Rural Water Use and the Environment: The Role of Market Mechanisms

Relevant LWA-funded projects to the Productivity Commission Inquiry

Land & Water Australia has funded and continues to manage a considerable body of research relevant to the terms of reference of this inquiry. However given the tight timeframe for this inquiry and the constraints this imposes on both the Commission and those making submissions to it, Land & Water Australia has provided brief descriptions of a broad cross-section of relevant research. Commission staff may choose to follow up any or all of these projects in greater depth as the inquiry takes shape.

The following table presents a summary of relevant LWA research to the Productivity Commission Inquiry.

Water use efficiency and addressing environmental externalities has been recognised since the 19th century. Alfred Deakin, considered by many to be the father of irrigation, said in 1890: "*It is not the quantity of water applied to a crop, it is the quantity of intelligence applied which determines the result. There is more due to intelligence than water in every case.* "

Economic definition of water-use efficiency	
Maximising the water efficiency for a total irrigation system	**Relevant Research** **Harvey Irrigation (Case Study for consideration by PC):** The Harvey Irrigation Area (HIA) located in the southwest of WA currently has around 10,000 ha of land under permanent irrigation for dairy farming, beef grazing and horticulture. The region has experienced soil salinity problems and produces drainage water that runs to environmentally sensitive estuarine receiving bodies. Implementation of a State Water Strategy and policy on water conservation plans is requiring Harvey Water to achieve improved water use efficiency at a system-wide level. Harvey Water is renovating their entire water conveyance system from dam to farm. They are converting from open channel to a gravity pressurised pipe. This is achieving a 14% water saving. The capital cost of the new piping is being paid for through an arrangement with the state government to sell the savings to Perth. This represents an opportunity for local irrigators. A survey of Harvey irrigators found that they were interested in changing to more efficient irrigation systems, but were seeking local on-farm research and demonstration results before investing in large-scale changes and costly systems. A project supported by the National Program for Sustainable Irrigation and the Harvey Water irrigator cooperative has recently been completed. Through a case-study approach on a commercial dairy farm it examined issues of on-farm water use efficiency, farm productivity, environmental impacts, whole farm planning requirements and water supply planning with the adoption of sprinkler irrigation for dairy pasture. The project demonstrated that water savings of 3.7ml/ha could be achieved by converting to a centre pivot, and dry matter production doubled per hectare. Improved water efficiencies were also achieved in both the border check and centre pivot irrigation systems. These efficiencies were largely due to better monitoring and

	measuring.
Determining the size of water use efficiencies available.	**<u>Relevant Research</u>** **Benchmarking Irrigation Supplier Distribution Efficiency** Water supply companies have generally been active in benchmarking their activities to increase water use efficiency. The Australian National Committee on Irrigation and Drainage has been undertaking industry benchmarking. The project has evolved from data collection to benchmarking. The reports provide a broad range of measurements including labour productivity measures. LWA supported the development of the concept it is now predominantly industry funded. The following research projects demonstrate the scope of losses within a channel system and the remedial actions necessary. The losses and savings made through intervention can be converted to economic measurement. There is the opportunity to use the research as case studies. This may involve following up with the irrigation supply authorities on changes they have implemented to their systems and the associated economic and social costs. **Benchmarking the Distribution Efficiency of an Irrigation Supply system – July 2000 (GMW3)** The research demonstrated it was possible to account for most of the water with 1-2.8% unallocated per year. Variations in the accuracy of measuring devices means errors are likely in measuring water use efficiency. The largest loss was of water came from channel outfalls (12%). It can be argued this is not a real loss as it is used by native vegetation that has adapted to a wetter water regime. Seepage and Channel losses were relatively low – 0.6 and 1.3% respectively. **Improving the Hydraulic Efficiency of Irrigation AND Drainage Systems through Benchmarking – 2002 (MIL1)** Overall, the project concluded that true water loss in an irrigation system is the result of evaporation (1.76%) and seepage (0.5%). The only way to eliminate these losses would be to convert from an open channel system to a piped system, but the costs of doing so would be prohibitive. However, the project also recognised that water released from ends of channels is a potential loss which needs to be reduced. Consequently, Murray Irrigation Limited has developed and implemented measures to increase the efficient operation of the channel system by installing automatic measuring devices on escapes, and automating channel offtake
	Determining Optimal Irrigation Intensity for Irrigation Areas (CWN3) 2000 SWAGMAN Farm provides irrigators in south-eastern Australia with a model that can determine the optimum mix of crops needed to make the best use of water, climate and groundwater conditions. It generates results that allow a balance to be struck between sustainability indicators such as water table rise, soil salinity and economically viable outcomes.
Identify the main factors that affect water-use decisions on farms - *how do the multiple factors involved in decision making on farm affect on-farm water use and physical water use efficiency* - *how do water-related farm management strategies and current taxation arrangements impact on water use efficiency?* - *Factors which influence decision to invest in new technologies and management strategies* - *Factors restricting uptake – such as lack of awareness, information* - *If physical wue improved on farm is total water use reduced? What happens to the "saved water".* - *Impact of water harvesting on on-farm water use decisions*	
Factors which restrict uptake – giving farmers	**<u>Relevant Research</u>** **Know the Flow project - 1999 (AIT5)** The project addressed the issue of accurate measurement of flows onto irrigation farms from water supply systems. Knowing their

better information.	own water use allows farmers to benchmark themselves, and improve their efficiency accordingly. **Soil Water Monitoring - 2005 (CLW23).** New publication under development. **Water Use Efficiency: An Information Package -2003 (DAN15)** This report brings together information on current equipment and techniques for measuring and monitoring soil water status. **An Evaluation of Short Term Weather Forecasting and Risk Management to Improve Irrigation Scheduling -2001 (QNR26)** The report explores water use efficiency at a range of scales including storage, conveyance and distribution systems, fields, and whole-of-system. The current situation, measurement, implementation and adoption, and emerging issues are addressed at each scale. **Rigorously determined water balance benchmarks for irrigated crops and pastures - 2003 (CLW21)** A crop water balance model (PERFECT) was adapted to explore the hydrological and yield implications of using short term weather data to modify irrigation scheduling. Modelled water savings were small but an economic analysis identified the benefits of avoiding the consequences of waterlogging. This project has improved the calibration of the water use models for maize, lucerne, annual pasture and winter cereals by providing data on soil water content at saturation, field capacity, irrigation applied and surface drainage. This allows farmers to benchmark their water use and better match irrigation to crop needs.
Salinity of water affects efficiency	**Relevant Research** **Salinity control with sustainable farm salt balance through integrated management - 2000 (MDB6, DAN11)** This project investigated options for farm management of saline groundwater, including farm reuse, salt export off-farm and use of sacrificial evaporative areas. The salinity of the irrigation water affects the amount of money that needs to be invested in on-farm infrastructure, such as evaporation basins, drainage systems and monitoring equipment. **Subsurface drainage design and management practices in irrigated areas of Australia - 2001 (CLW20)** A comparison of 10 irrigation regions around Australia is given, with special emphasis on the subsurface drainage technology that has been used in each area and the problems that the drainage is attempting to address.
Nutrient levels of water affect efficiency	**Relevant Research** **Sustainable Management of the Burdekin Delta Groundwater Systems -2004 (CLW32)** The study found that there was sufficient nitrate in the irrigation water that many crops could potentially obtain their total nitrogen requirement from irrigation alone. Modelling with the APSIM-SWIM showed that there was a good opportunity for uncoupling the nutrient movement from the water movement. That is, less water could be applied to the crop to reduce nitrate leaching, or applying fertiliser more regularly, through the growing season of the sugar cane crop, reduced the amount of leaching by 50%. To manage this, it is necessary to monitor soil moisture, crop growth, ET rates, flow metering and control water use; match field configuration (e.g. row length) to soil type and condition; and change to more efficient irrigation systems (e.g. sprinkler or drip).
Improving efficiency by saving water on-farm	**Relevant Research** **Evaporation Losses from On-Farm Storage - 2002 (QNR29)** A discussion of ways of reducing evaporation losses from farm water storages, including covers, monolayers and use of windbreaks.

	Improving Water Use Efficiency by reducing groundwater recharge under irrigated pastures - 2001 (DAN11) Irrigation water quality also has a large impact on recharge. Irrigation schedules have a greater impact on recharge (loss of water below the root zone) on a fine sandy loam than on other types.
Better decision-making on farm	**Relevant Research** **Determination of Optimal Irrigation Intensity for Irrigation Areas -2000 (CWN13)** A farm-scale model that enables evaluation of sustainable and economically viable management options through the integration of knowledge of water and salt movement and the economics of production has been developed. This model is known as SWAGMAN Farm (Salt Water and Groundwater Management). **Changing irrigation systems and management in the Harvey Irrigation Area – 2004 (DAW45, SOU3**) The approach used emphasises whole farm-planning to help with decision making for investment in changes to irrigation systems.
Strategies to improve productivity with less water	**Relevant Research** **Improving the water use efficiency of horticultural crops - 1999 (CDH1)** Partial root zone drying represents a significant advance in the manipulation of the plant's physiology, enabling plant water use to be reduced while still maintaining the production of fruit at acceptable levels of quantity and quality. The technique was developed for grapevines, but has now been proven successful for citrus and stonefruit crops as well. **Potential Use of Polyacrylamide (PAM) in Australian Agriculture – 2000 (UNE39, DAV34)** One application of PAM is for reduction in irrigation duration and water volumes applied.
Whole of catchment research that informs on-farm decision making	**Relevant Research** **Ecologically Sustainable Irrigation Development -1999 (JCU13)** This paper presents a literature review of best management practices for ecologically sustainable development within the irrigation industry. **Do Water Trade Policies Achieve Environmental and Socio-Economic Goals? - 1999 (USA1)** The operations of water trading policies, including the extent to which tradeable water entitlements improve the long term productive capacity, sustainable use, management and conservation of Australia's land and water resources was evaluated. Water markets seem to have largely achieved the expectations of policy makers and water managers relating to economic outcomes. However, there is also evidence that the markets have negative social and environmental implications which need to be addressed. **Determining Whole-of-System Water Use Efficiency for Macquarie and Murrumbidgee River Valleys - 2005 (DAN14)** The report documents socio-economic and climatic factors influencing crop planting and watering behaviour. **Improving hydraulic efficiency of irrigation and drainage systems through benchmarking. -2002 (MIL1)** This report provides a case study using the Mulwala channel, and demonstrates methods for calculating various components of loss and indices of efficiency.
Information	**Relevant Research – Information Resources**

Resources	**An agreed understanding of WUE - how it relates to the water cycle and common definitions is fundamental.** An Irrigation Insight – "An information Package on Water Use Efficiency" provides fundamental knowledge, terms and definitions. It demonstrates ways of measuring water use efficiency and the relationship of irrigation to the water cycle. **Provision of information to irrigations to support water use decisions on farm – soil water monitoring example** There are many soil water monitoring tools available on the market for irrigators, but finding the appropriate tool is a challenge. This Irrigation Insight document compares instruments so that irrigators can determine the best instrument set for their situation. This is highly valued by irrigators and is not otherwise available. It provides a helpful summary of methods and tools for monitoring soil water, ranging from simple tensiometers to electronic sensors that report back to a centralised computer in the farm office. Australian suppliers are also listed. **New techniques to manipulate the physiology of plants are continuing to occur. These may effect WUE** An Irrigation Insight **–" Regulated Deficit Irrigation and Partial Rootzone Drying" 2003** provides knowledge on our understanding of two techniques. Partial Rootzone Drying is considered one of the top agricultural innovations of the 20th century. Regulated deficit irrigation for pome and stone fruits is able to reduce irrigation water use over the year by as much as 25 - 30 %. This is achieved by applying less water to the trees in the second phase of fruit growth, after most cell division has occurred and before the enlargement and ripening phase begins. IN effect this tricks the plant into behaving as if it is drought, putting its resources into producing fruit rather than leaves. Partial rootzone drying (PRD) is able to reduce water use by as much as 50% in grapevines. There is a slight reduction in yield per hectare, but quality of the fruit is often better. The process involves alternating wet and dry cycles between two sides of the plant's root system, causing surges in the hormone ABA (abcissic acid) that partially closes plant stomata and restricts shoot extension. The plant remains turgid, but transpiration of water from the leaves is reduced. Further research results are available.
Tailoring water entitlements for irrigation businesses	**Relevant Research** A number of kits have been developed for industries including – dairy, permanent horticulture and rice. An example of the kits is **"Irrigation Risk Management for Dairy Farmers"**. It helps you decide what you can afford to pay for your water for a season. The report steps through a series of decisions to determine the need for irrigation water

Impediments to the economically efficient use of water that may justify government intervention

- *Market distortions – ie markets for seasonal water allocations and entitlements*
- *Information as a possible limiting factor in water managers decision making*
- *Externalities which limit shifts to greater efficiency*

Water Reform	**Relevant Research** **Implications of water reforms for the National Economy 2004 (CID6)** Implications of water reform are changing as the States and Commonwealth bring in new regulation and incentives**.** However if market based instruments are being considered, various scenarios on implications that may or may not fit with policy can be worth exploring. The following research provides a snapshot of potential implications under various scenarios. However they need to be

	considered in light of current policy. **Implications of water reforms for the National Economy 2004 (CID6)** This report provides one view of likely effects on reforms on the Australian economy. It includes implications for the irrigation sector and associated regional economies. The report has some limitations as there have been policy changes during and since its commissioning. **With the Wisdom of Hindsight: Reconsidering Institutional Arrangements for Water 2006 (UAD 24)** Summarise the nature of existing institutional arrangements in the Murray-Darling Basin and compare with other approaches to improve the management of environmental and other natural resources with particular attention to water dependent ecosystems and the ongoing healthy of the entire system. Building on the MDB case study, propose a subset of Australia-wide institutional reforms for serious consideration as the National Water Initiative and other parallel reforms are implemented. I**nvestigating an Effective System of Defining Water Property Titles (ACI9) 2003** Funded by DAFF and undertaken by ACIL Tasman the project outlines the basis behind the development of a workable system of water property titles for Australia. A final report has been published by LWA. **Improving Water Use Efficiency in Irrigation Conveyance Systems – a study of investment strategies, (MJA1) Marsden Jacob Associates, 2003,** Reports on government and industry strategies, activities and progress to reduce water conveyance transmission losses.
Irrigator and Community attitudes to water allocation and trading	**<u>Relevant Research</u>** **Irrigator and Community attitudes to water allocation and trading: A comparative study of the Goulburn Broken and Fitzroy Catchments (01/5) Technical Report 2001** A survey was distributed to 444 respondents in the Goulburn Broken catchment and 294 respondents in the Fitzroy catchment. Overall, respondents are supportive of water reform, but the community at large has been poorly informed in the reform process. Setting aside water for the environment prior to allocating it for their use is supported. There is overall agreement that the nexus between land and water should be broken and water rights be traded as chattels separate to land. Licensing of on-farm runoff is rejected. Constraints on trading rights may be spatial, sectoral or use related. There is strong support for free trade within and between sectors, including trade between irrigators, local towns and communities and local shires, but not with individuals or companies who do not intend to use the water. Irrigators discriminate between high security and general security water and expect to pay more for high security water in the future. There is indifference to the notion of extinguishing sleeper and 'dozer' licences. Catchment communities consider social justice objectives more important than maximising aggregate farm income.
Role of irrigation in vitalising rural communities	**Goulburn Broken Futures (VPI3) current** The aim of this project is to develop a shared vision on the future of irrigation in the Goulburn Broken catchment; to identify scenarios of major constraints and opportunities and of regional response options; and to understand the social, economic and environmental consequences of various scenarios through impact assessment based on an integration of the best available knowledge. Peer reviews have been very favourable and the work provides a model for other communities to follow. Work to date demonstrates the community's desire for a sustainable future which is likely to mean trade-offs.

Environmental externalities and change – impacts of irrigation

Impact of salinity within catchment and irrigation	**Relevant Research** **Tri-State salinity project** The high value horticultural production systems along the lower Murray are likely to continue to suffer during various periods from increasing salinity levels in irrigation water despite improved irrigation management, saline groundwater interception and future environmental flows. The effects that variations in leaching efficiency and irrigation management have on soil salinity are also inadequately quantified. The project funded through NPSI sought to determine the salinity relationships for irrigated horticulture along the lower Murray: Riverland, Sunraysia and NSW. It has determined the variance of EC (soil water) in the field under known soil conditions and irrigation management and simulated the performance of the main crops under different scenarios of river salinity at Morgan. The project has also provided input to the implementation of the Salinity Strategy and Integrated Catchment Management Plan of the Murray-Darling Basin and the Living Murray initiative The project has found that leaching efficiency continues to be a complex issue, and one that is essential to achieving improvements in sustainability; with the soil moisture content appearing to have an effect. It appears the higher the moisture content, the higher the leaching efficiency. In years of high Murray River salinity (800ec at Morgan) and low water allocation it will be difficult to achieve a salt leaching fraction, which will lead to reduced horticultural/agricultural production and potential tree death. This scenario is likely to occur with the Darling River discharge flows into the Murray increasing at very high salinities and a year of lower allocation. Confounding factors include purchased water shifting downstream and efficient irrigators having sold excess water right. The project results have the potential to influence irrigation practices which will minimise production losses when Murray River water EC levels are high, and/or during times of low water allocation. The economic analysis will be used by MDBC to consider if further salt interception works are required to minimise impacts from additional groundwater salts. These may enter the river if increased leaching fractions are required. The project's results are driving further investment by the program into root zone salinity and solute movement within and below the root zone. The project will provide inputs into the CRCIF solute signature project. The Steering Committee has started to consider whole-of-system ways to harmonise the natural and productive water systems.
Ecological Risk arising from the extraction and return flows of irrigation water	**Relevant Research** Ecological Risk arising from the extraction and return flows of irrigation water is a major issue that overrides the pure economics of WUE. A suite of four research projects have been completed: an ecological risk framework and three associated satellite case studies. **Ecological Risk Management Framework for the Irrigation Industry (umo40) 2005** This document outlines an ecological risk assessment framework for the Australian irrigation industry. The objective of the framework is to provide a robust process that will assist the irrigation industry to incorporate a transparent, scientific, precautionary and ecologically sustainable approach to its management of environmental risks. The framework is catchment-based and focuses on the difficult task of assessing the risks to multiple ecological assets from multiple hazards. The framework was developed by a team using experiences from case studies undertaken in three irrigation districts, the Goulburn-Broken (Victoria),

	Fitzroy (Queensland) and Ord (Western Australia). Although the focus of this framework is primarily on the risks to aquatic ecosystems (e.g. rivers, wetlands, estuaries), it should be robust enough to also be used to assess the ecological risks to other natural resource assets in catchments (e.g. land, soil, vegetation, biodiversity). **Assessment of ecological risk associated with irrigation in the Fitzroy basin: (UCQ3) 2002** This project in the Fitzroy catchment in Queensland was one of three case studies used to illustrate how ecological risk may be employed in the management of irrigation areas in Australia. Data was collected to compare species richness and pesticide concentrations in low impact areas, above a drain leading from an irrigation area, and below the drain. Testing was undertaken for a range of organophosphates and organochlorine pesticides, selected based on recent usage in the area. The study, which looked at a drainage point from a number of farms, found that there was no marked difference in taxa richness between the control sites upstream of the irrigation area and those downstream, nor was there any detectable gradient of impact along the river. At the only affected test site in the study, there was no return of the taxa that were present at other sites, suggesting that low levels of endosulfan that have been present for extended periods of time may contaminate sediment, making the site slow to recover. The results suggest that risks from pesticides to macroinvertebrate species living in rivers are only of local importance, and are not likely to affect the whole catchment. **Ecological Risk Associated with Irrigation in the Goulburn Broken - Stage 2 (GMW11) 2003** Providing irrigation water means changed river water regimes and dams. This can affect thermal temperature and nutrient movement. This report details the application of ecological risk assessment methodologies to blue-green algal blooms and fish survival in the Goulburn Broken catchment. Both the fish and Blue green algae Ecological Effects tables provide new information to refine the Goulburn Broken Water Quality Strategy. The project has provided new information to question the need to hold 30,000ml of environmental water for flushing potential algal blooms from Lake Nagambie and the Lower Goulburn. The main factor that could influence a bloom is filterable reactive phosphorous which is manageable. So the priority task is the management of nutrients in the system. The presence or absence of a fish barrier is the primary driver of the abundance of fish in this part of the catchment. There needs to be new consideration of a fish ladder at Goulburn Weir as the previously perceived issue of thermal pollution impacting downstream has been discounted. Collection of fish data was not consistent and there needs to be designed and introduced collection protocols. **Ecological risk assessment associated with irrigation in the Ord - Phase 2 (wrc12) 2005** The aim of the study was to determine the risk to biodiversity in the lower Ord River due to irrigation return drainage. Specifically: 1. To evaluate changes in macroinvertebrate communities, physical habitat, submerged plant communities, water chemistry, biofilm biomass, and biocide concentrations in response to a gradient of irrigation return drainage. 2. To evaluate whether the changes in Aim 1 were influenced by season. 3. To utilise the changes seen in the above Aims to develop the likely consequences of loss of biodiversity and habitat change. 4. To produce a qualitative assessment of the likelihood of loss of biodiversity within the lower Ord River in response to irrigation return drainage. 5. To undertake a qualitative risk assessment of the risks posed by irrigation return drainage to biodiversity in the Ord River. While total suspended solids and nutrient leaching into the river are considered to be a low risk, the report identifies biocide (insecticides & herbicides) drainage into the river as the greatest threat to river health. The issue of dilution flows from by pass channel water is discussed and further debate is needed on this requirement in terms of WUE.
New irrigation techniques under	**<u>Relevant Research</u>**

development	**Open Hydroponics: Risks and Opportunities. Stage 1 General Principles and Literature Review (DAN22) 2005** Open Hydroponics is a management practice recently introduced into Australian tree crop production. The system was originally developed by Professor Rafael Martinez (Spain). A number of commercial Open Hydroponics management programs have been adopted in Australia and a number of orchards are using variations of its principles (intensive fertigation practices). Higher productivity is reported in orchards using Open Hydroponics both in Australia and overseas. Aspects of Open Hydroponics management principles could be incorporated into conventional production systems to improve productivity. The aim of Open Hydroponics is to increase productivity by continuously applying a balanced nutrient mixture through the irrigation system, limiting the root zone by restricting the amount of drippers per tree and maintaining the soil moisture near field capacity. The combination of these practices is claimed to provide a greater control and manipulation of nutrient uptake at specific physiological stages and improved water uptake. The principles of Open Hydroponics are based on soil, water and nutrient interactions and crop physiology. Open Hydroponics can increase orchard productivity but also increases management risks. Risks identified include the ability to maintain water supply to the orchard and nutrition and irrigation management skill levels. Open Hydroponics orchards have restrictive root zones that may hold only a day supply of readily available water (RAW). If water supply is cut for a number of days during peak demand periods, this could impact significantly on the productivity of the orchard. On- farm water storage may be required to reduce the risk. Open Hydroponics requires a higher level of management skill for both nutrition and irrigation management. A misjudgement in irrigation scheduling or nutrient application rates could impact on productivity and returns. Important factors for the success of Open Hydroponics is the improvement of management skills by growers and the use of professional Open Hydroponics consultancy services. The principles of Open Hydroponics could have potential benefits in conventional production practices. An increasing number of growers are using intensive fertigation programs (IFP). IFP is a fertigation program that has similar principles to Open Hydroponics, but is less intensive than Open Hydroponics. IFP has a greater level of adoption than Open Hydroponics.
Water balance management	**Determining whole-of-system water use efficiency (DAN 14) 2005** The water balance is the fundamental tool for assessing water use efficiency at any scale. The uncertainty associated with the measurement of each of the elements of the water balance varies within and across these scales. Spatial and temporal heterogeneity, measurement error, and difficulty in obtaining some of the measurements all contribute to this uncertainty, making the seemingly simple task of accounting for water flow in a system a complex exercise. This project adopted a methodology to assess the water balance by considering three spatial scales (farm, scheme and catchment) and two temporal scales (daily and annual). The traditional water balance approach is to determine the variables that make up the inputs and outputs and then construct a simple mathematical equation to represent this water balance. This approach requires that all the variables in the equation are dimensionally equivalent, can be identified as an input or an output and are able to be quantified with some certainty. However, this is rarely the case when examining the water balance of farms, irrigation regions and catchments. The program has also created a model using a number of NSW catchments. With the correct data it may be applied in other catchments

Market mechanisms

- Removing barriers to trade - impediments
- Influence prices
- Create new markets – property rights rules etc
- The extent to which water markets help on-farm water-use decisions? To what extend do they hinder?

Environmental Water Allocation	**Natural resource 'buy-backs' and their use to secure environmental flows (BDA4) Environmental Water Allocation Program** The objectives of this project are to review experiences with natural resource buy-backs, and to investigate alternative buy-back designs suitable for sourcing water from the irrigation sector for use as environmental flows. This is particularly relevant to medium and low reliability entitlements in Victoria and NSW. The project is well advanced and will be completed by June 2006. **Improving Water Use Efficiency in Irrigation Conveyance Systems – a study of investment strategies, Marsden Jacob Associates, 2003,** Reports on current government and industry strategies, activities and progress to reduce water conveyance transmission losses.

Social and Institutional Research Program

The LWA Social and Institutional Research Program (SIRP) Strategy, 2005-10, identifies 3 priority research themes, under each of which potentially relevant research is undertaken:

- Institutions and governance arrangements will provide targeted assessment and knowledge support for the National Water Initiative and Regional NRM arrangements;
- Policy instrument choice and mix explores market and non market based instruments in context and within specific institutional settings;
- Landscapes, livelihoods and lifestyles assesses socio economic drivers of change including values, aspirations and institutions, and especially in peri urban areas and in indigenous communities;

A 10 point social and institutional research agenda relevant to implementation of the National Water Initiative was developed at an expert roundtable in May 2005. It is currently being discussed and taken up with the NWC and other parties.

Relevant existing SIRP-funded research projects include:

- ANU 36 Federalism and natural resources management in the Murray Darling Basin
- ANU 39 Cultural flows: country, identity and ecology
- AC 19 An effective system of water property titles
- MMA 3 Healthy waterways project model
- CWE 18 Spatio-temporal effectiveness of natural resource and rural adjustment policies
- GRU 21 Farm decision-making and resource use: new structures and changing responsibilities
- USA 3 Sustainability and profitability: Rural adjustment via water markets
- CSE 29 Assessment of social and economic values of Australia's tropical rivers
- CWE 17 Decision points for land and water futures