985. The *Murray-Darling Basin Initiative* is a cooperative intergovernmental approach to addressing land, water and environmental management issues in the Murray-Darling Basin by the Australian Government and state governments of New South Wales, Victoria and South Australia as well as the community. The initiative, which is a unique inter-jurisdictional arrangement, brings together government and the community to make a long-term, coordinated response to major environmental and economic threats to the Basin. The initiative has been at the forefront of developing integrated catchment management as a means of dealing with land and water degradation.

In 2001 the *Basin Salinity Management Strategy* was developed, providing a framework for action on managing salinity in the Basin. The Strategy established salinity targets for the Basin as a whole and at the end of each tributary valley, to be met by 2015. The end-of-valley targets set the 'floor' for the health of catchments, encourage the development of systems of management and accountability, and provide for the protection of key values and assets by setting 'Caps' on salinity levels and salt loads in the rivers.

The *Murray-Darling Basin Cap on Diversions* was introduced in 1997 in response to declining river health and the incremental erosion of security for existing irrigators. The 'Cap' limits diversions to those that would have occurred under 1993/1994 levels of development. While the 'Cap' restrains further increases in overall water diversions, it does not rule out new developments provided the water for them is obtained by using water more efficiently or by purchasing water from existing developments.

Whilst much has been achieved for the river, the Murray-Darling Basin Ministerial Council agreed that more is needed to ensure a healthy River Murray in the long term, that the health of the River Murray

is important in maintaining biodiversity and the health and economic success of the communities it supports.

In mid 2002 the Murray-Darling Basin Ministerial Council established its *Living Murray* initiative as a result of the substantial evidence suggesting that the River Murray system was degraded, combined with the concern that this degradation threatened the Basin's agricultural industries, communities, natural and cultural values and national prosperity. These issues formed the basis of Council's future decision making process in regard to the River Murray.

The Council works closely with the community in order to promote discussion of the issues and increase mutual understanding of them. In addition, the Council called for scientific analyses and a comprehensive study of the costs and benefits to the environment, industry and the community of returning water to the river.

This work is now underway through the *National Water Initiative* and the *Living Murray* initiative. In August 2003 the member jurisdictions of the Murray-Darling Basin agreed to make \$AU500 million available to address over-allocation of water in the Murray-Darling Basin which includes the *Living Murray* initiative.

Mouth of River Murray near Goolwa. Image courtesy of MDBC. Photograph by Michael Bell



On the 14 November 2003 the Murray-Darling Basin Ministerial Council took a historic First Step to address the declining health of the River Murray system. The First Step for the *Living Murray* marks the beginning of the Council's collective actions to return the River Murray to the status of a healthy working river.

The key elements of the First Step decision include an initial focus on maximising environmental benefits for six significant ecological assets – Barmah-Millewa Forest; Gunbower and Koondrook-Perricoota Forests; Hattah Lakes; Chowilla Floodplain; the Murray Mouth, Coorong and Lower Lakes; and the River Murray channel. These benefits will be achieved by targeted application of an average of up to 500 gigalitres

of water per year obtained over five years. Priority measures are on-farm initiatives, efficiency gains, improving and rationalising infrastructure to

make the best possible use of the water, market based approaches and purchase of water from willing sellers.

Image courtesy of Murray-Darling Basin Commission



CASE STUDY 1.02 TURNING WATER INTO WINE

The Southern Murray-Darling Basin (MDB) is a high water-use, high-yield grape production zone containing more than 80 thousand hectares of vineyards. In 1997 the Murray-Darling Basin Ministerial Council placed a ‘Cap’ on any increase in water diversions to help prevent further degradation of the Basin’s waterways. The ‘Cap’ was set at the volume of water that would have been diverted under 1993/94 levels of development.

The introduction of the ‘Cap’ on water extractions in the MDB has allowed the significant expansion of the wine industry over the last decade. In South Australia there has been a 67 percent increase in production in the River Murray vines region. In the Sunraysia district of New South Wales, the area of land under grape production has increased by 2,400 hectares.

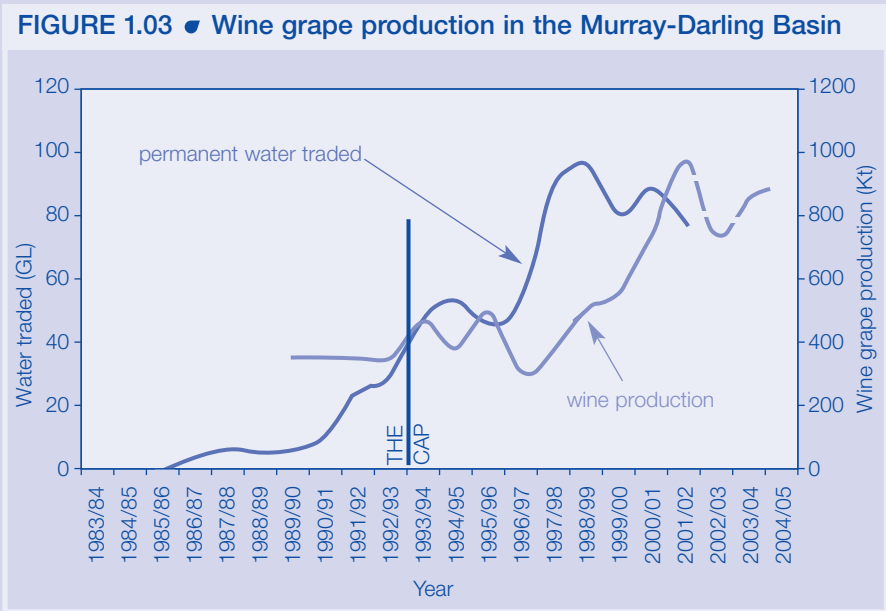
Due to the high level of investment required for vineyard establishment, this increase in production would not have been possible without access

to a permanent and secure water supply. Trading in water access entitlements allows water to move between users and from low to high value uses. As grapes have a relatively high profit margin and use a low volume of water compared with other irrigation activities, grape growers are able to out-bid other irrigators for water in the market place (Figure 1.03).

Since the introduction of the ‘Cap’, the majority of water traded to grape production is thought to have come from water that was previously from sleeper and dozer licence holders (potential water users that have been using only a small part, if any, of their entitlement).

Note the lag time of around 3-4 years after imposition of the ‘Cap’ until vineyards become established and production commences.

Source Stringer and Wittwer 2001, ABARE



Great Artesian Basin

The Great Artesian Basin is an enormous groundwater resource that underlies more than one fifth of the continent in the arid interior of Australia, where there is often no alternative reliable water supply. The pressure that drives the water to the surface is under threat because of excessive outflow. One third of bores that were once artesian have now ceased to flow. Up to 95 percent of water that reached the surface was wasted through evaporation and seepage.

The Great Artesian Basin Sustainability Initiative is a ten-year program to partially restore the valuable artesian pressure in priority areas by capping the old bores that have discharged freely onto the land surface for up to 120 years, and replacing the open earthen bore drains with a closed polypipe reticulation systems.

Funding for the initiative involves a cooperative arrangement between the Australian and state governments, with landholders also contributing a share.

Peter Fisher on his 14,400 hectare cattle station 'Quilberry' near Charleville in outback Queensland. The water trough is one of many on the property made possible by capping the old artesian bore and replacing the old wasteful earthen bore drain networks with a closed polypipe system of water reticulation. Image courtesy of DAFF



A secondary diversion channel on the left bank lower floodplain of Widden Creek at Baramul Stud, looking upstream. This forms part of the Natural Sequence Farming system. Photograph by I. White

Natural sequence farming offers solution to degraded rivers

The waterways of the Widden Valley in the Upper Hunter region of New South Wales suffer from degraded structures, salinity and poor riparian vegetation. However, a group of scientists and landholders is working to repair the valley's river system by re-establishing the structures of its natural landscape. They are confident that the valley will become a model for natural sequence farming and be restored in the process. The project is supported by a \$AU30,000 contribution from the Australian Government's *Natural Heritage Trust*, matched by the New South Wales Government, Southern Cross University and Hunter Catchment Management Trust.

Peter Andrews, Principal Researcher and instigator of the natural sequence farming concept, described the system:

'Natural sequence farming (NSF) focuses on the way the natural landscape worked to maintain its

balance. Existing flood plains are currently disconnected from creeks and rivers, leaving them unable to store water to support productive farming and riparian vegetation, and highly susceptible to erosion during floods.

'NSF takes a holistic approach to environmental health by re-establishing the river's connection to the surrounding landscape. Restoring connections between the river and its flood plains encourages a more natural storage of water in flood plains. This improves riparian vegetation and habitat and water quality by preventing salt seepage into the water table.

'To recreate the natural 'chain of ponds' effect, NSF uses secondary diversion channels to reconnect creeks and rivers to their floodplain. By mimicking the natural sequence of waterways we hope to rehabilitate a severely degraded stretch of river and surrounding flood plain. This will also benefit the farming land of that area,' he concluded.

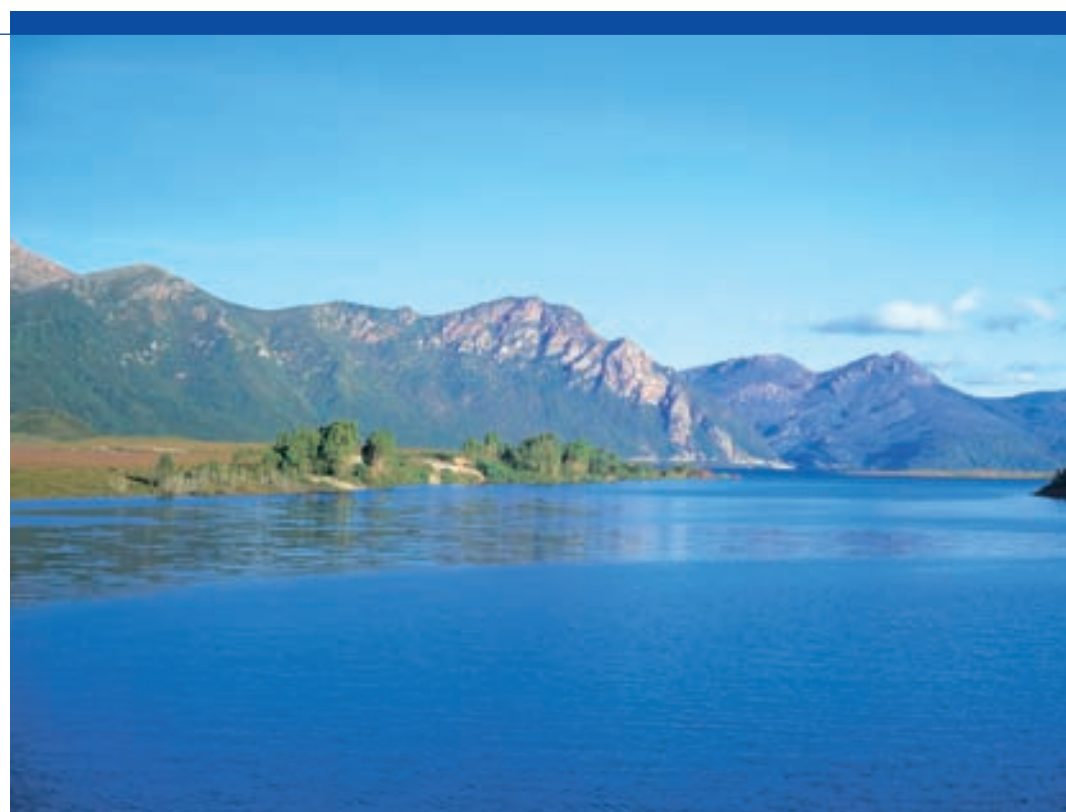
New South Wales

The Department of Infrastructure, Planning and Natural Resources coordinates and streamlines land-use planning, infrastructure development and natural resources management. The landmark *Water Management Act 2000* draws together all the critical elements of water management and provides the platform for an unprecedented overhaul of water-use policy. The Act balances the need to allocate water back to the environment while giving rural industries the certainty they need to make long-term business decisions. Farmers and irrigators will have secure, well-defined access rights to water, which they can trade. Trading of water will help shift water to more efficient and productive agricultural uses. These new access rights will be backed by water-sharing plans developed by local communities and will set long-term rules for water trading.

Water sharing plans (pages 97-98) set a hierarchy of rights for access to water, giving priority to the environment, then to urban supply, then extraction under access licence. Separate plans were developed for regulated rivers, unregulated tributaries and groundwater – a total of 36 plans across the state. Catchment blueprints have been developed to integrate all natural resource planning, including water sharing and regional vegetation plans. The blueprints will provide direction and purpose to achieve catchment targets and will be further developed and implemented through the newly appointed catchment management authorities.

Tasmania

Tasmania has significant opportunities for further development of water-dependent industries, especially agriculture. The *Water Development Plan* for Tasmania identifies strategic initiatives to manage and develop the state's valuable freshwater resources in partnership with the private sector.



The *Freshwater Conservation Ecosystem Values Project* ensures that development proposals do not have an impact on key ecosystem values. CAR (comprehensive, adequate and representative) principles are used to ensure protection of threatened species, wetlands and estuaries. The project is funded by the state (over \$AU1 million) in partnership with the Australian Government under the *National Action Plan for Salinity and Water Quality*.

During 2003, guidelines were developed for granting new water allocations under the *Water Management Act 1999*. The guidelines provide an equitable approach to granting new winter water allocations, principally allocation for dams, while protecting the rights of existing users and the health of rivers and estuaries. Applications for the construction or modification of dams in Tasmania are assessed and determined by the Assessment Committee for Dam Construction (ACDC), an expertise-based statutory body. During 2002-03, the ACDC approved 160 permits for dam works.

Hydro Tasmania, the state's major supplier of electricity, is licenced for over 15,000 gigalitres of water, the largest allocation in Australia. A memorandum

of understanding between Hydro Tasmania, the Tasmanian Farmers and Graziers Association and the Tasmania Department of Primary Industries, Water and Environment establishes procedures for rapid transfers of water between Hydro Tasmania and irrigators.

Environmental flows for the Mersey River and Cataract Gorge have been established through collaboration between Hydro Tasmania, government agencies and community stakeholders. A process of water management review has been applied in the South Esk, Great Lake and other catchments.

Hydro Tasmania's King River Power Development won the International Hydropower Association's (IHA) Blue Planet Prize for outstanding technical, environmental and economic performance in a hydropower development in 2001. The candidates for the award were assessed and reviewed by the IHA and UNESCO's International Hydrological Program.

Stream flows, salinity and water quality are being monitored in real-time by telemetry in 34 of Tasmania's prime agricultural catchments, and information made available to the community through the Internet.

Above: Lake Burbury.
Image courtesy of Hydro Tasmania

Australian Government Department of Education, Science and Training (DEST)

DEST provides about \$AU1.5 billion per annum for basic research.

The International Centre of Excellence

The International Centre of Excellence in Water Resource Management has recently been awarded by DEST to a consortium of WATER Australia. The Centre plans to integrate the best expertise across training, education, research, industry and government organisations throughout Australia and apply this to the specific needs of targeted international communities. Partners are:

- Deakin University, Victoria
- Flinders University of South Australia
- University of Adelaide
- University of Central Queensland
- University of Newcastle
- University of South Australia
- TAFE SA
- Centre for Groundwater Studies
- Cooperative Research Centre for Water Quality and Treatment
- CSIRO Land and Water
- South Australian Research and Development Institute (SARDI)
- Department of Water, Land and Biodiversity Conservation, South Australia
- Department of Employment, Further Education Science and Technology, South Australia
- United Water International Pty Ltd and its international parents Thames Water Ltd and Veolia Ltd
- SA Water Corporation, including the Australian Water Quality Centre
- AITEC Corporate Education and Consulting

There are fifteen other associates (contact: Professor John Lovering, Chair; Professor Graeme Dandy, Interim Director, University of Adelaide).

Universities

All universities are members of the Australian Vice-Chancellors' Committee, but also form their own consortia.

The great and established research-intensive universities (Group of Eight) comprise The Australian National University, The University of Melbourne, Monash University, The University of Sydney, The University of Adelaide, The University of Queensland, University of New South Wales, and The University of Western Australia. A group of five form the Australian Technology Network – Curtin University of Technology, Queensland University of Technology, RMIT University, University of South Australia and University of Technology, Sydney – and are distinguished by their emphasis on links with industry. Other newer universities are developing links to regional Australia. They include Charles Sturt University, La Trobe University, James Cook University and University of Western Sydney (page 63).

Most universities provide specialist administrative units for research and development (page 40-41).

CSIRO

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) conducts long-term strategic research in the national interest. It aims to combine scientific and business excellence as a world-class enterprise. More than 6,880 staff are located at 60 sites in Australia and overseas.

The National Research Flagships, led by CSIRO, are aligned to the national research priorities. The *Water for a Healthy Country Flagship* aims to achieve a ten-fold increase in the social, economic and environmental benefits from water use by 2025 (page 39).

One node of this program is helping to provide options and knowledge for the MDBC's *Living Murray* initiative. CSIRO has also invested in a series of organisation-wide innovative programs

of Emerging Science Areas. Those relevant to water include, particularly, the *Social and Economic Integration Program* and *Complex Systems Science Program*.

The following CSIRO Divisions conduct research into water and natural resource management:

- CSIRO Land and Water: Water allocation and quality, urban water reuse, land-use options, and environmental contaminants (pages 61, 83, 107, 129)
- CSIRO Sustainable Ecosystems: Management of sustainable agriculture, rangelands and savannas, tropical landscapes, and resource futures including groups specialising in resource governance, urban and regional development, and northern tropical and subtropical regions
- CSIRO Manufacturing and Infrastructure Technology: Urban water including system design, integration of sewage treatment technologies, social issues, water-use measurement, and techniques for aquifer storage and recovery
- CSIRO Atmospheric Research: Climate change and variability
- CSIRO Plant Industry: Biodiversity restoration, plant breeding for improving water-use efficiency
- CSIRO Forestry and Forest Products: Precision plantation solutions for watershed management
- CSIRO Mathematical and Information Sciences: Monitoring and assessment, environmetrics (statistical methodologies in environmental science), remote sensing and image integration to show maps of trends in land condition

Water for a Healthy Country



Image courtesy of ©CSIRO Land and Water

The future of water

Managing Australia's water resources to meet economic, social and environmental needs is fundamental to the nation's future development. As a scarce resource, water dominates much of the natural resources debate, both nationally and internationally.

Australia's capacity to deliver the science needed to underpin policy reform is world class, but needs continual improvement if it is to keep pace with the decisions that water users and managers make daily.

The Australian science community is meeting this challenge with the establishment of the *Water for a Healthy Country Flagship* – a partnership of leading scientists and research institutions. A CSIRO initiative, the *Flagship* partnership is expanding rapidly to become an Australia-wide collaboration that will develop the technologies and social systems needed to support management decisions, and to ensure Australia gains the maximum benefits from its water resources. To achieve this, the *Flagship* will deliver much of the science required to support the implementation of the *National Water Initiative* and various state and regional water resource strategies founded on the development and implementation of a water benefits accounting system.

The *Flagship* is addressing three major Australia-wide science challenges:

- Better water access – improving systems for entitlements and water access rights. How these 'water accounts' might change with climate variability and altered land and water use can be predicted by better understanding the location of water (surface and groundwater) in the catchment
- Smarter water use – improving efficiency and productivity for all water uses. To maximise water benefits, water accounts are needed at an intensity of scale and coverage that will facilitate economic decisions at suburb, farm and scheme levels
- Systems-based water management – protecting, repairing and managing aquatic ecosystems with management decisions based on various ecological scenarios

By responding to these science challenges, the *Water for a Healthy Country Flagship* will deliver increased productivity and water efficiencies, thus helping to sustain rural and urban communities while ensuring the health of Australia's rivers and groundwater systems.

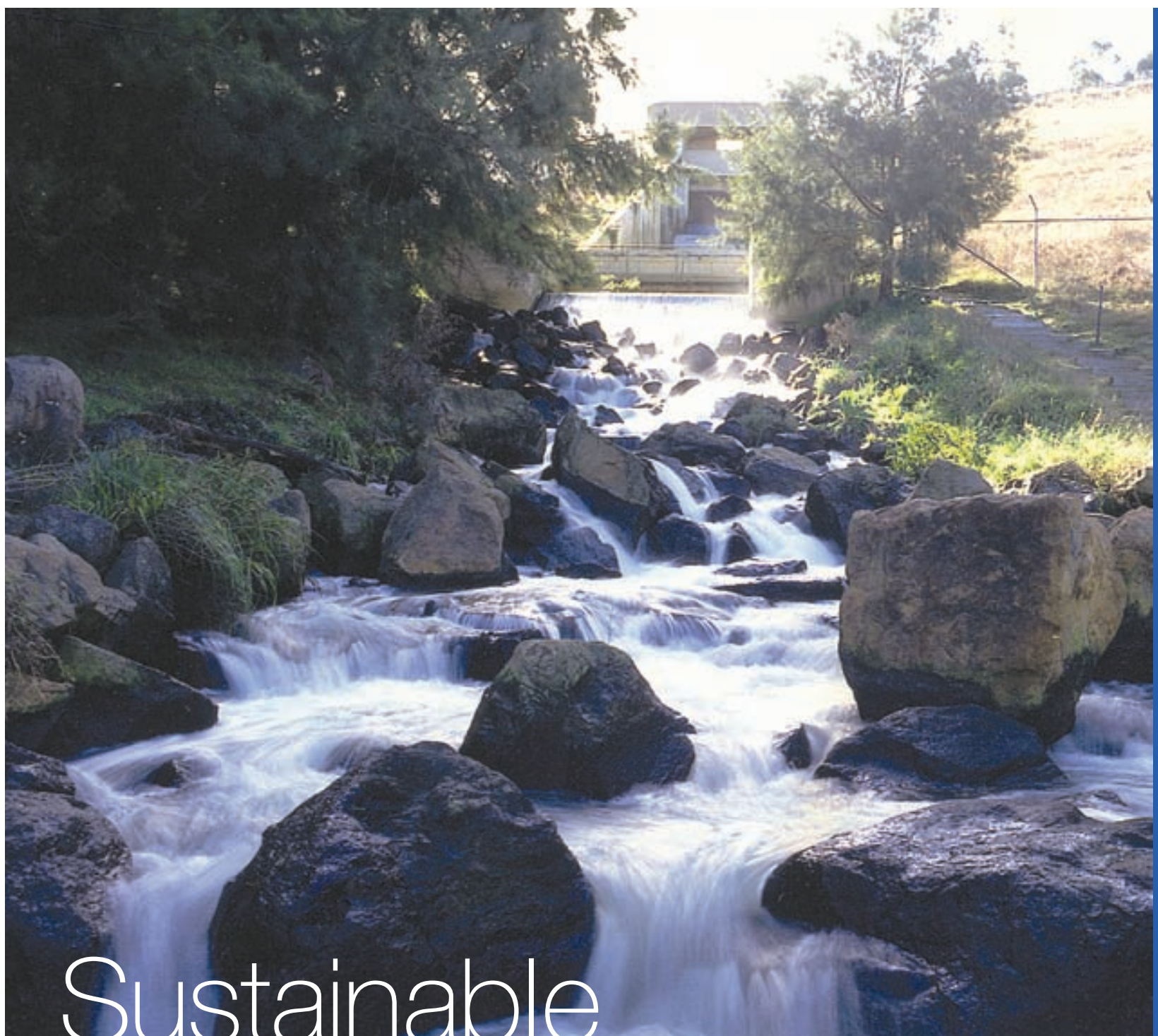
For further information please contact:

Colin Creighton
 Director – Water for a Healthy
 Country Flagship
 PO Box 2697 Canberra ACT 2601
 T 61 2 6246 5745
 F 61 2 6246 4564
 E Colin.Creighton@csiro.au
 W www.csiro.au



Table 1.06 • Strengths in university research

University	Expertise	Comments
The University of Adelaide School of Earth and Environmental Sciences Soil and Land Systems School of Agriculture and Wine	4a, 5	Hosts WATER Australia, DEST Centre of Excellence in Water Resource Management. A national research centre of excellence in agriculture, viticulture, and soil and water management.
The Australian National University National Institute for the Environment Institute of Advanced Studies – Centre for Resource and Environmental Studies etc	1acd, 2a, 3ab, 4b, 6abcde 1b, 4b, 6a	Ranked by the US-based Institute of Information Sciences in the top 100 world wide More than 150 staff in research-related fields International focus in the Asia Pacific
University of Canberra Applied Ecology Research Group Water Research Centre	4c, 5e 4c, 6ae	Hosts CRC for Freshwater Ecology. Freshwater ecology and aquatic biodiversity in relation to irrigation Helped develop National Water Quality Guidelines: endangered species vegetation assessment and rehabilitation: environmental flows
Charles Darwin University Centre for Tropical Wetlands Management Centre for Indigenous Natural and Cultural Resource Management	4c, 6e 1b, 7b	
Charles Sturt University Centre for Rural Social Research Johnstone Centre for Natural Resources and Society Farrer Centre for Sustainable Food and Fibre Production	1b, 7b 1b, 4bc, 6e 4ab, 5, 7b	Specialist in distance education with over 25,000 students in that mode. Located in the heart of the Murray-Darling Basin. International partnerships in Malaysia, Sri Lanka, China and India.
Curtin University of Technology Agribusiness and Environmental Management	4a, 7a	
Deakin University School of Ecology and Environment School of Environmental Engineering	4bc, 6ae 3ad	Prominent distance education provider. Over 45 staff in three broad themes – industrial water and waste management; primary industries; and ecosystems, catchments and society.
The Flinders University	6c	Hosts Centre for Groundwater Studies
Griffith University Centre for Riverine Landscapes	4abc, 6abe	
James Cook University	4bc, 6e	Hosts the National Tropical Wetland Centre. Hosts the CRC for Tropical Rainforest Ecology and Management. Campuses in Singapore and overseas with 31 institutions in 11 countries. Member of the Organisation of Tropical Studies, a US consortium of over 50 universities based at Duke University.
Macquarie University Commonwealth Key Centre for Biodiversity and Bioresources	4c, 6ae	
The University of Melbourne Melbourne Centre for Water Research Centre for Water and Landscape Management Centre for Environmental Applied Hydrology	1abcd, 2ab, 4a, 5, 6c, 7bc 2a, 4bc 2a, 3ab, 4bc, 6a	Melbourne Centre is supported by at least seven faculties. Centre for Water and Landscape Management is located at the Dookie campus to serve the Goulburn Valley in North East Victoria. Surface and groundwater hydrology and fluvial geomorphology.
Monash University Water Studies Centre	4c, 5, 6a	Programs in biogeochemistry, real-time instrumentation, field flow fractionation, ecological risk assessment.
Murdoch University Institute for Sustainability and Technology Policy Institute for Environmental Science Remote Area Developments Group Centre for Organic Waste Management	7bc 3cd, 4bc 6cd 3bd	Includes application of environmental technologies to developing countries and urban communities.
The University of Newcastle Centre for Sustainable Use of Coasts and Catchments	1b, 3d, 4c, 6e, 7bc	International partnerships in South Asia and the Middle East
The University of New England Centre for Ecological Economics and Water Policy Research Centre for Sustainable Farming Systems Institute for Rural Futures	1abc, 7a 4a, 5 7ab	
University of New South Wales UNESCO Centre for Membrane Science and Technology (UCMST) Centre for Environmental Modelling and Prediction Centre for Remote Sensing and Geographic Information Systems Centre for Water & Waste Technology School of Civil and Environmental Engineering	3cd 2, 6a 6b 3bcd 3bcd, 4b, 6c	Commercial arm – Unisearch. Links with NASA, European Space Agency, NASDA (Japan) and the Canadian Centre for Remote Sensing. Hosts the CRC for Environmental Biotechnology. Strong emphasis on Civil and Environmental Engineering. UCMST is the largest membrane research group in Australia. Applications include water production, reclamation and reuse. UCMST has UNESCO status with satellites in Thailand and Romania, and international links through CH2M HILL Australia.



Sustainable urban water systems

Paul J Perkins and Brian McRae

2

● Australia's urban water industry

Australia's urban water industry includes approximately 300 utilities; numerous businesses providing equipment, supplies and professional services; and organisations concerned with regulation, research and other activities. It services most of the country's 20 million inhabitants and urban-based industries, managing 17 percent of Australia's water use.

Models used by Australia's states and territories for water services include:

- A single utility for the entire region
- Utility services at the local government level
- Regional utilities, each servicing multiple local government areas

As a result of these arrangements, about 70 percent of Australia's

population are serviced by 26 utilities, while the 200 smallest utilities collectively service only 3 million customers.

Almost all utilities, whether small or large are joint water/sewerage service providers. Some manage source water collection and storage; others rely on bulk water suppliers for treated and/or raw water supplies. Catchment management services

follow a number of different state-based models, but local government provision of flood control and stormwater management services is the norm.

Variability in geography, climate and state institutional arrangements has inspired an industry that excels at adaptation and exhibits unparalleled diversity.

● Managing water systems

Australia's urban water management systems have benefited from internal and external catalysts for continuous improvement. Cooperative arrangements between national and state governments to promote transparency and contestability have improved efficiency and demonstrated that best practice can be achieved through both outsourcing and in-house provision of services. These government-driven initiatives have been supported by contributions from a vibrant commercial and research sector.

Regulatory reform

Australian water reforms, introduced in Chapter 1, promote a well-managed, competitive urban industry through:

- Tariffs based on consumption (not property value)
- Rates that reflect full cost recovery
- Separation of service provision and regulation
- Customer consultation
- Improved drinking water quality standards

Implementation of the policy framework by responsible state and territory governments has given rise to a spectrum of approaches. Formal progress against the reviews by the National Competition Council through access to payments are a powerful incentive to implement reforms.

Reform initiatives across the industry include:

- The introduction of this payment method in Queensland led to consumption in some areas falling by as much as 20 percent during the first year of implementation
- Robust models for cost recovery, including asset valuation, real rate-of-return, and dividend policies, with full cost recovery achieved for most utilities with more than 1,000 connections
- A customer-driven service orientation, significant reduction of cross-subsidies and transparent Community Service Obligations (public subsidies)
- Increased compliance with the *Australian Drinking Water Guidelines* (page 71)

Improving performance

Regulatory reforms have been accompanied by individual utility initiatives to promote efficiency and effectiveness. These utilities have benefited from collaborative industry initiatives such as performance assessment programs that:

- Ensure utilities are collecting and utilising relevant management data
- Document progress and suggest priorities for future action
- Allow businesses to compare their performance
- Facilitate the development of a vibrant, competitive industry

Industry-based reports include *WSAAfacts* (page 47), the *Australian Water Association NMU Report* (for non major urban utilities) and the *Victorian Water Review*, covering Australia's large, medium-sized and Victorian utilities, respectively. Several state governments, notably New South Wales, have also produced reports.

►► continued page 48

Recent developments include a movement towards social, economic and environmental ('triple bottom line') criteria and process benchmarking – exploring the underlying contributors to performance variance. These efforts promote transparency and have significantly enhanced Australia's capability to ensure that information collection is cost-effective and data interpretation is accurate.

Industry reform – public-private partnerships

Australian utilities have pursued cooperative ventures with private sector partners – including domestic businesses, privatised British utilities and French multi-national service providers – to complement their internal initiatives.

Sydney Water, Australia's largest water business, introduced private sector financing on a major program to upgrade water filtration. Within a few years, public-private partnerships (PPP) were being explored in all major cities. Financial innovation initially supported advanced filtration systems and other mechanisms to reduce health risks.

Early initiatives such as the Prospect Water Filtration Plant (Table 2.01) used the BOOT (build-own-operate-transfer) model, with the supplier consortium designing, building,

financing and operating (DBFO) the plant for a fixed period before the asset reverted to the client utility.

South Australia evolved a 'cluster industry' model, with the winning consortia's contracts for Adelaide's water operations tied to export development targets. The Water Industry Alliance's participating members, which number more than one hundred, have had significant export success.

The project alliance model has been applied by the water industry in two large contracts by the WA Water Corporation; the ACTEW-AGL public-private partnership; the NQ Water-Citiwater alliance in Townsville; and the recent North-Side Storage Tunnel project with John Holland and Sydney Water.

Recent activities favour the DBO (design-build-operate) model, which secures private technological expertise while retaining public asset ownership and financing. It also yields typically lower transaction costs than the DBFO alternative, perhaps reflecting more optimal risk sharing.

Allied sectors such as legal, professional and financial services have developed improved understanding and experience regarding contractual risk sharing and project management. Engineering firms including Gutteridge Haskins & Davey (GHD), consulting practices such as

PricewaterhouseCoopers and legal firms such as Blake Dawson Waldron and Mallesons Stephens Jacques are successfully marketing the model in Australia and overseas.

The development of about \$AU1 billion in PPP projects, with capital values from \$AU3 million to \$AU450 million, has fostered a robust industry. Access to private sector financing and rapid commissioning has boosted the application of technologically advanced water treatment designs and automated control and monitoring systems. Australian utilities and their public sector partners have used these arrangements to hone the industry's efficiency.

►►continued page 50



Prospect Water Filtration Plant, Sydney. Image courtesy of Australian Water Services Pty Ltd

TABLE 2.01 • Public-private partnerships			
Development and Capacity (Megalitres per day)	Consortium	Client	Contract
Prospect Water Filtration Plant (3,000)	Australian Water Services, Ondo-Suez (France), Lend Lease	Sydney Water	25 year BOOT
Macarthur Water Filtration Plant (265)	United Utilities (UK), Tenix	Sydney Water	25 year BOOT
Woronora, Illawarra water filtration plants (370 combined)	Wyuna Water (Veolia Water) (France)	Sydney Water	25 year BOOT
Yan Yean Water Treatment Plant (400)	United Utilities (UK), Tenix	Melbourne Water	25 year BOOT
Melbourne maintenance services	(1) Thiess (2) Serco (3) Tenix	Melbourne Water companies (x3)	5+ year service contracts
Complex \$AU90 million upgrade of Cronulla Sewage Treatment Plant	Bovis Lend Lease, Australian Water Services, CH2M HILL Australia, Sinclair Knight Merz	Sydney Water	DBO – operations and performance for 1 year before and 2 years after completion
Management of Adelaide's water system	Veolia Water, Thames Water, KBR	SA Water	15.5 years service contract. (Industry development condition)
10 water filtration plants for SA Riverland Region	United Utilities (UK), AMP, Bechtel	SA Water	15 year BOOT

SA Water

Reputation for innovation

SA Water is playing a key role in developing a vibrant water industry in South Australia to ensure sustainable water supplies for the State.

Innovation & Partnership

Many of SA Water's key achievements stem from vibrant partnerships and innovative projects including:

- MIE[®] (Magnetic Ion Exchange) water treatment process developed by SA Water, CSIRO and Orica. MIE[®] technology removes a significant portion of organics from raw water, resulting in a large reduction in the formation of disinfection byproducts. A pilot plant was established at Mount Pleasant in South Australia. This was followed by a large plant in Wanneroo, Western Australia. The MIE[®] technology is gaining international attention and, at the time of publication, four MIE[®] water treatment plants were committed and a significant trial program was under way in the United States
- Waikerie and Woolpunda Salt Interception Schemes won the Sir William Hudson Award for most outstanding national engineering project at the Australian Engineering Excellence Awards, 2002. The schemes, managed by SA Water and funded by the Murray-Darling Basin Commission, are successful in preventing more than 350 tonnes of salt per day from entering the River Murray
- SA Water's world renowned Australian Water Quality Centre – working with the Cooperative Research Centre for Water Quality and Treatment – continues to win accolades for its work in water quality research, testing, monitoring and solutions
- South Australia's first mini-hydro electric scheme, a joint venture between SA Water and Hydro

Tasmania, is powered by River Murray water that flows from SA Water's Terminal Storage site. The hydro turbine generates enough electricity to power 1,000 homes

- SA Water is a key player in the State Government's *Water Proofing Adelaide Project* and is working with the Department of Water, Land and Biodiversity Conservation to plan sustainable options for the State's water resources
- As the major sponsor of the Water Industry Alliance, SA Water supports local companies to export and grow. Alliance members secured \$AU180 million in gross exports in 2002/03

Commitment to Sustainability

Committed to implementing sustainability policy, procedures and reporting, SA Water has:

- Published its first annual *Sustainability Report*
- Established a Sustainable Business team, with expertise in the field of sustainability
- Established a Sustainability Advisory Group to report to the SA Water Board
- Commenced development of a *Blueprint for Sustainability*

Recycled Water Leadership

SA Water's \$AU240 million metropolitan and country *Environmental Improvement Program (EIP)* is reducing effluent discharge to the marine environment and increasing the amount of recycled water available for irrigation.



Checking the turbine runner at SA Water's first mini-hydro electric scheme.

In 2003/04, about 19 percent of all treated wastewater was reused. SA Water has a long-term aim of reusing 50 percent of this wastewater.

Water Conservation and Education

A new permanent regime of water conservation measures was introduced into South Australia in 2003. SA Water's efforts to raise immediate awareness of the new restrictions have led to the development of a longer-term water education program.

Market research has shown widespread support for water conservation measures and SA Water is working with the community to improve long-term water efficiency.

For further information please contact:

Anne Howe
Chief Executive
77 Grenfell Street Adelaide SA 5000
T 61 8 8204 1000
F 61 8 8204 1439
E anne.howe@sawater.com.au
W www.sawater.com.au



WOODMAN POINT, WESTERN AUSTRALIA



Woodman Point Western Australia. Aerial view of the Point Wastewater Treatment Plant featuring the highly-innovative circular Sequenced Batch Reactor (SBR) facility. Image courtesy of Water Corporation of Western Australia

Innovation in infrastructure investment

Objective

Following the successful use of the Project Alliance model to outsource services, the Water Corporation of Western Australia used the model in its more conventional application of a major project – in this case the \$AU150 million upgrade to the Woodman Point Wastewater Treatment Plant.

Client

Water Corporation of Western Australia

Suppliers (Partners)

Clough Engineering, Kellogg, Brown & Root

Features

This delivery model is relatively new. Key features include:

- A non-adversarial contract, constructed by mutual agreement, seeking an equitable balance of risk and reward for all parties
- Open book accounting with risk/reward arrangements
- Encouragement of openness and co-operation between parties
- Emphasis on business outcomes with an objective to achieve a 'win-win'

Expected outcomes are specified quantity capacity, improved effluent quality and greater than 12 percent whole-of-life savings. The Water Corporation has subsequently used the Project Alliance model for a number of other projects.

Technologies

The centrepiece of the upgraded plant, at a cost of approximately \$AU35 million, is a new 4 basin x 160m internal diameter secondary treatment Sequenced Batch Reactor (SBR) designed with sub alliance partner Environmental Solutions International Limited (ESI). The SBR technology was chosen by Water Corporation for the project after an exhaustive technical overview by independent experts and economic comparison (both capital and operating costs) with more traditional continuous flow plant options.

The Woodman Point WWTP SBR facility is one of the largest of its kind in the world and incorporates several innovative features in its engineering and operation.

These features include:

- A circular layout that provided significant construction cost savings and allows ready access to mechanical equipment located around the perimeter of the structure
- Bioselector reactor zones within each basin designed to ensure that excellent biomass settleability is maintained at all times
- Inter-basin inflow spilling control during peak inflow periods to provide partial flow-equalisation and to minimise the required reactor volume
- Multiple cycle times and aeration profiles that can be configured by plant operators
- A decanter synchronisation control system to ensure that all 8 x 11.3m decanters in each basin operate within a tolerance of just a few millimetres
- Process design and operation incorporating simultaneous nitrification and denitrification (SND) principles
- Centrifugal blowers and highly-efficient fine bubble submerged aeration diffusers, able to be turned down to an air flow of 10 percent of maximum capacity when required

Treated effluent quality for the first two years of operation is well within the standard required, and unit power consumption, after fine tuning, is low.

BRISBANE WATER: SMART WASTEWATER TREATMENT SOLUTIONS FOR A GROWING CITY

Objectives

Increase capacity, reduce odours and improve water quality in Brisbane River and Moreton Bay by upgrades to three major sewage treatment plants. (Cost \$AU180 million). Upgrade Luggage Point wastewater treatment plant to deliver wastewater reuse projects for several major tenants in the Australia Trade Coast Precinct.

Clients

Brisbane Water, major industrial customers and over one million Brisbane residents

Innovations – Brisbane Water Enviro Alliance

- Construction on track to achieve zero odour emissions goal
- Australia's largest conventional air-diffused sludge digestion treatment plant
- Heating biosolids to maximise gas recovery and minimise solid waste outputs

Innovations – Luggage Point treatment plant upgrade

- World-class biological nutrient removal (BNR) plant. Capital costs associated with nutrient removal have been reduced to below \$AU25 per equivalent person
- Process modelling and simulation software to analyse and interpret plant operating data
- The first Australian plant to incorporate cogeneration and methane capture (biogas) from sludge digestion using converted diesel marine engines
- Around 120MWh of renewable energy exported to the national grid, providing energy and heating for plant operation

Australia's largest wastewater reclamation plant at Luggage Point provides BP Australia with 14 megalitres of clean water daily for production process use. Image courtesy of Brisbane Water



ADVANCED TREATMENT AND PUBLIC-PRIVATE ALLIANCE PARTNERING, SUNSHINE COAST, QUEENSLAND

Objective

Provide upgraded water treatment to produce 140 megalitres of supply per day from the Landers Shute plant that serves the fast growing Sunshine coastal urban area of Caloundra-Maroochy, Queensland

Client

Aquagen (formerly Caloundra Maroochy Water Supply Board, Queensland)

Supplier

Landers Shute Water Alliance comprising Veolia Water, Walter Construction Group, Caloundra Maroochy Water Supply Board and Kellogg, Brown & Root

Technology

- Australia's largest ozone and Biologically Activated Carbon (BAC) water treatment plant, capable of producing 140 megalitres per day in a two-stage process
- Pre-ozone removes manganese and breaks down algae
- A post-ozone BAC process removes taste and odour compounds, algal toxins and pesticides, and reduces organic compounds leading to lower chlorine demand and disinfection by-products



Above: Veolia Water was a key player in the Landers Shute Water Alliance Treatment Plant, which provides 150,000 residents in the Maroochy and Caloundra region with world-class drinking water. Image courtesy of Veolia Water

Below: Landers Shute Advanced Water Treatment Plant. Image courtesy of AquaGen, Water & Renewable Energy



Government of the Australian Capital Territory (ACT) and ACTEW Corporation

Long-term commitment and successes

The ACT can claim considerable success in water resources management.

More than thirty years ago, and in light of deteriorating water quality in the Murrumbidgee River, a comprehensive catchment study was undertaken. Water quality objectives were determined and an integrated strategy was implemented:

- An advanced tertiary treatment plant which treats most of Canberra's sewage was commissioned in 1978. Through a continual process of modification and upgrade this plant remains at the forefront of sewage treatment today
- In 1984, Canberra pioneered erosion and sediment control requirements on land development and building sites which are now commonplace across the country
- A comprehensive approach to stormwater management was adopted, in which stormwater flows are managed through a system of vegetated floodways incorporated as urban open space, gross pollutant traps, wetlands, ponds and lakes

These measures resulted in water quality and flows in downstream waters similar to that which existed prior to urban development, as well as significant recreational opportunities, amenity and economic benefits.

Environmental flow

More recently, attention has been focused on reducing the impacts of water diversions from water supply catchments and ensuring that returns to the community from the use of this valuable resource are optimised.

A comprehensive environmental flow regime applies to all waters under Territory control including, notably, the Cotter River catchment which contains a number of threatened fish species.

Transparent costing

The ACT was the first jurisdiction to implement a two part pricing regime for urban water, comprising initially a standard fixed charge and volumetric charges that were not tied to land values. Now, a water abstraction charge is incorporated, ensuring that all costs of water supply and use are met directly by consumers – including costs of catchment management, a component reflecting the scarcity value of water, and a component for environmental costs of water supply and use.

A holistic approach

The ACT recognises the need for further improvement to secure future water supplies, safeguard water quality and ecological values of urban waterways, improve amenity and recreational opportunities.

A comprehensive water resource strategy, *Think water, act water: Strategy for Sustainable Water Resource Management in the ACT*, promotes an integrated and holistic approach to water resources management. The strategy is designed to:

- Provide a long-term, reliable source of water to the ACT and region
- Increase the efficiency of water use
- Promote the development and implementation of an integrated regional approach to ACT/New South Wales cross-border water supply and management

David Street Wetland. Water sensitive urban design at O'Connor. This partnership between community, business and government retains stormwater; enhances biodiversity and creates a peaceful urban environment.



AUSTRALIAN BUREAU OF METEOROLOGY: RAINFALL FORECASTING

Objective

Floods cause on average around \$AU400 million in damage each year in Australia. The greatest risk is from flash flooding in the heavily populated urban areas. Forecasts of rainfall with higher spatial resolution and longer lead times than presently produced can help reduce damage by improving warning services to emergency management agencies and the public. Such forecasts also assist urban water agencies in better managing drainage systems and other infrastructure to achieve improved public safety and environmental outcomes when managing stormwater run-off. The research objective of a combined Bureau of Meteorology, Cooperative Research Centre for Catchment Hydrology and UK Centre for Ecology and Hydrology project has been to develop a forecasting system to help meet this need.



Above: Urban flood.

Above right: Todd River flood, Alice Springs, Northern Territory. Photograph by Vic Stammers.

Below: Urban flood in Brisbane, January 1974. Photograph by Dr John Zillman. Images courtesy of Bureau of Meteorology



Outcome

Very short-term (0-3 hour) forecasts of rainfall are best achieved by clever extrapolation of radar-observed rainfall, whereas numerical weather prediction is preferred for the longer-term (12+ hour) forecasts. This research has led to the development of a prototype system that bridges the gap between these two approaches by combining radar-based forecasts with the outputs from numerical weather prediction models. This system, known as STEPS (STochastic Ensemble Prediction System), maintains the best features of both approaches to produce improved rainfall forecasts in the 0-12 hour range that is critical for flash flooding and other urban water management applications. STEPS will be evaluated by the UK Meteorological Office for the London area during 2004. It is also planned to use STEPS in new services flowing from recent Australian Government initiatives to provide the Bureau of Meteorology with new Doppler radars at selected locations and to upgrade the existing weather radar network.

University of Western Sydney

Water Futures Institute

The vision of the Water Futures Institute is to provide the opportunities for researchers, industry, government and the community to work together to develop a sustainable future for water management in Australia and beyond.

Inter-disciplinary and international research and education

Research at UWS brings knowledge to life through its interdisciplinary focus, collaborative orientation and responsiveness to the contemporary social, economic and environmental challenges in Greater Western Sydney and beyond. The Water Futures Institute of the University of Western Sydney coordinates water-related research in the University, bringing together more than 100 highly experienced researchers who significantly contribute to water-related research. The Greater Western Sydney region, the third largest economic region in Australia, with its large urban and agricultural areas and substantive natural heritage sites, provides excellent opportunities for research and product development.

The water research of the University includes themes in science, engineering, ecology, economics, agriculture, irrigation, and social studies. Researchers are active overseas, with work in China, Indonesia, the Philippines, and Central Africa showcasing our international involvement. Some examples of research and innovation are given below and elsewhere in this volume. The University provides opportunities for specialist short courses as well as research and coursework degrees.

Above right: Rainfall simulator developed by the University of Western Sydney, which can be used on areas of several thousand square meters in studies of hydrology, erosion and pollution transport in rural and urban studies.

Low-cost waste management

The Research Group in Sustainable Engineering and Technology, led by Professor Riley, is developing low-cost and robust waste management technologies for the developing world and small communities. The research has led to the development of a small vermiculture-based unit that can receive solid and liquid domestic waste and produce water suitable for irrigation and, with additional treatment, drinking water. The unit also produces compost for fertiliser and food to support aquaculture and supplement farm feeding.

The innovative technology is low risk; will require minimum maintenance and training; can be used at the household scale or in small communities; is suitable for both rural and urban situations; and can help solve the burgeoning problem of putrescible waste and wastewater disposal in rapidly developing urban areas.

Socio-economic patterns of water consumption

The Urban Frontiers Program, led by Professor Bill Randolph and Adjunct Professor Patrick Troy, includes a major research program on the physical and social determinants of water consumption in urban areas. In partnership with the ANU and supported by Landcom and the New South Wales Environmental Trust, the program focuses on the issue of how differing forms of built environment and socio-economic structure interact to determine water consumption across urban areas.



The research employs innovative research methods to establish the relative consumption profiles of 'typical' urban neighbourhoods (fringe, middle and inner, higher and lower densities, etc) and the way differing types of households consume water services in these areas. The research will provide water service providers and environmental planners with an improved framework to analyse the relationship between the built environment and water consumption, and to develop appropriate pricing and regulatory frameworks.

For further information please contact:

Director
Water Futures Institute
University of Western Sydney
Locked Bag 1797
Penrith South DC NSW 1797
T 61 2 9852 5732
F 61 2 9852 5717
E wfi@uws.edu.au
W www.waterfuturesinstitute.uws.edu.au

Mapping and monitoring

Australia has made significant investments in technology and Decision Support Systems for planning, system design, and water quality monitoring. In the context of source water management, very little is uniquely urban, although drivers such as health-related water quality considerations might influence the choice or application of tools.

Australia's commitment in this context is illustrated by the *National Land & Water Resources Audit (NLWRA)*, which provides online access to a wealth of data and demonstrates the spatial mapping and data management and presentation capabilities of firms such as Sinclair Knight Merz. *CANRI (Community Access to Natural Resources Information)*, a New South Wales Government Internet portal providing access to data sources from several state departments against a common spatial layer, further demonstrates Australian commitment and capability.

A large part of the urban water industry's investment in mapping and monitoring technology is actually concerned with reticulation and collection systems, applying SCADA (supervisory control and data acquisition) technology for remote monitoring and control. Australian firms such as MOX Products, Multitrode and Rubicon provide systems that have been applied in the water industry and other remote applications such as oil and gas supply systems.

A particular concern for potable source water supply managers is the risk of algal blooms. Australian consulting firm WBM Oceanics developed an Excel-based Riverine Algal Risk (RAR) model that applies the Ecological Risk Assessment (ERA) approach embodied in the *2000 ANZECC Guidelines*, the *Australian National Water Quality Management Strategy* component addressing ambient water quality.

The Environmental Management Support System (EMSS) is a sophisticated tool developed by the CRC for Catchment Hydrology that can model the effects of land-use on a catchment scale using a relatively limited set of parameters. The SEQWater EMSS provides predicted daily loading for suspended sediment, nitrogen and phosphorus for 175 sub-catchments (22,670 square kilometres). The system is modular, with linked and replaceable components for rainfall run-off and pollutant export, flow and pollutant routing and reservoir dynamics. Adjustable variables include climate, storage operations, and land-use management parameters such as point source loadings. An important feature of the model for catchment managers is the provision of three different user interfaces, permitting interaction by experts and less technically oriented stakeholders.

CASE STUDY 2.10

ACT WATER RESOURCE PLANNING – A WHOLE-OF-GOVERNMENT CHALLENGE

Objective

In June 2002, the Australian Capital Territory (ACT) Legislative Assembly unanimously agreed that:

- As far as possible, the building of further water supply dams in the ACT should be avoided
- The water leaving the ACT via the Murrumbidgee River should be of no less quality than the water flowing into the ACT
- Adequate flows should be maintained in the ACT's waterways to maintain their environmental values
- An ACT water conservation and reuse strategy should be developed to ensure that the water needs of any increase in population can be met, as far as possible, within existing resources

Outcome

The government set a range of ambitious targets covering the per capita reduction in potable water use, reuse of effluent, and the reduction in the quantity and intensity of stormwater run-off, and commenced the development of a comprehensive water resources strategy.

The *Think water, act water Strategy* has involved collaboration with all relevant agencies, including central agencies, environment and water resource management, planning and urban management, health, cross-border interests, and the water and wastewater utility. It has drawn on extensive expertise from the ACT and elsewhere, and involved extensive community consultation.

The strategy is now launched and will be given statutory effect as a new *Water Resources Management Plan* under the Water Resources Act 1998. It will guide day-to-day decision making by all the agencies involved in water resource management.

There are encouraging signs for the success of the strategy. During 2003-04, stringent water restrictions have been in place due to a combination of the drought and the 2003 bushfires. The Canberra community rose to the challenge and readily met or exceeded the target of a 40 percent reduction in consumption. Key targets in the strategy include: a 12 percent reduction in per capital use of potable water by 2013 and 25 percent by 2023; increasing wastewater reuse from 5 percent to 20 percent by 2013; and reducing the volume of urban stormwater flows to pre-development equivalents.

Valuing water

Globally, demand management has become a well-established complement to supply planning. Recent Australian activities have engaged consumers in a debate about the societal value of water – beyond price and commodity considerations – tipping economic scales and enabling paradigm shifts.

Approaches to best practice

Urban water strategies which include a range of measures to reduce demand and increase supply have been developed by all of the states and territories. Capital works are being designed to meet multiple objectives, including reduced impacts on inland and coastal ecosystems and opportunities for beneficial reuse.

The states and territories exhibit a range of conditions that have influenced local attitudes and responses to water resources. Coastal systems with local catchments predominate; however, Australia's urban systems include rural regional centres and extended catchments such as those that supply Sydney and South East Queensland. Adelaide is notable for its position at the end of the Murray-Darling system and Perth for its significant urban aquifers. The development of solutions that are appropriate to local conditions and expectations has been facilitated by a common pursuit of best-practice planning.

Using less drinking water

Between 1997 and 2001, residential water consumption declined by about 10 percent across the urban areas serviced by Australia's major and non-major utilities. Policy instruments, operational improvements and products and services such as those discussed below contributed to this result.

The University of New South Wales Institute for Sustainable Futures has helped several utilities with techniques

such as low cost, end-use analysis. Options are assessed for potential benefits such as avoided supply costs, reduced capital expenditure and energy costs, together with equity, risk, uncertainty and the time to implementation. Options considered include: leakage detection and repair; pricing reforms; water restrictions; appliance efficiency standards; audits for commercial, institutional and industrial customers; residential plumbing retrofits and education programs. The appropriate mix of options varies with utility circumstances, but the net cost of water efficiency options is typically lower than most other supply options.

Sydney Water's investments illustrate this multi-pronged approach. An 18 percent decrease in per capita consumption between 1991 and 2003 included savings from the detection and repair of system leaks (about 60 percent), indoor retrofit programs providing water-efficient plumbing fixtures (about 20 percent), and corporate customer programs (about 10 percent). Complementing these initiatives is a comprehensive education effort and recent incentives for rainwater tanks and efficient washing machines.

Australian industry has been an active partner in developing practical approaches. Caroma Industries of Adelaide is the leading supplier of dual flush toilet systems in South-East Asia. Rainwater tanks, common in Australia's arid interior, are becoming standard urban amenities due to education campaigns, rebate schemes and regulatory reforms. Australian companies such as Philmac, Davey Pumps (RainBank®) and Waste Water Systems have developed fixtures to service these expanding markets, both domestically and abroad. Australian manufacturer BlueScope Steel produces a corrosion-resistant steel product, Aquaplate® that has a

food-grade polymer skin suitable for potable water storage. Firms such as Western Australia manufacturer Pioneer Water Tanks have used this product for domestic and export applications. Australian tank manufacturers and distributors also use a range of other materials including concrete (Economy Concrete Tanks, Hume), fibreglass and plastics (Atlantis, Everhard, Rainsaver).

The Australian program, *Green Plumbers Program*, provides training that enables plumbers to educate customers about initiatives such as the voluntary *National Water Conservation Rating and Labelling Scheme*. The recently announced *Water Efficiency Labelling and Standards (WELS)* scheme, thought to be the first of its kind in the world, is expected to conserve about 5 percent of total household water use (87,000 megalitres per year), saving consumers about \$AU620 million per year in water and electricity bills.

Water-sensitive urban design

Water-sensitive urban design (WSUD) is firmly established in the Australian lexicon, although its meaning is a moving target. Early initiatives used natural systems such as vegetated swales and wetlands to reduce stormwater velocities, promote infiltration and control pollutants by settling and absorption. Recent Australian projects such as those discussed below include potable and sewerage systems to provide integrated water-cycle management.

The WSUD approach to stormwater management is exemplified in the VicUrban – Melbourne Water project, Lynbrook Estate, a 32-hectare, 271-lot residential development. The alternative design (incorporating bio-filtration, infiltration and wetlands) incurred only 5 percent higher capital costs than a traditional concrete pipe

CRC FOR WATER QUALITY AND TREATMENT: DELIVERING DRINKING WATER QUALITY



BOX 2.13

The *Australian Drinking Water Guidelines* provide an authoritative Australian reference on good quality drinking water. They are not mandatory standards but represent a framework for identifying acceptable water quality through community consultation.

A key provider of strategic knowledge on water quality issues, the CRC for Water Quality and Treatment has contributed to the ongoing review of these guidelines and has been able to inform and improve the way water authorities manage their water supply systems. One recent innovation – the framework for *Management of Drinking Water Quality* – proved so useful that it has influenced the development of drinking water guidelines internationally.

The framework is being incorporated into the next revision of the *Australian Drinking Water Guidelines*, which are being widely adopted throughout the industry as a guide to water system operation. The framework is a risk management system specifically tailored for drinking water supplies.

It integrates elements of several quality management and risk management systems, such as Hazard Analysis Critical Control Point, ISO Quality Management and Environmental Management, into a comprehensive preventive management system that addresses the complex problems of drinking water supplies.

Australia internationally recognised

In developing the framework, Australia has been recognised internationally as the first country to apply systematic risk assessment and management principles to the supply of drinking water. This concept has now also been adopted by the World Health Organization in the form of water safety plans in the latest edition of its drinking water guidelines, and is influencing regulatory approaches in various other countries.

Above: Catchment to tap: our business. Image courtesy of Melbourne Water

SYDNEY OLYMPIC PARK: TECHNOLOGICAL INNOVATION

Sydney Olympic Park's innovative water servicing infrastructure is the Water Reclamation and Management Scheme (WRAMS). The scheme began operation in July 2000 and is designed for a population of approximately 20,000 people. WRAMS is a large scale integrated urban water system incorporating collection and treatment of sewage and stormwater and supply of recycled water for non-drinking uses. The water is supplied to all residents, commercial premises and sporting venues, and is used for irrigation of parklands and playing fields. The system is designed to cater for the future sustainable township at Sydney Olympic Park.

WRAMS components

The WRAMS system includes:

- **A dual water reticulation network**

Separate drinking and recycled water mains are installed throughout the Sydney Olympic Park and the residential suburb of Newington. Each facility has two separate metered water connections for drinking (green meter) and recycled water (lilac meter)

- **A water reclamation plant**

Sewage from Newington and venues is treated at the Water Reclamation Plant at a rate of up to 2.2 megalitres per day. Advanced biological treatment processes remove pollutants and nutrients, leaving high quality effluent water that is disinfected by ultra violet light. This is then pumped to the water treatment plant for final processing

- **A water treatment plant**

Water from the Water Reclamation Plant or the Brickpit reservoir goes through a continuous micro-filtration process which removes particles down to 0.2 microns (including all water based human parasites and bacteria). A reverse osmosis process is also available to remove salts. Finally chlorine is used to disinfect the recycled water before it is supplied to the customers. The plant can treat up to 7 megalitres of source water per day

- **Stormwater management**

Stormwater collection and storage is one of the most valuable elements of the integrated water cycle system at Sydney Olympic Park. The Brickpit reservoir has a capacity of approximately 300 megalitres and is designed to hold both stormwater and treated sewage effluent as a source for the Water Treatment Plant

WRAMS incorporates existing and emerging technologies in the areas of biological treatment, microfiltration and reverse osmosis. WRAMS operation, performance and monitoring is fully automated and continuously controlled by using a highly advanced telemetry system.

Cost of recycled water

The initial capital cost for WRAMS was approximately \$AU30 million and ongoing operating costs are approximately \$AU1.60/1,000 litres of recycled water. The price of recycled water is currently set at 15 cents below that of drinking water and a small connection charge is also applicable on the quarterly basis. The price for recycled water is based on a recommendation by New South Wales Government's Independent Pricing and Regulatory Tribunal.

Recycled water quality

Recycled water from WRAMS is suitable and approved for toilet flushing, washing clothes, washing pets, watering gardens (including vegetables), lawns and parks, filling ornamental ponds and water features, fire-fighting and washing cars, windows and brickwork.

Recycled water from WRAMS is not suitable for human consumption, drinking, showering or swimming. Recycled water is treated and disinfected to meet all New South Wales Department of Health's required standards for non-drinking purposes.

The quality of recycled water is continuously monitored to ensure public health and safety is assured. Since WRAMS commenced operation in July 2000 comprehensive water quality monitoring shows that it has achieved all mandatory chemical, physical and biological performance standards, and other safety measures including appropriate signage, labels and public information to eliminate any risk of cross connections between drinking and recycled water systems.

Integrated water management at Sydney Olympic Park.



Harvesting water

'Harvesting' is a fitting term for the production of water; more appropriate than 'manufacturing', 'generating' or 'creating'. Australia's investment in infrastructure such as dams is complemented by recent initiatives to manage both the quantity and quality of supplies.

Catchment management

Catchment management is evident across Australia; urban water is only a subset of this activity. Some utilities have relatively simple relationships with their catchments; others are remote from their source water catchments,

but discharge locally. This gives 'catchment management' unique meanings for the urban water industry. Developments such as aquifer storage and recovery, rainwater tanks, WSUD, desalination and recycling provide a shifting landscape.

CASE STUDY 2.17

SA WATER: LEADERS IN WASTEWATER REUSE

In an average year, SA Water collects and treats 89.5 gigalitres of wastewater in metropolitan Adelaide. Through its \$AU240 million *Environment Improvement Program (EIP)*, SA Water has a long-term aim of reusing 50 percent of this wastewater.

Key objectives

- Reduce Adelaide's potable water demand
- Improve performance of SA Water's metropolitan treatment plants
- Drive economic growth by distributing recycled water for irrigation
- Significantly reduce nutrient load in the treated wastewater
- Dramatically reduce nitrogen discharge into the marine environment
- Reduce level of groundwater extractions in areas where these resources have been severely diminished

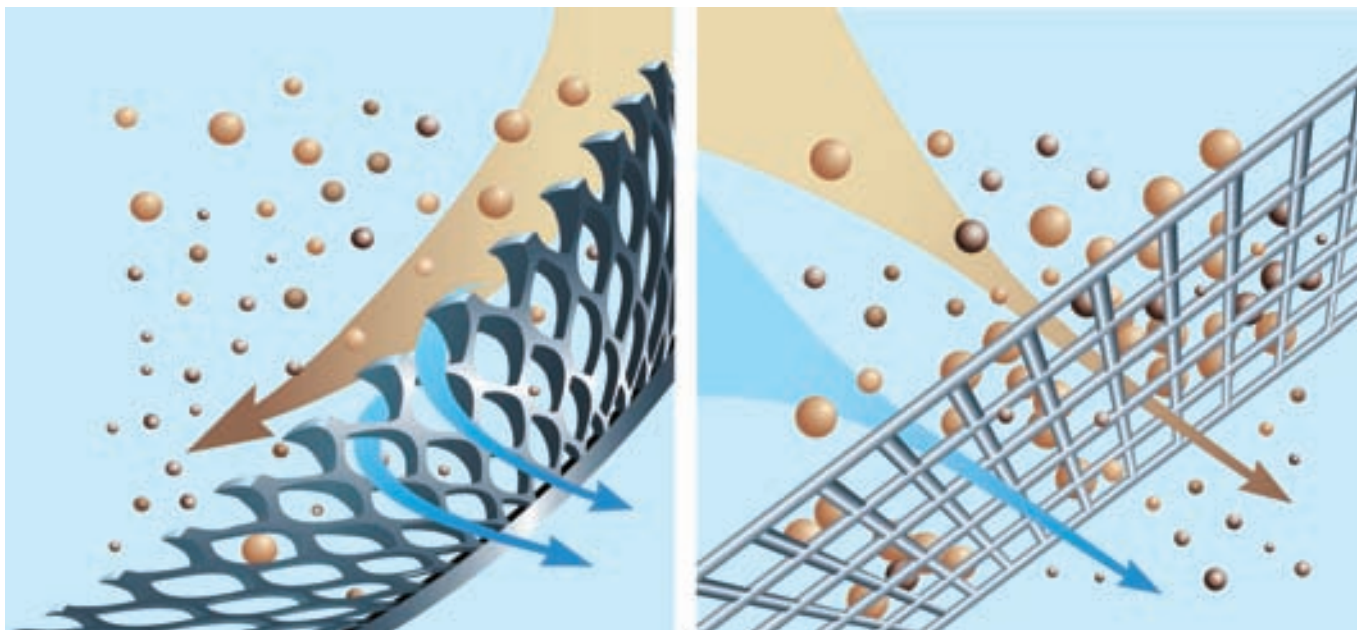
Key projects and results

- **Virginia Pipeline Scheme:** one of the largest schemes of its type in Australia, providing 15 gigalitres per year of recycled water from Bolivar – SA Water's largest metropolitan treatment plant – to about 250 irrigators in the Northern Adelaide Plains. Includes \$AU30 million Dissolved Air Flotation Filtration Plant to treat effluent to suitable recycled water standard, and a privately built and operated pipeline
- **Willunga Basin:** the \$AU13 million scheme uses treated wastewater from SA Water's Christies Beach Wastewater Treatment Plant to irrigate in the McLaren Vale wine region. Fully financed by the private sector it has reduced reliance on depleted groundwater supplies

Dissolved Air Flotation filtration plant.
Image courtesy of South Australian Water Corporation

- **Mawson Lakes:** an innovative development 12 kilometres north of Adelaide, Mawson Lakes incorporates a dual potable water supply and recycled wastewater system aimed at reducing potable water demand by at least 50 percent. Once the system is commissioned, both stormwater and wastewater from the development will be treated to a high standard and contribute to the supply of reclaimed water for flushing toilets, watering gardens and irrigating public open space





Screens used in gross pollutant traps: CDS high rate non-blocking screen (L) and conventional (blocking) screen (R). Image courtesy of CDS Technologies

Melbourne Water exemplifies the 'simple' model, relying on local protected catchments which are dedicated to water supply. Nevertheless, Melbourne Water is an active catchment manager, which is vital to its ability to deliver high-quality water without filtration. A landmark study by the CRC for Water Quality and Treatment, supported by Melbourne Water, demonstrated that filtration did not reduce gastrointestinal illness. Forestry, one of the few permitted activities within certain areas of Melbourne Water catchments, is the focus of research such as sediment tracer studies to rank erosion control and the effect of post-bushfire revegetation options on the yield of water from catchments.

South East Queensland presents a different model, with a number of utilities relying on a common set of catchments that support grazing and other activities. The region has been actively engaged in an innovative partnership to manage the effect of urban catchments on Moreton Bay. Water supply catchment management is vested in a newly corporatised body, South East Queensland Water (SEQWater), which is jointly owned by the local authorities and the state government.

The Sydney Catchment Authority (SCA), similar to SEQWater, has the singular focus of raw water supply management. An important aspect of the SCA (page 89) is that it is required to provide water to Sydney Water and maintain appropriate environmental flows. The product SCA delivers must also be of an agreed quality. The revenue from water sales to Sydney Water provides the SCA with resources to carry out its responsibilities as an environmental steward, effectively compensating the environment for its water services.

Equally important to the effectiveness of the SCA is its power to review and impose conditions on development activities within the catchment. This innovative model provides a single point of accountability that has both the resources and authority to carry out its responsibilities.



Cutaway view of CDS stormwater litter trap showing major components. Diversion chamber is behind the unit. Image courtesy of CDS Technologies

Protecting and harnessing natural systems

The impacts of urban wastewater and stormwater on Australian riverine, estuarine and coastal systems have been significantly reduced by recent projects, with larger inland cities such as Canberra and Bendigo installing full tertiary treatment. Other inland areas such as the New South Wales towns of Albury and Goulburn divert 100 percent of their effluent to land-based applications. Full reuse of biosolids has also been achieved by a number of utilities.

Major developments are incorporating porous paving materials and a robust market has developed for GPTs (gross pollutant traps) or SQIDS (stormwater quality improvement devices) such as those developed and commercialised by Australian firms including CDS Technologies, Rocla and Humes.

The Manly Council *Stormwater Treatment and Reuse (STAR) Project* brought together innovative Australian technologies to demonstrate comprehensive management of an urban stormwater catchment. The project's multiple barriers include source reduction (education and signage), a comprehensive street cleaning program, porous paving from Rocla suitable for

heavy traffic loads, litter and sediment traps at catch basins and a treatment system from Australian firm Atlantis Water Management. The Atlantis system provides sub-surface biological treatment using naturally occurring microorganisms to degrade and remediate hydrocarbons, metals and other pollutants typically found in road and car park run-off. Norfolk Pines, a major feature of the Manly seascape, are spray irrigated with the treated run-off. The University of New South Wales Water Research Laboratory and Sydney Water are measuring the effectiveness and efficiency of the project.

Australia's use of natural treatment systems has a long history; the 400 megalitre per day Werribee Sewage

Farm in Melbourne originated in the 1880s and remains one of the major land-based treatment systems in the world. Australian firm Vermitech has applied sophisticated science to compost biosolids using worm-power. Victorian utility Portland Coast Water has applied CSIRO research to provide tertiary treatment using the largest reed-bed system operating in Australia. Several firms, including Australian Wetlands, Bio-Tech Waste Management (BTWM) and Oceans-ESU, have been advancing the use of duckweed and other natural systems for sewage and stormwater treatment. Recent work by Dr Keith Bolton, Southern Cross University, Lismore, has demonstrated the effectiveness of hemp as a 'mop crop' for sewage treatment plant

effluent. A 100-hectare trial over a 100-day growing cycle handled 10 megalitres of effluent and produced 18 tonnes of hemp, a product with substantial commercial significance.

Engineered solutions

Advanced treatment options such as membrane filtration have blurred the distinction between 'water' and 'effluent.' Paradigm shifts are suggested by technologies such as sewer mining (ACTEW CRANOS), dry composting toilets (Rota-Loo®) and advanced on-site systems (Biolytix Australasia, Enviroflow). The Australian industry provides examples of progressing traditional approaches to new levels, as well as advancing alternatives.

CASE STUDY 2.18

CRC FOR ENVIRONMENTAL BIOTECHNOLOGY: MICRO-ORGANISMS AND WATER

Micro-organisms at work

The Cooperative Research Centre for Environmental Biotechnology (EB CRC) will use biotechnology to benefit the environment by putting micro-organisms to work in areas ranging from improving the management of waste by industry, to remediation, to the detection and prevention of environmental problems.

Microorganisms are smart. They can break down municipal waste or convert sewage to compost.

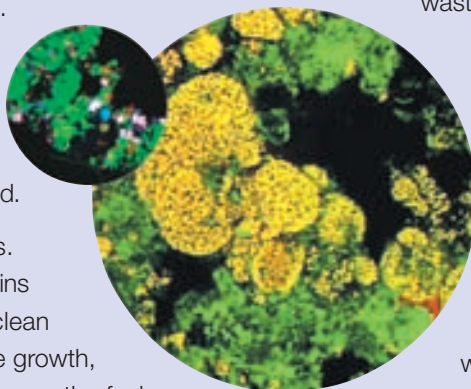
However, present applications of biotechnology are rudimentary, as microbial communities form complex ecosystems to break down the waste materials, and they are largely uncontrolled.

Microorganisms also create problems. Biofilms grow on the inside of water mains and harbour pathogens in otherwise clean water. Another form of biofilm is marine growth, which can sink fish enclosures and increase the fuel consumption of merchant ships.

Understanding microbial ecology will lead to new solutions and products

The EB CRC's research on microbial ecology, and genetic composition and functions of microbial communities, will reveal how complex microbial systems transform

substances and interact. Research projects have been carefully selected to meet the needs of the EB CRC's industry partners and have significant potential for return on investment. Outputs will include valuable new chemicals from waste, improvements in the efficiency of waste treatment, and transforming low-value by-products into high-value products. Technologies to be explored by the EB CRC have significant potential for application in industries such as water supply, wastewater and solid waste treatment.



Novel detection methods

Industry's pressing needs for early, accurate and inexpensive detection of pathogens and other organisms is addressed in a project that aims to produce robust, rapid, real-time detection systems. These techniques will enable early institution of control measures, thus reducing the risk of contamination of water supplies and the food chain.

The EB CRC's education program will provide the human and intellectual capital to drive a commercially viable environmental biotechnology sector in Australia. The CRC offers research scholarships and post-doctoral fellowships to stimulate high-quality research.

Identifying pathogens in wastewater. Image courtesy of CRC for Biotechnology

ACTEW's Lower Molonglo Water Quality Control Centre in Canberra, Australia's largest inland sewage treatment plant, recycles more than 50 percent of Canberra's potable water demand. The tertiary-treated effluent provides environmental flows of an equal or better quality than the Molonglo River upstream of the discharge, as well as irrigation for a golf course and a vineyard. Recent upgrades incorporated Australian Citect SCADA systems and Aquatec-Maxcon's fine screening and flow attenuation mechanical equipment.

The Virginia Pipeline Scheme is a commercially viable project that provides recycled water from the Bolivar Wastewater Treatment Plant to a large agricultural area north of Adelaide. The scheme was privately developed to take advantage of the high-quality effluent produced by the SA Water dissolved air flotation and filtration (DAFF) plant (built by United Water).

At the other end of the scale, Biolytix Australasia has designed an on-site system that provides the potential for local reuse. Redland Water and Waste, in cooperation with GHD and the Queensland Government, established a pilot-scale BioWater system on Macleay Island in 2003. Twenty residences were supplied with a Biolytix Filter, a soil ecosystem-based system that can be installed within a normal septic tank to produce an odourless effluent of secondary treatment quality. For this project, the individual units are networked to a central storage tank that supplies a sub-surface irrigation system at a local golf course.

Large or small, local or centralised, Australia has demonstrated the capability to develop and apply innovative approaches, such as electrocoagulation, utilised in systems offered by Australian firm Electropure. Potential advantages of this approach included short cycling time, chemical-free treatment, low energy and maintenance requirements and high-quality effluent.



Summary

The Australian urban water industry provides a world-class competitive service. The doubling of investment in the sector over the past decade and the evolution of Australian-style public-private partnerships have fuelled a dynamic industry that has produced and adapted many innovative products and services. Water is prominent in Australia's historical development; current concerns regarding the sustainability of supply, climate change, drought and salinisation suggest that water will be equally important to Australia's future. The industry will continue to grow domestically, and to share its capability abroad, in the face of the continuing need to meet higher environmental, health and economic standards.

Above: Copeton Dam. Image courtesy New South Wales Department of Infrastructure, Planning and Natural Resources. Photograph by Bruce Cooper