AUSTRALIA’S DYNAMIC WATER INDUSTRY
Fostering excellence in water management
Australia has a unique water challenge. Increasing variability in extreme climate conditions has required governments, industry and citizens to prioritise water management. This focus has led to distinctive approaches, changes in governance, behavioural change and technology innovation. Australia’s experience and approach to addressing water management challenges is regarded as among the most progressive in the world. This publication has been prepared by the Australian Water Association, with the support of the Australian Trade Commission (Austrade), the Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE), waterAustraliA and industry partners to illustrate some of the innovative solutions developed by Australian business and research groups that have built resilience to water management by urban, agricultural and industrial sectors across Australia.

About this publication

Disclaimer

This publication has been prepared as a general overview. It is not intended to provide an exhaustive coverage of water innovation in Australia. The information is made available on the understanding that the Australian Trade Commission (Austrade), the Department of Industry, Innovation, Science, Research and Tertiary Education and the Australian Water Association (the parties) are not providing professional advice. Therefore, while all care has been taken in the preparation of the report, the parties do not accept responsibility for any losses suffered by persons relying on the information contained in the report or arising from any error or omission in the report. Any person relying on this information does so entirely at their own discretion and the parties strongly recommend the reader obtain independent professional advice prior to acting on this information.

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Australian water sector expertise is in demand internationally and Australian companies are active around the world. Australia’s expertise in governance, system management, water treatment technologies, river and environmental management and in other fields is highly respected. To promote Australia’s expertise further, a number of services are available to Australian firms, and to those who may gain value from Australian expertise. These include:

> **WaterAUSTRALIA**: WaterAUSTRALIA is a private sector company which works with the close support of Government agencies, including the National Water Commission, the Department of Industry, Innovation, Science, Research and Tertiary Education and Austrade.

> **Water Supplier Advocate** – The Water Supplier Advocate is championing Australian water firms and leading practical business development projects aimed at raising the competitiveness of firms and linking them with opportunities.

> **Austrade (The Australian Trade Commission)** – Austrade is the Australian Government’s trade, investment and education promotion agency. Through a global network of offices, Austrade assists Australian companies to grow their international business, attracts productive foreign direct investment into Australia, and promotes Australia’s education sector internationally.

> **The Australian Water Industry Capability Portal** – The ICN Water Directory is a pivotal connection point for suppliers and project managers working within the Australian water industry. The comprehensive directory has a powerful supplier search function and a full listing of water projects underway and planned. The Water Directory can be accessed at www.water.icn.org.au.
Foreword

Australia’s vast experience of drought and flood conditions has placed the Australian water industry in a unique position to capitalise on its significant capabilities and strengths in the management of water resources. Backed by a strong governance framework, Australian water businesses have produced innovative, world-class products, services and solutions to address the challenges of water management.

Water shortage remains a crucial issue in Australia and around the world. Strategies to manage this challenge are dependent on accessing fit-for-purpose technologies and know-how. Australian water firms have developed the capabilities required and are well placed to provide innovative solutions.

In my role as Water Supplier Advocate, appointed by the Australian Government, I have the honour of championing the Australian water supply industry and providing leadership for water suppliers by developing and implementing industry development activities and promoting opportunities for local industry in order to maximise their involvement in water projects. I work closely with the Australian Trade Commission (Austrade) and waterAUSTRALIA to facilitate access to international opportunities for these firms.

Australian companies providing water management services, technologies and solutions for the water industry are renowned for their innovation, efficiency and capability. There are many success stories to their credit and this booklet is a testament to their capability. On behalf of the Australian Government, I am proud to promote their story.

This publication provides an overview of the Australian water story and the unique water achievements of Australia. Please take the opportunity to enjoy the story and engage with Australia to develop a collaborative solution for your business needs.
Australia is a land of extremes: it is the driest inhabited continent – yet some regions are among the planet’s wettest; it suffers from prolonged drought, yet catastrophic flooding can occur in a matter of days; it is the least densely populated major landmass, yet it is more urbanised than almost any other country.

These contrasts have defined both the nation and its water industry. The challenges faced in Australia have led to the development of an industry that is innovative, vigorous and focused on results.

Australians understand the importance of water in a world in which climate change, population growth and limits on financial and ecological resources present ongoing challenges. They also understand that water systems must be resilient in the face of extremes – and that such resilience comes not just from building robust systems, but also in managing them well.

The Australian urban water industry is highly capable. It provides first class technical and engineering solutions, and offers world-leading expertise in strategic asset management, governance and price reform, and this capability is underpinned by world-class scientific and technical expertise.

Reform in the water sector over the past 15 years has led to an increase in productivity of more than 50 per cent and water use efficiency per capita that is among the best in the industrialised world.

The Australian agricultural sector has benefited from the development of open markets for water trading and the development of modern irrigation systems, helping farmers to consistently deliver high-quality produce across the globe at competitive prices.

The mining sector is a world leader in the reuse of water, mine water use efficiency and in the securing of water supplies in remote, difficult-to-serve areas.

In today’s world, more needs to be done with less. Australian knowledge, technologies and experience in providing innovative solutions in a volatile environment mean that Australia’s water sector is competitive, highly efficient, creative and flexible.

The following pages highlight the sector’s capabilities and showcase some of the world’s most resourceful and innovative water-related companies.

Australian water innovation at a glance
Working together for a healthy water industry

Water in Australia is a national priority. Since 1994, all governments in Australia – federal, state, territory and local – have been working together to implement a far-reaching program of reform. The initiatives undertaken have rationalised water use, improved its management, made the sector profitable and fostered innovation.

The Australian water industry is well governed, inventive, productive and secure. Governments, water utilities and the private sector have worked together to achieve these outcomes. A starting point was to introduce new governance arrangements that have ensured that the sector is independent, well managed and financially sound.

Historically, water utilities were operated as government departments. The reforms undertaken have, however, established these entities as independent trading enterprises with a clear focus on delivery of safe and secure water and wastewater services.

With these goals in mind, utilities have a much greater focus on financial performance. Safe and secure water systems must be sustainable and this means that the companies supplying the services must be financially sound.

Thus, utilities are no longer subsidised by governments, but are responsible for their own financial performance. Cross-subsidies between user groups have also been removed, and the full cost of service delivery is charged to consumers; customers pay for what they use.

This makes water a controllable cost for industry and consumers and has contributed to substantial falls in water consumption per capita.

A new kind of marketplace

Having responsibility for their own financial performance has led to a focus by utilities on improving the management of water assets. The Australian water industry is known globally for its leadership on strategic asset management, improving system performance and reducing costs.

In rural areas other innovations have been introduced to facilitate trading in water entitlements. No longer are water rights attached to land. Instead, irrigators can purchase a temporary or permanent entitlements, or where they hold these entitlements, can sell them to other users.

Development of a water market has made agriculture more sustainable, despite recent persistent drought, not least because the capacity to sell water entitlements has provided income for farmers even when they choose not to raise a crop.

The creation of market conditions has also stimulated the private sector to develop a range of goods and services to support sound water management. A number of companies, for example, have developed irrigation flow and management devices that have significantly improved water use efficiency. Many of these are highlighted in this publication.

Australian water sector expertise is in demand internationally and Australian companies are active around the world. Australia’s expertise in governance, system management, water treatment technologies, river and environmental management and in other fields is highly respected.
**Creating the Framework for Reform**

Water reform in Australia has been a partnership between governments, utilities and the private sector.

Governments have created the frameworks for innovation and reform. The National Water Initiative, successor to the first round of reforms initiated in 1994, sets out a reform ‘schedule’ which is monitored by the National Water Commission, and reported on biennially.

The Murray-Darling Basin Authority is responsible for planning the integrated management of the water resources of Australia’s largest river system, the Murray-Darling Basin.

**The Basin Plan**

The Murray-Darling Basin is one of the most significant agricultural areas in Australia. Most of the 1,061,469 km² (409,835 sq mi) basin is flat, low-lying and far inland, and receives highly variable rainfall with frequent drought conditions. The Basin extends across the boundaries of several states of Australia, each with its own approach to managing water within its own boundaries and with sharing water across boundaries under rules established many years ago. The many rivers contained within the Murray-Darling Basin tend to be long, slow-flowing, and carry a volume of water that would be considered small in many other areas of the world.

After several years of prolonged drought and deteriorating conditions, the Australian government set out to develop a Basin Plan to support strong and vibrant communities, resilient industries, including food and fibre production, and a healthy environment. The Basin Plan will also improve the way water is managed to adapt to future climate change.

In November 2011, the Murray-Darling Basin Authority released a draft plan to secure the long-term ecological health of the Murray-Darling Basin. After a lengthy process of consultation and negotiation by the Murray Darling Basin Authority the Basin Plan was approved in November 2012. The Basin Plan is designed to set environmentally sustainable limits on the quantities of water that may be taken from Basin water resources, to set Basin-wide environmental, water quality and salinity objectives, to develop efficient water trading regimes across the Basin, to set requirements for state water resource plans, and to improve water security for all Basin users. It also intends to minimise social and economic impacts while achieving environmental outcomes.

Key elements of the Basin Plan include:

- **Long-Term Average Sustainable Diversion Limits (SDLs):** SDLs are limits on the volume of water that can be taken for human uses (including domestic, urban and agricultural use) and are set at both a catchment and Basin-wide scale.
- **Environmental Watering Plans (EWP):** EWPs are frameworks being developed for planning and coordination to ensure that the size, timing and nature of river flows maximises benefits for the environment.
- **Water Quality and Salinity Management Plans:** These are plans which provide Basin-wide objectives for ensuring that basin water is ‘fit for purpose’ for irrigation, recreational uses, maintaining aquatic ecosystems, and being treated for drinking water.
- **Water Trading Rules:** Australia leads in the establishment of water trading rules. The Basin plan outlines rules that will apply to water markets across the Basin, in line with National Water Initiative guidelines, and will incorporate advice on water trading rules from the Australian Competition and Consumer Commission. These rules aim to ensure that all water markets function consistently, fairly, efficiently and effectively. This will help ensure that water reaches its highest value use, optimising economic, social and environmental outcomes in the Basin.
- **Water Resource Plans to be developed by the states:** These plans set out rules about how resources will be managed – usually for a ten year period – for a water resource plan area.

**Monitoring and Evaluation:** This program is based on the concept of adaptive management, which outlines a framework for measuring progress towards restoring the Murray-Darling Basin to a sustainable and healthy working state while supporting strong communities and a productive economy, and ensuring compliance with international agreements (such as the Convention on Wetlands of International Importance).

The Basin Plan also ensures that volumes are set aside to meet the critical human needs of New South Wales, Victoria and South Australia – the states that depend on the waters of the River Murray system.

The Bureau of Meteorology prepares annually the National Water Account, which provides invaluable information on water stocks and flows, water rights, and water use. It transparently reports on volumes of water traded, extracted and managed for economic, social, cultural and environmental purposes across Australia.

**The Commonwealth Scientific and Industrial Research Organisation (CSIRO),** the nation’s premier science institution, is actively involved in researching surface and groundwaters, urban water systems and quality, climate and adaptation and other vital issues of concern to the water sector.

Other Australian Government institutions, such as the Productivity Commission, are involved in reviewing the economic performance of the industry, to recommend further reforms that can improve the sector’s economic efficiency.
TAILORING SOLUTIONS TO CIRCUMSTANCES

The Australian water industry is based on principle and built on experience. Securing water supplies for urban areas and for agriculture has always been a priority. The extremes of Australia’s climate have meant that extraordinary effort has gone into building infrastructure that can cope with adversity, from drought to flood and from drenching cyclones to catastrophic fire.

But Australians know that you can’t always engineer yourself out of a problem. In the modern world, solutions need to be flexible and multi-disciplinary.

The success of Australia’s water industry is dependent not just on building robust infrastructure, but in tailoring solutions to circumstances, taking into account current and future social, ecological and economic conditions, in continued innovation and in effective management.

Meeting evolving objectives

Historically, the goal of the Australian water industry was to secure water supplies and provide for effective sanitation. While these objectives remain priorities, they are no longer enough. A large land area, limited freshwater resources and a sensitive environment – as well as a growing economy and rapidly expanding population – mean that the Australian water industry must use water efficiently and manage it well.

Recognising these facts, in the early 1990s, through the agreement of all Australian state and territory governments and the federal government, a national water reform process began. These reforms created independent and financially sound water utilities, delivering high-quality services to consumers and industry. They removed cross-subsidies between customer groups and established a framework for prudent and effective regulation of the industry. They exposed the industry to competition, leading to a much expanded role for the private sector. They reduced costs while improving performance. They fostered innovation.

The results of these reforms speak for themselves.
> Overall, Australian utilities maintain AAA credit ratings.
> Water use efficiency per capita in urban areas has increased by more than 25 per cent over 1990 levels in all capital cities and many regional centres.
> Investment in maintenance and expansion of water assets has increased but also become better targeted and more efficient.
> Customer service standards have improved. Examples include a significant reduction in service interruptions, reduced leakage, a marked improvement in environmental performance and consistently high water quality.
> Despite drought, the value of Australian agriculture has increased. More effective water management policies have seen water directed to the highest-value crops and used with greater efficiency.
> Value has been created in the water sector through the creation of a market for water, whereby primary producers can sell water entitlements permanently or temporarily according to their economic circumstances.
> More water has been provided to the environment, underpinned by a deepening understanding of the resilience of ecosystems and their water demands.

Australians know that you can’t always engineer yourself out of a problem. In the modern world, solutions need to be flexible and multi-disciplinary.
Fostering excellence in water management

These reforms have fostered vibrancy in the Australian water sector that has stimulated private companies, research houses and utilities, and even governments themselves to develop world-leading capabilities in water management.

The independence and soundness of the sector has led to the development of a focused, vigorous and highly competent industry which provides consulting services, scientific research, management expertise and technical innovation both domestically and internationally.

 Capacities in governance, in the design of both ‘hard’ and ‘soft’ water solutions, in the strategic management of assets, in the use of market-based approaches to water management and in ensuring the long-term sustainability of water systems are hallmarks of the Australian water sector.

Combining innovation and environmental sensitivity

A further success has been the management of water in the mining and energy export sector.

The mining and energy sector is Australia’s largest exporter, contributing A$193 billion in export revenue to the economy in 2011-12. Many mining sites are remote and located in challenging environments (either arid or tropical); others are in highly sensitive environments in which sustainable management of supply and waste discharge is vital if ecosystems are to be protected.

The environmental and other regulatory requirements that must be met by the sector, and the sector’s own commitment to sustainability and efficiency, have driven innovation in mine water management, particularly in the areas of planning, water treatment, in-mine water management, recycling, desalination, monitoring and remote sensing.

These abilities are now exported to the world.

Australia may be known for the harshness of its climate, but its capabilities in water management address more than just this circumstance. They also reflect a deep commitment to effective water management, which is dedicated to efficiency, economic performance and sustainability, challenges shared by nations around the world.

Australia’s water sector is mature, innovative and highly capable. We invite you to examine this publication, which showcases Australia’s capacity in urban, agricultural and mine water management, and features the ability of some of our most innovative and creative private and public sector organisations.

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Improving irrigation supply systems around the world

Rubicon Water has developed a range of irrigation solutions that improve the productivity of the irrigated agriculture in an environmentally sustainable way.

TCC® (Total Channel Control®) is Rubicon’s technology set designed to optimise large-scale irrigation channel systems. The technology provides irrigation districts with unprecedented levels of operational efficiency and management control, increasing water availability and improving production for the benefit of farmers, communities and the environment.

Oakdale Irrigation District (OID) is a 29,000 hectare irrigation district located in the San Joaquin Valley of Central California.

The district implemented Rubicon’s technology on two of its main irrigation channels to reduce water spills and improve service by reducing fluctuations in channel water levels. With stable water levels, OID will be able to provide more consistent flows at customer service points.

The solution involved replacing 42 water control gates with Rubicon FlumeGates™ and installing software which controls the operation of the gates. The software automatically coordinates and controls the FlumeGates in the two channels so that the water passed through them exactly matches measured outflow at all points downstream.

Spill reduction, water level control, service to irrigators and delivery of flow commitments downstream have all greatly improved since the implementation of Rubicon’s solution.

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Australia’s research centres are focused on delivering world-class research outcomes.

Our universities, Centres of Excellence, Cooperative Research Centres and the nation’s premier research institution, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), are consistently cited as our most trusted and credible sources of information and research.

Internationally, Australia’s tertiary institutions are ranked highly (occupying five of the top 100 spots in the Academic Ranking of World Universities in 2012) and its independent research centres conduct groundbreaking research that has achieved global recognition.

CSIRO is ranked among the top 10 research institutions in the world in absolute terms, and also in three specific research fields, two of which – plant and animal science and agricultural science – are highly relevant to water management.

CSIRO has established a number of ‘flagship’ initiatives directed to improving the management of water, including the Water for a Healthy Country Flagship and the Sustainable Agriculture Flagship. These national research Flagships bring together leading Australian scientists from CSIRO, research institutions, private enterprises, community groups, government and non-government organisations.

The Water for a Healthy Country Flagship aims to provide Australia with solutions for water resource management, creating economic gains of A$3 billion per annum by 2030, while protecting or restoring Australia’s major water ecosystems.

The Sustainable Agriculture Flagship is focused on increasing agricultural productivity while maintaining a healthy environment and reducing greenhouse gas emissions from rural lands. Water use efficiency on farms and catchment scales are a priority research area for this Flagship.

Urban planning

The Water for a Healthy Country Flagship includes, among other things, a focus on Integrated Urban Water Management (IUWM). Traditionally, urban water systems have been linear, importing water onto the city, using it and then discharging it to the environment. IUWM, on the other hand, considers the total urban water cycle and how the integration of water, wastewater and stormwater systems can provide more sustainable outcomes for city residents. Implementing effective IUWM options can minimise the water industry’s impact on the environment, maximise its contribution to the economy and promote overall community wellbeing and improvement. This parallels the Australian urban water sector’s need to diversify supplies in the face of climate extremes, reduce the environmental impact of its operations and reduce its costs per capita.

Water trading: A new way to allocate water

All governments in Australia – federal, state, territory and local – have made a commitment to the National Water Initiative (NWI), a high-level policy that is improving the management of urban and regional water supplies nationwide.

A feature of the NWI is the development of more efficient markets for water. Irrigators, environmental water managers and water supply utilities can all participate, purchasing or selling water according to their needs and economic circumstances. Water trading is important because it allows scarce water resources to be transferred to their most productive uses. Trades can occur on a permanent or temporary basis.

As in any market, good data is essential. Among other things the NWI is intended to ‘ensure that adequate measurement, monitoring and reporting systems are in place in all jurisdictions, to support public and investor confidence in the amount of water being traded, extracted for consumptive use, and recovered and managed for environmental and other public benefit outcomes’.

The Australian Bureau of Meteorology has been given responsibility for developing the National Water Account, that will quantify the water available, the volume traded and used, and record who holds it. The lessons taken from the development of a National Water Account will be applicable to many developed and developing countries worldwide.
Stormwater and Human Health Risk

Stormwater has been seen as a viable alternative water resource for different end uses. However, it may contain a wide range of chemicals and pathogens, some of which are harmful to public health. Major impediments to stormwater harvesting and use include a lack of public acceptance and clear regulatory guidance. Research is being carried out to:

> Identify potential pollutants that may be present in stormwater; and

> Characterise the associated risk based on exposure.

The Advanced Water Management Centre at the University of Queensland, along with CSIRO, Griffith University and other industry partners working in the South East Queensland Urban Water Security Alliance, is investigating chemical/pathogens and human health risk associated with stormwater as part of project known as Cities as a Catchment for Water Supply. The results will be applicable globally as water-short urban areas seek to diversify supplies in a sustainable manner.

Regional approach

The Water for a Healthy Country Flagship has completed the first ever audit of current and future water availability in the Murray-Darling Basin, Australia’s major food producing area. This A$12 million research project is the first attempt worldwide to estimate, at a basin scale, the impacts on water resources of:

> Catchment development

> Changing groundwater extraction

> Climate variability; and

> Anticipated climate change.

The Regional Water initiative approaches the challenge of regional water management from a systems view; research is directed to assessing the availability and use of water on a catchment (watershed) basis, including groundwater and surface water supplies and demands, and water for the environment.

The Flagship programs aim for widespread adoption of research outcomes with scientists working closely with researchers, industry and water users to develop high-value outcomes that can be readily commercialised.

Balancing community, economic and environmental needs

To balance the competing needs of communities, farmers and the environment, the Australian Government has funded Water for the Future, a 10-year, A$12.9 billion initiative. Water for the Future is a suite of urban and rural policies and programs which provide funding for water purchases, irrigation modernisation, desalination, recycling, and stormwater capture. Water for the Future is built on four key priorities: taking action on climate change; water use efficiency; securing water supplies; and supporting healthy rivers and wetlands. Part of this initiative has been the establishment of two National Centres of Excellence – one for Desalination and one for Water Recycling. By developing linkages between governments, scientists and industry, the Centres of Excellence accelerate leading edge research, develop and pilot new technologies, and commercialise the results.

Desalination research

Australia has invested more than A$6 billion in desalination plants in our capital cities to diversity supplies, making cities water-secure into the future, so it makes sense to complement this expenditure with a significant investment in desalination research funded from the National Urban Water and Desalination Plan.

The National Centre of Excellence in Desalination Australia (NCEDA) funding of research and development is guided by international context but focuses on developing solutions driven by Australia’s needs and priorities. The NCEDA has a research mandate to:

> Optimise and adapt desalination technology for use in Australia’s unique circumstances;

> Develop suitable desalination technology for use in rural and regional areas; and

> Efficiently and affordably reduce the carbon footprint of desalination facilities and technologies.

The NCEDA’s research program is closely aligned to industry needs, making commercialisation easier and faster. The products and knowledge that emerge from this research effort will be applicable globally, particularly in areas challenged by water shortages now or in the future.

The Australian Centre of Excellence in Water Recycling is focused on delivering industry relevant research and development in the rural, regional and metropolitan water sector. While water recycling has been occurring in Australia for many years, the scale of opportunities for recycling schemes is now growing.

In addition to research on the optimisation of recycling technologies and the development of novel techniques, the Centre’s activities are strongly focused on demonstrating the economic, social and environmental benefits of recycling; on developing validation processes that ensure the quality of the product; and on building greater community acceptance and adoption of water recycling for a range of end uses.

The outcomes of the Centre’s investment in technological and socio-economic research and development will benefit business, governments and communities in Australia and overseas.

Ecotoxicology Toolbox

In Australia, as in other areas that experience intermittent or chronic water shortages, recycled waters are being considered as new sources of supply for a variety of purposes, including indirect potable reuse. Water Quality Research Australia Limited (WQRA), along with its project research partners, has invested in the development of an Ecotoxicology Toolbox. This study has demonstrated the usefulness of combining multiple lines of evidence such as chemical analysis, in vitro assays, and in situ monitoring in the assessment of water quality. Biomarkers of exposure (in vitro) and effect (in vivo) are complementary, and together provide information with a greater level of ecological relevance than chemical measurements alone.
Cooperative research

The Australian Government, in partnership with industry, invests in various Cooperative Research Centres (CRCs). These develop and rapidly commercialise research by bringing researchers and industry partners together in a tightly focused investigative effort.

CRCs exist across a wide range of disciplines and topics, covering matters related to water or delivering products that assist water managers and users. They include CRCs for Cotton Catchments, Environmental Biotechnology, Contamination Assessment and Remediation of the Environment, and Information and Communications Technology.

Another important organisation that has emerged from earlier CRCs is Water Quality Research Australia (WQRA), successor to the CRC for Water Quality and Treatment. The establishment of WQRA marks the successful transition from a CRC model to an industry-funded company. WQRA’s research strategy addresses the critical water quality research needs of Australia’s water industry with an emphasis on public health outcomes related to public health risk in both current water sources and in new and alternative water products and services, primarily in urban areas.

Collaborative efforts

Australian water sector research is highly collaborative and the industry itself has become highly commercial in its outlook. Its research partners recognise the need to collaborate, be responsive to industry needs and commercialise research outcomes rapidly. Independent research centres such as the following serve the needs of industry and are held in high regard both nationally and internationally:

- **SMART Water Research Centre** is dedicated to water research and scientific services with a wide range of multi-disciplinary capabilities provided through the Centre’s university members and industry. This capability is complemented by a global network of expertise.

- **Cooperative Research Centre for Water Sensitive Cities** - The CRC for Water Sensitive Cities brings together the inter-disciplinary research expertise to undertake research to revolutionise water management in Australia and overseas. In collaboration with over 70 research, industry and government partners, the CRC has been established to deliver the socio-technical urban water management solutions, education and training programs, and industry engagement required to make towns and cities water sensitive.

- **ICE WaRM** – The International Centre of Excellence for Water Resource Management is Australia’s leading water resources education, training and research organisation. ICE WaRM has created pioneering tertiary education programs, hosts high-level study programs and facilitates a short course program in water resources.

- **Advanced Water Management Centre: The University of Queensland** – The Advanced Water Management Centre (AWMC) at the University of Queensland is an internationally recognised centre of excellence in innovative water technology and management. Its particular strength is the close integration of biological and chemical sciences, process engineering and informatics. This combination forms the basis for groundbreaking research, as well as exciting opportunities for the development and application of user-specific solutions to challenging environmental problems.

The AWMC has a vast expertise base in its research team, with over 40 academic and research staff and more than 30 research students covering the seven research programs of Water Recycling, Anaerobic Technologies, Sewer Research, Microbial Ecology, (Bio) Electrochemical Systems, Greenhouse Gas Research and Nutrient Removal and Bioproducts. The AWMC has an outstanding track record of successful research, development and application projects currently worth almost A$10 million per annum, many in close collaboration with industry or international collaborators.
Agriculture is vital to Australia. In 2011–12, Australian agricultural merchandise exports were valued at A$36.4 billion and the industry employed approximately 290,000 people. In total, around 60 per cent of commodities produced on Australian farms are exported yearly, with Asia consuming over 60 per cent of this.

The success of Australian agriculture is testament to the ingenuity of its farmers, the quality of its research, the capacity of its firms to innovate and deliver new products, and the quality of sector governance.

**Importance of irrigated agriculture**

Irrigated agriculture too is vital. In 2010–11, the total area of agricultural land watered was 2 million hectares, the largest area of which was for pasture for grazing, which accounted for 538,000 hectares, or 27 per cent of the total area irrigated. Australia’s total agricultural water consumption during that period was 7,350 gigalitres. The majority of this is sourced from surface storages and delivered to farm by open canal or sourced from dams, rivers, creeks and lakes.

While irrigated agriculture takes only 0.5 per cent of all agricultural land in Australia, the value of the production from this sector is A$9 billion, or 25 per cent of the gross value of agricultural production. Sixty one per cent of Australia’s irrigated agricultural land is within the Murray-Darling Basin, Australia’s largest river system.

In 2010–11 the agricultural industry consumed the largest volume of water representing 54 per cent of Australia’s water consumption. Over the past 10–15 years, Australia has experienced periods of extended drought, with flows in river systems very restricted. Changes to water governance, the introduction of transparent water markets and investment in infrastructure has enabled farmers to use water more efficiently and put towards its highest and best uses.

Australia’s agricultural practices promote water use efficiency, foster innovation and use the best scientific research to achieve productivity gains.

**Allocating water for the economy, people and the environment**

Drought has not been the only catalyst for water efficiency. The environment itself has a right to water, and allocations have been made accordingly. Regional centres have also increased in size and population and have made their own demands for water. And, of course, major cities do not exist in isolation; Adelaide, a city of 1.1 million people, is at the end of the Murray-Darling river system and has traditionally relied on water from that source.

Improved management of water in rural areas is a national priority. The National Water Initiative (NWI) – endorsed by all Australian governments (federal, state/territory and the Local Government Association) – is a cohesive national approach to the way Australia manages, measures, plans for, prices and trades water.

**Objectives of the National Water Initiative**

The overall objective of the NWI is to achieve a nationally compatible market-, regulatory- and planning-based system of managing surface and groundwater resources for rural and urban use that optimises economic, social and environmental outcomes.

The NWI is overseen by the National Water Commission (NWC). The Commission’s job is to report on progress in implementation of the initiative and comment on the extent to which its agreed targets are being achieved.

The NWI covers a myriad of reforms related principally to the management of rural water, and not all are covered here. However, the development of trade in water and the huge gains that have been made in water efficiency are features more than worthy of mention.

**Valuing water as a commodity**

Water is a scarce resource. While it is renewable, at any one time there are limits on what is available.

Irrigators, urban areas and the environment itself all have a claim on water. Water could be allocated by regulators but this approach is inefficient. Giving irrigators the chance to make decisions for themselves about what water to use, when to use it, and for which crops, adds flexibility and promotes efficiency. To these ends, water has been separated from land rights and can be traded on an open market.

Consider an irrigator currently growing rice, a relatively low-value water-intensive crop. This irrigator could, in dry periods, choose to sell their water allocation to a farmer producing a higher-value crop, say, grapes. This produces income for the rice farmer, enables a greater value per unit of water used to be generated, and potentially frees up water for the environment. During the recent drought, some farmers survived on income from water sales, rather than the income from crops.

Because the environment has no capacity of its own to buy water, the government acts on its behalf, buying water rights on the open market. Once again, income is generated for farmers and the problem of over-allocation of river water that exists in many locations is reduced.

The NWC has estimated that water trading in the southern Murray-Darling Basin has increased Australia’s gross domestic product by A$220 million in 2006–2009 through reallocation of water used in agriculture.

Markets don’t just happen. For investors to have confidence good regulations must be in place and accurate information must be available.
Efficiency, enterprise and inspiration

Australia’s harsh and unpredictable climate of drought and flooding rains, together with a landscape where immense areas are arid, infertile or marginal, has forged agricultural practices which promote water use efficiency, foster innovation and which use the best scientific research to achieve productivity gains. Water trading opens up opportunities not just for irrigators and investors, but for innovative companies able to act as brokers, improve the management of water, modernise irrigation systems and match technology to irrigators’ needs.

Waterfind, Australia’s water market specialist, is a pioneer in the water market industry. Waterfind facilitates the buying and selling of both permanent entitlements and temporary allocations across the major irrigation regions in Australia. Waterfind offers a fully integrated water brokerage service including an online trading system, trade matching, contract documentation, conveyancing processing and settlement. Waterfind’s national network of buyers and sellers together with its knowledge of the local markets means that it can provide irrigators with access to a comprehensive range of water trading opportunities.

The success of Australian agriculture is testament to the ingenuity of its farmers, the quality of its research, the capacity of its firms to innovate and deliver new products, and the quality of sector governance.

CASE STUDY

Australia’s National Water Account

Those interested in making water purchases need to know how much water is available, where it is being traded, who owns it and the price at which it was last traded. Without this knowledge, water markets cannot be open and won’t function fully. There will be risks to investors that many may find unacceptable.

Here in Australia, responsibility for preparing the National Water Account has been given to the Bureau of Meteorology (BOM). BOM is responsible for:

> Issuing water accounting standards;
> Compiling and maintaining water accounts for Australia, including a set of water accounts to be known as the National Water Account; and
> Publishing annually the National Water Account in a form readily accessible by the public.

The lessons taken from the development of Australian water accounting standards and producing a National Water Account will be applicable globally in all developed and many developing nations.
WATER MANAGEMENT IN THE AGRICULTURAL SECTOR

The Goulburn Murray Irrigation District in Victoria covers 68,000 square kilometres and is Australia’s most extensive irrigation network. The Goulburn Murray Water Connections Project (G-MW Connections Project) is responsible for planning, designing and delivering Australia’s largest irrigation modernisation project, upgrading irrigation infrastructure in the Goulburn Murray Irrigation District (GMID).

The project is the most significant upgrade to the region’s irrigation infrastructure in its 100-year history, with automated technology and repairs to outdated channels enhancing water delivery and efficiency. The project aims to recover water lost through leakage, seepage, evaporation and system inefficiencies through channel automation and remediation, metering upgrades and realigning the historical layout of the irrigation channels.

It is estimated that up to 700–800 gigalitres of water in the Goulburn Murray irrigation system was lost through leaks, evaporation and other inefficiencies. The A$2 billion investment by the Australian and Victorian Governments, Melbourne Water users and Goulburn-Murray Water is achieving long-term average annual water savings of 425 gigalitres and increase irrigation water use efficiency from approximately 70 per cent to at least 85 per cent. Modern channel automation technology is sensitive enough to detect discrepancies in water delivery and to identify where maintenance is required. Critical water level and flow monitoring via automated gates ensures precise amounts of water are delivered when and where they are needed, shortening ordering times and providing more consistent and reliable delivery of water to irrigators.

For example, with 532 gates in place automating 75 per cent of the Shepparton Irrigation Area, unplanned spills and releases (outfalls) for the entire Shepparton Irrigation Area were reduced by 79 per cent from 8,850 megalitres in 2007–08 to 1,813 megalitres in 2008–09.

The G-MW Connections Project is redeveloping the Goulburn Murray irrigation system into a world-class, best-practice system and help secure the future of the region’s A$9 billion irrigated agricultural industries and A$1.53 billion export market. The project will also enhance environmental flows and urban water supplies.

Irrigators will manage their businesses confidently knowing their water delivery is accurate and delivered at the requested time. This confidence will extend beyond the farm gate to support the region’s future, attract investment and business, create new jobs and contribute millions of dollars to the local economy, further boosting regional development.


The value of trading water is also appreciated in Western Australia, where the south-western region has been suffering a pronounced decline in rainfall and increasing salinity for some years. In these circumstances, trading of water between farmers enables all to share a precious resource with the highest value crops being the beneficiaries. Harvey Water is one such company that has been offering this service in the West since 1996.

Other enterprising approaches to farming in a challenging climate are evident in the Murray-Darling Basin, one of the most productive agricultural areas in Australia. The Riverina, the north Victorian region and the Goulburn Valley support towns such as Shepparton, a thriving centre for agriculture, food processing, farm machinery and related industries. The area produces apples, cherries, sunflowers, millet, rice, mung beans and vegetables for domestic and export markets. Many crops depend on irrigation, but with persistent drought and reduction in the volumes of water that can be drawn from the rivers, farmers have adopted sophisticated water efficiency measures.

Not only must the available water be used effectively, it must not be needlessly wasted. Supported by the federal, state and territory governments, and the irrigators themselves, a major program of works has been undertaken to reduce water loss from irrigation channels. The Goulburn Murray Water Connections Project (formerly known as the Northern Victoria Irrigation Renewal Project) (NVIRP) has produced huge savings.

Goulburn Murray Water Connections Project

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Salinity management project to assist farmers

A Catchment Demonstration Initiative (CDI) open day in late 2006 in the Western Australian wheatbelt shire of Kellerberrin, an area very much affected by dryland salinity, marked the roll-out phase of a project that has seen many local farmers implement salinity management options on their farms. Research for the multi-million dollar project has been delivered through the Water for a Healthy Country flagship. The project is run by the Wallatin Wildlife and Landcare Group and explores a combination of engineering and agronomic solutions to salinity identified by the landholders.

The result is a ‘how-to’ guide of remedial activities, with a checklist of biophysical, economic and social pre-conditions needed to limit risk. Crucially, the project also focuses on the urgent need to protect vital assets such as water and natural resources.

The project includes three sub-catchments spreading across 44,457 hectares, including the Wallatin/O’Brien Catchments and Woolundra Lakes. Salinity expansion in Western Australia has been a major concern. There are between one and two million hectares of dryland salinity in the state, and between two and four million hectares at risk from rising groundwater, amounting to A$400 million in lost agricultural production.

The CDI project is an example of how local, state and national groups can collectively tackle salinity. Various state departments, Curtin and Murdoch Universities and the University of Western Australia, as well as a range of private contractors, have also contributed.
FutureFlow Alliance Program: modernising irrigation systems

FutureFlow, a Goulburn-Murray Water alliance comprising Comdain Infrastructure, SKM, Transfield Services and Goulburn Murray Water (GM-W) has recently completed possibly the world’s largest irrigation modernisation project in one of Victoria’s key food production areas.

The A$290 million FutureFlow alliance was established in 2008 by GM-W to modernise the existing irrigation infrastructure (over 6,300 km of open channels) with a world-leading IT based system and in the process save over 30 percent of water (on average 94 GL per year) that was previously lost through leakage, seepage or evaporation. The project in the Goulburn-Murray Water region in northern Victoria is now the world’s largest automated irrigation water management system.

Water previously lost through leakage, seepage or evaporation is now being returned to irrigators and the environment to maintain the region’s strong agricultural output.

Hardware and software solutions

Rubicon Water has a vision to improve the productivity of the world’s irrigated agriculture in an environmentally sustainable way. Rubicon achieves this by using advanced technology to improve the operation and management of open channel irrigation supply systems.

The company produces solar-powered water control gates, flow meters and management software which are all designed to operate as an integrated system. The technology enables rural water authorities to deliver accurately measured, high-flow, on-demand water to farmers utilising existing open channel systems.

Comdain Infrastructure is one of the largest irrigation infrastructure constructors in Australia, with a strong capability in irrigation modernisation and constructing sustainable irrigation networks. Comdain specialises in infrastructure construction and maintenance services in the irrigation sector and also in the urban water and gas utility sectors. Comdain delivers major integrated infrastructure projects that improve levels of service and help save water.

Comdain has delivered over A$300 million of irrigation modernisation works over the last three years and has won a number of awards for its project innovation and management.

The company’s irrigation sector capabilities include irrigation infrastructure construction such as meters, gates, channel lining, major weir structures, gravity pipelines and pressurised pipelines and automation control.
The right tools for the job

Equipment is another area where Australian irrigation suppliers such as \textit{Ludowici Watergates} have incorporated modern technology into devices that control water delivery to crops and onto fields. Ludowici Watergates designs, manufactures and installs high-quality water control equipment including penstocks, stopgates, floodgates, knife gates and flap gates for sustainable water management.

On the farm, other Australian companies can improve the efficiency of water use and reduce costs while ensuring crop yields are maintained and even enhanced. As water shortages become more acute and demand increases across the globe, these companies offer methods, technologies and systems to improve efficiency throughout the region and across the world.

\textit{Padman Stops} is another local manufacturer of water control structures and automatic irrigation controllers for the surface irrigation industry. The company’s key product, which was designed and manufactured over 20 years ago by John Padman, is the ‘Padman Stop’ bay outlet and channel stop. It is a 100 per cent watertight rubber flap set in a concrete structure that makes it easy to automate gravity flow water, thus reducing the loss of water from leaking outlets. Fast-watering technology, in conjunction with Padman Stops bay outlets, has been able to increase the efficiency of surface irrigation without increasing energy use and provides environmental benefits as a flow-on effect.

\textit{Observant} offers turnkey solutions to irrigation water management. Our products monitor and control all aspects of on & off farm water use. Our products are designed to integrate with existing irrigation equipment, such as gates, outlets, pumps, centre pivots and laterals, flow meters, soil moisture probes and weather stations, providing a single system that’s easy to run.

With Observant, asset owners and irrigators can manage water delivery, monitor water usage and minimise water loss, access accurate metering and soil moisture data, better manage irrigation schedules, turn pumps on and off, receive alerts for critical events, and improve overall water management.

Find out more

The sample of Australian organisations and companies featured here provide services and tools designed to help farmers and the agricultural sector achieve efficient water use, at the same time as producing a crop that gives an economic return. Many are unique to Australia’s agricultural sector and are the products of investment by successive governments at state and federal level as well as the private sector. Their aim has been to develop tools to assist farmers working in the Australian environment, one often plagued by salinity, drought or floods.

The focus of innovation has been on design and management options to suit these varied conditions, with an emphasis on maintaining and improving the land for the future. While the companies referred to here offer and promote their services locally as well as on websites, the majority are interested in markets beyond Australia and would welcome enquiries.

\textbf{CASE STUDY}

\textbf{Phoslock: an innovative treatment for algae}

\textit{Phoslock} was developed by Australia’s leading research organisation, CSIRO, and later commercialised by Phoslock Water Solutions (PWS). PWS manufactures and distributes Phoslock and is a listed company on the Australian Stock Exchange (ticker: PHK).

Phoslock is a modified clay product that removes phosphate from water bodies such as recreational lakes, drinking water reservoirs and aquaculture ponds. Phosphate is an important food source for algae (particularly the potentially harmful blue green algae) that thrive in water bodies high in nutrients. By removing phosphate from the water column and preventing its release from sediments, Phoslock starves algae of its food source and the proliferation of algae, particularly blue green algae, is greatly reduced.

Phoslock has been applied to over 200 water bodies around the world, including 29 lakes in Europe and the United Kingdom. PWS’s North American business is developing strongly with a number of well-credentialled licensees covering Canada and the United States.

\textit{Observant technology managing overhead irrigation equipment}
Operating efficiencies in the order of 50 per cent or greater have been achieved in Australia. Households are conservation-minded, yet the sector remains profitable. Water supplies have been diversified; desalination, recycled water, stormwater, groundwater, rainwater and water conservation programs are all part of the supply mix.

**Water as a business**

Australia’s urban water sector is reform-minded and innovative. Utilities operate commercially, subject to the full gamut of regulatory controls, as applied to private firms. Investments are expected to generate a rate of return, and the full cost of providing water and sewerage services is expected to be met by consumers.

Water has become a controllable cost for industry, rather than a tax burden. Operating efficiencies in the order of 50 per cent or greater have been achieved. Households are conservation-minded, yet the sector remains profitable. Water supplies have been diversified; desalination, recycled water, stormwater, groundwater, rainwater and water conservation programs are all part of the supply mix.

The private sector is crucial, with private firms meeting an increasingly large proportion of the sector’s needs. They are providing new approaches that improve the performance of water systems in substantial ways. Water quality management, smart systems, new treatment processes, and innovative improvements in managerial and operational efficiency are hallmarks of the private sector’s capacity.

**Global recognition**

The Australian urban water sector is a vital mix of public and private, with the knowledge, technical ability, products and services to contribute to the better management of water resources and systems globally.

The sector is recognised around the world for its robust institutions, the quality of products and services it produces, its technological prowess and its determination to collaborate to deliver the best solution.

- Our cities are now more efficient, more sustainable and more secure.
- Our utilities are financially robust and profitable.
- Our private companies offering services to the water sector are competitive, creative and customer focused.
- Our achievements are evidence-based, backed with hard science and with a high level of technological ability.
- Our education sector, which delivers water sector-related training to domestic and foreign students, is equal to the best.

In short, Australians are committed to getting the job done, and done well.
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**A dynamic industry**

The Australian urban water industry is dynamic and forward looking. It invests in new approaches to promote efficiency and diversity in water supply. The Australian urban water industry:

> Serves approximately 19 million people, roughly 90 per cent of the Australian population.

> Achieves almost universal compliance with health and environment regulations.

> Is profitable. Net profit after tax in 2009–10 was almost A$2 billion, an increase of 43 per cent over 2006–07.

> Invests in the maintenance and expansion of its networks. Capital expenditure has increased from approximately A$2.5 billion in 2005–06 to A$6.7 billion in 2009–10, with a peak of A$7.2 billion in 2008–09.

> Promotes water conservation. The average volume of water supplied per property served, among utilities providing water to more than 100,000 properties, has declined from 212 kilolitres/property in 2005–06 to 177 kilolitres/property in 2009–10.

> Supports the use of recycled water, with supplies increasing by 34 per cent over the past five years to 245 gigalitres in 2009–10.

> Seeks to be energy efficient and to reduce greenhouse gases. Almost all the energy used by the desalination plants built over the past five years is sourced from renewable sources. Many utilities are committed to significant greenhouse gas reduction targets in the near term and several intend to become carbon neutral by 2020.
Working together for the customer

Water systems are becoming increasingly complex. Even seemingly simple procurement contracts are multi-faceted, needing to meet technical specifications, promote efficiency, meet external customer requirements, be robust and be capable of adaptation. Traditional contracting arrangements tend to promote adversarial approaches to business, with changes in specifications often leading to variations which can be costly for the purchaser or difficult for the provider to meet within the contract price. Increasingly, the Australian water sector seeks partnerships and collaboration, rather than the inflexibility of traditional contracting arrangements. Collaborative contracting (also known as alliance contracting) is often used to ensure that the skills of all parties – purchasers and suppliers – are directed to common ends: delivery of the project on time, to budget and with the greatest effectiveness.

The Australian urban water sector is a pioneer in this area, with more than 320 large and complex projects delivered successfully over the past 15 years. A selection of companies experienced in alliance contracting and other forms of innovative contract delivery include:

> WorleyParsons is a major Australian firm with 32,900 personnel located in a network of 137 offices across 41 countries. It has a reputation for major project and program delivery and has experience across a range of delivery models including EPCM, alliancing and PPP to deliver projects in infrastructure, power, mining and metals and hydrocarbons. WorleyParsons provides consulting services through its specialist consulting practices in water solutions, advanced analysis, carbon consulting and the like. It provides water solutions across the whole spectrum, from resource management and abstraction to treatment and reuse, and can act as a sole provider, project leader or alliance member, depending on what best suits the customer and their project. WorleyParsons have been involved in many of the major water projects in Australia including four of the major desalination plants underway or completed.

> SMEC – a professional services firm with Australian origins and a global footprint that provides high-quality consultancy services for major infrastructure projects. SMEC has over 4,000 employees and an established network of more than 40 offices in Australia, Africa, the Middle East and North Africa, South Asia and Asia Pacific. SMEC provides consultancy services for the lifecycle of a project. Its expertise in the water sector is derived from one of the world’s most significant water projects – the Snowy Mountains Hydroelectric Scheme in Australia. This project enabled the development of large agricultural areas, which provided economic prosperity for Australia in the 1950s and beyond. SMEC has successfully completed a range of water projects in many developed and developing countries worldwide.

> Sinclair Knight Merz (SKM) is a leading projects firm, with global capability in strategic consulting, engineering and project delivery. It operates in three regions: Asia Pacific, the Americas and EMEA (Europe, Middle East and Africa), deploying some 6,500 people from more than 40 offices while serving the Buildings and Infrastructure, Mining and Metals, Power and Energy and Water and Environment sectors. Its growing global water and environmental practice provides services including environmental planning and management, stakeholder engagement, water engineering, resource efficiency and natural resource management.
New approaches and technologies

Australia is urbanised, and the world is urbanising. All nations face the challenge of providing a safe and secure supply of water and wastewater services to urban dwellers, particularly in the face of climate change and population growth.

Around Australia, cities are diversifying their supplies, improving the quality and efficiency of water and wastewater treatment processes, adopting new approaches to the management and remediation of infrastructure, and promoting water efficiency, among other things.

In the face of drought, some fundamental questions have been asked about the way in which we manage water and how we continue to provide secure water supplies to meet the needs of a growing population. These inquiries have led to new knowledge, approaches and technologies.

Adelaide, Australia’s fourth largest city, lies at the end of Australia’s largest river system, the Murray-Darling. This system drains an area of one million square kilometres, about twice the size of Spain. While the basin is highly productive, it is also stressed. Runoff, scarcity, salinity and the need to provide water for the environment are all issues that affect the amount and quality of river water available to Adelaide.

The city was once almost dependent solely on river water, but it is now developing a diversified supply using techniques such as aquifer storage and recovery, stormwater capture and reuse, recycled water and desalination.

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Irrigating Adelaide’s parklands

Adelaide is a city of parks, but being in a semi-arid area, it takes a lot of water to keep the parklands green and thriving. To reduce costs and dependency on the Murray River, an innovative recycling scheme has been developed. The scheme reduces wastewater discharge to Gulf St Vincent, on which Adelaide is located, and provides water for irrigation and, potentially, other non-potable purposes. This project was delivered by the CityGreen Alliance, a public-private partnership comprising SA Water, United Water, Leed Engineering and Construction (Leed), Guidera O’Connor and others. Leed and Guidera O’Connor are South Australian companies specialising in the design and construction of water treatment infrastructure.

The project comprises construction of a new ultrafiltration plant adjacent to the existing plant at Glenelg, a suburb of Adelaide. Treated water will be pumped by underground pipeline to a 34-kilometre-long distribution network to irrigate the parklands. The project forms the backbone of a broader recycling scheme for Adelaide that will benefit businesses in the centre of Adelaide and to its north, by providing a sustainable, cost-effective source of recycled water for use for all non-potable purposes.

Australians are innovative and solutions oriented. We have to be; the country’s historical isolation and harsh climate have contributed to the emergence of a self-reliant culture. With water as a national priority, it is not surprising that a range of companies have emerged with expertise in specific and critical areas.
Drought-proofing Adelaide

Initiatives to drought-proof Adelaide have led to considerable investment in research, particularly on aquifer storage and recovery (ASR), and to the launching of new firms to service the market. Thus, companies like Australian Groundwater Technologies have emerged with world-class expertise in aquifer management, artificial recharge (AR) – also referred to as Managed Aquifer Recharge (MAR) – and ASR techniques and methodologies. Australian Groundwater Technologies was a partner in the Willunga Basin Scheme and other notable stormwater harvesting and reuse projects.

Parafield Partnerships Urban Stormwater Initiative

The Parafield Partnerships Urban Stormwater Initiative required collaboration between the private and public sectors, and research scientists. The challenge was to reduce polluted runoff to a nearby embayment and reduce the cost of water supply to a wool processing plant. The wool processor used a billion litres of water annually and was confronted with significant trade waste charges, undermining the viability of the plant.

On an experimental basis, recycled water from another aquifer storage and recovery site was used as feedwater for the wool processing plant. This led to a significant reduction in chemical use as the water was softer than mains supply. Later, the rinse water from the processor was run through an experimental constructed wetland. The natural filtering provided by the wetland produced a water of a high enough quality for aquifer injection. However, as land available at the processing plant was insufficient to treat all the rinse water, a much larger wetland was constructed adjacent to an airfield, from which runoff had been a problem in the past. The combined flow was injected into an aquifer and recovered for later use by the processing plant.

This project significantly reduced the processing plant’s costs by lowering the cost of raw water, improving its characteristics with respect to wool processing, and reduced the processors’ trade waste charges. The quality of runoff from the airport was significantly improved, reducing impact on the nearby embayment, which is a sensitive breeding ground for fish and the ‘nursery’ for the local fishing industry. Annually more than 100 tonnes of silt, rubbish and residuals is captured in the first stage of the scheme, with further polishing occurring as water moves through the wetlands.

Western Corridor Recycling Scheme

Of course, Australia is a huge country and water conservation projects are being carried out nationwide. They are important, high profile and necessary in the face of climate change.

Demand management has been a real success story in the South-East Queensland region, but more needed to be done to achieve water security and climate resilience. In 2007, at the height of the drought, the major surface water storage servicing the city of Brisbane fell to less than 30 per cent capacity – yet this region is Australia’s fastest-growing urban area. At the same time, wastewater discharges to Moreton Bay, a particularly sensitive marine/estuarine environment, have been increasing and have the potential to impact the receiving waters.

Part of the solution lay in the construction of a water grid for South-East Queensland. The SEQ Water Grid includes new sources of water, dams and other storages and more than 535 kilometres of bulk water transportation pipeline. It allows water to be moved around the region from areas of abundance to areas of need, and for operational issues to be managed by isolating and blending water from different sources. With the establishment of the Water Grid, total water supply capacity for the region has increased by 55 per cent, from 350,000 megalitres to 545,000 megalitres per annum.

A project of particular note is the Western Corridor Recycling Scheme in South-East Queensland in Australia’s sub-tropical north. This Western Corridor project is the largest water recycling scheme in the southern hemisphere and one of the largest in the world. The three treatment plants included in the scheme have the capacity to produce up to 232 million litres of water each day. The scheme supplies water to power stations and there is significant potential to supply industrial and agricultural customers in the future. Should levels in the major storage fall below 40 per cent, recycled water will also be used to supplement dam water supplies.

A key focus for the Water Grid is the smart operation of climate-resilient supplies, as part of an extensive and diversified portfolio of water assets. This was exemplified during the Queensland floods in January 2011, where desalinated water was used to support supply when water treatment plants struggled to treat turbid water. In addition, recycled water was made available for the post-flood clean-up.

Delivering the Western Corridor Project

The project was broken into five packets of work with each portion designed and constructed under an alliance contracting arrangement. This multi-alliance structure enabled design and construction to occur concurrently and allowed the project to become operational progressively. Companies involved in delivering this innovative project include:

- AJ Lucas – Winners of the 2009 Australian Sustainability Award, AJ Lucas offers building, construction and drilling services to the property, utilities, water, coal, oil and gas sectors in Australia and the Asia-Pacific.

- Transfield Services delivers essential services to key industries in the Resources and Industrial, Infrastructure Services and Property and Facilities Management sectors. A leading global provider of operations, maintenance, and asset and project management services, Transfield Services has more than 28,000 employees in Australia, New Zealand, the United States, the United Arab Emirates, Qatar, New Caledonia, South East Asia, India, Chile and Canada. Transfield Services Limited is publicly listed in Australia and included in the S&P/ASX 100.

- GHD is at the forefront of the water industry, delivering sustainable water solutions across the globe, covering every element of the water cycle – from catchment to tap – for urban, rural and industrial water applications.

- SunWater is a bulk water infrastructure developer and manager playing a key role in Australia’s water industry, owning and managing around A$7 billion in water infrastructure assets and supplying approximately 40 per cent of all water used commercially in Queensland.
Recycled water for agriculture

Faced with water shortages in a prime grape-growing region of South Australia, a collective of primary producers banded together to access wastewater from the local water utility’s wastewater treatment plant at Christie’s Beach, south of Adelaide. The group, established as Willunga Basin Water, paid for the construction of the infrastructure necessary to transport treated water from the plant to the Basin, but allocated only 25 per cent of the water to themselves. The remaining water is available to third parties and has underpinned expansion of irrigated agriculture in the area without duplicating the pipeline already constructed.

From an initial contracted demand of 2.1 gigalitres of water annually, the scheme now supplies more than 5.4 gigalitres of reclaimed water annually to users, and has an identified demand for more than another 2 gigalitres. The scheme is user-friendly, with water available on demand without the need for pre-ordering, as required in other irrigation schemes.

Willunga Basin Water’s initiatives reduce the discharge of treated effluent to the Gulf St Vincent, and the scheme replaces water that would otherwise be taken from a stressed groundwater resource and the Murray River. It underpins the economic sustainability of this premium wine region and results in over A$38 million per annum of grape value, more than A$100 million per annum in base wine value and an inestimable contribution to the tourism industry.
Aqua Diagnostic products and services are profound. Companies have emerged with expertise in niche markets, but the impact of their impact is not surprising that a range of smaller companies may occupy niche markets, but the impact of their impact is profound. With water as a national priority, cultural isolation and harsh climate have contributed to the emergence of a self-reliant culture. Australians are innovative and solutions oriented. We have to be; the country's historical isolation and harsh climate have contributed to the emergence of a self-reliant culture.

**High-tech solutions borne of a self-reliant culture**

Australians are innovative and solutions oriented. We have to be; the country’s historical isolation and harsh climate have contributed to the emergence of a self-reliant culture. With water as a national priority, it is not surprising that a range of smaller companies have emerged with expertise in specific and critical areas. These firms may occupy niche markets, but the impact of their impact is profound.

> **BIOGILL Environmental** was formed in 2009 to commercialise new technology researched and developed in the laboratories of the Australian Nuclear Science and Technology Organisation (ANSTO). This patented aerobic wastewater treatment system is based on nano-particulate membrane technology, which provides optimum habitat on which a vibrant biomass can grow. The membrane sheets are arranged vertically in pairs (picted, above right). These ‘gills’ are suspended in air with wastewater dispersing between them. Fungi and bacteria (biofilm) grow on the membranes in direct contact with air, consuming nutrients many times faster than microbes in other treatment systems because oxygen is readily available to them. Nutrient removal is very rapid and the system does not foul and is self-optimising. This technology is ideally suited to the ‘difficult-to-treat’ high-nutrient wastewaters from food processing industries and other commercial wastewaters that may include fats, oils and grease.

> **Aqua Diagnostic** – Knowing what quality of effluent is being received at a wastewater treatment plant in real time is essential to lowering energy use and operating costs of treatment processes. Until now, effective analysis of chemical and biological oxygen demand (COD and BOD), a key determinant of wastewater quality, has been inhibited by lengthy delays in obtaining results. Australian firm Aqua Diagnostic has now developed PeCOD, which utilises a unique photo-electrochemical technology allowing real-time or rapid analysis of COD or BOD. With its initial focus on the rapidly growing global market of water management, Aqua Diagnostic COD analysers are able to offer significant improvements in both the quality and economy of water management.

> **H2O Organiser** is an innovative Australian company that has developed the H2O Pressure Pump Controller (PPC) to limit water loss when leaks arise, pipes burst or taps or valves are inadvertently left open. For example, modern pressure pumps will kick in when there is a pressure drop, normally caused by a tap being opened. However, the pump will continue to operate until the tap is shut. If the tap is left open accidentally or if there is a leak, water will flow to waste. The H2O Pressure Pump Controller prevents this by intelligently monitoring the flow of electricity and turning off the electricity to the pumps after a pre-set time of continuous electricity flow. The company has also developed Town Water Saver (TWS), TWS performs in the same way as the PPC, but at a building scale. This unit fits water systems ranging from 19mm-100mm and above. Both the PPC and TWS are state-of-the-art technology and unique in the world.

> **EC Sustainable Environment Consultants** is a multi-disciplinary environmental consultancy providing specialist advice in a range of areas relevant to water management, waste minimisation and sustainability. Working within diverse environmental sectors (Water, Land and Soil, Air, Waste, Chemicals) EC Sustainable is committed to finding the viable pathways for business and society to achieve superior environmental outcomes consistent with Ecologically Sustainable Development. EC Sustainable Environment Consultants operates globally with specialist expertise in inter-continental business matching programs to enhance clients’ opportunities.

> **STAR Water Solutions Pty Ltd** provides proven stormwater, industrial and agricultural wastewater treatment and reuse solutions internationally. Using proprietary Reactive Filter Media technology and with over 12 years of research, development and installations, there is a wide range of treatment options available to remove contaminants such as nutrients, heavy metals, toxic compounds (e.g. hydrocarbons) and pathogens. The technology is adaptable to many conventional drainage systems for civil engineering and water-sensitive urban design applications such as curbs, parking lots, median strips, roof gardens and landscaped areas. Treated water can be reused as a non-potable water source or conveyed to natural water bodies in a purified state, helping to meet water quality emissions standards. Star Water Solutions has a network of distributors and manufacturers in Australasia, United States, Canada and Europe.

> **Everything Water** is a proudly Australian-owned and based company with 15 years’ experience in wastewater treatment. Everything Water’s Domino range of commercial water recycling systems is custom designed to meet client needs. Mine and power plant water recycling and agricultural wastewater reuse are among the applications for its technologies. The system is particularly suited to treating oily water prior to discharge into the sewer or stormwater. Everything Water also offers water treatment solutions from simple grease traps through to turn-key wastewater solutions for mines, power stations, water authorities, manufacturers and others.

> **Envirostream Solutions** is a water filtration technology and engineering company focused on the development and design of stormwater treatment and harvesting systems. The firm’s patented enviss™ filter technology achieves high levels of pollutant removal from urban runoff, and is suitable for both new developments and retrofitting. enviss™ significantly improves the quality of stormwater runoff on a very small footprint.
AUSTRALIA: SETTING THE PACE IN EFFECTIVE WATER USE IN MINING

Mining plays a significant role in Australia’s economy, contributing more than 10 per cent of the country’s Gross Domestic Product (GDP) in 2011–12, and up to 60.5 per cent of the country’s export revenues. It directly employs approximately 248,000 people and indirectly provides employment for countless others in downstream manufacturing, processing, transport and export, among others.

Mining investment in Australia has risen to record levels. Continued commodity demand from emerging Asian markets has been a major driver for the growth of mining investment in Australia. Commodities attracting the most investment are oil and gas, iron ore, coal and associated infrastructure, which collectively account for more than 90 per cent of all committed capital expenditure.

Australia’s mine sites are often in remote locations and in arid areas, making the securing of adequate water supplies a particular challenge.

Water is an essential requirement for any mining site. Each year, exploitation of Australia’s mineral resources consumes 4 per cent of the nation’s available water supply, or almost 600 gigalitres. Australia’s water industry consultants who have been involved in the planning and delivery of mine projects have gained invaluable experience in dealing with issues such as remoteness, too little or too much water, lack of easily accessible power, as well as harsh operating conditions for both equipment and personnel.

Overcoming challenges with the right expertise

As their operations are frequently in remote locations, Australian and international mining companies must know how to access and treat available water, where to find new local sources from groundwater aquifers or, in coastal locations, how to treat seawater.

Careful water use with an eye for conservation and sustainability is a focus for Australian mining companies, and Australian water industry specialists ensure that their services are able to meet these twin objectives.

The Australian water industry delivers genuine cost savings for water supply and enhances the sustainability of Australian mining as an industry.

In remote locations where rainfall is low, miners are frequently forced to rely on poor-quality groundwater carrying high levels of salt, sediments and minerals. In many instances, the poor-quality water that is found at mining sites is not even suitable for washing mined ores.

Australian water industry consultants such as WorleyParsons, Earth Systems, SMEC and GHD can advise on the use of new technologies involving membranes, distillation and ultraviolet disinfection to thoroughly cleanse the water of micro-pollutants, including bacteria, silica, nutrients and sediments. They also provide solutions to the problems arising with fouling, scaling of plant equipment and corrosion of fittings which can disrupt operations.

High levels of treatment can produce water of a quality suited to drinking purposes and other high-end uses, reducing the cost of transporting treated tank water long distances from an urban facility to the mine site.

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Santos and Osmoflo: Solving the problem of salinity

Santos is a leading Australian oil and gas company supplying over 20 per cent of eastern Australia’s domestic gas. In 2008 Santos produced 54.4 million barrels of oil equivalent. Santos is active in the Cooper Basin, a remote region encompassing an area of north-east South Australia and south-west Queensland, which potentially holds rich reserves of oil and gas. Water is a vital resource for Santos’ operations, however, the local groundwater, the only reliable source of water available, is not only saline but has the potential to contain a range of contaminants, including hydrocarbon compounds. It has extreme temperature variations ranging from 90°C to near freezing. As a result, extensive treatment is required before Santos can use the groundwater for process and drinking needs at its Moomba, Ballera, Jackson and Tarbut facilities.

Osmoflo, a majority-owned Australian company, was commissioned to deliver a comprehensive treatment solution. The plants developed had to overcome a number of site-specific challenges. Using advanced reverse osmosis technology, the plants now produce over 2.05 ML of water each day including the delivery of high-purity water for power generation and process needs, and potable water for drinking. Commissioning occurred in 2004, providing Santos with a secure, reliable supply of water to maintain its operations ever since.

Osmoflo has supplied and operates the plants under an all-risk operation and maintenance agreement where it assumes responsibility for efficient operation, quality and delivery as required. This arrangement allows Santos to focus on their core activity of delivering energy.

Ensuring seasonal availability

Parts of Australia experience monsoon-type weather patterns with large volumes of water falling within very short periods.

Australian consultants from organisations such as CSIRO provide sophisticated advice on capturing large volumes of stormwater for use during subsequent dry seasons. Treatment and storage of water in aquifers for subsequent reuse improves reliability of supply so that a mining site can maintain production throughout the year. It also ensures that high-quality water can be reserved for drinking purposes, thereby reducing costs for the operator.

The same technique can be used to deal with large volumes of water produced when saturated ores are dewatered, or when open-cut mines become flooded. The dewatered product can be pumped and stored into an aquifer for removal and reuse as required.

Continuous Ionic Filtration

Clean TeQ’s latest development in water treatment, Continuous Ionic Filtration™ (CIF™), will help industrial and municipal water users meet water quality standards for reuse economically, and with minimal environmental impact. CIF™ can be used for brackish water desalination or as a pre-treatment prior to membrane desalination. It can be operated without fouling or scaling and with minimum maintenance.

CIF™ has been used to reduce the TDS (total dissolved salts) and metals in a number of water sources. Examples include treatment of:

- Mining waters containing nickel (Ni 100mg/L), to reduce the nickel levels (<10mg/L) and with a water recovery of more than 98 per cent and recovery of the nickel. The technology can be configured to treat the majority of dissolved metals (cations and anion forms).
- Groundwater (TDS 8,000mg/L, Ca 140mg/L, Mg 400mg/L), in combination with RO, to reduce the TDS to less than 500mg/L with water recovery of more than 87 per cent.
- Coal seam gas produced water (TDS 11,000mg/L), in combination with RO, to reduce the TDS (<300mg/L) and with water recovery of more than 85 per cent.
- Secondary effluent (TDS 670mg/L, TN 15mg/L, TP 7mg/L) to reduce the TDS (<15mg/L) and nutrient levels (TN<0.5 mg/L, TP<0.5 mg/L) and with water recovery of 95 per cent and a power use of less than 0.5kWh/m3.

Water is becoming the limiting resource for many mining, gas, industrial and agricultural operations globally. CIF™ is able to work with a wide variety of feed water specifications with high water recoveries, a low waste production and at reasonable energy inputs; a zero liquid discharge (ZLD) approach is now within economic reach.

CASE STUDY

Ensuring seasonal availability

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Making mining more sustainable

Rising global demand for energy and increasing pressure for cleaner fuels to reduce greenhouse gas emissions are spurring the development of Queensland’s LNG industry, using coal seam gas as the feedstock. Sustainable mining and reuse practice is required in the emerging field of coal seam gas extraction, which is a new low-emissions source of energy.

During the gas extraction process, large volumes of highly saline and dirty water, with high levels of hydrocarbons, are released and drawn to the surface. Rather than evaporate this water in large surface ponds occupying open areas, Australian consultants such as SKM, URS and WorleyParsons have selected pre-treatment methods to address the unique water quality at each location, followed by reverse osmosis desalination to make the water suitable for further use in agriculture or for cooling water for power stations.

Queensland Gas Company: Treating coal seam gas water for reuse

The Queensland Gas Company (QGC) has signed contracts with an Australian consortium of water companies to build a water treatment facility in the state’s Western Downs region that will treat water from its coal seam gas project for beneficial reuse. The gas is piped to Chinchilla from the multiple individual sites in the Surat Basin where the company’s gas wells are located.

The A$350 million facility, Kenya Water Treatment Plant, will treat water produced at QGC’s Chinchilla gas processing plant and pump it to storage for reuse. The treatment facility is expected to open in October 2011.

The plant will use advanced membrane and thermal water treatment technologies to desalinate water produced during the extraction of gas from the coal seams. This process will produce water that is suitable for a variety of applications, such as irrigation for farmers and process water for industrial customers.

The facility will have the capacity to treat up to 72MG/day and will produce 150 tonnes of salt, which could potentially also be used by industry.

CASE STUDY

Fortescue Metals Group’s Managed Aquifer Recharge (MAR) scheme at Cloudbreak Mine

A sophisticated Managed Aquifer Recharge (MAR) scheme at the Cloudbreak mine site, owned by Fortescue, has delivered a water management system that is good for the environment and conserves a scarce resource.

Of the 25 gigalitres (GL) of brackish water removed every year to provide dry mining conditions, 18GL/annum is returned to the aquifer via borehole re-injection. This re-injection results in a net water use for Cloudbreak of just 7GL/annum despite the mine’s annual water requirement being 25GL.

Cloudbreak’s aquifer re-injection conserves precious water resources for future redraw and secures a zero discharge status for the mine – a status which has been maintained since the project was completed.

CASE STUDY

Red Gorge, Karijini National Park, Western Australia.
Aspiring to best practice

To protect fragile and harsh environments, the mining industry follows strict environmental regulations. Emissions, contaminants and wastes from processing activities are tightly monitored and must be reported to authorities.

Closure of a mine site after available ore for extraction has been removed must not leave the environment damaged or degraded. Strict conditions are imposed on mining companies to ensure mine sites are managed effectively, post-closure.

Cases such as CRC Care, Earth Systems and Clean TeQ provide advice on mine-site rehabilitation and management.

Transparency and accountability for economic, environmental and social corporate performance are core notions embedded in the approach Australian mining companies adopt when evaluating future mining projects. Australian consultants are mindful of these triple bottom-line goals. Firms such as Coffey have been instrumental in boosting the industry's interest in improving the social fabric of communities in which mines are sited through to sustainable management of the site and resources including water.

Alice Springs Water Reclamation Plant: Setting new environmental standards

The Alice Springs Water Reclamation Plant marks a major shift in sewage treatment and water conservation in Central Australia. It sets innovative environmental standards in waste processing and industrial building design, and offers community awareness programs and landscape research opportunities. The project is a credit to the expertise of those involved, including Australian firm Arup.

The plant’s first stage treatment utilizes Dissolved Air Flotation (DAF), chemical dosing and storage tank settling to produce treated water suited to Soil Aquifer Treatment (SAT) plant located over the original Todd River Artesian Basin, where potable water will be stored underground for future reuse. Located within the Ilparpa Valley, adjacent to existing sewage evaporation ponds, this new facility maximises passive building design principles to enhance the efficiency of the town’s sewage treatment and processing.

Integrated architectural building components and packaged engineering solutions have been used which exploit building form, solar orientation and natural ventilation techniques to create thermo-siphoning opportunities, and transform basic industrial sheds into visually dynamic, highly valued public assets.
Sharing Australian innovations

The unique problems of an arid landscape, unreliable and often poor-quality water supplies have stimulated the search for new technologies to improve efficiency and provide better service to clients. The use of remote technologies to monitor operations at a water treatment plant hundreds of kilometres away is routine practice for Australian company Osmoflo.

The need for power at a remote location where transmission lines do not exist has led to the refinement of solar power units that can keep a local mining community supplied with water or operate a wastewater (sewage) treatment plant. Arup is among the more active companies developing innovative, sustainable designs in order to cater for these special situations.

Australian firms providing services to the domestic mining industry are also active internationally, providing advice on water management in arid environments, on treating and reusing water and on innovative methods for water conservation. Their interest in reaching out and sharing their knowledge and experience is only matched by their enthusiasm to lend a hand — a significant feature of Australian business enterprises.

CASE STUDY

Ensuring optimal operation – an essential part of every mine site

Mine site water and wastewater treatment systems are a fact of life. Ensuring they operate at optimal levels is essential.

Stornoway’s experience in supplying and operating treatment systems means they understand the plant’s critical nature and key operating risks, helping them develop systems and operational support that reflect resource industry needs.

Stornoway has over 30 plants installed across Australia, each with remote monitoring technology, allowing engineers to see plant operational status instantly, removing the need to travel to the site and providing greater operational support and control.

The technology has proven beneficial in supporting on-site plant operators, particularly in the 6-12 months after installation. Wastewater specialists can assist operators to understand and fine tune their plants, adjusting to suit local conditions. For biological wastewater plants, it’s very useful given the complexity in growing the living organisms needed for an effective treatment process.

Remote monitoring means Stornoway’s field service technicians can review plant performance data before periodic site services, and can log on from anywhere in the world.

In many cases, this technology has proven to be a powerful support, problem-solving and training tool, reducing plant downtime and operating cost.

Photo courtesy of Water Corporation.
Useful websites

Australian Trade Commission (Austrade)
austrade.gov.au

Australian Water Association
awa.asn.au

Enterprise Connect – Clean Technology Innovation Centre
enterpriseconnect.gov.au

Industry Capability Network
icn.org.au

waterAUSTRALIA
wateraustralia.org

Water Supplier Advocate
innovation.gov.au/SupplierAdvocates
Lake Eyre National Park, North Warburton River, South Australia.