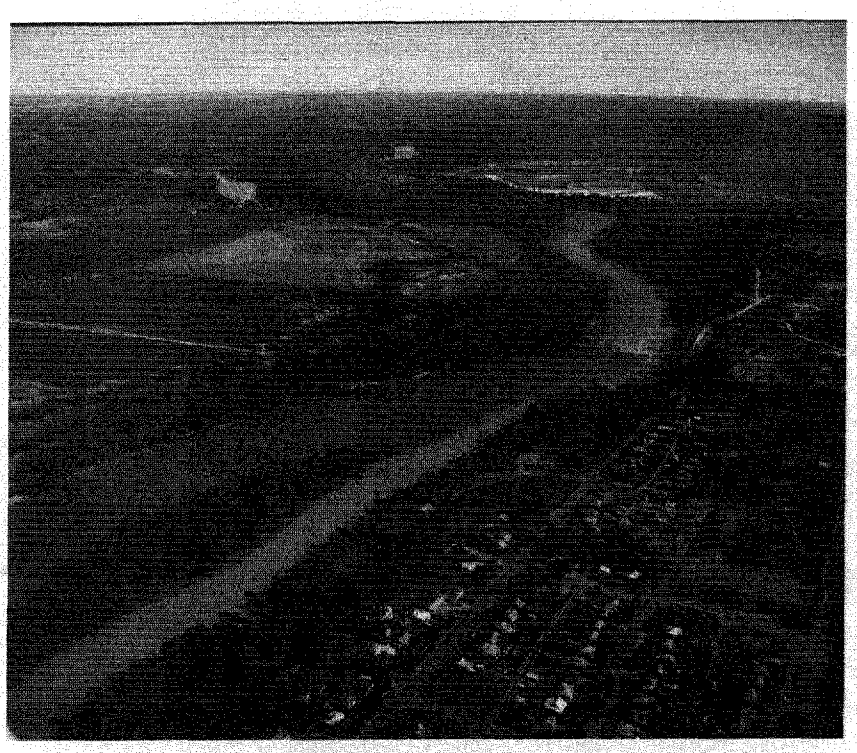
Department of
AGRICULTURE
FISHERIES &
FORESTRY –
AUSTRALIA

THE PROVISION OF FUTURE WATER SUPPLIES FOR AUSTRALIA'S RURAL INDUSTRIES AND COMMUNITIES



SUBMISSION TO THE HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON AGRICULTURE, FISHERIES AND FORESTRY

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on

THE PROVISION OF FUTURE WATER SUPPLIES FOR AUSTRALIA'S RURAL INDUSTRIES AND COMMUNITIES

by

AGRICULTURE, FISHERIES AND FORESTRY - AUSTRALIA

1. EXECUTIVE SUMMARY

The Role of the Commonwealth

The Commonwealth has played a significant role in the development of Australia's water resources through leadership, national coordination and financial assistance to the States/Territories. However, under Australia's constitution, the management of water and other natural resources lies with State and Territory Governments.

In the early 1990's the focus across Australia shifted from developing water resources to improving sustainability and efficiency of water use and managing water quality. Against this background, Commonwealth water policies aim to ensure that water resource management and use is sustainable, thereby securing for the long-term the resource base on which many rural industries and regions heavily depend.

The Commonwealth encourages sustainable water resource management by the States and Territories through a number of initiatives developed through the Council of Australian Governments (CoAG), the Natural Resource Management Ministerial Council and the Murray-Darling Basin Ministerial Council. The most notable of these are the CoAG agreement in 1994 to the Water Reform Framework, the Murray-Darling Basin (MDB) Agreement in 1992 and, more recently, the National Action Plan for Salinity and Water Quality (NAP) and the extension of the Natural Heritage Trust (NHT).

The Council of Australian Governments' Water Reform Framework

The CoAG Water Reform Framework was introduced in 1994, in both the urban and rural sectors, to address institutional issues required for an efficient, profitable and sustainable water industry, and to manage the environment and resource base that underpins many rural industries.

It addresses:

- water pricing;
- water property rights and trading, including the provision of water for the environment;
- environmental issues including water quality;
- institutional reform; and
- public consultation and education.

These reforms have brought about substantial changes to the way water is managed and used in Australia and has placed Australia at the forefront of international water management.

Progress by States and Territories against the CoAG reforms is annually assessed by the National Competition Council and is linked to substantial national competition payments. All States and Territories have implemented new or substantially amended legislation to reflect the reforms. However, the on-ground implementation of these new water management arrangements, particularly in terms of property rights and trading, is continuing. Further effort is still required if the full social, environmental and economic benefits of the reforms are to be realised.

Regional Initiatives

Addressing natural resource management issues, such as water, also requires integration at the regional scale to involve landholders and regional communities who are closest to the problems and the opportunities. Major initiatives include the National Action Plan for Salinity and Water Quality, the Natural Heritage Trust and the Murray-Darling Basin Initiative.

Water management is a key feature of each of these initiatives. Each of the initiatives rely on, and contribute to, the implementation of the CoAG reforms and are integral to achieving its aim of an efficient and sustainable water industry. These initiatives also focus on regional action by local communities to achieve regional outcomes against specified standards and targets.

The *National Action Plan for Salinity and Water Quality* (NAP) was endorsed by CoAG on 3 November 2000 and aims to improve water quality and combat the spread and effect of salinity in 21 priority regions across Australia. The Commonwealth has contributed $700 million to the National Action Plan, with matching funding from the States and Territories over a seven-year period. Both water quality and quantity are key issues being considered under the NAP, which will target investment on a regional basis to address regional issues. An important linkage for the NAP was the confirmation by States and Territories, in the NAP Intergovernmental Agreement, of their commitment to the CoAG water reforms.

In the 2001 Budget, the Commonwealth announced the Extension of the *Natural Heritage Trust* (NHT) for a further five years from July 2002, with additional funding of over $1 billion beyond the original funding of $1.5 billion over six years. Funding under the Trust is shared between four programs: Landcare; Bushcare; Rivercare; and Coastcare. The Rivercare Program will invest in activities that contribute to improved water quality and environmental flows in river systems and wetlands. The

Commonwealth has also committed to spend at least $350 million of Trust funds directly on measures to improve water quality over the five years to 2006-07.

A major focus of the *Murray-Darling Basin Initiative* is to encourage and support integrated catchment management (ICM), which considers the social, economic and environmental features of managing all aspects of the natural resource base (land, water and vegetation) in a coordinated manner.

An important focus of the Murray Darling Basin Initiative is the 'Cap' on surface water diversions in the Murray-Darling Basin system that was introduced in 1995 to prevent further environmental degradation in the Basin's river systems due to water extraction and to protect the security of allocations for existing water users. A review of the MDB Cap in 2000 found that while the Cap alone will not necessarily provide for sustainable ecosystems in the basin (as it was based on levels of extraction in 1995, not an assessment of environmental requirements), it has been an essential first step in achieving this outcome. Consequently, a major issue now confronting the Murray-Darling Basin States is the consideration of water recovery to address environmental needs of the River Murray.

Issues

The major issues associated with future water supplies relate to:

- progressing water reform, particularly of property rights, water trading and pricing;
- managing for a highly variable climate, including variable rainfall and runoff;
- maximising the use of the water available to us (water use efficiency);
- ensuring sustainable river and aquifer systems to support the quality and quantity of water available for the future; and,
- the risk management approach of the new drinking water quality guidelines.

Water reform

An effective set of institutional arrangements is a vital tool to encourage more efficient and sustainable use and management of our water resources. Institutional arrangements and instruments can significantly impact on how water is managed and used. In particular, effective property rights, trading and pricing regimes can increase the value placed on water, encourage investment to use this water more efficiently and allow water to move to less water intensive industries, ensuring that water is used appropriately and sustainably. The Commonwealth, through CoAG, is working with States/Territories to address property rights and water trading issues.

Water trading expanded rapidly in Australia during the 1990s and is delivering substantial economic benefits to Australian agriculture and other water users. Under the CoAG Water Reform Framework, States and Territories agreed to trading entitlements for water, independent from land, and cross-border trading within social, physical and ecological constraints. The establishment of a water trading market allows water to be treated as any other valuable business asset that can be traded to meet both seasonal and permanent farming demands. It can provide irrigators with greater flexibility for their business and farming practices, through, for example,

selling their water entitlement and leasing it back, which frees up significant amounts of capital previously tied up in a valuable water entitlement.

Impediments to trade still exist, including the uncertainty over long-term access to water rights, restrictions on permanent trade from irrigation districts and incompatibilities between the definitions and characteristics of rights between States. These issues are part of the CoAG's current consideration of water issues.

The CoAG water reform framework requires a number of reforms to water pricing regimes which have already been, or are in the process of being, implemented. For example, water users now generally pay, or are on a pathway to ensure that they will soon pay, the full cost of water service provision through a two-part tariff (ie a fixed supply charge and a variable volumetric charge). However, there are pricing issues, such as the capacity for prices to reflect the negative externalities of water use or capacity constraints, which have not yet been fully considered or resolved.

Climate variability

Compared to other continents, Australia is relatively dry in terms of overall rainfall and runoff and its climate is extremely variable. Extended dry periods and droughts are common occurrences affecting most agricultural areas at different times across Australia. Further, rainfall is unequally distributed over the continent, with only a small proportion (around 6 per cent) occurring in the Murray-Darling Basin.

As a result of Australia's highly variable climate, our per capita water storage is high compared to other countries. The high levels of storage are in order to manage for prolonged periods without rain.

Climate data must be long term in nature (to capture a representative sample) and be frequent enough to characterise the processes of interest. Scientific capacity to provide specialist forecasts is well developed and utilised.

Water use efficiency

An important opportunity to secure water supplies in rural areas is in improving the efficiency of water use. Efficiencies can be applied on-farm, in irrigation conveyance systems, throughout the manufacturing process and to other urban use.

Improving efficiency allows users to maintain production on reduced water availability or expand production without requiring an additional water allocation. The establishment of clear property right and trading regimes provides a clear economic incentive for water users to improve efficiency, as surplus water can now be traded to another user.

There are a range of strategies and technologies that can be applied to improve water use efficiency. These include improved monitoring and management practices, adoption of more efficient technology, and recycling and reusing water. Each of these strategies are being adopted in Australia and are encouraged by government water use efficiency programs.

The Commonwealth has also recognised the need to improve water use efficiency by making a call for ideas for water savings for rural Australia. The submission period closed on 13 June 2003, with more than 500 submissions being received.

Sustainable river and aquifer systems

In establishing water entitlements under the CoAG Water Reform Framework, jurisdictions agreed to allocate water to the environment and to legally recognise the environment as a legitimate user of water. As well as recognising the intrinsic value of the environment, the framework acknowledged that sustainable river systems enhance consumptive rights in the long-term though improved security of water supply.

Environmental allocations should be based on the water required to maintain the health and viability of surface and groundwater, calculated using the best available scientific information. Where river systems are stressed or over-allocated, jurisdictions have agreed to implement arrangements to ensure a greater balance in water resource use in order to restore the health of river systems. States have also made specific commitments to this in signing the Intergovernmental Agreement for the National Action Plan for Salinity and Water Quality.

The National Water Quality Management Strategy (NWQMS) contributes to sustainable use of the nation's water resources by establishing guidelines for communities and industries for the protection and enhancement of water quality while maintaining economic and social development. The *Guidelines for Freshwater and Marine Water Quality* and the *Water Quality and Monitoring Reporting Guidelines in particular* provide the benchmark for communities working with governments, under the National Strategy for Salinity and Water Quality, to develop regional catchment-based management plans.

Drinking water guidelines

The draft revision to the National Water Quality Management Strategy *Australian Drinking Water Guidelines* (ADWG) has identified a new framework that incorporates hazard identification, risk management and a multiple barrier system for the management of drinking water supplies. This framework is designed to protect drinking water quality from catchment to consumer by providing guidelines for managing the whole drinking water cycle. The Guidelines have received international recognition from the World Health Organisation as a viable and cost-effective system for providing drinking water in developing nations.

There is potential to use this approach to identify appropriate guidelines that could allow for the increased use of reclaimed and recycled water for agriculture.

Research and Development

The Commonwealth makes substantial investments in improving the science that supports the management of our water resources. This investment is made directly through the:

- Commonwealth Bureau of Meteorology;
- CSIRO Division of Atmospheric Research;
- Australian Research Council through the Cooperative Research Centres, including the recently announced CRC for Irrigation Futures;
- Natural Heritage Trust;
- Agriculture Forestry and Fisheries – Australia through the Bureau of Rural Science and the Research and Development Corporations; and
- Land and Water Australia.

The major vehicle for collaborative climate research for land management between the Commonwealth and external agencies for the last 10 years has been the Climate Variability in Agriculture Program (CVAP). For much of its history, CVAP has concentrated on developing and communicating better seasonal forecasts and has been instrumental in changing the 'mental map' of climate for many Australians. More recently, it has broadened its focus into managing stream flow variability.

Overall, scientific capacity to provide specialist forecasts is well developed and utilised. The use of simple indicators and assessment techniques has proved highly effective in assisting the policy environment.

This Submission

This submission outlines the role of the Commonwealth in water reform (Section 3) and the CoAG water reforms (Section 4) which establish the institutional framework for sustainable and efficient management and use of Australia's water resources.

It also highlights regional initiatives (Section 5) being used to deliver sustainable and efficient management and use of water resources on-ground particularly through the Murray-Darling Basin Agreement; the National Action Plan for Salinity and Water Quality and the Natural Heritage Trust. It provides an outline of research and development activities (Section 6).

Attachment A details issues and opportunities in water resource management in the future.

2. INTRODUCTION

Water is a fundamental resource in Australia and is essential to the continued viability of our urban and rural sectors, industries and agricultural production.

Australia is the world's second driest continent after Antarctica, with 75 percent of land arid and 40 percent desert. A further 10 percent is arid for much of the year and only 15 percent is well-watered.

Of the more than 23,000 gigalitres of water used in Australia every year, 70 percent is used for irrigation (90% in the Murray-Darling Basin), 21% for urban and industrial use and 9% for other uses.

Irrigated agriculture is highly valuable to Australia in both economic and social terms. While it uses only 0.4% of agricultural land in Australia, it accounts for $7.3 billion, or 25%, of the gross value of agricultural production. Products derived from irrigation, such as dairy, wine and fruit, attract investment in value-adding infrastructure, providing jobs and wealth for rural communities. It is likely that in Australia, as elsewhere in the world, irrigated agriculture will become increasingly important in food supply.

Cities and towns also depend on water supply from surface and groundwater resources. With very few exceptions, water supply is sourced from resources also providing water for agriculture, including irrigated agriculture. Increasing demand from small and large urban centres will impact on the water available for agriculture.

Many of Australia's water resources are now under significant pressure. Urban and industrial sectors are continuing to grow and overall water use has increased by 65 % since 1985. At the same time the agricultural sector is under pressure to reduce levels of extraction in areas of over allocation and allocate more water to the environment.

Effective management of our water resources is therefore vital to ensure the demands from urban, industrial and agricultural water users and the environment are balanced to ensure the sustainability of our rivers and protect our future water supplies.

This submission outlines the role of the Commonwealth in water reform (Section 3), and the CoAG water reforms (Section 4) which establish the institutional framework for sustainable and efficient management and use of Australia's water resources. It also addresses regional initiatives (Section 5) to deliver sustainable and efficient management and use of water resources on-ground particularly through the Murray-Darling Basin Agreement; National Action Plan for Salinity and Water Quality and the Natural Heritage Trust. Section 6 provides an outline of the research and development activities relevant to water resources.

3. THE ROLE OF THE COMMONWEALTH IN WATER RESOURCE MANAGEMENT

Under Australia's system of government, the management of water resources and other natural resources lies with the State and Territory Governments. However, river basins, groundwater aquifers and biophysical regions are not bound by State and Territory boundaries.

Until the early 1990s, Australian governments focused on developing water resources through large scale dam construction and the development of irrigation systems in an attempt to develop and "drought-proof" industries and communities and support its major urban centres. This was characterised by intense competition between States for development to attract investment. In the past, the Commonwealth played a significant role in promoting this regional development through provision of financial assistance to the States for water resource infrastructure. This development led to a high utilisation of water resources for production over time, particularly in the Murray-Darling Basin, which contributed to a decline in water quality, environmental health and security for irrigators.

Since the 1980's issues of environmental health, sustainability, water availability and water quality uses have emerged as significant issues. Commonwealth policy now encourages the development of sustainable water resources management by State and Territories through initiatives developed through the Council of Australian Governments (CoAG), the Natural Resource Management Ministerial Council (made up of Australia's natural resource and environment ministers) and the Murray-Darling Basin Ministerial Council (comprising environment, natural resource and agriculture ministers from New South Wales, Victoria, South Australia, Queensland, Australian Capital Territory and the Commonwealth). The most notable examples of this approach are the CoAG agreement in 1994 to the Water Reform Framework and the Murray-Darling Basin Agreement in 1992, which enabled the implementation of the Murray-Darling Basin Cap in 1996.

The Commonwealth has also provided financial assistance on a matching basis with the States/Territories through the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality. These programs address a range of natural resource management issues including the sustainable management and use of water resources. The emphasis of these programs is on regional delivery mechanisms with regional communities responsible for planning and action.

The Commonwealth is responsible for the implementation of international conventions to which Australia is a party, such as the Convention on Wetlands of International Importance (Ramsar Convention). The Ramsar Convention aims to halt the worldwide loss of wetlands of international significance and to conserve those that remain through wise use and management. This requires international cooperation, policy making, capacity building and technology transfer. Australia has 57 wetlands that are recognised as being of international significance under the Convention.

The *Environment Protection Biodiversity Conservation Act (1999)* (EPBC Act) gives the Commonwealth jurisdiction where there are environmental issues of national

environmental significance. Actions likely to have a significant impact on matters of national environmental significance are subject to an assessment and approval process, initially undertaken by the State or Territory government. An action includes a project, development, undertaking, activity or series of activities.

The EPBC Act identifies six matters of national environmental significance. These include: World Heritage properties, Ramsar wetlands of international significance; nationally listed threatened species and ecological communities; listed migratory species; and Commonwealth marine areas.

3.1 Agriculture, Fisheries & Forestry – Australia

Agriculture, Fisheries and Forestry – Australia (AFFA) is the Commonwealth Department responsible for natural resource management and water issues. The role of the Department is to help the Government to achieve its policy objectives and administer legislation in these areas by contributing to the following:

> *Australian agricultural, fisheries, food and forestry industries that are based on the sustainable management of and access to natural resources, are more competitive, self-reliant and innovative, have increased access to markets, are protected from diseases and are underpinned by scientific advice and economic research.*

3.1.1 Enhancing the Natural Resource Base

AFFA's responsibilities include activities which enhance the natural resource base on which portfolio industries rely. In particular

> *To advance the sustainable use and management of and security of access to Australia's land and water resources, fisheries and forests through the provision of high quality and timely policy advice and services and the efficient delivery of effective programs, and stakeholder consultation and collaboration.*

Key areas of activity related to water include:

- developing national policy frameworks, such as strategies and agreements, for achieving sustainable resource management and use;
- providing a suite of information products and tools to enhance the management of Australia's natural resources and to support Australian objectives in international climate change negotiations;
- building the information bases necessary for natural resources management through products and processes which integrate economic, scientific, social and environmental information in a consistent and transparent manner and which provide a sound, factual basis for communication amongst stakeholders in natural resource management;
- developing policy frameworks for assessing and reconciling differences among competing resource users including frameworks which promote an improved understanding of the costs and benefits of different resource management options;

- ensuring Portfolio and Commonwealth priorities and perspectives are taken into account in policies and strategies related to natural resources that are developed outside the Portfolio both domestically and internationally;
- promoting and facilitating the adoption of sustainable natural resources management by administering programs;
- developing initiatives such as management arrangements defining property rights to ensure reasonable and secure access to resources for resource based industries in particular forestry, fisheries and irrigated agriculture; and

AFFA works cooperatively with Environment Australia (EA) and the Department of Transport and Regional Development (DOTARS) to deliver reforms consistent with their responsibilities and through cooperative action. In particular, the management of the NHT and the NAP are joint responsibilities with EA.

AFFA has Commonwealth responsibility for the oversight of State implementation of the CoAG Water Reform Agenda. It liaises closely with EA who have responsibility for the environment and DOTARS who have an interest in regional impacts of water reform and the participation of rural communities in planning and development.

AFFA also works with State and Territory Governments to manage its responsibilities for natural resource management through Natural Resource Management Ministerial Council processes.

Cooperation between jurisdictions in recent years has produced a range of comprehensive guidelines, recommendations and other policy documents relating to water management and water quality, for example: *A National Framework for Improved Groundwater Management in Australia; A National Approach to Water Trading; National Principles for the Provision of Water for Ecosystems;* and *A National Framework for the Implementation of Property Rights in Water.* There are opportunities for further work through the Natural Resource Management Ministerial Council to develop similar guidelines for emerging issues in the future.

3.1.2 The Bureau of Rural Sciences (BRS)

The BRS is the scientific bureau within the AFFA. Its objective is to deliver effective, timely, policy-relevant advice, assessments and tools for decision-making on profitable, competitive and sustainable Australian industries and their supporting communities. Within BRS there are nine programs covering a wide range of scientific disciplines and subject areas. These include a Water Sciences program and a Climate and Agricultural Risk unit.

The Water Sciences program provides scientific advice on water resources, including support for CoAG water reforms. The Program uses tools such as mapping, GIS-based data analysis, numerical modelling and hydrochemistry to assess regional groundwater systems, water quality, sustainable yield and recharge rates, and environmental issues such as chemical contamination, salinity and acidity. The Program has published extensive reports on the Great Artesian Basin (GAB), which underpin the GAB Sustainability Initiative.

The BRS Water Sciences and other programs work in association with other parts of AFFA and various State and other jurisdictional organisations to assist in the development of water policy that has a sound scientific basis, through, for example representing the Commonwealth on government committees requiring technical expertise. The BRS also provides input into technical standards and other documents produced through the NRM Ministerial Council and its predecessors.

The Climate and Agricultural Risk (CAR) unit specialises in the analysis and characterisation of risk factors impacting on Australian agriculture at regional scales. In characterising risk, CAR considers climate and wider 'landscape' factors such as topography, soils, drainage, ecology and sustainability so that the analysis is placed in a meaningful context.

In relation to water resources the BRS focuses on the following areas:

- provision of scientific advice to Commonwealth areas of water policy and management, including Ministerial advice, and representation on behalf of the Commonwealth on multi-jurisdictional committees (eg within the Murray-Darling Basin Commission);
- scientific support in the development, review and assessment of natural resource management programs such as the National Action Plan on Salinity and Water Quality and the Natural Heritage Trust. This includes technical review of catchment management plans, monitoring guidelines and performance indicators;
- carrying out the scientific component (eg hydrology, social sciences) of water-related Commonwealth programs such as assessments of Exceptional Circumstances as part of the Commonwealth Government's Agriculture Advancing Australia program;
- undertaking scientific projects, collaboratively with other agencies such as State water agencies, focusing on implementation of the CoAG Water Reform Framework; and
- involvement in collaborative water-related projects that are cross-border or national in scale, such as development of national guidelines or standards, or work in multi-scale catchments or groundwater basins.

3.1.3 Australian Bureau of Agricultural and Resource Economics (ABARE)

ABARE is the Bureau within AFFA responsible for provision of economic policy analysis and forecasts to enhance the competitiveness of Australia's agriculture and resource industries and the quality of the Australian environment.

The work of ABARE makes a significant contribution to AFFA and government and resource commodity industry stakeholders through the conduct of high-level policy and economic research. This is achieved by providing economic policy analysis and forecasts. ABARE has made a separate submission that provides more details about their key priorities and activities.

4. CoAG WATER REFORM FRAMEWORK

The CoAG Water Reform Framework was introduced in 1994 with the aim of achieving an efficient and sustainable water industry, in both the urban and rural sectors, and arrest widespread natural resource degradation. The Framework links economic and environmental issues within an integrated reform package. The major elements of this package are:

- water pricing regimes based on the principles of full cost recovery and consumption based pricing;
- separation of water property rights from land title;
- providing for permanent trading in water entitlements;
- specific provisions of water for the environment;
- water service providers to operate on a commercial basis ;
- Improved institutional arrangements, separating water the water service provision role from the roles of water resource management, standard setting and regulatory enforcement;
- public consultation and education; and
- new water infrastructure developments, and extensions to existing developments, to be undertaken only after they have been shown to be both economically and environmentally viable.

The Framework is a joint Commonwealth and State initiative with States and Territories responsible for implementation of the framework by 2005-2006. The reforms are critical to future water supplies as they provide the institutional framework that enables governments, suppliers and users to maximise the benefits of water available for use. The reforms are aimed to ensure that water management and use is sustainable, thereby ensuring water is available for industry and communities in the long term.

National Competition Policy

In April 1995 all Australian Governments reached agreement on a National Competition Policy (NCP) for Australia. The NCP is a package of microeconomic reforms relating to essential infrastructure facilities, pricing principles, fair competition between government and private sector business and structural reforms to the gas, electricity, water and road transport industries. Implementation of the requirements of the CoAG Water Reform Framework was incorporated into the NCP at that time. The National Competition Council (NCC) was established to assess the progress of jurisdictions in implementing the NCP reforms and makes recommendations to the Treasurer as to whether full National Competition Policy payments should be made.

The provision of payments to jurisdictions has been a key driver of the NCP reforms, including water. While the funds are not hypothecated directly to specific actions or reforms, suitable progress across all reform areas is required for jurisdictions to receive full competition payments. Progress with water is a key element and has led to a number of payment suspensions and reductions during the course of the reforms.

The National Competition Council 2002 assessment of State progress on water reform was released on 6 December 2002. The NCC recommended that all jurisdictions receive their full National Competition Policy payments, except Queensland who were penalised $270,000 over their failure to implement two-part tariffs (a fixed supply charge and variable volumetric charge) for urban water supplies in Townsville. The Treasurer accepted these recommendations and competition payments were adjusted accordingly.

The following discussion outlines the major reforms under CoAG and their status according to NCP assessments and other relevant Government processes. Further discussion on these issues is under Section 6 of this document "Opportunities, Threats and Challenges".

4.1 Pricing (urban and rural)

Historically, water charges to both urban and rural water users did not reflect the full cost of building and maintaining infrastructure, such as dams and weirs, or repairing the environmental damage of water use. Investments in rural water infrastructure schemes have often been heavily subsidised by governments, and pricing did not reflect different patterns of water consumption by different users, industrial and commercial users of water. The low cost of water provided little incentive for efficient water use or for consideration of the economic and environmental consequences of water use. In fact, the use of pricing mechanisms was seen as an important demand management tool.

Under the CoAG Water Reforms, jurisdictions have agreed to a range of new policies for both urban and rural water pricing in Australia. These policies are:

- consumption-based pricing;
- full-cost recovery;
- removal or transparent reporting of cross-subsidies;
- disclosure of community service obligations; and
- adoption of two-part pricing tariffs.

Through consumption-based pricing, consumers are charged for the volume of water used rather than a flat rate for water supply. Most urban water providers have introduced 2-part tariffs, which comprise a fixed access component for the cost of supplying the water to the consumer and a volumetric cost component to reflect the quantity of water actually used. Consumption-based pricing is intended to encourage more efficient water use by providing consumers with the opportunity to reduce the size of their water bill.

In order to achieve full-cost recovery, water businesses need to set water prices between what is known as the 'upper' and 'lower' bounds. The lower bound sets a minimum threshold that should be recovered for a water business to be defined as viable. The upper bound was set to avoid water providers from recovering monopoly rents. These bounds are:

Lower Bound

- at least the operational, maintenance and administrative costs, externalities, taxes or equivalents, interest costs on debt, dividends (if any) and make provision for future asset replacement or refurbishment.

Upper Bound

- not more than the operational, maintenance and administrative costs, externalities, taxes or equivalents, provision for the cost of asset consumption and cost of capital

In a number of jurisdictions, water prices are set by independent pricing regulators, such as the *Independent Pricing and Regulatory Tribunal* in NSW.

The removal, or transparent reporting, of cross-subsidies under the Water Reforms ensures water provisions are equal for all groups of customers, both domestic and business. Water can be provided to customers with special needs at less than full cost under a community service obligation (CSO), but this must be transparently reported.

Overall the National Competition Council was satisfied that States and Territories implementation of pricing reforms in the rural sector met at least the minimum CoAG requirements in the 2002 assessment. Progress by jurisdictions in rural water pricing includes reporting of cross-subsidies and CSO's, recovery of externalities through levies charged by Water Management Boards and frameworks for assessing the viability of new rural water schemes.

In its assessment, the Council identified a number of concerns that it will investigate in future assessments. These included:

- incorporation of externalities associated with water supply and use into pricing policies, for example through a levy on water consumption;
- the need to recover the cost of taxes or tax equivalent regimes;
- concerns about the high rates of returns generated by some water providers; and the need for further identification and elimination of subsidies.

It should be noted that in NSW, once bulk water is sold to irrigation water providers, the Government has no control over the pricing regime. However it is in the best interests of the irrigation authorities, as private companies, to pass on the costs to end-users. NSW accounts for 58% of water diverted for irrigation in the Murray-Darling Basin (MDB), although not all of this is distributed through irrigation water providers.

4.2 New Rural Water Infrastructure Schemes

Under the CoAG Water Reform Framework, investment in water infrastructure schemes or extensions to existing schemes is to be undertaken only after it can be shown to be economically viable and ecologically sustainable. This policy aims to ensure that government subsidies for uneconomic projects are removed, future generations do not have to pay the consequences of poor investment decisions and environmental impacts are recognised.

Following the 1999 NCC assessment, 25 per cent of the Queensland Government's second tranche competition payment was suspended over the proposed development of the St George Off Stream Storage. This scheme did not subsequently proceed and suspended payments were later paid.

4.3 Water Property Rights

Water property rights may refer to either water entitlements or water allocations:

- water *entitlements* are in the form of a licence or access right, which allows a holder access to a certain amount of the total pool available for consumption, provided certain responsibilities are met. This is commonly known as a water property right.

- water *allocations* are, in effect, the annual interpretation of the entitlement based on seasonal water availability. Allocations are determined as a function of both the entitlement (property right) and the relevant water allocation plan.

Historically, water property rights, or entitlements, have been tied to land and were often unclear in terms of quantity and security of water supply. Under the CoAG Water Reform Framework, States and Territories have agreed to implement comprehensive systems of water allocations or entitlements backed by separation of water property rights from land title and clear specification in terms of ownership, volume, reliability, transferability and, if appropriate, quality.

For efficient trade, use and investment, buyers and sellers need a clear understanding of what the water property right actually is. In 2001, the National Competition Council noted that efficient trade, use and investment requires that water rights be well specified in terms of both the nature of the right and ownership. According to the NCC, the right needs to be well specified in the long-term and the benefits and costs associated with the use of the right must be exclusive to the owner of the right. Ultimately, a right needs to be sufficiently secure to allow for efficient use, management and lending. The formal determination and clear specification of water property rights established under the CoAG Water Reforms will, if implemented properly, provide greater certainty regarding security of water supply and create a tradeable and bankable asset which can enable sound business investments to be made and protect the integrity of the water resource.

The National Competition Council's 2001 assessment of State and Territory's progress in implementing National Competition Policy concluded that all jurisdictions, with the exception of New South Wales, met the requirements for property rights under the Water Reform Framework. The assessment found that while New South Wales had generally achieved sound progress there was insufficient information available to be certain that the water property rights obligations had been fully addressed. In particular, the Council recommended that a water entitlement registry system should be implemented by New South Wales as a priority. A registry system provides a record of ownership of water entitlements, including the share of available of water to which the owner is allocated, and information on third party interests, such as banks or other mortgagors.

To address this issue, the Council conducted a supplementary assessment in January 2002 of New South Wales' progress. The supplementary assessment concluded that New South Wales is developing a sound model for a water entitlements register, in consultation with stakeholders, and has addressed the concerns raised by the Council in the June 2001 assessment.

As a result of changes to State water legislation there is widespread uncertainty over the ongoing level of access that users can expect, and the conditions under which this access may be granted. The Council noted that the implications of changes to water property rights for investment and the impacts of the changes on water users, particularly farmers, needed to be considered, but did not make strong statements regarding the efficacy of property rights regimes, including compensation and trading.

This is consistent with their previous assessments that found that the legislative systems in place in all jurisdictions met the requirements of the CoAG reforms. The NCC, however, can only assess States and Territories on the basis of the 1995 National Competition Policy Agreement which takes a principle based approach rather than an outcome based approach. States are required to address specified characteristics of property rights, but little guidance was given by CoAG on how those characteristics should be addressed. This has led to separate processes in each jurisdiction for water property rights.

Water property rights and trading issues are to be considered again by the NCC in 2004.

In response to widespread community concern over declining security of water property rights as a result of State government reform, the Commonwealth raised the issue of water property rights at the 5 April 2002 meeting of CoAG, where it was noted water has been a key driver in regional and national development. The CoAG also noted that substantial progress is being made on the national water reforms and that water management is currently in a transition phase as jurisdictions implement new water allocation arrangements. The CoAG stated that there needs to be consideration of the implications of changes to water property rights for investment and the impacts of the changes on water users, particularly farmers.

In order to clarify these issues, jurisdictions agreed to report to CoAG on opportunities and impediments to better define and implement water property rights regimes (including water trading markets and, where appropriate, the responsibilities of water users) and how they are addressing uncertainties.

The Chief Executive Officers' Group on Water (CEOs' Group) was established to provide strategic input to assist jurisdictions in the transition to more sustainable water management. It examines issues relating to water rights, trading and pricing in the context of environmental flows, river health and community development and adjustment.

The CEOs' Group, with representatives from key jurisdictions and the Commonwealth, provided a paper on water property rights to CoAG. The paper

outlines principles to address property rights, water trading and structural adjustment. At its meeting of 6 December 2002, CoAG noted progress on water reform in all jurisdictions and reaffirmed commitment to those reforms as set out in the 1995 National Competition Policy Agreement. It also drew particular attention to the need to clarify water property rights, especially to deal with the tension between establishing certainty for irrigators and the need for adaptive management to address environmental needs. CoAG also noted that the national principles on water allocation and entitlements developed by the CEOs Group on Water are broadly consistent with the 1995 Agreement and agreed to the release of this reform for a consultation process with key stakeholders and to finalise this report by April 2003.

The consultation process resulted in 50 written submissions and meetings with key stakeholders in 6 locations across the country. This paper is available at www.affa.gov.au (Select Natural Resource Management from Output menu – go to Hot Topics: Water Property Rights) and a copy is attached to this submission for information. Actions arising from the CEO Group on Water report will be a matter for future CoAG consideration.

The report covers all water resources, including surface and groundwater and recognises that there are a wide range of users and beneficiaries of water resources as well as areas of the community, including indigenous interests that are affected by decisions on water management. The report addresses the impediments to implementing reforms arising from the transition to a more sustainable water management regime in the irrigation sector. It aims to reinforce and realise the economic benefits that can come from a nationally consistent approach to the efficient and sustainable use of water.

The approach proposed by the CEOs Group is to provide greater certainty for business investment and the environment through governments:

- adopting common principles for water access entitlements;
- providing guidance for adjustment assistance where existing users may be severely affected by the transition; and
- ensuring that the market can operate in a sufficiently open way so that it enables adjustment of allocations between users.

The report does not set out to provide detailed solutions but provides a set of high level principles and guidelines which, if adopted by CoAG, will provide the community with the confidence and clarity of intent of government at the highest level.

4.4 Water Trading

Water trading is an important tool in achieving sustainable management as it encourages use of water for the most valuable or profitable purpose. Water trading is one way of generating higher economic growth arising from implementation of effective water reforms. Additionally, water trading creates a value for water on the trading market and allows the transfer between users of water that is no longer required by an entitlement holder.

Previously water entitlements were tied to land, in order to purchase water the associated land would also need to be purchased. Regulation, not price, was the major factor in the allocation of water among competing users, and restrictions were placed on transferable entitlements. Currently, water and land entitlements are being separated in States and Territories, and increasingly water entitlements can be traded independently of land.

Under the CoAG Water Reform Framework, States and Territories agreed to trading, including cross-border trading of entitlements for water, independent from land, and within social, physical and ecological constraints. The establishment of a water trading market allows water to be treated as a valuable business asset which can be traded to meet both seasonal and permanent farming demands (temporary or permanent trading is possible). It can provide irrigators with greater flexibility for their business and farming practices.

While volumes of temporary trades have been significant over the last decade, permanent trade remains limited. This has been for several reasons, including the uncertainty over long-term access to water rights, restrictions on permanent trade from irrigation districts and incompatibilities of rights between different States. Under the current drought conditions, some irrigators have not had sufficient allocation to grow a crop, so temporary trade has enabled them to earn some income from the water available to them. In other cases, irrigators would receive a greater income from temporarily trading their water allocation than they would have from growing a low-value, water intensive crop.

The establishment of cross-border trading has enabled the transfer of water between catchments, jurisdictions and sectors. The Murray-Darling Basin Ministerial Council has established a Pilot Interstate Water Trading Project to facilitate and promote the interstate transfer of water entitlements and to improve the efficiency and effectiveness of consumptive water use in ways that facilitate sustainable production and do not increase or accelerate environmental degradation. The project aims to establish and improve existing procedural frameworks and standards to demonstrate that the Pilot Project is accountable and does not result in increased levels of salinity, reductions in environmental flows or degradation of the natural environment.

The framework for licensing of water entitlements and for trading is established in State and Territory water legislation. The last National Competition Council assessment raised concerns that provisions in the legislation of some States and Territories inhibits trade, for example by limiting the volume of water that can be traded between districts.

The CoAG resolution of 5 April 2002 also recognised the importance of ensuring the effective operation of water trading markets. The report developed by the CEO's Group on Water and being revised following stakeholder consultations seeks to develop common frameworks to guide the operation of markets, so as to improve flexibility of allocation between users.

4.5 Environment and Water Quality

Many of Australia's rivers and aquifers are stressed due to over-allocation and over-extraction, leading to degradation of water resources, reduced supply reliability and economic losses. Water resource degradation impacts on the usability of water and the ability to meet current and future demands for water.

In establishing water entitlements under the Water Reform Framework, jurisdictions agreed to allocate water to the environment and to legally recognise the environment as a legitimate user of water. These environmental allocations should be based on the water required to maintain the health and viability of surface and groundwater, calculated using the best available scientific information. Where river systems are stressed or over-allocated, jurisdictions have agreed to implement arrangements to ensure a greater balance in water resource use in order to restore the health of river systems.

The framework for water allocation to the environment is established under State legislation and implemented through regional or catchment plans, using the same mechanisms as water allocations to consumers, although environmental water is usually a prior, or first priority, right. Outcomes of these policies include restored biodiversity, reduced salinity, improved water quality and recreational tourism advantages. Sustainable river systems also enhance consumptive rights in the long-term though improved security of water supply.

While generally satisfied with implementation of water quality reforms, the National Competition Council highlighted the insufficient progress by some jurisdictions on meeting commitments to allocations for the environment, especially for over-allocated or stressed river systems, the level of farm dam development and a lack of transparency in developing water resource plans.

4.5.1 National Water Quality Management Strategy

The objective of the National Water Quality Management Strategy (NWQMS) is helping achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development.

One aspect of the Strategy is the development of National Water Quality Guidelines, in consultation with Commonwealth and State agencies, industries and the general community. Currently 19 of the 21 guidelines have been published, covering effluent and sewerage system management, urban stormwater, drinking water quality, fresh and marine water quality and groundwater protection. The two remaining documents yet to be published are related to sewerage systems and deal with overflow and biosolids management.

The National Water Quality Management Strategy (in particular the *Guidelines for Freshwater and Marine Water Quality* and the *Water Quality and Monitoring Reporting Guidelines)* provides the water quality benchmark for communities working with governments, under the National Strategy for Salinity and Water Quality, to develop regional catchment-based management plans. The adoption of

nationally consistent guidelines provides a shared national objective, while local implementation allows for flexibility to respond to regional and local differences.

New management techniques coupled with technological advances led to a decision by ARMCANZ, ANZECC and the National Health and Medical Research Council to undertake a rolling revision of the NWQMS *Australian Drinking Water Guidelines*, which were published in 1996.

The Australian Drinking Water Guidelines now focus on a new framework for managing drinking water quality by developing a multiple barrier/preventive risk management approach. This approach concentrates on managing the water supply system from catchment to consumer introducing a multiple barrier system to protect drinking water supplies. The Guidelines have received international recognition from the World Health Organisation as a viable and cost-effective system for providing drinking water in developing nations.

There is potential to use this approach to identify appropriate guidelines that could allow for the increased use of reclaimed and recycled water for agriculture.

4.6 Institutional Arrangements

In the past, the State agency responsible for allocating water was also the water provider and regulator. This resulted in a lack of clear roles and responsibilities in water management and supply, with the potential for conflicts of interest.

The Water Reform Framework requires separation of the water service provision role from the roles of water resource management, standard setting and regulatory enforcement, with each role being undertaken by separate agencies. In addition, water service providers, particularly those in metropolitan areas, should operate with a commercial focus and local bodies should have greater responsibility for the management of irrigation areas.

These institutional reforms aim to clarify the roles and responsibilities in relation to water supplies, enable organisations to focus on their core business, establish accountability and transparency, minimise conflicts of interest and ensure transparent and independent price setting.

States and Territories are continuing to implement institutional reform through new and updated legislative frameworks, transfer of responsibility for price setting from government to private industry, establishment of independent bodies as economic regulators of the water industry and establishing local management within irrigation districts.

While the National Competition Council was generally satisfied with the progress of States and Territories in implementing institutional reform, it had some concerns about the transparency of price setting and water provision in a number of jurisdictions.

4.7 Consultation and Education

The Water Reform Framework states that government agencies and service deliverers should undertake public consultation where any changes or new initiatives are being considered involving water resources.

All jurisdictions have agreed to develop public education programs in relation to water use, and the benefits of water reform. In particular, water agencies should work in cooperation with education authorities to develop a range of water resource materials for use in schools.

States and Territories have adopted a range of mechanisms to implement the consultation and education reforms. For example, considerable public and stakeholder consultation has been carried out during the development of water management legislation to implement the water reforms, and stakeholder advisory groups have been established in a number of jurisdictions. Public education in relation to water reform and water conservation is being conducted through information websites, public reports, participation in Waterwatch and National Water Week and various State Government programs.

In its June 2001 Assessment, the National Competition Council was satisfied that all States and Territories have met the requirements of the consultation and education reforms. The Council noted that conflicts of interest needed to be avoided where service providers are also responsible for public education programs addressing water conservation. It recommends that responsibility for public education lie with government agencies, not with the service provider.

Wider consultation by governments and water service providers ensures there is sufficient information on which to base water resource management decisions. There is also a greater likelihood of these decisions being agreed to by interest groups. Informing the public on the benefits of the water reforms means the reforms are more likely to be accepted by consumers.

5. REGIONAL INITIATIVES

The emphasis of the CoAG Water Reform Framework is on institutional reform to support market-determined outcomes and improve sustainability of water use and management. However, institutional reform is insufficient by itself. Addressing natural resource management issues requires integrated action at the regional scale and must involve those closest to the problems and opportunities - landholders and regional communities. Although issues of water quality, scarcity and salinity are common across the Australian landscape, regions vary biophysically, socially and culturally, engendering a range of possible responses to the social, economic and environmental values and threats they face.

In 1999 the Commonwealth and State and Territory Governments outlined a new national approach for Natural Resource Management through the discussion paper *Managing Natural Resources in Rural Australia for a Sustainable Future*. This paper recommended a strategic, regional and partnership approach to address the ongoing challenges facing Australia's threatened resource base. Specifically, it

suggested investing funding at a regional scale and devolving greater authority to regional bodies.

The new strategic regional and partnership approach which was adopted by the Commonwealth Government as part of the *National Action Plan for Salinity and Water Quality* represents a new development in the way natural resource management programs are delivered.

Major regional initiatives in addition to the National Action Plan for Salinity and Water Quality include the Natural Heritage Trust, the Murray-Darling Basin Initiative, the Great Artesian Basin Sustainability Initiative and the Lake Eyre Basin Intergovernmental Agreement. These programs will deliver the CoAG Water Reforms in the regions through greater sustainability and efficiency in water management and use.

5.1 National Action Plan For Salinity And Water Quality

Research from the National Land and Water Resources Audit shows that 5.7 million hectares of Australia are at risk or affected by dryland salinity. The degradation of natural capital through salinity carries a high economic and social cost to Australia. These costs are evident in lower agricultural yields, higher costs of production, damage to infrastructure from salinity and expenditure on land rehabilitation.

The National Action Plan was endorsed by CoAG on 3 November 2000 and aims to improve water quality and combat the spread and effect of salinity in 21 priority regions across Australia. The Commonwealth has contributed $700 million to the National Action Plan, with matching funding from the States and Territories over a seven-year period. Agreements between governments have been established in an overarching Intergovernmental Agreement and further detailed in bilateral agreements between the Commonwealth and most States and Territories. The National Action Plan is jointly implemented by AFFA and Environment Australia.

The National Action Plan is based on five key elements:

- integrated action at the regional scale;
- strategies developed and implemented by landholders/regional communities;
- strategic efforts and investments with clearly defined targets;
- better monitoring and evaluation and assessment tools; and
- improved governance framework to secure investments and institutional frameworks for natural resource management.

In the Intergovernmental Agreement (IGA) on the National Action Plan for Salinity and Water Quality, the Commonwealth and the States/Territories agreed on the need for an improved policy framework, including clarifying property rights, establishing appropriate pricing of water and introducing regulatory reforms for water and land use, to secure government investments and to motivate best practice in land and water resource management.

Jurisdictions have also agreed to cap, by January 2003 or as otherwise agreed, extractive use of water from all surface and groundwater systems that are over-

allocated or approaching full allocation. It is a requirement that all catchment and regional plans developed under the National Action Plan include an agreed timetable and strategy to implementing these caps. Strategies may include reducing ground and surface water allocations or investing in projects that increase water use efficiency. In addition, jurisdictions agreed to remove impediments to the effective operation of trading markets in both surface and groundwater systems. Commitments on land and water reforms have also been made through bilateral agreements with the States and Territories.

The National Action Plan recognises that, in order to address water quality, salinity and the associated biodiversity issues in a particular region, regional NRM plans should address the harder adjustment and property amalgamation issues which could have significant impacts on regional communities. Under the National Action Plan States and Territories have prime responsibility in this area, but given the national significance of these issues and the potential for substantial costs, the Commonwealth has indicated it is prepared to consider a contribution towards appropriate compensation to promote adjustment.

5.2 Natural Heritage Trust (NHT)

At Commonwealth level, the NHT is jointly managed by AFFA and EA. The first phase of the Natural Heritage Trust (1996/97 to 2001/02) addressed a broad range of land, water and biodiversity issues. It included programs specifically addressing river health and water quality issues.

In the 2001 Budget, the Commonwealth announced the extension of the Natural Heritage Trust (NHT) for a further five years commencing July 2002, with additional funding of over $1 billion.

The focus of the Trust is through four programs. These are Landcare, Bushcare, Rivercare and Coastcare.

A particular proposal under the NHT is work with the Victorian Government on the Wimmera-Mallee pipeline. The Commonwealth has contributed $3.885 million for a detailed design study for a project which would potentially save 103,000 ML of water per year currently lost through evaporation and seepage associated with 17,500 km of open earthen channels across the Wimmera and Mallee regions.

5.3.1 Rivercare

The Rivercare component of the NHT is of particular relevance to the long-term sustainability of water resources and the availability of water for human uses.

- improved water quality in rivers and streams, and in coastal and estuarine environments affected by river systems;
- improved resource security and sharing arrangements between the environment, human uses and industries;
- sustainable and productive land and water management systems, including:

  - caps on the extractive use of water from all surface and groundwater systems that are over-allocated or approaching full allocation, and a strategy and timetable for meeting the caps;
  - removal of impediments to the effective operation of trading markets in, and integrated management of, both surface and groundwater systems;
- improved water use efficiency and re-use;
- improved adoption of clean wastewater and stormwater systems;
- protection, conservation and restoration of wetland systems;
- conservation of the biodiversity of aquatic and riparian systems;
- restoration of important fish migration routes through such activities removal of barriers and the construction of fish passage devices;
- protection of priority in-stream, riparian and floodplain habitats, including Ramsar sites, nationally significant wetlands and migratory water bird habitat;
- reduction in inputs of nutrients, sediments and other pollutants into waterways and groundwater;
- reduced impact on water quality and biodiversity from feral animals and weeds;
- prevention or control of the introduction of aquatic pests and weeds and reduction of their ecological and economic impact;
- engagement of the community in monitoring and protecting Australia's waterways, wetlands and groundwater;
- improved awareness, understanding and support among the wider community of the need for sustainable water management and aquatic biodiversity conservation;
- development of data collection, information, research and skills to support decision making; and
- improved and integrated management of aquatic systems, rivers, streams, wetlands and groundwater and their associated environments as a single integrated resource, while not discounting the special requirements of any aspect of that resource.

Linkages between National Action Plan for Salinity and Water Quality and the Natural Heritage Trust

Trust funding will be available across Australia and will cover the range of Trust priorities. The National Action Plan provides substantial additional support for the salinity and water quality outcomes in the 21 priority regions.

In general, where NHT investment occurs in National Action Plan regions, integrated delivery processes are to be used when possible. For example a single integrated accredited plan will be used to target investment and monitoring. To assist this integration, the Commonwealth has recently moved to considerably expand the Joint AFFA/EA team responsible for delivery of the NAP to deliver the Trust extension at the regional level.

5.3 The Murray-Darling Basin Initiative

The Murray-Darling Basin (MDB) is the catchment for the Murray and Darling Rivers, and their many tributaries. Crossing four States and the ACT, the Basin provides an important source of fresh water for domestic, agricultural and industrial consumption.

Average annual run-off into the Basin is around 24,000 GL. The Basin is also currently guaranteed annual inflows of 2,088 GL from the Snowy Mountains Scheme. Average annual diversions from the Basin's rivers for both urban and agricultural uses are approximately 11,000 GL. These diversions include supplementary water supply to Adelaide and other South Australian towns outside the Basin.

The MDB has a population of 2 million and an economic output of $23 billion per annum of which agricultural output is $10 billion a year. The basin contains almost three quarters of all irrigated land in Australia. However, it is facing issues in relation to increasing dryland salinity, overallocated water resources and declining water quality.

The *Murray-Darling Basin Initiative* (established in 1985), which is a partnership between six governments and the community, was established to give effect to the *Murray-Darling Basin Agreement*. The purpose of the Agreement is "to promote and coordinate effective planning and management for the equitable, efficient and sustainable use of water, land and other environmental resources of the Murray-Darling Basin".

A major focus of the Initiative is integrated catchment management (ICM), which considers the social, economic and environmental features of managing the natural resource base. ICM also recognises the diverse interests in the Basin and the necessary partnerships between communities and governments in managing natural resources.

The Murray-Darling Basin Ministerial Council (MDBMC) is the primary body responsible for providing the policy and direction needed to implement the Initiative. Its main functions are to:

- consider and determine major policy issues concerning the use of the Basin's land, water and other environmental resources; and
- develop, consider and authorise (as appropriate) measures to achieve the purpose of the Agreement.

The MDBMC is chaired by the Commonwealth Minister with responsibility for land and water and comprises up to three ministers with primary responsibility for land, water and the environment from each of the participating governments of the Murray-Darling Basin Initiative.

The Community Advisory Committee (CAC) reports directly to the Ministerial Council. The CAC advise the Ministerial Council and Commission on:

- natural resource management issues referred to the CAC by the Ministerial Council or Commission; and
- the views of the Basin's communities on matters identified by the CAC as being of concern.

Currently, the CAC comprises an independent Chairman and 28 members, namely:

- twenty three state representatives chosen on a catchment/regional basis, and
- a representative nominated by each of five "peak" special-interest organisations: the National Farmers Federation, the Australian Conservation Foundation, the Australian Local Government Organisation, the Australian Landcare Council, and the Indigenous Land Corporation.

The Murray-Darling Basin Commission (MDBC) is the executive arm of the Ministerial Council and is responsible for managing water sharing arrangements between NSW, Victoria and South Australia, managing jointly owned assets along the River Murray and Menindee Lakes system of the lower Darling River, and developing and implementing Council initiatives related to the use of the water, land and other environmental resources of the Murray-Darling Basin.

5.3.1 Murray-Darling Basin Cap

In 1995, in response to declining river health coupled with the incremental erosion of security of supply for existing irrigators, the MDB Ministerial Council directed that an audit of water use in the Basin be undertaken.

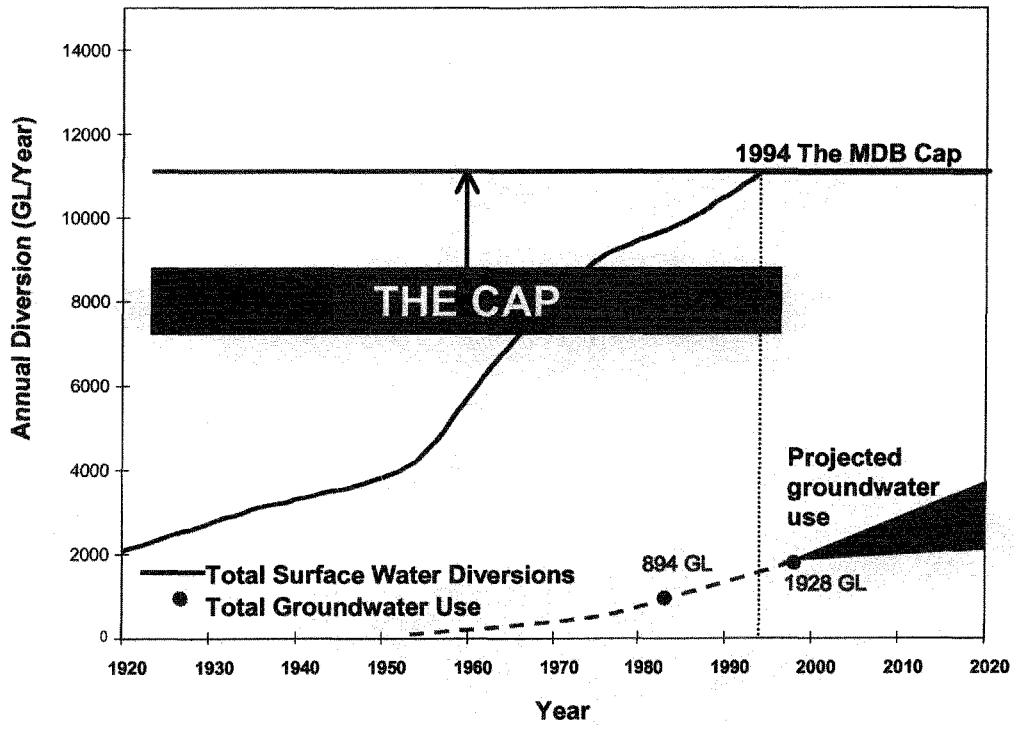
The audit concluded that if the volume of water diversions continued to increase, river health would deteriorate, the security of water supply for existing irrigators in the Basin would be reduced and there would be lower reliability of water supply during drought conditions.

The MDB Ministerial Council determined that a balance needed to be struck between the economic and social benefits obtained from the development of the Basin's water resources, and the environmental requirements of the river systems. The Council introduced a limit, or 'Cap' in June 1995, which limited the quantity of water that could be diverted from the Basin for consumptive use to the quantity which would have been diverted under 1993-94 levels of development. The Cap aimed to prevent diversions from the Basin from increasing, rather than restraining new developments. Under the Cap, new developments are permitted provided the water for them is obtained by improving water use efficiency or by purchasing water from existing licence holders.

An independent review of the operation of the Cap was released in August 2000. The review aimed to identify and address any matters that may not have been resolved in the initial phase of implementation. The review found that the Cap:

- prevented acceleration of environmental degradation in the Basin's river systems;
- provided an environment within which a water trading market could be developed;
- provided security of supply for water users;
- provided a more certain climate for long-term investment;
- reduced the sensitivity of irrigated agriculture to extreme climatic events;

- prevented the development and activation of 'sleeper and dozer' water entitlements (non-activated or partially activated entitlements respectively) without a method of overall control; and
- helped provide a focus for community discussions on resource sustainability.



However, the review recognised that the Cap as it currently stands does not necessarily reflect a sustainable level of diversion. It recommended that as more detailed information on the condition of the Basin's resource base becomes available the level of the Cap should be adjusted accordingly. The Review also recommended that groundwater be managed on an integrated basis with surface water.

A further recommendation from the review was the implementation of a "Sustainable Rivers Audit" (SRA) – a regular environmental audit of the health of rivers in the Basin. The SRA is intended to assess river health and ecological condition at the valley scale and enable the assessment of long-term trends. This information will be of benefit to stakeholders at community, catchment management, government and Ministerial Council levels. The MDB Commission is currently developing a pilot audit to trial the framework for a full SRA. The Commission is aiming to complete the pilot audit by the latter half of 2003.

5.3.2 Environmental flows for the River Murray

The importance of the Basin to the national economy underlines the need to ensure that the condition of its natural resources is maintained for profitable use and to provide benefits for all Australians.

The challenge for governments, industries and communities is to agree on how to continue operating in this modified environment for everyone's benefit.

This challenge incorporates two interlinked issues:

- putting in place water allocation and property rights arrangements that provide certainty and durability for all water users; and
- deciding whether enough water has been allocated to meet the environmental needs of the River Murray and its surrounding floodplains.

At its meeting in April 2002, the MDB Ministerial Council initiated a process to achieve a healthy working River Murray providing integrated economic, social and economic benefit. The process, known as the Living Murray Initiative, will also consider how water could be recovered for this purpose if it were considered necessary.

The Council is undertaking a comprehensive community engagement process to ensure that there is community input into decision-making for the Initiative. The Council has established an Independent Community Engagement Panel to provide advice on the appropriateness of the engagement process.

To improve understanding of the costs and benefits of recovering water for the environment, the Commission is preparing business cases for the recovery of 350 GL, 750 GL and 1500 GL to the River Murray. These amounts will be used as reference points for further analysis and community consultation, and include the 70 GL to become available to the River Murray from the Snowy River environmental flows process.

The process will include social and economic analyses and will identify local as well as system-wide environmental problems and benefits, and identify costs and benefits of various options and strategies to manage the social and economic impacts of measures for improving the health of the River Murray.

The MDBC will prepare a specific proposal for the Council's November 2003 meeting as a first step to implementing the Living Murray initiative. This possible first step is likely to be at the lower end of the reference points that were identified for use in the studies commissioned by the MDBC. The proposal will need to be clear on the environmental outcomes it would achieve, where the water would come from, what the social and economic impacts would be and what the cost sharing arrangements would be between the States, Commonwealth and community.

However, the Living Murray Initiative is not just about environmental flows. It also focuses on developing a strong Murray-Darling Basin water market as a basis for achieving the flows and facilitating adjustment processes. This will require support through appropriate property rights, trading and market arrangements and exchange rates for inter-valley and interstate trade.

Particular areas in the Murray-Darling Basin have already seen the benefits of providing environmental flows to better imitate natural flows for the benefit of particular ecosystems and provide for fish passage at critical points in time.

For example, in 1993, it was agreed to put 100 GL of water aside each year from NSW and Victoria irrigation supplies to improve ecosystems in the Barmah-Millewa Forest. The Barmah-Millewa Forest is a 70,000 hectare group of river red gum forests with a unique range of wetland habitats. It is located on both sides of the River Murray. The Barmah forest on the Victorian side of the river is Ramsar listed. In 1998 and 2001, 97 GL and 341 GL water were released to slow the rate of drainage of natural floods occurring at the time. This created longer, more natural conditions for bird breeding and forest renewal resulting in a flourish of bird, frog and fish populations.

Environmental flows have also been provided in the Goulburn River in Victoria to improve flow patterns where the River reaches the River Murray. They provided flushing flows to simulate small spring floods and to protect the quality of water in the River.

5.3.3 Return of Flows to the Snowy River

In October 2000 the Victorian, New South Wales and Commonwealth Governments announced a $375 million agreement to restore the Snowy River to a long-term target of 28 percent (or 294 GL) of the river's natural flows, while protecting other river systems and water users.

The agreement sets a target flow rate of 21 percent (or 212 GL) to be returned to the Snowy River over 10 years. The remaining 7 percent to reach the full 28 percent is proposed through the development of new infrastructure projects in the Murray-Darling Basin involving the private sector. As part of this agreement, the Commonwealth is providing $75 million to find up to 70 GL of water for environmental flows for the River Murray. NSW and Victoria are each providing $150 million to fund the Snowy River flows.

The environmental water is to be sourced principally from identified and verified water savings on diversions from the River Murray System, the Murrumbidgee System and/or the Goulburn River System.

The three governments are establishing a joint government enterprise to manage the water savings projects to deliver water savings for environmental flows.

5.4 Great Artesian Basin Sustainability Initiative

The Great Artesian Basin (GAB) extends under 22% of Australia, stretching from the Great Dividing Range to beyond Lake Eyre, and is one of the largest artesian groundwater basins in the world. Groundwater from the Basin supports an extensive pastoral industry, towns and settlements, mining ventures, tourism and groundwater dependant ecosystems in the semi-arid inland. Artesian water was first discovered in the 1880s. Since then, uncontrolled discharge of water from flowing bores has resulted in depletion of groundwater pressures. Up to 90% of water extracted from GAB aquifers is estimated to be wasted, largely due to the poor water efficiency of earthen channels.

Through the Great Artesian Basin Sustainability Initiative (GABSI), the Commonwealth Government has committed $31.8 million over 5 years (July 99 – June 04), with matching funding from relevant State and Territory governments and a landholder contribution, to accelerate the rehabilitation of these bores and replacement of the open drains with polypipe. The Initiative will provide opportunities for changes in farm management for pastoral outcomes, improved environmental management and for new uses of the groundwater resource. This package is being delivered in partnership with State agencies.

The Initiative will assist with the implementation of key actions of the Strategic Management Plan prepared by the Great Artesian Basin Consultative Council. The Strategic Management Plan has been endorsed by all jurisdictions in the Great Artesian Basin and was formally launched in September 2000.

Scientific work undertaken by the BRS has been used to prioritise GABSI expenditure using a basin-wide approach. This involved development of a predictive numerical groundwater model across the whole of the basin. Research shows that significant pressure recovery is occurring in priority areas after the first three years of the program.

A formal review of the effectiveness and efficiency of the GABSI is underway.

5.5 Lake Eyre Basin Intergovernmental Agreement

The Lake Eyre Basin covers over a million square kilometres in Central Australia, and overlaps substantially with the Great Artesian Basin. The area supports varied and unique ecosystems, and is culturally important, containing both Aboriginal and non-Aboriginal history. Land use within the Basin includes pastoral production, mining, tourism, oil and gas production and conservation reserves. The area is environmentally, economically and socially important for people both within and outside the Basin.

In October 2000 an Inter-Governmental Agreement (IGA) was established between the Commonwealth, South Australian and Queensland governments. The purpose of this Agreement is to provide for the development and implementation of policies and strategies concerning water and related natural resources in two of the main catchments in the Lake Eyre Basin.

The IGA established the Lake Eyre Basin Ministerial Forum and a Community Advisory Committee to the Ministerial Forum.

6. COMMONWEALTH FUNDED RESEARCH AND DEVELOPMENT

The Commonwealth Government has made substantial commitments to research and development that support sustainable use and management of our surface and ground water resources. These commitments include:

- The Bureau of Rural Sciences (BRS)
- CSIRO
- Land & Water Australia and other research and development corporations

- CRC's, including the CRC for Catchment Hydrology, the CRC for Freshwater Ecology and the CRC for Irrigation Futures

The States and the Murray-Darling Basin Commission also undertake research and development supporting sustainable use and management of our water resources.

A major issue is ensuring that the outcomes of research and development are accessible and can be utilised. For example, the Murray-Darling Basin Commission has recognised the importance of knowledge generation and dissemination and has made this latter aspect a priority for its studies and investigation program.

6.1 Bureau of Rural Sciences (BRS)

The BRS Water Sciences Program fulfils its role of providing scientific advice into water management and policy in a number of areas of hydrology including:

- development of standards and protocols;
- case studies that help implement the CoAG water reforms;
- socio-economic studies in related areas;
- cross-border groundwater systems including assessment of sustainable yield and recharge;
- surface water–groundwater interactions and impacts on groundwater dependent ecosystems;
- water quality and evaluation of aquifer vulnerability to contamination; and,
- environmental assessments and work on environmental issues such as salinity and acidity.

6.2 Land & Water Australia

Land and Water Australia (LWA) receives direct appropriation funding from the Commonwealth Government of $11 million for investment in broad public interest and environmental issues. LWA also leverages further funding for individual programs from a range of organisations. Key programs addressing the sustainable management and use of water resources include:

- National Program for Sustainable Irrigation – aimed at enhancing the sustainability of irrigation; exploring future visions and values; informing public policy development.
- A range of other programs under the "Rivers Arena"
- The Social and Institutional Research Program – specifically focused on the social, economic, commercial, legal, policy and institutional dimensions of natural resource management
- The Redesigning Agriculture for Australian Landscapes Program – to design agricultural systems which ensure economic production and ecosystem and landscape function, by matching these systems to the unique biophysical characteristics of the Australian environment.

6.3 CSIRO

CSIRO Land and Water Division's research addresses major land, water and environmental issues. The key focus is the delivery of innovative large-scale solutions to Australia's natural resource management problems, contributing to the sustainable long-term management of the Australian landscape. Its current research program has a very strong focus on water resources use and management.

6.4 Cooperative Research Centres

Cooperative Research Centres bring together researchers from universities, CSIRO and other government laboratories, and private industry or public sector agencies, in long-term collaborative arrangements which support research and development and education activities that achieve real outcomes of national economic and social significance.

- The Commonwealth has recently announced the establishment of a CRC for Irrigation Futures (CRCIF), which aims to address the sustainability of irrigated agriculture. Funding will be $16 million over 7 years.
- The CRC for Catchment Hydrology seeks to deliver to resource managers the capability to assess the hydrological impact of land use and water management decisions at a whole of catchment scale.
- The CRC for Freshwater Ecology provides research on the ecological basis for the sustainable management of Australian temperate region surface water. It has six research program areas addressing issues including: flowing waters, standing waters, floodplain and wetland ecology, water quality and ecological assessment, urban water management and fish ecology.
- The CRC for Waste Management and Pollution Control has a strong focus on wastewater issues from waste treatment process design through to detection of contaminants and minimisation of waste in all stages of material production.
- The CRC for Water Quality and Treatment aims to provide important research and knowledge management capability to support the Australian water industry in its role of providing safe and aesthetically pleasing water supplies to Australian communities.
- The CRC for Rice Production and the CRC for Sustainable Sugar Production include a focus on improvements in soil and water management.

6.5 Climate Variability in Agriculture Program

The goal of the Climate Variability in Agriculture Program (CVAP) is to work with the Australian agricultural sector to develop and implement profitable and sustainable management strategies using climate information.

The Government announced in May 2002 a further commitment of $500,000 from the Natural Heritage Trust for the next phase of the program – this funding is for 2002-03 only.

The 2002-03 program build on previous work to develop sustainable and profitable climate risk management systems for application by landholders and to provide landholders with an understanding of, and skills in, climate risk management.

Land and Water Australia administer the funding and have a prospectus seeking funding from other sources.

As a result of previous phases of CVAP:

- The coordination of climate variability R&D has improved;
- Agriculture has been recognised as a client for provision of climate services;
- There has been a central focus for climate risk management;
- Farmers have the tools and understanding in order to become more self-reliant and able to manage climate risks; and
- There has been an increased level of networking between researchers in climate and agriculture.

6.6 Climate Variability, Weather Prediction, Forecasting Systems

Climate and weather forecasting are important to Australian agriculture because of their direct influence on production systems and supplies of water for irrigation and stock use. Agriculture is the dominant land use over 60% of the continent and climatic variability can be very high in some regions. Most analyses of variability assume that historical rainfall patterns are a representative sample of future rainfall probability. A wide range of industries, decision-makers and strategies across rural Australia must allow for climate variability.

The Bureau of Meteorology runs a comprehensive set of weather stations that provide the basic information for weather and climate analysis, predictions and forecasts. The network not only covers land-based stations, but also atmospheric and sea-based stations. Their Climate Analysis Centre undertakes some climate forecasting.

Other organisations that participate in climate analysis include the CSIRO Division of Atmospheric Physics, the Queensland Centre for Climate Applications, and some university researchers.

Analysis of the impacts on agriculture are undertaken by the Climate Group in Agriculture Western Australia on wheat yields, and the Climate Impacts and Natural Resource Systems group of the Queensland Department of Natural Resources and Mines on pasture production.

These groups have undertaken world quality research activities and provide on-line access to many current analyses and forecasts.

Scientific capacity to provide specialist rainfall forecasts is relatively well developed. At the Commonwealth level a set of key biophysical indicators are used to enable analysis of climate variability including individual and seasonal events. Well-defined techniques are available to examine the reliability of predictions made with regard to each analysis. These are widely applied to:

- Seasonal forecasting – spatial and temporal reliability and relationship to decision points

- Extreme events – drought, cyclones etc

These simple and rapid assessments of rainfall conditions are widely used in Government organisations mostly to provide customised advice for policies and to program implementation on an ad-hoc basis.

Overall, scientific capacity to provide specialist forecasts is well developed and utilised. The use of simple indicators and assessment techniques has proved highly effective in assisting the policy environment. However, the continuation of indicator development for rapid assessment would increase the power of prediction across Australia.

Current scientific research approaches to analysing and predicting climate variability and adaptation strategies are often limited by a lack of high quality data at the appropriate scale. In particular, given Australia's highly variable climate, data must be long term in nature (to capture an representative sample) and be frequent enough to characterise the process of interest.

There is insufficient information that underpins analysis of the climatic factors, other than rainfall, that affect water use, including digitally available historical data on temperature, evaporation and wind. In some cases where smaller scale monitoring and evaluation data is available there is limited coordination between levels of government and research institutions.

There are also difficulties in evaluating and selecting the appropriate predictive technique for particular circumstances. There are few process models available for forecasting long term climatic variability and they largely provide snapshots of the circumstance concerned. Techniques that provide continuous assessment are required so that climate adaptation strategies over the long term can be examined. Simple guidelines for selecting the most appropriate available biophysical tools would to assist decision makers in using the available science to best advantage.

Research approaches for examining adaptation to climate variability need to consider the social, economic and biophysical impacts of climate change. Predictive and scientific tools of this nature would provide a useful mechanism for quantifying impacts and investigating adaptation strategies under a range of scenarios.

In addition to temporal techniques for predictive assessment, spatial displays of forecasts are also widely used in Government research organisations using Geographic Information Systems (GIS). However, the use of remotely sensed and GIS based approaches in better predicting impacts of climate variability on various land uses is underdeveloped. Further enhancements in the analysis of climate variability and adaptation strategies at local scales would flow from strengthening research links into the use of biophysical predictive tools and GIS with the policy environment.

A SUBMISSION TO THE HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON AGRICULTURE, FISHERIES AND FORESTRY

on

THE PROVISION OF FUTURE WATER SUPPLIES FOR AUSTRALIA'S RURAL INDUSTRIES AND COMMUNITIES

by

AGRICULTURE, FISHERIES AND FORESTRY - AUSTRALIA

ATTACHMENT A

ISSUES AND OPPORTUNITIES

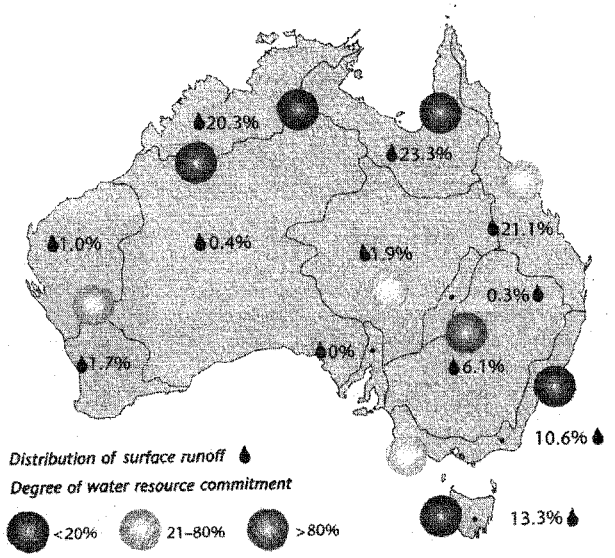
The major issues and opportunities associated with future water supplies relate to:

- managing for a highly variable climate, including variable rainfall and runoff;
- maximising the use of the water available to us (water use efficiency);
- progressing COAG reforms, particularly of property rights and water trading;
- ensuring sustainable river and aquifer systems to support the quality and quantity of water available for the future; and,
- the risk management approach of the new National Water Quality Management Strategy Drinking Water Guidelines.

1. AUSTRALIA'S CLIMATE

1.1 Australia's Water Resources

Total runoff in Australia has been estimated to be about 390,000 GL per annum. The distribution of this runoff is shown on the map below.



Much of Australia's agricultural production, including 40% from the Murray Darling Basin alone, comes from southern areas which have a very high demand for water and which receive only a small portion of the continent's rainfall. By contrast, the two drainage divisions covering most of the far north of Australia contribute 46% of Australia's runoff with only a very insignificant amount being diverted.

According to the *Australian Water Resources Assessment 2000* (National Land and Water Resources Audit, 2000), Australia has about 26,000 GL of relatively fresh groundwater useful for potable, stock and domestic, or irrigation purposes that is estimated to be able to be sustainably extracted each year. In 2001 the National Land and Water Resources Audit estimated total groundwater use in Australia was about 5,000 GL per annum. However,

there are indications of significant aquifers being under stress with about 30% of groundwater management areas considered to be highly or over-developed.

1.2 Climate Variability

Compared to other continents, Australia is relatively dry in terms of overall rainfall and runoff, its climate is extremely variable and its soils are old, weathered, fragile and relatively infertile.

- 75% of Australia's land is arid, including 40% which is desert
- a further 10% is arid for much of the year
- rainfall varies from less than 150 mm annually over parts of central Australia to more than 2000mm in parts of the monsoonal north.
- Climate is highly variable.

Extended dry periods and droughts are common occurrences affecting most agricultural areas at different times across Australia. Examples of droughts that have anecdotally had major impacts include: The "Federation Drought" (1895-1902); the 1914-15 drought; the droughts of 1937-45; the 1965-68 drought; the short but sharp 1982-83 drought; the Long El Niño - 1991 through 1995; and, the 2002-03 drought.

Australia is improving its ability to deal with climate variability through better understanding of some of the climatic drivers (eg El Niño/Southern Oscillation- ENSO), better predictive tools (eg historical data, ENSO-based forecasting tools, sea surface temperature-based seasonal forecasts) and better understanding of the need in agriculture to manage financial and production risk. The accuracy of seasonal forecasting is improving as the understanding of climate increases.

Australia's highly variable rainfall and runoff has led to high levels of water storage infrastructure in Australia. Many of these storages support irrigated agriculture, which accounts for 0.4% of agricultural land but 25% of the gross value of agricultural production. Some storages support urban supply. There is also significant storage capacity on-farm to meet domestic and stock requirements and support irrigation. In spite of Australia's high storage capacity, in times of drought urban areas face water restrictions and irrigated agricultural production reduces, creating difficulties in meeting market requirements, for example in the rice industry in 2002.

1.3 Climate Change

In addition to normal weather variation, there is growing evidence that the climate is changing on a global scale. Climate change is a change in the "average weather" whether it be temperature, wind patterns or precipitation.

An international scientific consensus has emerged that our world is getting warmer. Abundant data demonstrate that global climate has warmed during the past 150 years. The increase in temperature was not constant, but rather consisted of warming and cooling cycles at intervals of several decades. Nonetheless, the long term trend is one of net global warming. Corresponding with this warming, alpine glaciers have been retreating, sea levels have risen and climatic zones are shifting. Most experts agree that average global temperatures could rise by 1 - 3.5 degrees Celsius over the next century.

Increased temperatures will lead to changes in many aspects of weather, such as wind patterns, the amount and type of precipitation, and the types and frequency of severe weather events that may be expected to occur. Such climate change could have far-reaching and/or unpredictable environmental, social and economic consequences.

In Australia, climate change is generally predicted to bring about increases in extreme weather episodes such as cyclones, severe storms, floods and prolonged droughts. CSIRO also estimates that in 2030 Australia's climate will be up to 10% drier in winter, and up to 10% drier in summer in the east and south west, and that there will be more storms and heavy rain.

In parallel, Commonwealth and State departments and agencies are working to develop a framework for longer and shorter term greenhouse strategies covering three main strands: international, domestic emissions mitigation and adaptation issues.

Impact on Hydrology

There are five elements of climate change that are having a significant impact on the hydrology of the Australian continent. These are discussed below in order of certainty.

Carbon Dioxide

Although it is well known that the concentration of carbon dioxide in the atmosphere is a major driver of the enhanced greenhouse effect, it is less well known that it has a major effect on the way plants behave. It is estimated that rising carbon dioxide levels have increased the biomass production of plants by about 8% since 1950 and this will rise to around 30% by mid century.

One of the consequences of this is that the ability of plants to 'harvest' available water is increasing and this will affect both supply by reducing soil water balances and demand from increasing biomass production putting further pressure on stream flows.

Temperature and Evaporation

Australian temperatures have been increasing since the 1950s. Minimums are increasing twice as fast as maximums resulting in a decrease in the day/night (diurnal) temperature range and a significant shortening of the 'frost season' over most of Australia.

The *way* that temperature has increased in the last 50 years has been a major factor in recent increases in crop and pasture yields further increasing demand on available water.

Paradoxically, evaporation rates in Australia appear to be going down because increasing levels of atmospheric aerosols, mainly water vapour, has offset the effects of higher temperature

Rising Sea Levels

Sea levels have been rising over the latter part of last century due to thermal expansion of the ocean with temperature increases. Assuming that there are no discontinuous changes to the West Antarctic Ice Sheet in particular, sea levels will rise by 10 – 30 cm during this century. The major impact for Australia will in riverine estuaries. Although the Murray's estuary will continue to be affected by this process, the major impact will be in Northern

Australia. Here, a combination of land subsidence and sea level rises has already seen significant salt water ingress into formerly fresh water estuaries and this trend will accelerate for the remainder of this century.

Rainfall

When rainfall is aggregated for continental Australia for the last century there has been no significant changes that can be ascribed to climate change. Regional changes during this time however have been significant. The south western corner of the continent has experienced a reduction in average annual rainfall by as much as a quarter in the last thirty years the while annual average rainfall has risen by about 15% in New South Wales, South Australia, Victoria and the Northern Territory.

Current forecasts indicate a fall in rainfall for Australia in line with most mid latitude countries during the current century. Low and high latitude countries will experience rainfall increases. For the Macquarie Valley in NSW, modelling indicates that a combination of increased evaporation and rainfall reduction will reduce inflows into Burrendong Dam by between 11 and 30% by 2030. This modelling did not take into account increased biomass production and hence increased water demand from plants or vegetation changes in the catchment. Recent studies indicate that either of these factors on their own could be as significant as changes in temperature and rainfall.

Seasonality

The key question for Australia with climate change is its effect on seasonality in general and the El Nino and Southern Oscillation in particular. The high variability in Australia's climate makes long term trends in seasonality very difficult to detect.

There are some indications the ENSO cycle has been behaving unusually since the 1990's. Surrogate climate records (coral cores, tree rings and ice cores) indicate that the 1990-5 El Nino event was the first 'locked phase' El Nino for nearly three hundred years. Locked phases occur when the ENSO gets stuck at a particular point in the cycle rather like a record being stuck in a groove.

The major difficulty is that our perception of what is 'usual' for Australia's climate is constrained by a relatively short instrumental record and the fact that the resolution capabilities in the surrogate record fall away quickly with time

Until there is a significant improvement in climate modelling capacity, changes in seasonality will remain an important 'wild card' in planning for climate change.

What is being done about climate change? With the realisation Australia's climate has been changing for the last fifty years, there has been a move at both state and Commonwealth level to integrate climate change into existing climate programs by developing a scenario planning capability. There is also a realisation that a better national integration of climate programs is required and this will be a major policy focus for the coming year.

1.4 Variability in Irrigation Water Supply

Because of Australia's extreme climate variability and therefore variability in rainfall runoff, supply of water for irrigation varies considerably from year to year. This variation has been managed differently by the various States.

For example South Australia has been conservative in its overall allocation of water for irrigation. The enables variability in supply to be absorbed with little impact on irrigators. Given the high level of perennial crops grown (wine grapes and fruit) there is little scope for South Australian irrigators to adjust to large variations in supply from season to season.

Victoria seeks to ensure that its storages carry over sufficient water each year to cover its next year's requirements. Although allocations have remained steady from year to year there has been a reduction in the amount of "sales water" over the past few years. Sales water is additional water that can be made available to irrigators, over and above their entitlement, in a season. Irrigators have often developed their businesses and irrigation infrastructure on the expectation that sales water will continue to be available. However in the 2002/2003 season irrigators in the Goulburn-Murray area received only 57% of their entitlement.

NSW maximises its use of available water each year. It guarantees water to those with high security entitlements (ie for horticulture) but general security water which is used for annual crops may vary significantly. For example general security allocations for Murray Irrigation Limited had only reached 8% by the end of November 2002 with a severe impact on the rice industry. Murrumbidgee Irrigation low security entitlements had reached 38%.

The shortage of water in 2002-2003 resulted in calls from irrigators to access water held by the Snowy Hydro. However, there is limited ability by governments to direct Snowy Hydro to release water beyond its minimum commitments (2,088 GL per annum), given the long lead times involved in procedures to vary Snowy Hydro's licence or to change legislation which sets out procedures for varying the licence. Variations in the licence may have impacts on future water and electricity supplies. Further, Snowy Hydro is required to operate commercially and the release of additional water may negatively impact on Snowy Hydro's revenue and decrease its ability to provide essential energy services to the Victorian and South Australian markets. Bringing forward future years' water releases may also reduce future water security for irrigators and have flow-on effects to the processors relying on irrigators for manufacturing inputs.

2. USING AVAILABLE WATER MORE EFFICIENTLY

There is a significant over-allocation of water in some regions resulting in reduction in entitlements for some irrigators, particularly in NSW. Further, the 2002-2003 drought has exacerbated water scarcity which has resulted in reduced allocations and focused public and media attention on possible alternative sources of water to supplement current supplies, such as diversions of coastal and northern rivers, desalination or construction of new dams.

While some of these options, such as improvements in desalination technology, may have limited application, the best opportunity for managing reduced availability of water, increasing the security of water available for irrigation, or increasing development and production, is to maximise efficient use of water.

There are a range of strategies and technologies that can be applied to reduce "wastage" of water. These include improved monitoring and management practices, adoption of more efficient technology, and recycling and reusing water. Efficiencies can be applied on-farm, in irrigation conveyance systems, throughout the manufacturing process and to urban and rural/urban water use.

2.1 On-Farm Water Use Efficiency

Water use efficiency on farm is potentially the best source of increased water use efficiency. However, some on-farm efficiencies go hand in hand with improved infrastructure efficiency and addressing both in an integrated way is likely to provide the best outcome for improving our water use efficiency.

Work undertaken by the Murray Darling Basin Commission on "The Potential for Improving Water Use Efficiency" has identified the potential for water savings in the Murray Darling Basin. These numbers are indicative only, because of the difficulty in obtaining consistent data. However, indications are that relatively low levels of investment on-farm and specific changes to management practices, may result in a 7-8% reduction in water use over ten years. Whether saved water would contribute to environmental flows, increased production or higher security would largely depend on the ownership of the water and who made the investment.

At the farm level, drivers of water use efficiency gains vary across commodities but are likely to be:

- The price of water, particularly for pasture and other lower value crops;
- The opportunity to sell unused water on the water trading market;
- Increased scarcity of water, especially where water entitlements are being reduced;
- Reduction in labour costs, greater productivity and greater economies of scale through changes to more efficient irrigation systems;
- Improved quality of produce, such as through the partial root zone drying technique of growing wine grapes;
- Public image and consumer expectations, for example for rice and cotton;
- Environmental outcomes, including lower water tables and reduced salinity; and
- Marketing and trade – the need to demonstrate environmental credentials to gain entry to some overseas markets.

Increased water use efficiency through improved management practices and adoption of technology could result in up to 23% increase in water availability in the Murray-Darling Basin. A reduction of this magnitude would require substantial changes to policy to influence adoption of water efficient practices and technology, and would need to include a well-defined and secure system of property rights to provide investment certainty and robust water trading systems so investors have the opportunity to realise the value of their water on the market. Governments and the Murray-Darling Basin Commission and are investigating these issues.

Achieving on-farm savings at a rate sufficient to support improved environmental outcomes and development will depend on investment by water authorities, commodity groups and water users in increasing the application of monitoring, management and irrigation technology; development of industry water use benchmarks; holistic farm planning; information and training where this is appropriate. A particular role for State

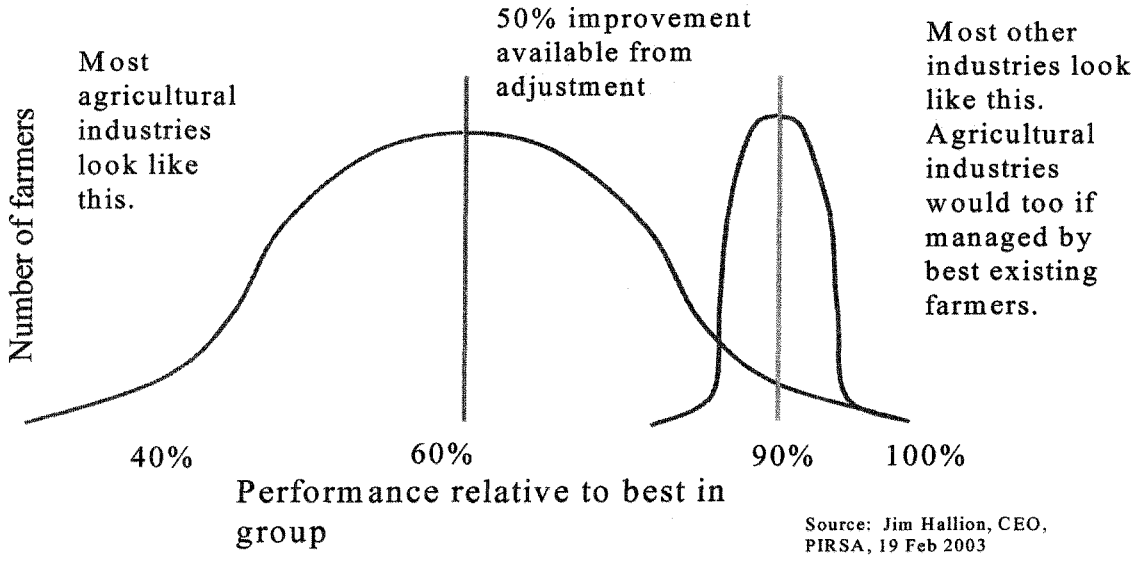
Governments is the development of market-based instruments and/or judicious use of regulations.

Increased on-farm efficiencies are likely to occur through improved measurement, monitoring and management; adoption of more efficient watering technologies; new technologies in relation to crop water requirements (eg the use of partial root zone drying in wine grapes) change in enterprise mix, and of water re-use. These measures have been implemented by many irrigation enterprises but there remains considerable scope for increased adoption.

The diagram below shows results from farm benchmarking studies which indicate there is a gap between the management performance of farmers (including irrigators) and that of other types of business. There is clearly considerable scope to build the capacity of farmers to adopt the best available practices, including managing the sustainability of their natural resources, and including water.

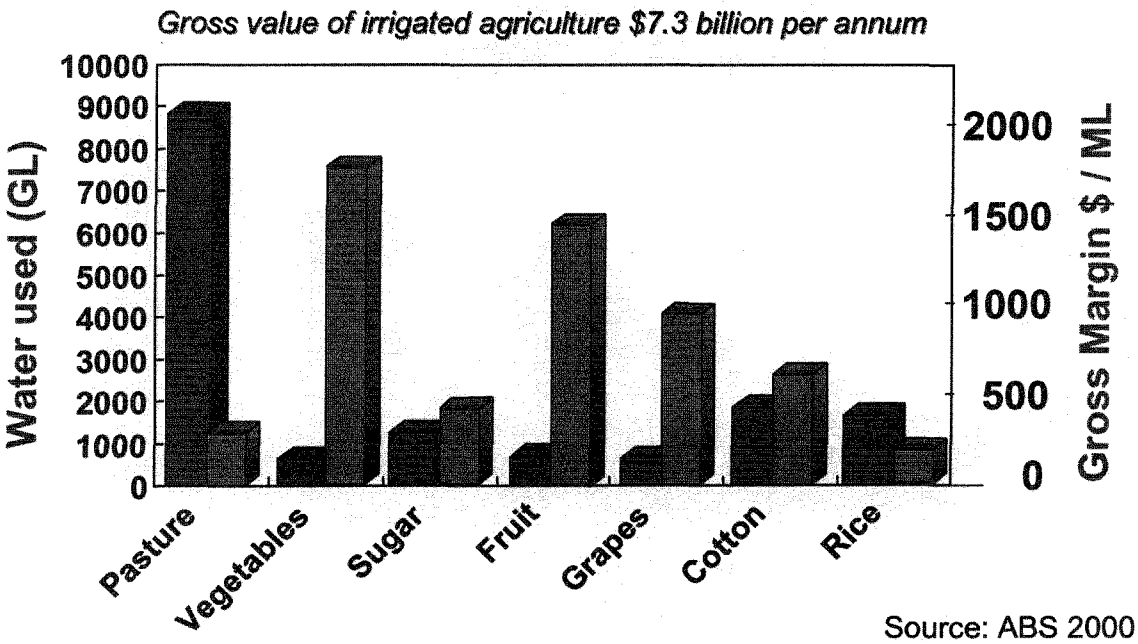
- The curve on the right indicates that most industries, including food processing and retailing, perform consistently at a relatively high standard.
- The curve on the left indicates that the difference between our highest and lowest performing farms is huge

Typical results from farm management performance benchmarking studies



Source: Jim Hallion, CEO, PIRSA, 19 Feb 2003

One commonly used measurement of the efficiency of water use is gross margin achieved per megalitre of water. This measure does not include the capital cost of on-farm infrastructure, the return for all inputs, or the profitability of the enterprise. However, this data is often used in comparing the performance of various commodities due to a lack of data in relation to other indicators, such as profitability. The table below indicates the wide range of efficiency, in terms of gross margin/ML for each commodity.



Source: ABS 2000

The most efficient and profitable use of water is in horticulture. Water trading systems, including the interstate water trading system being implemented through the Murray-Darling Basin Commission, have fostered some movement of water to horticulture, particularly to the wine-growing regions of South Australia. It would seem to make sense that there would be a greater movement by irrigators towards these types of enterprises, particularly given there do not seem to be market limitations at this stage. However, there are a number of impediments as discussed below.

On-farm water use efficiency often goes hand in hand with infrastructure upgrades. The Loxton Irrigation Scheme Rehabilitation which involved 70 km of pipeline and connection to around 250 farmers made significant water savings, with environmental benefits, and resulted in on-farm water savings after additional investment by irrigators beyond the government investment in the irrigation upgrade.

Rice Industry

The rice industry has set an industry standard for water use of 12ML per hectare. This standard is policed by the relevant irrigation authorities and a large majority of growers now operate around the industry target. Most rice is grown in the large irrigation areas where there is an ability to police the target. The target of 12ML is a significant reduction from average application rates of 15-20ML per hectare in the 1990's and reflects the cohesiveness of the rice industry and efforts by the industry to drive greater water use efficiency. This has resulted in a reduction in water usage over the past ten years of 30% while at the same time increasing yields by 60%. This effort has been supported by expenditure by the industry in research and development to address water use.

Techniques used to reduce water use include laser landforming, development and adoption of shorter-season varieties, computer modelling and electromagnetic surveying to ensure the correct amount of water is applied, and efficient supply and drainage systems on-farm

The rice industry is often criticised for having low gross margin returns per megalitre of water ($50-$200) compared to other industries, such as horticulture. However, it is important to note that rice is profitable at the farm level, due to:

- labour efficiencies and on-farm economies of scale
- low capital requirements – on-farm and conveyance systems
- the role of rice as one enterprise within the whole farm business.

In addition, rice provides an important contribution to the Australian economy, including through exports, generating more than $500 million from value added exports annually.

Ongoing research and development is aiming to reduce the need for flooding rice paddocks through developing varieties which are more cold/frost tolerant (water is required to provide cold/frost protection and weed control).

Work by CSIRO indicates that potential also exists to follow rice crops immediately with wheat to utilise remaining soil moisture rather than leaving the land fallow for a period. This would increase the return per megalitre of water and have a positive impact on watertable levels.

Although rice has been a mainstay of a number of irrigation areas, there has been continued diversification by growers into other crops. For example 60,000ML of water has been transferred from rice to higher value crops in the Murrumbidgee Irrigation Area over the last five years.

Dairy Industry

Data from the dairy industry indicates there is a wide variation in water use across dairy farms. This indicates considerable potential for improvements in water use efficiency in the sector. General sources of data, however do not distinguish between pastures grown for dairy and that grown for other livestock.

However, explanation for this wide variation in water use efficiency may include differences in soil type, stocking rates and level of supplementary feeding and the currently high rate of turnover of farms as the dairy industry adjusts. This can result in temporary understocking as herds are being built up.

The dairy industry has experienced significant increases in productivity over the past decade, particularly in terms of yields per cow, and reduction in the number of farms from 16,000 (1990) to around 13,000 (2000). Dairy deregulation is likely to continue this trend towards larger farms and greater productivity.

There is no industry developed program that specifically addresses water use efficiency in the dairy industry. Likely impediments to improvement in water use efficiency include the high capital costs and/or labour costs involved in any transition to new technology. This becomes an issue for farmers on high intake soils with higher than average water use levels.

The dairy sector in Victoria has recently reduced its dependence on irrigation, with increasing substitution of bought-in fodder for irrigated pasture, resulting in a decline in the area under irrigation of 10-15% over the past 2 years. This development mirrors an increase in the area set aside to grow fodder crops in Victoria and NSW with only some being grown on irrigated land.

Cotton Industry

The Australian cotton industry has grown significantly in the past decade with potential for further expansion in new areas, provided irrigation water is available. Australian cotton is competitive on world markets with high yields, quality and production efficiency.

The cotton industry is aware of the need to demonstrate it is managing its water resources in an economically and environmentally sustainable manner. The industry has developed a suite of best management practices which include the management and use of water. 11% of growers, representing 25% of cotton production, have been audited. The audit showed that 70% of growers are making progress in implementing best management practices.

The average production yield for cotton is $613 per ML compared to rice at $189/ML and fruit at $1,460/ML (ABS *Water Account for Australia* 2000).

Although the industry is potentially highly efficient in terms of crop water use, conveyance and storage efficiency is low. The conditions that existed while the industry was developing have led to storage that is predominantly in large shallow dams which are exposed to high evaporation rates.

Horticulture – Citrus and Wine Grapes

Horticulture is a high value crop/s especially suited to piped systems and drop/sprinkler systems. There is generally high water use efficiency on farm. These efficiencies also have environmental benefits as they are often located in high salinity impact zones and efficiencies reduce the amount of drainage water carrying salt back into the river system. There is scope for further efficiencies, both through improved management practices and new technologies. A major driver for efficiencies is labour savings and economies of scale, and in the case of wine-grapes, quality.

Grapes, fruit, and in particular vegetables have a high gross margin in terms of $/ML. However, water is used extensively in washing and packing, either on-farm or by consolidators and processors. Manufacturers can achieve significant savings through increasing the efficiency of their manufacturing plans and seeking alternatives to water where viable.

Some efficiency in wine grapes has been driven by quality and results in a significant reduction in water use through partial root zone drying. This technology has potential to reduce water use in other horticultural crops as well.

Pasture

Pasture for livestock is a low value crop relative to rice, cotton, horticulture and dairy. It has been difficult to measure water use efficiency and production efficiency. However, this industry is likely to be particularly sensitive to price and other structural pressures. For this reason, the price of water is likely to be the most effective stimulus to improve water use efficiency or movement of water to higher value uses.

2.2 Conveyance Efficiency

Both the hydrology (including the inter-relationship between groundwater and surface water) and supply systems associated with irrigated water are highly complex. Therefore, the potential for investment in water savings in irrigation infrastructure, and the methods and strategies used, need to be assessed on a case by case basis along with the farming enterprises and systems involved. There is no single solution to maximising conveyance efficiency.

The Australian National Council for Irrigation and Drainage (ANCID) reports that on average about 30% of water delivered to irrigators was lost in transmission in 2000-01, however the range across systems is large. The generally accepted benchmark for an acceptable level of conveyancing system loss is 15%. The major sources of these losses, particularly in southern systems, are outfalls (water flowing out of the downstream end of conveyance systems), metering inaccuracy, unrecorded usage, leakage and seepage, and evaporation - with evaporation being more significant in hotter and dryer areas and for large shallow storages, and seepage being a particular problem on sandy soils, eg Wimmera-Mallee.

Irrigation authorities continually invest in improved infrastructure, including strategically targeting seepage and leakage. However, the most cost-effective investments in improved conveyance efficiencies have already been carried out. These include better water metering, streamlined ordering and delivery systems, and management of seepage, leaking and evaporation. Once the investment cost reaches $3,000 per ML of water saved, irrigation authorities consider the investment not worthwhile.

Further investments in water use efficiency in conveyance systems are likely to range from $2,000-$20,000 per ML. The delivery price of water is generally between $30-$90 per ML – the higher price applying to pumped systems. The entitlement price in the temporary water market in the northern Victoria rose to $500/ML this year as a result of the drought up from $50-200/ML in 2001/02. It is therefore often difficult for an irrigation authority to recoup the cost of investment in conveyance systems.

Emerging technologies with potential for the future include desalination and aquifer storage. Aquifer storage and recovery enables water harvesting and storage in aquifers when water is available (often during winter and spring) and extraction and use during peak demands (often spring and summer).

Evaluating Water Savings Proposals

The Minister for Agriculture, Fisheries & Forestry announced in November 2002 that the Government would be seeking ideas from major engineering firms, other expert non-government agencies and the public for major water savings in the Murray-Darling Basin and elsewhere.

Proposals worthy of further evaluation will undergo a feasibility study to which the Commonwealth will contribute half the cost through NAP or NHT funding. The outcome is expected to be a pool of properly costed and evaluated proposals that can be put together for consideration by governments to achieve savings.

An expert Evaluation Panel has been established to undertake initial assessment of proposals. An Advisory Committee (with State representation) will provide advice on further action to take worthwhile projects forward.

A public call for ideas closed on 13 June 2003, with more than 500 submissions being received from individuals and organisations. Initial assessment by the Evaluation Panel is likely to be completed in September 2003.

2.3 Water Use Efficiency in the Processed Food Industry

The processed food industry is Australia's largest manufacturing industry with a turnover in excess of $50 billion. In 2000-2001, Australia exported over $18.5 billion in food products, an increase of 22.6 per cent over 1999-2000.

Around half of Australia's 4000 processed food and beverage firms and about 40 per cent of the 163 000 employees, are located in rural and regional areas so rely directly on rural and regional infrastructure. In addition, food processing companies located in metropolitan areas often source some or most of their raw ingredients from rural and regional producers.

Inputs to food processing range from unprocessed products such as fresh fruit and vegetables, through to partially processed products such as peeled and chopped fruit, shelled nuts, frozen fish, milled flour, pre-mixes and dry milk powder, to highly processed items such as flavour essences. Many processed items are destined for further downstream processing before reaching the consumer.

Water is an essential ingredient in many products and is a key element in the process of manufacturing safe and healthy food. In order to operate, food manufacturing facilities require guaranteed access to competitively-priced, food-grade water. It has a variety of essential uses without which the processing plant cannot operate, including:

- washing food inputs such as vegetables, fruit and fish
- cleaning and disinfecting surfaces in preparation and processing areas
- purifying PET and glass bottles, jars and other containers
- coating mixtures for fresh fruit and vegetables
- cooling and heating both products and the manufacturing equipment.

The primary driver for decreased water-use in food manufacturing is economic rather than environmental. In addition to paying to purchase water, food manufacturers also pay to dispose of waste-water. While some water is either used or lost in the manufacturing process (as an input or to evaporation), the remainder requires treatment generally at four to five times the cost of the original purchase.

An issue associated with this in some States or regions within States is the lack of industry development focus from both the water utilities and the EPAs. Two problems arise:

- water utilities are seen by some processors to have a vested interest in selling more water rather than assisting companies do more with less; and
- food processors are told they have a problem to deal with, namely the cleaning and disposal of waste water, but may have trouble accessing the tools or information to manage this process or difficulty realising the potential gains from reuse or recycling of impurities removed from the water.

While smaller companies in particular are constrained by imperfect information in reducing water usage or deriving an economic benefit from waste-water, some larger companies are reducing this cost by undertaking primary processing of waste-water on site to remove polluting bi-products such as protein or salt which can then be re-used.

In plants which clean raw ingredients, more proactive firms have already reduced usage to the minimum required by health and safety regulations by substituting chemicals for some cleaning applications and reusing grey water in non-food applications such as the cooling towers.

Simple changes to plant and machinery, such as water-saving nozzles for wash-down hoses, can be used to save considerable amounts of water, and reduce input costs for the company. However, efficiency measures with a payback period of more than 12 months are often beyond the financial capability of processors. This problem is particularly bad for smaller processors where the costs of undertaking the re-engineering and rebuilding required to implement the changes can be prohibitive.

The increasing cost of water will affect the ability of the food processors to compete on price both on the export market and with imports on the domestic market. The impact will be felt throughout the industry, across all sectors and by all companies. While larger companies may be able to absorb the costs more readily, it may also prove to be one more reason to relocate manufacturing to a lower-cost location and a potential disincentive for investment.

Flow-on effects

Reduced supply and market pricing of water will potentially create opportunities for on-selling waste products (eg grey water) in sectors which release significant amounts of water as a by-product of processing. Many of the opportunities for water recycling are currently not cost-effective due to the high infrastructure costs and low (or negative) rate of return.

Australian food manufacturers currently struggle to compete on price both in domestic and export markets. The increasing cost of water will further impact on profit margins, making some companies unsustainable in both regional and metropolitan areas, particularly where they are competing with product from lower-cost competitor countries such as Thailand, China and Chile.

In some key export destinations such as Japan and the UK, environmental assurance is in the process of becoming a pre-competitive requirement for sales to many retail chains. The increasing cost of water in Australia may act as a catalyst to encourage food processors to compete on non-price factors such as quality in these markets, forcing them to investigate environmental management systems to reduce water usage and to adopt effective waste management strategies. These management systems could be used as the first step towards meeting the stringent requirements being developed by retailers in these export markets.

Another potential positive might be that manufacturers able to produce grey water of a sufficient quality could sell this by-product to local enterprises including farms. Currently many efforts to recycle water in this way have proved too costly, but the rising real price of water may make them cost-effective.

2.4 Achieving Increased Irrigation Water Use Efficiency

There may be a range of drivers and impediments to increasing water use efficiency in both conveyance systems and on-farm. These may relate to institutional arrangements and settings, investment capacity and environment, social and cultural issues, structural adjustment, and information availability. In particular, for conveyance systems, there may be issues associated with measuring losses and savings, issues of private and public good, ownership and business structures of suppliers and capacity to borrow.

Institutional Issues

In achieving savings through water use efficiency, it is important to ensure that regulatory settings support and drive improved efficiencies. This includes security and investment certainty in relation to water property rights, effective water trading markets, pricing regimes and licensing arrangements. Some of these are discussed further below.

In 2002 AFFA investigated the extent to which institutional arrangements for water authorities may promote or impede efforts to improve water use efficiency by rural water providers. These institutional arrangements include legislation, regulations, privatisation or corporatisation of rural water authorities and price setting arrangements.

The study identifies the following issues as having an impact on incentives for adoption of water use efficiency in irrigation systems:

- the level of devolution to local management;
- the form and extent of devolution and licensing; and.
- the role of irrigation providers in relation to water use efficiency, for example in NSW, irrigation water providers must foster sustainable water use on farm as part of complying with their licence, while in Queensland, Sunwater is specifically prevented by legislation from interfering with irrigation practices beyond the farm gate.

Cost Effectiveness

Barriers to ongoing investment by irrigation authorities include cost/effectiveness of the project to the authority, scale of investment required, ability to capture savings within their district and the need to match irrigation delivery systems with production systems. For example, adoption of technologies to refine water delivery can be cost effective in areas producing high value crops where full cost recovery is possible. Change of enterprise and production adjustment may be necessary to meet higher costs imposed by upgrading the standard of service through improved technology – this requires close consultation and negotiation with irrigators before investments can be made and changes implemented.

In many areas irrigation infrastructure has been established to support specific types of uses. For example, the Murray Irrigation Area supports a significant amount of rice. In South Australia, the pumped systems of the Central Irrigation Trust support a significant amount of horticulture, including fruit and grapes. Rice relies on flood irrigation several times a season, but horticulture requires frequent waterings, on demand throughout spring and summer. Rice therefore requires less sophisticated delivery technology with lower capital investment than horticulture where flows need be managed to ensure deliveries can be made on-time and in the right quantities.

Price Elasticity

Price as an economic measure to enhance water use efficiency may be more effective for some industries than others. Commodities such as pastures and rice may be sensitive to price but in the case of dairy, horticulture and cotton, water is a small cost in relation to other inputs and price may not easily drive further water use efficiencies.

In the case of rice and pastures, the structural adjustment costs in the event of increasing water prices may be considerable. Increased capital investment, both on-farm and in the conveyance systems would be required to move to higher value crops which require more precise delivery mechanisms.

Other Farm Level Issues

The adoption of improved water use efficiency, including improved measurement, monitoring and management may be affected by a range of factors. These include:

- the profitability of the enterprise and investment capacity;
- management practices, including measurement and monitoring;
- ability and willingness to take up new technologies;
- linkages between the farm business and the supply chain ;
- effectiveness of markets, including water trading markets; and
- taxation incentives and other economic incentives for improving water use efficiency.

Drivers for Water Use Efficiency

Drivers for water use efficiency on farm may be:

- reduction in labour costs, eg through change from furrow to drip irrigation, and increased automation;
- increased productivity benefits;
- improved quality of product eg through partial root zone drying of wine grapes;
- enterprise profitability;
- response to increased scarcity as a result of short-term drought conditions or change in licence conditions; and
- price – more important for some lower value crops (eg pasture and rice).

At the commodity level, industries, particularly rice and cotton industries, are continually working towards increased efficiency through the adoption of best management practices, benchmarks for water use, research and development on water efficient technology, crop varieties and alternative management practices.

Irrigation authorities regularly invest in irrigation system efficiencies, and in some States, work directly with their irrigators to foster improved efficiency. The authorities, through the Australian National Committee on Irrigation & Drainage (ANCID), benchmark performance on an annual basis. ANCID and the Irrigation Association of Australia are working together to improve the information available to the public on irrigation performance on economic and environmental indicators.

South Australia has recently legislated to ensure that irrigated water users must have 85% on-farm efficiency to retain their water licenses.

2.5 Private Sector Investment In WUE

AFFA investigated the scope for investment in water savings in irrigation conveyance systems and the potential for private sector investment in these systems. This study indicates that there may be some scope for private sector investment in reducing conveyance losses but that public and private partners should consider a gradual increase in the involvement of the private sector in irrigation and water savings, rather than starting directly with complex partnership arrangements.

Investment by the Pratt Water Group

As a result of a proposal by the Pratt Water Group a feasibility study for water savings in the Murrumbidgee Valley is being initiated under the National Action Plan for Salinity and Water Quality (NAP). This investment could be regarded as a first step in engaging with the private sector in identifying the potential for water savings.

The proposal by the Pratt Water Group is for a detailed project definition study of specific infrastructure investment projects within the Murrumbidgee Valley, with Commonwealth funding assistance to:

- enhance reliability in current irrigation uses;
- increase the total irrigated area within the Murrumbidgee Region; and
- improve environmental flows in the system.

The cost for the study as proposed by the Pratt Water Group is up to $5.3 million. The feasibility study on water savings in the Murrumbidgee Valley has the support and involvement of the community and catchment groups and could inform a broader approach to water use efficiency and provide a template for similar studies in other irrigation regions.

2.6 Rehabilitation of Artesian Bores in the Great Artesian Basin (GAB)

There are 13,815 bores tapping the GAB aquifers, of which less than 5000 are artesian. The pastoral industry is the dominant user of Great Artesian Basin water; accounting for around 500 GL of the total estimated annual extractions of 570 GL. Modelling of full control of extractions from the GAB suggests that water savings in the order of 200 GL per annum are achievable.

There was an estimated 34,000 km of open earthen bore drains in the Basin at the commencement of bore rehabilitation programs. Under the Initiative, piped reticulation systems have replaced 2,078 km of bore drains to date.

Modelling of pressure recovery attributable to the works approved under the first three years of the Great Artesian Basin Sustainability Initiative suggest that significant pressure recovery will occur over time. The model suggests widespread pressure recovery of up to 8 metres, although more commonly 2 – 3 m, over extensive areas of New South Wales, South Australia and southern Queensland. Informal advice from the States is that direct measurements at monitoring bores and rehabilitated bores are confirming the predicted recovery.

2.7 Can We Divert Water Inland?

There have been a range of suggestions made for schemes targeted at "drought-proofing" Australia. In particular the idea of diverting water from abundant sources, principally in northern Australia, to provide water to inland Australia has been actively promoted. It is a COAG requirement that any investment in new infrastructure be economically viable and environmental sustainable. Not only do these schemes generally fail to meet this criteria, they are also likely to be a huge impost on Government budgets. For example:

- A study on a proposed pipeline from the Fitzroy River to Perth in Western Australia indicates a cost of more than $10 billion in terms of capital, with a cost of $4000 per megalitre of water per year. This can be compared to the current price of water in Perth of $400-$1470 per megalitre. A major component of capital and ongoing operational costs would be the energy and infrastructure costs of pumping water.
- A 1981 assessment of diverting the Clarence River inland indicated a capital cost of $4.1 billion (2002 dollars) and $600 per megalitre per year at the headworks. This does not include the development of infrastructure and delivery costs. Currently irrigators are paying between $17 and $90 per megalitre per year for irrigation water. Such diversions would be an environmental threat to the Clarence Estuary and also impact on prawn and seafood industries at the estuary and the adjacent coastal zones. It would also put more water into already saline environments.
- The Bradfield scheme proposes transferring water from the northern coastal rivers of Queensland to inland Queensland and beyond. The capital cost of the scheme was estimated at around $5 billion (in 2002 dollars) and would require pumping 409 metres in head to get over the Great Dividing Range. Water would cost $1500 per megalitre per year at the farm. The scheme would divert water from irrigators along that portion of the Queensland coast and impact on the environment both at the source and destination of the water.

2.8 Piping Open Channels

Numerous suggestions have been made to pipe open irrigation channels to eliminate seepage and evaporation.

The three major irrigation areas in the Murray-Darling Basin (Goulburn-Murray, Murray Irrigation and Murrumbidgee Irrigation) account for 12,000 km of open channels. Current costs of estimated savings from piping open channels, according to Goulburn Murray Water, are:

- over $100,000 per megalitre of water saved in primary channels, such as Mulwala Canal.
- over $32,000 per megalitre of water saved in secondary channels
- $13,000-$20,000 per megalitre of water saved in tertiary channels.

Where investment costs are over $3000 per megalitre, the investment is not generally considered viable.

Piping is best targeted strategically where seepage from irrigation channels is a problem. Most irrigation areas are on clay soils, but seepage can occur where channels cross over bands of sandy soils. An exception would be the Wimmera Mallee which is largely located on sandy soils and has an efficiency of 10 per cent (ie a loss of 90% of water diverted). It is important to examine the costs and benefits of investment in piping in this area and the Commonwealth has committed $3.885 million for a detailed design study for a project which would potentially save 103,000 ML of water per year currently lost through

evaporation and seepage associated with 17,500 km of open earthen channels across the Wimmera and Mallee regions.

Evaporation is a particular problem where there are large shallow storages, for example, the Menindee Lakes, Lake Mokoan, Barren Box Swamp, and shallow on-farm ring tanks in the northern portion of the Murray-Darling Basin.

2.9 Water reuse and recycling

The re-use of water and wastewater is an area where opportunities for increasing rural water supply may exist. The future demands and rising cost for water will require that we recognise the importance of stormwater and wastewater and utilise this as a resource, not as a waste product. There are issues of health and public perception to be dealt with if this resource is to be fully utilised.

There is potential for recycled water from urban areas to be transported to support irrigated agriculture. In many cases the cost of piping and distributing the water may be prohibitive because of distance and elevations which would resulting in considerable infrastructure and pumping costs. To be cost effective, water would need to be applied to high value crops, such as horticulture, but there are limitations on the application of recycled wastewater directly onto food crops. Land capability of the region where water could potentially be piped would also need to be considered.

In the MDB, where 90% of available water is currently used for irrigation and urban and other water uses comprise only 10%, the potential for recycled water to supplement the total supply would be limited. Given that across Australia only a small proportion of total available water is used for urban supplies, the potential for reuse to increase irrigation production or to increase availability of water in times of drought is limited. Alternative strategies are to conserve water use in urban areas and recycle water locally, for example, the use of grey water on gardens.

Co-use of irrigation water for inland aquaculture is becoming increasingly viable. Already a number of farmers in the Sunraysia region and throughout the MDB are experimenting with agri-aquaculture systems. Most trial systems utilise existing on-farm water storage tanks to grow native fin-fish such as Murray cod or silver perch. The wastewater, rich in nutrients, is then used to water and fertilise crops.

2.10 Aquifer Storage and Recovery

Aquifer storage and recovery (ASR) is an emerging technology that enables water harvesting (e.g. during peak flows or effluent reuse), with storage and release during heavy demand periods. ASR involves the use of an aquifer as an underground reservoir by injecting surplus water for later pumping and use. Aquifers have the potential to store significant water volumes while reducing the problems inherent to surface storages such as evaporation losses and risk of contamination. In some feasibility studies the cost of ASR is as low as 10% of comparable surface water storage requirements.

2.11 Desalination

A recent study by Land and Water Australia investigated the technical and financial aspects of desalination technologies in the Australian context. Specifically, the study aimed to determine if and where desalination of surface and groundwater resources has the potential to be a cost effective option as an alternative water supply or as a salinity management tool.

The study recommended that desalination could potentially provide an alternative to conventional sources of water are considered as an additional water supply where traditional water supplies are limited, there is low cost energy available and an availability of labour. This is not only relevant in providing water supplies to support increasing levels of coastal development, but could also enable use of the significant resources of inland saline groundwater. The study also produced a decision-making guide for use when considering installation of a desalination plant.

Australia currently has a number of mines and power stations that use desalination for the production of boiler feedwater or to process effluent. A limited number (less than 10) of small desalination plants provide public water supplies in Australia. The cost of providing water through desalination is high in comparison to the costs of conventional water supplies. Some examples include:

- a desalination unit on Kangaroo Island, South Australia, supplements the domestic water supply for the town of Penneshaw;
- Rottnest Island in Western Australia has operated a desalination plant for a variety of freshwater uses since 1995;
- a desalination facility to supplement municipal water supplies for Port Lincoln and the lower Eyre Peninsular is currently being investigated; and,
- the Western Australian Water Corporation is investigating the feasibility of developing several desalination facilities for industrial and urban application.

Desalination may become a more viable option for providing fresh water for communities and industry in the future should the cost of fresh water supplies increase or the cost of desalination technologies falls further.

2.12 Water Availability in Northern Australia

A large proportion of Australia's total rainfall runoff occurs in the tropical north of Australia. There are irrigation developments in the Northern Territory and in the Kimberleys in Western Australia. However, primary production in Northern Australia is dominated by cattle, rather than irrigated agriculture.

There may be some constraints to significant development in these areas:

- limited land capability for intensive agriculture;
- the humid/dry environment;
- low topography which would limit storage capacity;
- lack of infrastructure; and,
- lack of market drivers.

A key driver for development in the North is likely to be expanding Asian markets. This coincides with improvements in transport infrastructure such as the Darwin Port and the

Alice Springs – Darwin Railway. However, it will be important for governments to ensure that infrastructure development in the north to support irrigation is both economically viable and environmentally sustainable.

3. PROGRESSING WATER REFORM

Institutional arrangements and instruments can impact on how water is managed and used. Institutional settings can represent an incentive or an impediment to more efficient and sustainable use and management and use of our water resources. In particular, effective property rights, trading regimes and pricing regimes can have a significant impact.

3.1 Property Rights and Investment Certainty

Considerable progress has been made in all jurisdictions to develop legislation for clearly defined water property rights separate from land title and well specified in terms of ownership, volume, reliability and tradability.

In response to the requirements of the COAG water reform framework, all States and Territories developed new, or substantially amended, existing water legislation to provide for property rights, water trading and environmental flows

In the past, financial institutions lent against the total value of the land and water asset held by irrigators, reflecting the fact that water was tied to the land and its value was therefore incorporated into the total of the value of the property. Property rights for water have now been separated from land, largely to facilitate water trading. As the value of the water entitlement is a significant proportion of the total value of the assets held by irrigators there are concerns about loss of equity and financial hardship on the part of irrigators should loss of allocation deflate the total value of the water access entitlement.

A clearly defined and secure property right to water is essential for the efficient use and management of water resources. Investment in water use efficiency management tools and technologies, as well as increased development and production, will be hampered unless irrigators have some certainty about the water they are entitled to and the conditions under which it can be accessed over a reasonable investment timeframe.

Prior to the recent debate and reforms to water property rights, there was a perception by users and the community that water entitlements were "in perpetuity" as most entitlements were renewed without question or alteration. In reality, however, entitlements in some jurisdictions were of short duration and had little real legal security behind them.

Water entitlements can generally be defined as a right of access rather than ownership as State and Territory water resources are vested in the Crown. The respective State and Territory government therefore owns the water but provides users with the right to access that water under certain conditions. Where rights conflict, the right of the Crown prevails. This becomes a significant issue where water allocations are being wound back by governments to meet environmental or other requirements.

Security of entitlement relates to the probability in any given year that an irrigator will receive their entitlement or a certain proportion of that entitlements. The Cap on diversions in the Murray-Darling Basin was established to, among other things, protect the security of water entitlements from being eroded by the continued allocation of already fully-utilised

resources. However, while it has achieved this outcome, the Cap and the introduction of water trading has led to an unintended activation of previously unused water allocations (known as sleeper and dozer entitlements), which has further threatened the security of entitlement holders.

Where water has been over-allocated, there is a need to wind-back the amount of water allocated to holders of water entitlements. This has already been a major issue in New South Wales where some groundwater systems are over-allocated (such as parts of the Namoi Groundwater Management Area). Other surface and groundwater systems will need to wind-back allocations to some extent.

Wind-back in allocations can also affect the profitability of the farm business as less can be produced unless significant water use efficiencies can be realised. Also returns on capital investment in irrigation infrastructure on-farm may not be realised. On the other hand, increasing the scarcity of water will lead to water having a higher value than before and any unwanted entitlement may be able to provide a return through its sale on the water market.

There is a tension between the need for governments to be able to adaptively manage the water resource by responding to new science or information about its environmental sustainability, and the immediate economic interests and expectations of water users, including the need for investment certainty. This is particularly evident at the point of renewal of both water rights and management plans. In NSW and Queensland, there are currently no guarantees that existing levels of access will remain the same or even continue at all at the roll-over of the plan. This is a particular concern for irrigators, and resolution of this issue would go a long way to increasing certainty for water users. Producers need certainty about the availability of water and the ongoing value of their entitlement to support planning and investment to improve their productivity, including water use efficiency.

There are a number of steps that are being taken to address water property rights issues.

At its meeting of 6 December 2002, COAG noted progress on water reform in all jurisdictions and reaffirmed commitment to those reforms as set out in the 1995 National Competition Policy Agreement. The CEOs' Group on Water, with representatives from all jurisdictions and the Commonwealth, provided a paper on water property rights to CoAG. The paper outlines principles to address property rights, water trading and structural adjustment.

However, in the Commonwealth's estimation, it is unlikely that implementation of the CEOs' Group on Water principles alone will resolve ongoing concerns with water management arrangements. The Commonwealth will continue to work with the states to ensure the delivery of outcomes at the next COAG meeting that maximise the economic, social and environmental performance of Australia's water management.

3.2 Water Trading

Water trading expanded rapidly in Australia during the 1990s and is delivering economic benefits to Australian agriculture and water users.

The water trading market in Victoria is well established and plays an important role in agricultural production. In Victoria between 1% and 4% of water rights are traded

permanently every year, and up to 17% are traded on a temporary basis. Permanent water has generally transferred to higher value agriculture with most permanent trading going to wine grapes and horticulture in recent years.

In NSW the water trading market is active in regulated river systems but not yet well developed in groundwater and unregulated river systems. Temporary transfers have been allowed for Queensland for around 10 years. In South Australia there has been major progress in some areas such as the Barossa Valley, where reforms have led to significant high value development which would not have otherwise occurred due to lack of locally available water. There has been limited development of water trading markets in other States and MDB Pilot Water Trading is estimated to have added some $50 to $100 million to production each year in the Murray-Darling Basin.

While volumes of temporary trades have been significant over the last decade, permanent trade remains limited. This has been for several reasons, including the cost of purchasing permanent water entitlements and restrictions on permanent trade from irrigation districts. Under the current drought conditions, some irrigators have not had sufficient allocation to grow a crop, so temporary trade has enabled them to earn some income from the water available to them. In other cases, irrigators would receive a greater income from temporarily trading their water allocation than they would have from growing a low-value water intensive crop.

This indicates that while the water trading framework has been generally accepted and adopted, subject to physical and environmental constraints and the protection of third parties, overall the actual volume of permanent water traded remains a small fraction of total water use. The southern Murray-Darling Darling Basin has the most potential for the development of robust water trading markets and already features well operating water exchanges. The slow uptake of permanent trade has caused some opportunities and economic benefits to be foregone or delayed.

Water trading must be underpinned by a secure system of property rights with compatibility between regions and States. Currently, there are many different property right regimes in the Murray-Darling Basin and a lack of compatibility between property rights which apply across borders.

A review of the Murray Darling Basin Commission's Pilot Interstate Water Trading Project concluded that interstate water trading through the pilot had increased the value and efficiency of use of water in the Murray-Darling Basin. For those districts that had acquired water, the trading had positive social impacts. The review also recommended the improvement of the administrative arrangements of interstate trading, such as registers of water licences. It also reported that while in the long-term interstate trading could have a negative impact on river salinity, this impact could be reduced if States improved the mechanisms for enforcement of environmental plans and standards. The MDB Ministerial Council also highlighted the need for full public disclosure of the amount paid for water, as this is essential for market development and transparency and for consumer confidence.

The MDB Ministerial Council is considering the environmental needs of the River Murray through the Living Murray Initiative, which is examining the economic, social and environmental implications of returning water to the Murray. The Council recognises the fundamental importance of a fully functioning water market to the ability of governments to recover water for environmental purposes and to facilitate structural adjustment in Basin

industries. At its meeting of May 9 2003, Council endorsed the following key requirements for an expanded and effective permanent trading market:

- clear specification by government of water access entitlements including duration of tenure and arrangements under which tenure may be modified;
- clear registration of water access entitlements by governments for individuals to hold, use and trade permanently between zones, valleys and interstate;
- removal of current administrative barriers that limit access to permanent interstate water markets in water access entitlements; and
- agreement between States with respect to the environmental clearance requirements for new irrigation developments.

The Natural Resource Management Standing Committee (NRMSC) released the occasional paper *A National Approach to Water Trading* in 2002. This publication aimed to develop a national framework for water trading markets that was applicable across different jurisdictions.

A National Approach to Water Trading identified two conditions which are essential for trade to occur. Firstly, resource availability has to be capped or constrained in some way. Trade will not be required if individuals are able to acquire further resources through administrative means, free of charge or at limited cost. Secondly, gaps must existing in buyer and seller situations. There is no need for trade if all parties are in precisely the same position. For example, sellers must have a surplus of water available for trade and buyers must have urgent needs for the water.

However, the development of trading regimes has been uneven both across and within the States and Territories, regions and water systems. Major impediments to efficient use and trade remain in both surface and groundwater systems.

Benefits of Water Trading

Water trading has the potential to provide economic, social and environmental benefits to the irrigation industry, and the economy as a whole, provided it is socially, physically and ecologically sustainable. However, much of the potential benefit is yet to be realised.

By shifting water from low value to high value uses, water trading can accelerate structural adjustment within communities. The Australian Bureau of Agricultural and Resource Economics (ABARE) has estimated that the more widespread use of water trading in the Murray-Darling Basin would increase output by around $48 million annually.

Permanent water trading also gives irrigators and other water users the opportunity to increase the flexibility of their operations by either buying water to expand activities or selling their water entitlement for a financial return. Landholders seeking to retire, restructure or exit their industry are able to realise the full value of their water asset through the market.

Environmental benefits will also arise where water moves from degraded areas to areas more suited to irrigation where higher sustainable production can be achieved. Water trading also provides a financial incentive for more efficient water use by farms and water businesses.

A National Approach to Water Trading outlines the benefits of water trading as follows:

- contributing to community recognition that water is a scarce resource that can be transferred to its most productive environmental or consumptive use via water trading;
- providing sustainable regional development opportunities though the transfer of water from low value use to high value use with the resulting economic and job growth delivered to rural communities;
- providing a financial incentive for achievement of efficiency savings in water use. These savings are available on farm and to water businesses and can be achieved by improved operating procedures and capital investments;
- allowing new investors to acquire water without jeopardising the jurisdiction's responsibilities for adherence to sustainable environmental flow regimes and associated caps on consumptive use;
- allowing vegetables, rice, cotton, tomatoes and other profitable annual crops to use the surplus water allocations which are available in most years from permanent plantings;
- reducing environmental pressures, for example, by transferring the water away from areas of high leakage (or other in appropriate areas where land degradation has occurred) to prime development zones where higher more sustainable production can be achieved;
- gaining fuller advantage of the physical interconnections in the river and delivery systems (such as the inter-linking of the Murray, Murrumbidgee, Lower Darling and Goulburn-Murray systems through shared headworks in the Snowy and Lake Hume and the interstate obligations to South Australia under the River Murray Agreement). The potential benefits of trade in these interconnected systems extend to more efficient production and use of both water and electricity;
- allowing businesses to access the market to overcome expected declines in security as previously sleeper or dozer licences are activated;
- allowing more efficient consumptive use of water without impacting further on environmental flows or the requirements of groundwater dependent ecosystems; and
- allowing landholders seeking to retire, restructure or exit to realise their assets at full value through efficient and, desirably, equitable markets. While the "drying" of heavily-watered and irrigated properties may reduce income flows within some regions, the sale of water is usually a major cash injection into the local community.

Impediments to Trade

There are a number of impediments preventing the full potential of water trading to assist adjustment and increase economic benefits from being realised. These include:

- water entitlements that are poorly defined and measured, and often inadequately understood by many entitlement holders;
- inconsistent definitions of water entitlements in terms of reliability and tenure;
- lack of clearly specified trading rules, including inadequate definition of water trading zones;
- restrictions on water trading out of many of the privatised irrigation districts;
- a limited range of the type of transactions which may be made;
- lack of market information and administrative support infrastructure;
- limited channel and storage capacity to enable the movement of water use to some locations; and
- seasonal impacts, such as drought, which limit the availability of surplus water for trade.

In addition to these administrative impediments, there are physical constraints to water trading. Water infrastructure, such as river channels, irrigation canals and pipelines has limited capacity, and may not be physically able to deliver water to the location of the buyer. The delivery of traded water may also place additional demands on river flows at certain points in the river system. As a result, it might not always be possible to supply the

additional demand without affecting supplies to existing water users and meet minimum flow requirements. Therefore, the magnitude and location of the proposed water transfers must be considered.

A further consideration in water trading is its potential impacts on third party interests. Third parties may include the environment and other users of the water who may be affected by changed flow regimes or reduced reliability of water supplies. It is important that third parties are protected from the adverse impacts of water trading, without excessively restricting trade. The adverse impacts may be felt most strongly in regions which become net exporters of water. For these reasons, a number of irrigation companies and other water management authorities have restricted or prohibited permanent sales out of their regions. These limits should be reduced wherever possible and alternative mechanisms to protect third party interests should be considered, such as infrastructure contracts or exit fees.

When an irrigator sells their water entitlement and exits the industry, the remaining irrigators face higher costs for the shared infrastructure. This has led to restrictions by some irrigation authorities on trade outside of the irrigation area. In this case, the *National Approach to Water Trading* recommends an 'exit fee' be charged to help overcome this barrier.

Transferring a water entitlement from one location to another can change the level of security of supply, both for the buyer of the water entitlement and for other water users. This is because the entitlement may have been from a 'sleeper' (or unused) licence, or water may have to come from a different source, such as a different reservoir or river. For example, less storage options are available when a water entitlement is moved upstream, reducing the security of water supply, while trades further downstream mean more storage options become available, increasing security.

In order to limit the impacts of water trading on supply security and the environment, the MDBC has introduced exchange rates for interstate water trades. These rates are established to be equitable between users, accommodate changes in the levels of security of water and ensure other water users are not adversely impacted by the trade. However, these exchange rates only apply to interstate transfers at present.

The transfer of water entitlements also has the potential to affect salinity levels by moving water to higher or lower salinity risk uses or changing the volume of water at different locations, thereby affecting the river's dilution capacity and so changing the salinity level of the water. Under the Murray-Darling Salinity Management Strategy, all trades have salinity credits or debits to address this issue. Interstate trades are also subject to environmental clearances to minimise the salinity impacts of trade.

There is scope for governments to improve administrative arrangements, while accounting for third party impacts through:

- developing a best practice template on how to specify water entitlements, and an agreed framework for harmonising differences in water entitlements, agreed principles for defining trading rules, and better alternatives to barriers to trade out of irrigation districts;
- reviewing and evaluating the range of transactions that could be made with respect to water entitlements, beyond the current temporary and permanent transfers;

- review existing and proposed registration systems, with a view to ensuring that they optimise confidence in water entitlements and transactions and facilitate and efficient and transparent market;
- developing best practice templates for approval mechanisms and audit procedures; and
- developing industry standards and regulatory specification for water brokers and water exchanges, and proposals for improving price and other market information.

3.3 Pricing Water

The COAG water reform framework requires a number of reforms to water pricing regimes which have to a large extent been implemented. For example, rural water users now either pay, or are on an established price path to pay, the full cost of water provision. Details of how full-cost recovery is achieved is given in the main document.

The introduction of full-cost recovery has led a change in the way rural water infrastructure is developed and managed. Previously, governments were actively involved in the construction and funding of rural water infrastructure as a means of encouraging rural growth and development. Irrigation areas tended to be managed by State Governments, often inefficiently and not on a commercial basis. The institutional reform brought about by the CoAG water reforms resulted in these irrigation areas adopting commercial principles for water supply. In NSW, this was taken one step further, with irrigation areas fully privatised.

At the same time, the introduction of full cost pricing meant that these water service supply companies or irrigation authorities now needed to begin to recover the full cost of service provision. Water supplied to users increased in price substantially in most areas through the late 1990s as irrigation authorities began to recover the costs of administration, maintenance, asset refurbishment and replacement and other business costs. As these costs were substantially higher than those that irrigators were accustomed to, a price path was often established that would result in the irrigation authority achieving full-cost recovery within a specified period (say, five to ten years). Most areas have either reached, or are close to, the end of this price path.

The introduction of volumetric pricing, generally through a two-part tariff, was an important step in improving the efficiency of water use. A two-part tariff is a pricing structure that differentiates the fixed costs of water supply from the variable costs, thereby charging water users for the service charge of infrastructure and a volumetric charge for the water they actually use. Similar arrangements are used for urban water and electricity billing. As irrigators only pay for the water they use, there is a clear financial incentive to conserve water. This incentive is compounded if excess water can be traded to other users.

There are other pricing issues which require further effort to fully implement. Of particular interest is the incorporation of externalities into pricing regimes. The CoAG Water Reforms defines this as the inclusion of the environmental and natural resource management costs attributable to and incurred by the water business in the price of water. In practice this has only been adopted partially by the States, although is likely to form a part of future assessments by the NCC.

There are many difficulties associated with incorporating externalities into pricing systems. Most externalities associated with water use are diffuse and not necessarily based solely on extractions. Externalities in relation to water extraction and use is just one of a range of

externalities that apply across all industries. Consequently imposing externality costs on water users could be seen inequitable compared to other industries.

4. SUSTAINABLE RIVER AND AQUIFER SYSTEMS

4.1 Water Quality

Contaminants in surface and groundwater can impact on the reliability of water for industrial, agricultural and in particular domestic purposes. Land management practices can, in some instances, result in contamination of water bodies. Potential contaminants include salinity, nutrients, pesticides and sediments arising from soil erosion. Unlike many industrial pollutants, contamination from agriculture is often diffuse and not as easy to target with "polluter pays" principles. Salinity is a major, and in many cases increasing, source of diffuse pollution which is being addressed by the National Action Plan for Salinity and Water Quality.

Pesticides are an example of human-derived contaminants that can impact on reliability of water for domestic consumption. A summary of pesticides found in surface and ground waters was provided in a review of pesticide use in Australia (AATSE, 2002). Surface water investigations to date have focused on areas of intensive irrigated agriculture such as cotton, rice and horticultural production. AATSE (2002) highlighted that little is known of the effects of pesticides on Australian species in their natural habitats.

Nutrients such as nitrate and phosphorus are essential for aquatic food chains. However, excessive inputs can lead to nutrient pollution known as eutrophication (NLWRA, 2000) and promote blue-green algae blooms, which can contain compounds toxic to humans and stock. National investigations of groundwater quality underlying irrigated crops (Budd *et al.*, in prep.) has shown nitrate to be a significant contaminant that could limit domestic use of groundwater. In humans, nitrate affects the body's ability to carry oxygen. Whilst the median concentration of nitrate in groundwaters from all areas studied by Budd *et al* was below the Australian Drinking Water Guidelines (50 mg/L nitrate), eight of the sixteen catchments surveyed had some ground waters in excess of this value. In general, the frequency of violations increased as depth to water table decreased.

National Water Quality Management Strategy

With the developmental phase of the NWQMS nearing completion, the implementation of the guidelines has become a priority.

The most recently published NWQMS documents are the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (revision of the 1992 document) and the *Australian Guidelines for Water Quality Monitoring and Reporting*. These NWQMS guideline documents are two of the key tools which are being used in the development of catchment management plans for implementation of the National Action Plan for Salinity and Water Quality (NAP) and the Natural Heritage Trust (NHT).

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* outlines the management framework for managing natural and semi-natural marine and freshwater resources; provides a summary of national water quality guidelines; and provides advice on designing and implementing water quality monitoring and assessment programs. The *Australian Guidelines for Water Quality Monitoring and Reporting* complements these guidelines and provides a structure for the design of a water quality monitoring program

through: the setting of monitoring program guidelines and objectives; designing monitoring studies and an effective sampling program; guidelines for laboratory analysis; the choice of suitable data analyses in conjunction with monitoring and sampling program design; and methods to report on the results and conclusions.

To assist in implementing these complex guidelines (over 1200 pages in three volumes) two web-based data sources have been created. The first summarises water quality targets and provides an easy to access and use data-base outlining the steps and values required to set water quality targets. A water quality targets handbook has also been developed. Also, a prototype of the Fresh and Marine Guidelines is being designed to simplify these guidelines through innovative linkages to various key elements in the guidelines.

Some of the other activities being developed to improve the implementation of the NWQMS and expand its appeal to a wider audience include:

- improvements to the linkages between stakeholders to coordinate implementation (options include establishing a central facility for handling queries and standardising answers);
- the training of key people to be able to provide seminar presentations and run workshops for professionals and the public to explain how to apply the guidelines and key concepts;
- communication and promotion of the NWQMS and implementation approaches (including availability and web access to documents); and
- alignment of Commonwealth funding programs and projects with industry guidelines under the NWQMS.

Australian Drinking Water Guidelines (ADWG)

New management techniques coupled with technological advances led to a decision by ARMCANZ, ANZECC and the National Health and Medical Research Council to undertake a rolling revision of the NWQMS *Australian Drinking Water Guidelines*, which were published in 1996. These guidelines, which provide a fundamentally new framework for managing drinking water quality, plus the addition of a series of fact sheets on key water quality issues, were released for public consultation in November 2002. The next version of the ADWG should be approved for public release in the near future.

The ADWG now focus on a new framework for managing drinking water quality by developing a multiple barrier/preventive risk management approach. This approach concentrates on managing the water supply system from catchment to consumer, introducing a multiple barrier system to protect drinking water supplies. The Guidelines have received international recognition from the World Health Organisation as a viable and cost-effective system for providing drinking water in developing nations.

The 'Framework for management of drinking water quality' encompasses:

- 12 steps for managing drinking water quality.
- Hazard identification and risk management process; and
- A multiple barrier approach to drinking water quality.

The 12 steps in the Framework

The 12 steps which make up the Framework for managing the protection of water quality in the drinking water cycle are:

1. Commitment to drinking water quality management;
2. Assessment of the drinking water supply system;
3. Preventive measures for drinking water quality management;
4. Operational procedures and process control;
5. Drinking water quality monitoring;
6. Management of incidents and emergencies;
7. Employee awareness and training;
8. Community involvement and awareness;
9. Research and development;
10. Documentation and reporting;
11. Evaluation and audit; and
12. Review and continual improvement.

Each of these 12 steps consists of a number of components and actions, which are linked to the identification of all potential hazards, their sources and potential events, an assessment of the level of risk presented by each and coupled to the multiple barrier approach.

Hazard identification and risk assessment

The ADWG provides a comprehensive list of potential hazardous agents in drinking water, including physical, microbial, chemical, and radiological agents. These potential hazards can arise from particular sources and events, including point sources of pollution (eg human and industrial waste discharge) as well as diffuse sources (eg those arising from agricultural and animal husbandry activities).

The ADWG provides the principles in which the level of risk for each hazard or event can be estimated by identifying the likelihood of occurrence (eg certain, possible, rare) and evaluating the severity of consequences if the hazard were to occur (eg insignificant, major, catastrophic).

Based on the assessment of risks, priorities for risk management and application of preventive measures can be established. Risk are assessed at two levels: maximum risk in the absence of preventive measures and residual risk after consideration of existing preventive measures.

Multiple barrier approach

The most effective means of assuring drinking water quality and the protection of public health is through adoption of a preventive management that encompasses all steps/stages in water production from catchment to consumer. No single water quality barrier is effective 100% of the time against all conceivable sources of contamination. Robust barriers are those that can handle a relatively wide range of challenges with close to maximum performance and without suffering major failure. Although it is important to

maintain effective operation of all barriers, the advantage of multiple barriers is that short-term reductions in performance of one barrier may be compensated for by performance of other barriers.

Rural Communities and Towns

Rural communities and townships use a relatively small proportion of total water supply. Nevertheless, during the current drought there have been water restrictions in many towns. Like some of our major cities there is scope for recycling and reuse of water within towns as well as water conservation.

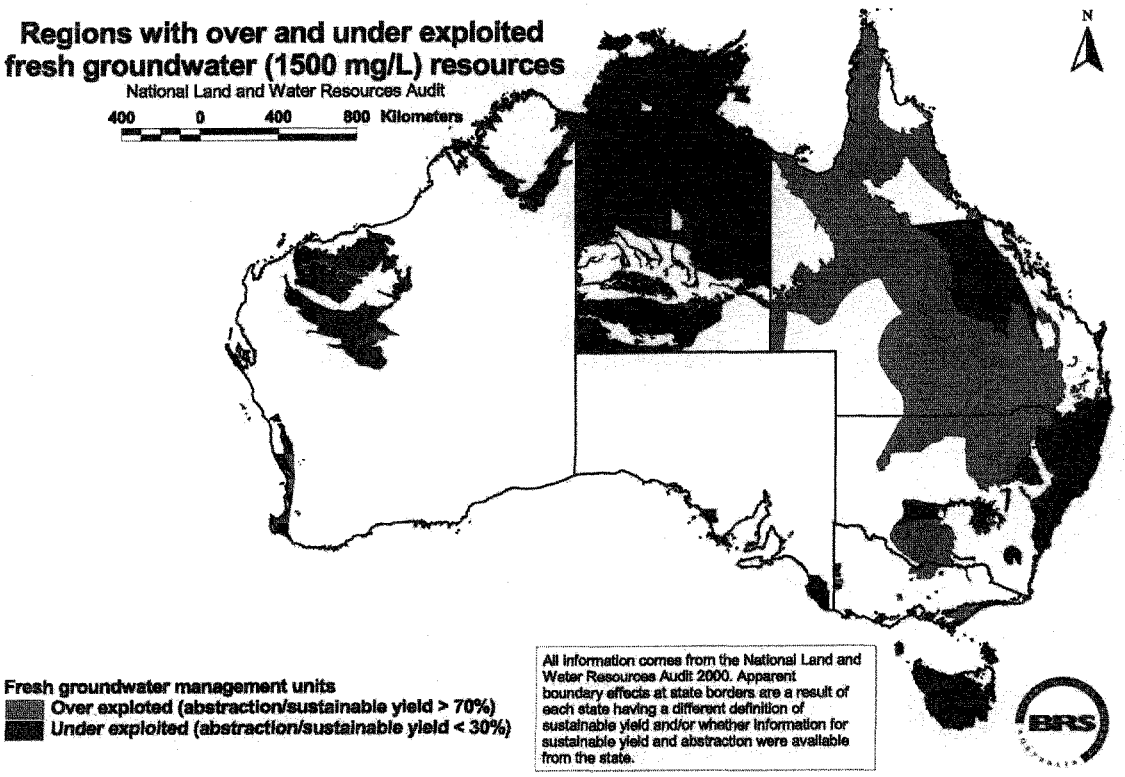
Water quality is also an issue for rural communities and towns. The BRS undertook an assessment of the sustainability of use of rural and remote community water supplies over a number of years. This work includes information on water supply quality, sustainable management of groundwater supplies, management of rainwater supplies and reliability of domestic water supplies.

The project has assessed water supplies from a number of rural communities across Australia with populations between 50 and 10,000. It is noteworthy that preliminary results from the study indicate that up to about 20% of rural communities use water that exceeds Australian Drinking Water Guidelines (NHMRC/ARMCANZ, 1996) for total dissolved salts.

The Commonwealth has also undertaken work to assess the quality of domestic drinking water in rainwater tanks in the Anangu Pitjantjatjara lands in South Australia in collaboration with AIATSIS (Australian Institute of Aboriginal and Torres Strait Islander Studies) and Nganampa Health Council. There was a high degree of thermotolerant coliforms contamination in the rainwater tanks mainly due to lack of maintenance and poor system design (Plazinska, 2002). The findings of this study support the implementation of national guidelines for the construction and maintenance of rainwater tanks (Cunliffe, 1998).

4.2 Groundwater

In 1996 a *National Framework for Improved Groundwater Management in Australia* was developed through the then Agricultural and Resource Management Council of Australian and New Zealand. Groundwater reforms have progressed in the States although some aspects require greater impetus. Significant issues include the appropriate identification of the sustainable yield of groundwater resources that incorporate environmental water requirements; the integration of groundwater and surface water management including assessment of stream-aquifer interactions; a better understanding of the size and dynamics of components of the water budget for a groundwater resource, particularly recharge; making the linkage between groundwater quality and quantity management; and integrating groundwater management with other NRM issues such as salinity and land use change.



The interaction between surface and groundwater systems is an important issue for sustainable water resources management, as management decisions are requiring more detailed information of our entire water resources. Surface and groundwater systems are inter-related - reductions in surface water allocations put pressure on groundwater resources while increased groundwater use can reduce surface water availability. Previously, surface and groundwater systems have often been managed as separate resources, creating the potential for inconsistent management and double allocation of water.

Recently, the integration of surface and groundwater management has been recognised as a vital for ensuring sustainability of overall river systems. Under the Inter-Governmental Agreement of the National Action Plan for Salinity and Water Quality, governments agreed to the 'removal of impediments to the effective operation of trading markets in, and the integrated management of, both surface and groundwater systems'. The review of the operation of the MDB Cap also recommended that groundwater be managed on an integrated basis with surface water and that a new approach to groundwater and surface water be developed to recognise their interdependency and improve salinity and water quality outcomes.

There are some institutional impediments to integrated management of surface water and groundwater. Surface water and groundwater are generally administered by different areas of an organisation. A critical risk of such management is where allocation does not take adequate account of interactions between groundwater and surface water. Where significant interactions are not accounted for, the same water can be simultaneously licensed for extraction as surface water and groundwater, thus resulting in a "double allocation" of the resource.

4.3 Land Use Change

Land users are continually making changes to their mix of enterprises and their management strategies on their land. Changes are generally a result of responses to a range of economic, environmental and cultural factors. Most change is relatively insignificant but large scale changes in land use may result over time or through major planned projects. These can lead to significant changes in the water balance and affect environmental flows and/or the security of downstream water users through reduction in catchment yields. The type of changes that may have an impact include:

- proliferation of farm dams in upper catchments;
- large scale afforestation;
- urban development, including processing facilities;
- other large-scale changes in a region over time, eg pasture to horticulture (or vice versa); and
- large scale land clearing.

Vegetation intercepts and utilises rainfall and runoff and releases moisture into the atmosphere through transpiration. Changing the nature of the cover to radically increase or decrease transpiration and/or runoff changes the water balance. This increase or decrease in runoff due to large scale change such as plantation forestry has not been incorporated into water allocation decisions or planning decisions and can have a dramatic impact on water availability.

There are few planning limitations on changing land-use, apart from urban development. Responsibilities for planning also usually lie with local governments who do not have responsibility for managing water resources or ensuring environmental flows and security for irrigators.

Farm Dams

There has been concern about the growth in numbers of dams in the upper catchments of major rivers. This is perceived by many as a threat to river health and the reliability of supply to downstream water users as farm dams intercept the rain that may otherwise reach the river. The contrary view is that landholders should have the right to take a share of the water from their property and use it for any purpose. Some States are moving to clarify and limit the rights of farmers to capture runoff on their own land.

The NSW farm dams policy, for example, limits the right of landholders to capture and use runoff for any purpose to 10% of the average yearly rainfall runoff for their property. This is known as a Harvestable Right and is tied to the land – it is intended to satisfy essential farm needs such as for stock watering, house and gardens and may be used for any purpose, including irrigation. This right will not be licensed and no fees will apply.

In Victoria, the *Water (Irrigation Farm Dams) Act 2002* came into operation on 4 April 2002. It amended the *Water Act 1989* and extends licensing arrangements to cover all irrigation and commercial use in the catchment. Irrigation and commercial dams of any size built off waterways have the same effect on water availability as dams built on waterways. They affect the amount of water available for use in the catchment and they reduce stream flows. The amendments to the Water Act aim to ensure that water use across Victoria is sustainable.

4.4 State of science

The last decade has seen a marked improvement in understanding of natural resource management issues. There is now greater expectation and awareness in the community about the health of waterways. To ensure an optimum balance between consumptive and environmental uses of water, there is a need for ongoing scientific monitoring of the resource base producing long-term trend data.

Current knowledge of the environmental use of ground water is limited due to a lack of long-term monitoring of the resource and its behaviour. The *Australian Water Resources Assessment 2000* (AWRA) produced by the National Land and Water Resources Audit reports that on average only 77% of the groundwater management units have information on aquifer characteristics, allocation, use and extraction. Similarly, 78% of all surface water management areas have information on water availability, allocation, use and trading. The reliability of this data is extremely variable.

According to the AWRA, Australia requires "an ongoing commitment to data collection, research, extension and innovation if we are to continue to adapt and improve the way we manage, use and benefit from our natural resources. Investment in information and knowledge generation to underpin decision-making is vital."

The AWRA identified a number of knowledge and data gaps in relation to water resources in Australia – these included assessing environmental water provisions, the impact of farm dams and surface and groundwater interactions.

As science progresses and more long-term monitoring of water resources is undertaken management of river systems will adjust to reflect this new information. It is important to recognise that science will never be perfect, and is always susceptible to varying interpretations. Further, many outcomes in natural resource management are long-term, and may not always be immediately evident.

5. DATA

One of the difficulties facing decision-makers and researchers is lack of reliable data relating to water resources and water use. For example, there is no consolidated set of information on the extent, location or value of irrigation across Australia, or for individual catchments. Current data is collected infrequently, is based on sample only and often has a high error rate. The main sources for economic and finance data are Australian Bureau of Agricultural and Resource Economics and the Australian Bureau of Statistics.

A range of data on irrigation agriculture is held by irrigation authorities, State Governments, and the Murray-Darling Basin Commission. However, much of this data is unpublished and not available in a consolidated and compatible format.

Given the current and potential rate of change in relation to irrigated agriculture there is a case for greater production and socio-demographic information on irrigated agriculture. A good set of consolidated data on irrigated agriculture should cover:

- location of irrigated agriculture (eg GIS coding);
- value of irrigated agriculture at farm-gate and value of first stage processing (meat vs saleyard returns);

- crop x area x water applied (x valley system);
- nature of the resource used: groundwater, irrigation area; direct diversions; on-farm supplies;
- irrigation technology used;
- enterprise productivity;
- whole of farm finance information; and
- socio-demographic data

The lack of consolidated data on irrigation has led the Murray-Darling Basin Commission to commence a project, *Developing an Irrigation Management information and Reporting System (IMIRS) for the Murray-Darling Basin* which aims to make it easier to access the most up-to-date and complete data available about irrigation in the Murray-Darling Basin. Its key objective is to consolidate and then build on current data collection networks that have been established within the Basin, and to facilitate basin-wide alignment of data collection, storage, analysis and retrieval.

The National Land and Water Resources Audit is the major source of data on the state of our water resources but there are still gaps and limitations to accessing and comparing the data across jurisdictions.

There is also a lack of consolidated data on the use of water by the food manufacturing industry. Companies generally have information on the total amount of water in and out of their facility based on statements from their local utility. However, more valuable data is now being collected and collated by environmentally-aware companies. This data pinpoints water use throughout the manufacturing plant by specific function such as in washing product or cleaning floors and surfaces.

Collation of the information allows companies to undertake simple cost-benefit analyses for introduction of new equipment or reduction of inputs. This data is useful in isolation but would be considerably more informative if companies had an Australian or international benchmark against which to measure performance.

5.1 Australian Bureau of Statistics (ABS) Data

The most recent data produced by the ABS in relation to irrigated agriculture is the *Water Account for Australia 1993-94 to 1996-97.* This was released in 2000.

The ABS has finished data collection for a second edition of *The Water Account for Australia.* The second edition, scheduled for a mid-03 release, will cover 2000/01.

5.2 ABARE Data

ABARE produces compilations of Commodity Statistics and Farm Survey data at a National and State level. These surveys generally are funded by Government and industry.

Farm Surveys Data is funded through AFFA and by a number of broadacre industries and the dairy industry, resulting in high quality data for those industries. The data provide production and financial performance information on these industries. Data are generally presented on an industry, State and regional basis. Detailed information is collected on irrigated agriculture including areas and production from irrigated crops and pastures,

water use and water trading. Data is also collected for other industries from time to time where funding is provided.

The Commodity Statistics provide economic data for a broader range of commodities utilising mainly Australian Bureau of Statistics Agricultural Census Data and Commodity Survey Data which does not distinguish between irrigated and dryland agriculture.

5.3 National Land and Water Resources Audit

The National Land and Water Resources Audit (NLWRA) was established in 1997 as a program of the Natural Heritage Trust. The Audit provides a comprehensive catalogue of the latest information and data on Australia's land, water and vegetation resources. It has contributed to improved decision making in natural resource management, identified changes in the condition of our land and water resource, developed a nationally consistent data set and provided a framework for the continued monitoring of resources.

The Australian Water Resources Assessment 2000 published by the NLWRA in 2002 provides a snapshot of the level of water use with respect to sustainable yields in rural and regional Australia, as well as identifying levels of water quality.

The recent reports of the National Land and Water Resources Audit (including the *Australian Water Resources Assessment 2000*) and previous reviews of Australia's water resources highlight the potential value of access to a national data base on the availability, use and threats to Australia's water resources. With many organisations collecting a range of hydrological data across Australia, there is a role for the Commonwealth to improve the coordination of data collection and the access to these national data sets.

The National Water Data Infrastructure project, funded under the national component of the NHT is a continuation of the water audit theme of the Audit. This project will develop a national water resource data infrastructure for water, underpinned by national agreement on core data standards, that enables distributed access (ie access from centres remote from the data itself) to up-to-date water resource data by water resource managers and water policy offers (agencies), regional natural resource managements, farmers and community groups.

The project will also facilitate greater standardisation of data and data collection and facilitate periodic national assessments of Australia's water resources.

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