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Economics of Water Reform in the Murray-Darling Basin

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Abstract

The paper reviews current water reforms and initiatives in the Murray-Darling Bain from an economic perspective. It argues that while the principles (National Water Initiative) and rules (Water Act 2007) of water reform provide the framework to achieve the goals of reform, the financial incentives (2008 Water for the Future) need to change. In particular, the $3.1 billion allocated to buying water entitlements and the $5.8 billion targeted for water infrastructure subsidies under Water for the Future should be combined and spent on the basis of 'value for money'. If this were accomplished, and the funds were spent prior to the implementation of sustainable diversion limits in July 2011, the Australian Government would be much more likely to achieve a sustainable future for the environment and agriculture within the Basin, at no extra cost.

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"It was the best of times, it was the worst of times, …, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us…"
A Tale of Two Cities, Charles Dickens.

1. Introduction

Water reform in the Murray-Darling Basin (MDB) is like a tale of two cities. It is both the best and the worst of times. The former because the National Water Initiative of 2004, the Water Act 2007 and the Water for the Future Package of 2008 worth $12.9 billion, collectively, provide a unique opportunity to resolve environmental and structural problems decades in the making. This offers an once-in-a-lifetime opportunity to discard the 'ancien regime' of subsidies for irrigation, overuse of water, and restrictions on water trading. But it is also the worst of times. The 'Big Dry' in the southern part of the Basin, on-going since 2001, has placed many environment assets in a critical state. This is not only because of reduced inflows due to the drought, but because of a proportionally much greater decline in water allocated by States to environmental flows relative to diversions by irrigators (Connell and Grafton 2008).

Many water dependent communities are suffering from reduced incomes as water used within irrigation districts has declined. As a result, some irrigators have argued for continued restrictions on water trade so as to keep water, and their associated jobs, within their communities. It against this background that the Australian government is undertaking water reform with the aim to overcome overallocation of water to irrigated agriculture. The stated goals of reform are to "…ensure the health of river and groundwater systems by establishing clear pathways to return all systems to environmentally sustainable levels of extraction." (Council of Australian Governments, 2004, preamble).

This paper focuses on the economics of water reform in the MDB. It uses economic analysis to evaluate the existing reforms and to propose ways that the reform goals can be achieved cost effectively. At this critical juncture, it is argued that the financial incentives to achieve water reform need to be revised to both achieve the stated goals of reform and 'value for money'. In particular, if the $3.1 billion allocated to buying water entitlements and the $5.8 billion targeted for water infrastructure subsidies under Water for the Future were combined, the Australian Government would be much more likely to achieve healthy working rivers within the Basin, and for no extra cost. In other words, a change in how Australian Government funds are spent would deliver much greater environmental flows and larger environmental benefits with the same budget. It would also provide a solid basis for ensuring sustainable future for the environment and agriculture within the Basin.

The paper provides a brief overview of the 'State of the Basin' in terms of water diversions and entitlements, water trade, the current drought or 'Big Dry', its people, the environment and irrigated agriculture. Section three describes the recent water reform

process and provides evidence as to why planned reforms will fail to deliver cost-effective outcomes. In section four, key changes to the reform process are outlined to meet the stated goals of Australian governments in a cost effective way. In the final section, concluding remarks are offered.

2. State of the Basin

The Basin occupies about one million square kilometres, or about 14 per cent of the Australian continent, and has a population of just over two million people (Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and Bureau of Rural Sciences 2009). Its two main rivers are: the Murray that has its source in the Victorian Alps and dominates the southern part of the Basin, and the Darling that originates in Queensland and connects to the Murray at Wentworth. The Murray and its major tributaries in the southern part of the Basin are 'regulated' rivers such that there are large water storages that regulate the flow to increase water availability in the drier summer months. This regulation has assisted in the development of irrigated agriculture that accounts for over 80 per cent of total water use in the Basin. By contrast, in the north of the Basin many of the rivers lack large, public storages so river flows follow the pattern of actual inflows. Farmers, with appropriate water licences, also have the right to capture and store flows for their own use.

The northern and southern parts of the Basin differ in terms of their rainfall patterns. The southern connected or 'regulated' part of the Basin receives most of its rainfall in the winter months while in the North, subject to cyclonic activity, receives about half of its inflows during the summer. Consequently, the type of irrigated agriculture differs across the Basin. Irrigation in the North, typically, is opportunistic based on the prevailing rain patterns while in the South, at least in the hotter and drier parts downstream of Mildura, perennial irrigation (especially horticulture and viticulture) is based on reliably supplied water released from upstream dams.

Water Diversions and Entitlements

Water for diversions in the Southern Basin is managed from storages via controlled releases and natural inflows. Holders of water entitlements receive water allocations every season based on the amount of water in storages, expected inflows and other factors. These allocations are defined as a percentage of the nominal quantity of the water entitlement that represents a share of a consumptive pool, and vary by catchment. Water entitlements have different levels of 'reliability' where high security entitlements receive their allocations before holders of general security entitlements. Water entitlements with 90 per cent reliability would expect to receive a full allocation 90 years out of 100. The quantity of water an entitlement holder would expect to receive is denominated by its long-term cap equivalent (LTCE) and it this amount, rather than the nominal quantity of water assigned to an entitlement, is what should be expected to be delivered in actual allocations of water.

In addition to allocating water to entitlement holders, states also provide 'planned' or 'rules-based' water to the environment under water resource plans. This planned or rules-based water is, however, not a fixed entitlement despite the Cap because of the operational rules of water management. As a result, in many water sharing plans the proportion of rules-based water allocated to the environment declines with inflows to accommodate the needs of irrigators. As rules-based water is determined by States they are set based on the perceived needs and interests of the individual states rather than the needs and interests of the entire Basin. The discretionary nature of rule-based water has prompted the purchase of water entitlements by governments, especially the Australian Government, to ensure volumes of water are available for environmental flows.

Water Trade

Irrigators are able to buy and sell water entitlements although restrictions are in place to limit sales out of irrigation districts. Restrictions on sales of entitlements are in place in other states, but they have been imposed with greatest effect in Victoria. Its implementation of the 4 per cent rule limits the revocation of association between Victorian water entitlements and land in an irrigation district.[1] Sales of allocation water, the water assigned each season to water entitlements are also traded, but with much fewer constraints on trade.

Water trade in the Basin has occurred since the early 1980s and rapidly increased following the freeing up of some restrictions on trade and the establishment of the Cap in the mid 1990s. Trade volumes have also increased in response to reduced inflows and low seasonal allocations. In 2008-09 there were over 1,000 GL of water entitlements and over 1,700 GL of water allocations traded in the southern connected Murray-Darling Basin (National water Commission 2009a, p. 5). This water trade generates very substantial economic returns to irrigators (both buyers and sellers) and their farming communities worth over one billion dollars annually in terms of the value of water traded, and hundreds of millions of dollars in net gains from trade (Peterson et al. 2004).

The Big Dry

The past decade has witnessed a sharp drying trend in the southern part of the Basin that provides, on average, about 80 per cent of the river flows of the MDB. The Big Dry has been caused by both reduced rainfall and also higher temperatures that have increased evapo-transpiration. As a result, the proportion of agricultural land declared as being under 'exceptional circumstances', a proxy measure of the impact of the drought, has increased from about 5% in 2000 to about 70% in 2009 (Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and Bureau of Rural Sciences 2009, p. 92).

For the period 2002-2007, average annual net inflows in the Murray River totalled 3,986 GL — the lowest recorded for a five year period. This is much less than in any other

recorded drought. By comparison, net inflows averaged 5,501 GL over the period 1940-45 and 5,707 GL over the period 1897-1902 during the Federation Drought (see Figure1). This has translated into much reduced water diversions by irrigated farmers of between 30 and 50 per cent (see Figure 2 for the Murray River) and virtually no flows to the River Murray Mouth (see Figure 3). It has also resulted in the proportion of inflows diverted for agriculture in the River Murray to increase from less than 50 per cent in the 1980s and 1990s to 76 per cent over the period 2000-2008 (Grafton and Jiang 2010).

The impact of the drought on the environment has been greater in terms of reduced flows because of the way regulated water is allocated in many parts of the Basin. Under existing water sharing rules reductions in water diversions are typically much smaller than the actual declines in inflows. 'Rules-based' or 'planned' water for the environment is, typically, treated as a residual after allocations to water diversions (Connell 2007a), and incurs a greater proportional reduction in volumes as inflows decline.[2] Suspension of water sharing plans that have specified volumes of water for the environment has exacerbated this problem (Hamstead et al. 2008).

The consequence of the decade-long drought, with extremely dry years in 2002-2003 and 2007-2008, is that irrigators have had to manage with much less water. This has sharply reduced production in the driest years (Horridge et al. 2005) and led to substantial changes in terms of what crops are grown. For instance, there have been large falls in the production of annual water-intensive crops, such as cotton and rice (Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and Bureau of Rural Sciences 2009, pp. 60-61), with negative impacts on communities dependent on these activities. Much reduced environmental flows have aggravated an already serious decline in key environmental assets in the Basin. Concerns over the state of the environment in the lower part of the Basin led to a 2008 Senate Inquiry by the Standing Committee on Rural and Regional Affairs and Transport. The Inquiry concluded that "The prolonged dry period across the southern half of the Basin continues to severely impact on wetland and floodplain ecosystems across the Basin…Floodplain vegetation is under severe stress… up to 80 per cent of the River Red Gums are declining or dead…" (The Senate, 2008, p. 11).

The People

Although agriculture dominates in terms of water use within the Basin, it accounts for only 10 per cent of employment or some 100,000 jobs. It does, however, represent a higher proportion of total employment in smaller communities. Such towns and rural localities are, typically, areas of greatest socio-economic disadvantage (Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and Bureau of Rural Sciences 2009 pp. 113-114). Agriculture's importance in the labour market is also in decline in the Basin with a 12% reduction of those employed in agriculture, forestry and fishing between 2001 and 2006.

About half of the population in the Basin lives in communities larger than 10,000, about a quarter in towns between 1,000 and 9,999 and the remainder, or a little over half a

million people, live in rural localities or independently. It is these smaller communities and rural localities, with their greater dependence on agriculture and with less diversified economies that will be most affected by the current water reforms.

The Environment

The current drought has made it transparent that there is insufficient water flowing to key environmental assets to maintain them in a healthy state. The biggest impact is at the Murray Mouth at the end of the system, but assets throughout the Basin are in major state of decline (The Senate, 2008, p. 39). The root cause is that regulation of inflows has meant that flood events that would regularly occur within the Basin now only happen rarely, at least in the southern part of the Basin. It is these flood events that allow the 'flushing out' of salts harmful to plant growth and enable inundation of areas to ensure bird and fish-breeding events. Periodic flooding is also necessary to maintain healthy ecosystems such as river red gum forests.

Much less regular flood events and minimal flows during dry periods has also exposed acid-sulphate soils in substantial parts of the Basin that can contribute to die offs associated with high acidity. As a result, 20 of the 23 river valleys in the Basin are classified as either in poor, or in very poor, state of health (Davies et al. 2008). Some of these assets have been described as being in a critical state, such as the Lower Lakes and the Coorong, and also river red gum forests (Natural Resources Commission 2009) .

Irrigated Agriculture

The gross value of agricultural production in the Basin was some $15 billion in 2005-2006 of which irrigated agriculture contributed about one third of the total. While farming occupies 84 per cent of the total land area in the Basin, irrigated agriculture accounts for about 2 per cent of the total and, thus, generates much higher returns per hectare than dryland agriculture.

Overall, there are about 18,000 farm businesses that irrigate within the Basin while the total number of farming enterprises (dryland and irrigation) totals 61,000. The largest water users by activity in 2005-2006, in order of importance, were pasture (dairy, cattle and other livestock), cotton, rice, hay, cereals, grapes and fruits and nuts. For the same period the gross value of irrigated production by activity, in order of importance, were livestock (dairying, cattle and other livestock), fruits and nuts, cotton, grapes and vegetables (Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and Bureau of Rural Sciences 2009 pp. 57-58). Despite the Big Dry, the gross value of irrigated agricultural production increased, in nominal terms, by 9 per cent between 2000-2001 and 2005-2006 (Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and Bureau of Rural Sciences 2009 p. 58). In large part this is because of water trade that has allowed water to move from low to higher valued uses despite reduced water allocations to farmers.

3. Review of Recent Water Reform

Water reform in the Murray-Darling has a long history. The biggest change following European settlement was the transformation of riparian rights into statutory water rights by States at the end of the nineteenth century. Water also features in Section 100 of the Constitution and allows for state jurisdiction given their "… reasonable use of the water and rivers for conservation and irrigation". Post-Federation reform led to the 1915 River Murray Waters Agreement that provided for the sharing of water between states (Connell 2007b). In 1987, the Murray-Darling Basin Agreement established a Ministerial Council for the Basin and the Murray-Darling Basin Commission to assist the states and the Commonwealth to promote and co-ordinate planning across the Basin.

The past decade or so has witnessed major water policy reforms and initiatives. Following agreement at the Council of Australian Governments (COAG), an interim Cap was placed on surface water diversions in the Basin in 1995 (see Table One). This was viewed as a first-step measure to avoid further overallocation and increase in water diversions. The Cap, however, is based on historical water use and not on what may be environmentally sustainable.

A five-year review of the cap in 2000 and on-going concerns about the environment, popularised by a landmark report by the Wentworth Group of Concerned Scientists in November 2002 that coincided with a program of dredging to keep the Murray Mouth open, provided the stimulus for further reform. It prompted governments to implement in 2004 the Living Murray First Step Initiative and the National Water Initiative. The Living Murray sought to acquire 500 GL of water for the environment by 2009 by improving water use efficiency with infrastructure investments and the purchase of water entitlements (Grafton and Hussey 2007). At the time of its implementation an assessment by scientists recommended that both operational improvements and 1,630 GL/year of water, on average, were required to ensure a moderate chance of a healthy River Murray (Jones et al. 2002).

National Water Initiative

A set of principles on water use and governance was agreed to by all governments in the Basin in 2004 in what is commonly called the National Water Initiative (NWI). For the first time, governments agreed to give primacy to meeting the needs of environment in terms of water use. It assigned a set of goals to work towards including the freeing up of water trade, ensuring nationally consistent and secure water entitlements in the Basin and statutory-based water planning to achieve environmental, social and economic outcomes.

A key provision of the NWI is the assignment of risk to water entitlement holders in terms of changes in the reliability or quantities of water allocated to their entitlements. This is defined under Sections 48 and 49 of the NWI. Beyond 2014, reductions in reliability in excess of 3 per cent of water allocations due to new knowledge or change in policies will be borne by governments. Importantly, water entitlement holders are to bear the full risk of reductions in reliability due to changes in climate or drought. To help

implement the NWI, the National Water Commission was established to report on the state of water markets and progress towards all of the goals of the NWI.

Water Act 2007

Concerns about the lack of progress towards achieving the NWI, and state rivalries and inconsistencies in implementation, prompted the Commonwealth Government to legislate the Water Act 2007. This act represents the rules under which the Basin will be governed. A key aspect of the Act is the creation of the Murray-Darling Basin Authority that is charged with developing and implementing a Basin Plan. The Basin Plan will be operational from July 2011 and will set sustainable diversion limits for the entire Basin and its catchments.[3] The responsible Commonwealth Minister has the power under the Act to require state and regional water resource plans to conform to the overall Basin Plan. However, existing state water resource plans will not be legally obliged to meet the requirements of the Basin Plan until they expire. In the case of New South Wales these plans expire in 2014, but in Victoria existing plans remain in force until 2019. The Act was amended in 2008 to give additional responsibilities to the Australian Competition and Consumer Commission (ACCC) in the setting of water market rules for the Basin and to specify arrangements for meeting critical human needs for water.

Water for the Future

The third key pillar in water reform was announced in January 2007 as the National Plan for Water Security and was a 10 point plan over 10 years with $10 billion of funding. Most of the funding was allocated for two purposes: $5.8 billion for infrastructure to improve water use efficiency both off and on-farm and $3.0 billion for the purchase of water entitlements to reduce the overallocation of water and to increase environmental flows.

In March 2008, following a change in government at the Commonwealth, the plan was revised and repackaged as the Water for the Future with an enlarged budget to $12.9 billion. The amount allocated for infrastructure remains at $5.8 billion under the rubric of Sustainable Rural Water Use and Infrastructure (SRWUI) programs. SRWUI seeks to deliver substantial and lasting returns for the environment *and* secure a long-term future for irrigation communities while delivering 'value for money' (DEWHA 2009). The water entitlement purchase component of Water for the Future is called Restoring the Balance (RTB) and has a budget of $3.1 billion over ten years with substantial expenditures 'front loaded' in the first few years of implementation. The goal of RTB is to obtain water for the environment from willing sellers that represents 'value for money'. The Minister responsible has also stated that the RTB program will be used to "...ease the transition to lower diversion limits expected under the [Basin] Plan." (Wong 2009) As of the end of 2009, over $1.2 billion had been spent or was in the process of being spent to purchase approximately 800 GL of water entitlements that translates into about 500 GL of LTCE.

The Water for the Future, funded entirely by the Commonwealth, provides the means by which state priorities for water reform are realised. Financing these state priorities of up to $3.7 billion out of the $5.8 billion allocated for SRWUI program, as detailed in the July 2008 Intergovernmental Agreement on Murray-Darling Basin Reform Agreement, was crucial in ensuring state acceptance of the jurisdictional reforms detailed in the Water Act 2007 and its 2008 amendments. Thus, the Water for the Future includes irrigator incentives to achieve desired goals for the Basin as well as subsidies for priority projects to ensure the co-operation of States for water reform.

4. Economics of Water Reform

The ability of governments to alter course and improve current water reform is limited by past agreements and current budgets. In other words, what might be recommended if given a 'carte blanche' to undertake water reform is different to what can be done under existing institutional and financial constraints. In the 'carte blanche scenario', a full cost-benefit analysis would be undertaken to consider all benefits and costs of public expenditures of various water reforms. In the 'constrained scenario' an economic analysis is restricted to promoting cost effectiveness of the planned expenditures to maximise the benefits from the given budget. We only evaluate the cost effectiveness of the current reform and suggest ways to progress the goals of water reform further with the same budget.

Some of the limits to current water reform that constrain policy makers include:

(1) $12.9 billion allocated to Water for the Future;
(2) Incentives to states to co-operate on water reform as defined by planned expenditures in each state under the Intergovernmental Agreement on Murray-Darling Basin Reform;
(3) Requirements of the Water Act 2007 that includes the establishment of a Basin Plan by July 2011; and
(4) The Murray-Darling Basin Authority decision to define water entitlements for the environment as part of 'no take' or non-consumptive water allocations in the setting of sustainable diversion limits.

Any reform measure that fails to account for any one of these constraint is unlikely to be implemented, at least in the foreseeable future. To evaluate the cost effectiveness of water reform, we first review the economics of market-based water recovery and water infrastructure subsidies.

Market-based Water Recovery versus Infrastructure Subsidies

Market-based water recovery, as currently practised by the Australian Government, is to have a series of 'rolling tenders', whereby holders of water entitlements are able to provide an offer price to sell their entitlements to the Department of Environment, Water, Heritage and Arts (DEWHA) that is charged with undertaking the purchases. If the offer price is deemed to represent 'value for money' relative to competitive water markets, and

if the entitlement is in a catchment where there are key environmental assets (such as Ramsar wetlands), then DEWHA accepts the bid and the eventual sale takes place after the necessary conveyancing. The actual water available for the environment is less than the nominal volume on the entitlement as the LTCE, that represents the average allocation to the entitlement, can be much less. As of September 2009 the LTCE of water entitlement purchases undertaken by the Australian Government up until that date was about 64 per cent. Thus, if the commonwealth had 1,000 GL of water entitlements then, on average, it would only expect to receive 640 GL for these entitlements. In dry years, it would receive much less than the LTCE.

An important issue with market-based water recovery is the existence of trade restrictions. Although the Australian Government has secured an exemption for its purchases of water entitlements for the environment in terms of the 4 per cent rule in Victoria, in September 2009 it signed a Memorandum of Understanding with the New South Wales Government that limits its purchases in that state. This agreement restricts Australian Government purchases of general security water entitlements to a maximum of 200 GL until 2011-2012.

Water reform subsidies for infrastructure are in two principal forms. They include upgrades to public or supply infrastructure off-farm and improvements in on-farm irrigation to increase water-use efficiency. Under Water for the Future, and in return for providing infrastructure subsidies, the Australian Government though the Commonwealth Environmental Water Holder (CEWH) receives water entitlements that it will use for the environment. Typically, CEWH will receive 50 per cent of the expected water savings from infrastructure subsidies in the form of water entitlements. The actual cost of the water delivered for the environment varies substantially by project. Some of the planned projects, such as the Northern Victoria Irrigation Renewal Project will deliver 175 GL at a cost of over $11,000 ML.[4] By comparison, the median price of high-reliability water entitlements in ML in Northern Victoria in 2008-2009 was $2,300/ML (National Water Commission, 2009a, p. 87).

The Australian Government expectation is that both market-based water recovery and infrastructure subsidies the expenditures should deliver 'value for money'. In the case of subsidies, they should also secure a long-term future for irrigation communities. Based on the market price of water entitlements and the cost of acquiring water via efficiency investments, the Social and Economics Reference Panel for the Murray-Darling Basin Commission concluded in April 2008, in a period of low-water availability, that water buybacks are a cost effective method of acquiring water. In a more recent evaluation by the Productivity Commission in December 2009, they find that "…the Australian Government may pay up to four times as much for recovering water through infrastructure upgrades that through water purchases" (Productivity Commission 2009b, p. 123)

Research by Qureshi et al. (in press) supports the economic arguments for the cost effectivenesss of market-based water recovery relative to subsidies for infrastructure (Grafton 2007). In their modelling of the Murrumbidgee catchment they account for

return flows from irrigation that subsequently becomes available for downstream and aquifer users while also augmenting environmental flows. An improvement in on-farm efficiency that reduces return flows will have an offsetting and negative impact on environmental flows. As a result, in locations where there are lower levels of irrigation efficiency and return flows are larger, the cost effectiveness of water buybacks is enhanced relative to infrastructure subsidies. They find that improvements in water use efficiency in the Murrumbidgee would, at most, deliver 143 GL of increased environmental flows for a cost of up to $6,000/GL. By contrast, market-based water recovery could deliver up to 733 GL of environmental flows at a cost of $3,000 per GL.

A key reason for cost effectiveness of water buybacks is that, in contrast to infrastructure subsidies, they provide farmers with flexibility as to how to use less water. Farmers that voluntarily choose to sell their water in a buyback and remain farming can employ deficit irrigation, change their land use and/or tillage practices or invest in improvements in irrigation efficiency. In the subsidy approach, water is acquired only through efficiency improvements whether it is the least costly method or not. Water efficiency improvements may also have a 'rebound' effect in terms of reduced return flows and economically disadvantage irrigators and irrigation districts that, at their own expense, have already installed efficient irrigation systems.

Environmental Benefits, Environmental Flows and Opportunity Costs

Securing increased environmental flows is an important component to ensuring environmental sustainability. While necessary, how the water is used in terms of the timing and location of flows and the size of the individual volumes released for the environment are equally critical.[5] Thus fully 'carry over' rights of allocations to environmental water entitlements will be required to ensure the appropriate watering regime so that water can be saved and stored to ensure required 'pulse' events. In turn, the flow regime affects habitat quality, population of native species, biodiversity, recreational values and so on. To account for these benefits an environmental benefits index (EBI) should be used when determining 'value for money' when acquiring water for the environment. In other words, the benefits of acquiring water near to a key environmental assets may be such that that the EBI per dollar spent may be greater than in another catchment even if the cost per ML to acquire the water entitlement is higher.

When securing water for the environment, a key question is how much water to secure? Jones et al. (2002) in a landmark study argued that 3,350 GL of extra environmental flows and improved operations would be required to have a high probability of restoring the River Murray to a healthy working river. More recently, work by Marsh et al. (2009) have used the eFlow Predictor tool to assess 20 environmental assets across the Basin and calculated the volumes of environmental water to achieve CSIRO (2008) water requirements to deliver flows at pre-development frequency. These volumes of water can be viewed as a lower bound for increased environmental flows for the 18 regions of the Basin and sums to some 2,150 GL, on average, per year. Marsh et al. (2009) also calculated a 'conservative' watering rule of some 4,400 GL on average per year that

represents the volumes of additional environmental water that would be required on average to return end of system flows to two thirds of natural flow. This may be viewed as an upper bound for increased environmental flows.

The lower and upper-bound estimates of increased environmental flows approximately equal 20 per cent and 40 per cent of the total agricultural water diversions in a 'normal' year of inflows, as experienced in 2000-2001. The annual opportunity cost to irrigated agriculture in reduced net returns of delivering these reductions in water diversions, assuming unrestricted water trade across the regulated part of the Basin, for the years 2000-2001 and 2005-2006 is provided in Table 2. The opportunity costs are higher in 2005-2006 because there were substantially lower inflows relative to 2000-2001 and, thus, the marginal value of an extra ML of water was higher. These reductions in profits would be fully compensated for with the voluntary sale of water entitlements, and range from 8-12 per cent fall in profits for a 20 per cent reduction in diversions to 17-24 per cent fall in profits with a 40 per cent reduction in diversions. The present value of these losses assuming a 50-year time horizon and a 5 per cent discount rate are provided in Table 3. These losses vary between 1.71-2.41 billion for a 20 per cent reduction in water diversions and $4.65-5.48 billion for a 40 per cent reduction in water diversions.

Table 4 provides the maximum extra costs to acquire additional water entitlements as a percentage of 2000-2001 agricultural water diversions in the Basin. These costs are over and above those already purchased under the Restoring the Balance program under Water for the Future. They represent the maximum extra costs to acquire water as some water entitlements have already been acquired in the Living Murray Initiative, and there will additional volumes of water for the environment under the SRWUI program and state-based initiatives. [6] Table 4 indicates that to attain the lower-bound value for environmental flows would cost an extra $1.7 billion with current entitlement prices in addition to what has currently been allocated in the Restoring the Balance program. To attain the upper-bound of desired environmental flows would cost $6.54 billion at current entitlement prices over and above what has been already allocated under RTB program.

Important implications of Table 4 and the underlying modelling are:

(1) There is a high probability that key environmental assets in the Basin can be maintained using the calculated upper-bound increases in environmental flows equivalent to about a 40 per cent reduction in water diversions for irrigated agriculture;
(2) The funds budgeted in the Water for the Future are sufficient to achieve environmental sustainability *if* there is a reallocation of funding from investments in infrastructure towards additional market-based water recovery; and
(3) To allow environmental water to 'piggy back' on natural flood events and ensure required 'pulse' events, allocations to environmental water entitlements need to be allowed to be fully carried over in water storages from one season to the next.

Sustainable Diversion Limits and Market-Based Water Recovery

A draft Basin plan will be announced in mid 2010 and the final Basin Plan, as developed by the Murray-Darling Basin Authority (MDBA), should be implemented from July 2011. A key feature of the Basin Plan will be the sustainable diversion limits (SDLs) for both groundwater and surface water across the entire Basin and by catchment. These SDLs will replace the existing Cap that was developed based on historical use. Although the Basin Plan will be operational from July 2011 it will not legally affect the water resource plans of the States until current plans expire. While many water resource plans will need to be compliant with the Basin plan by 2014, in the case of Victoria full compliance could be delayed until 2019.

Until the draft Basin Plan is announced it is not known what will be the proposed reduction in current diversions within the Basin. However, given the dire state of many of the environmental assets and the requirement of the Water Act 2007 that water diversions under the Basin Plan are environmentally sustainable it is highly unlikely that there will be less than a 20 per cent reduction in current average agricultural diversions. Given that a 40 per cent reduction in agricultural diversions would likely achieve healthy working rivers in the Basin, a decline greater than this proportion in the Basin Plan would be unexpected. Reductions in current diversions by these amounts in the to-be-defined sustainable diversion limits can be achieved prior to the implementation of the Basin Plan through Restoring the Balance program, and also be reducing the allocations to holders of water entitlements after the plan becomes operational.

A difficulty in continuing market-based water recovery after the Basin Plan is implemented is that water entitlements purchased by governments for environmental purposes will not be considered as part of the 'take' or consumptive use. Consequently, market-based water recovery after the Basin Plan is implemented would require revisions to the SDLs to account for increased environmental holdings by governments. Rather than change the Basin Plan shortly after it is implemented, which will be difficult to do institutionally, it would be preferable to complete the purchases of water entitlements for the environment prior to July 2011. This would have the added benefit of providing financial compensation to entitlement holders who wish to sell their entitlements before the reliability of entitlements are adjusted downwards as part of the Basin Plan.

The Basin Plan and Value for Money

Reductions in water diversions before the Basin Plan is implemented could be achieved if the entire budget for Restoring the Balance, and also extra funds allocated for subsidies under Water for the Future, were spent prior to July 2011. Using the figures provided in Table 4, a 30 per cent reduction in diversions would require additional funding of about $4 billion. These funds could be made available from the $5.8 billion currently allocated under the SRWUI program. If needs be, separate funding out of Water for the Future,

matched by States, could be provided to support public and community services in vulnerable Basin communities to help achieve the goal of securing a long-term future for irrigation communities. Such assistance would be targeted to supplementing services, where appropriate, rather than grants to individuals or businesses.

The buyback would be best accomplished through two reverse tenders *after* the announcement of the draft Basin Plan.[7] This would allow for better targeting of purchases to meet the sustainable diversion limits and could be achieved at a lower cost per ML of LTCE water acquired than previous purchases by the Australian Government because the alternative for irrigators will be reduced reliability of their water entitlements from July 2011.

Irrigated farmers, states and entitlement holders would all be allowed to participate in the tenders, but the selection of what projects or water entitlements were funded would be based solely on the expected environmental benefits per dollar spent, or if this proved impossible to implement, then on 'value for money' calculated on the basis of the cost to acquire per ML of actual water restored to the environment. The amount *spent* in each state could also be specified as a constraint, if necessary, to meet the spending targets agreed to by COAG in the July 2008 Intergovernmental Agreement on Murray-Darling Basin Reform. However, a reasonable condition by the Australian Government for accepting state spending constraints in the tender process would be the full co-operation by all states in the removal of restrictions on water entitlement and allocation trade. If state spending constraints were implemented, however, the actual projects or entitlements purchased would *not* be constrained within each state and would still be determined on the basis of 'value for money'.

The purchase of water entitlements, and subsidies for infrastructure project funding when cost effective, in such a tender process would provide the farmers in the Basin with the funds necessary to undertake autonomous adjustment to the Basin Plan. It would also provide the Australian Government with a large holding of water entitlements prior to implementation of the Basin Plan that would be treated like any other entitlements in terms of water allocations. Thus, unlike rules-based or planned water in existing water resource plans that lack rules aligned to objectives (Hamstead 2009), there would an assurance that the actual water allocated to entitlements would be used for environmental flows. This is particularly important given the very poor state of most river valleys in the Basin, and the fact that it will not be until 2019 that all state water resource plans need to become fully compliant with the Basin Plan.

5. Concluding Remarks

Water reform in the Murray-Darling Basin is at proverbial watershed. The principles in the form of the National Water Initiative are well defined and agreed to by all governments and the rules in the form of the Water Act 2007 and its amendments provide the framework to implement reform. Unfortunately, the financial incentives for reform, as defined under the $12.9 billion Water for the Future, will not achieve the twin goals of ensuring environmental sustainability and 'value for money'.

Using the principal constraints faced by the Australian Government in terms of the amount of funding available and the existing expenditure commitments to states, it is argued that the stated objectives could be achieved in a much more cost effective way. In particular, if the $3.1 billion allocated to buying water entitlements and the $5.8 billion targeted for water infrastructure subsidies were combined, the Australian Government would be able to ensure a high probability of healthy working rivers within the Basin and for no extra cost. The combined funds would be spent to ensure 'value for money' either in terms of maximising expected environmental benefits per dollar spent, or by maximising the water acquired per dollar of expenditure. If this money were spent prior to the implementation of the Basin Plan in July 2011 in a two-step tender process it would greatly assist farmers and their communities to autonomously adjust to lower water diversions.

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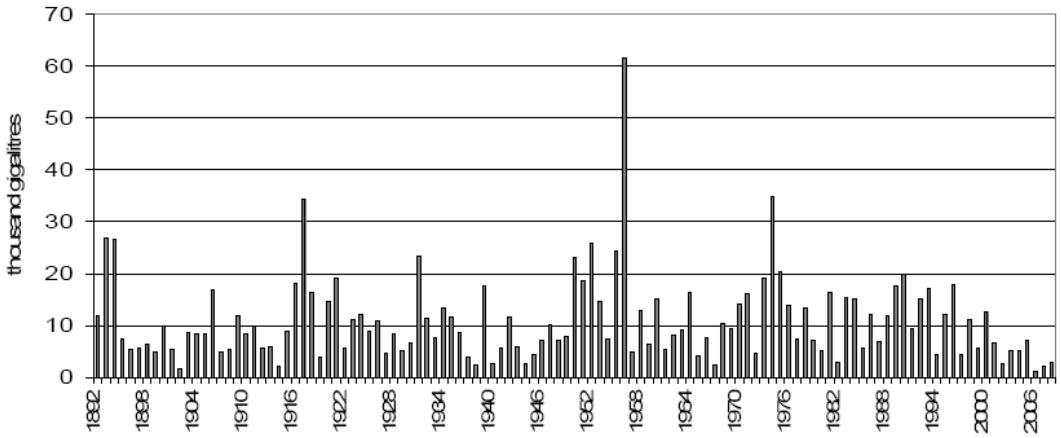
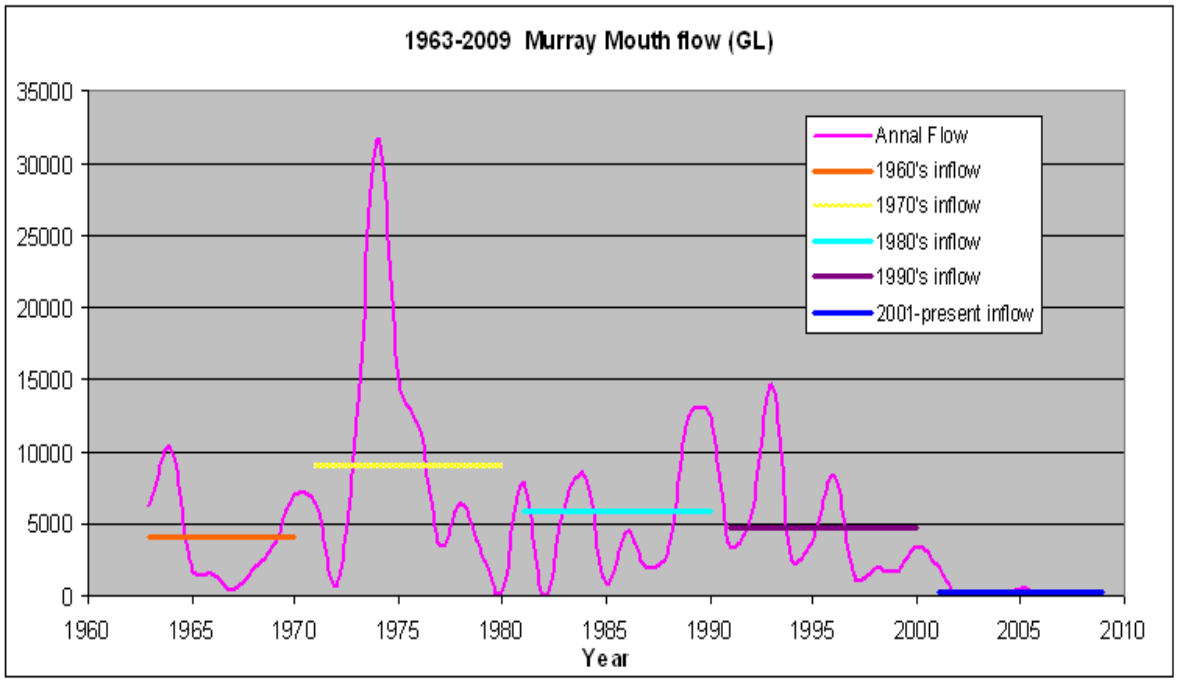
Figure 1 Murray system inflows (including Darling), 1892 to 2008 (Thousands of GL per year)



Source: Productivity Commission (2009a, p. XXI)

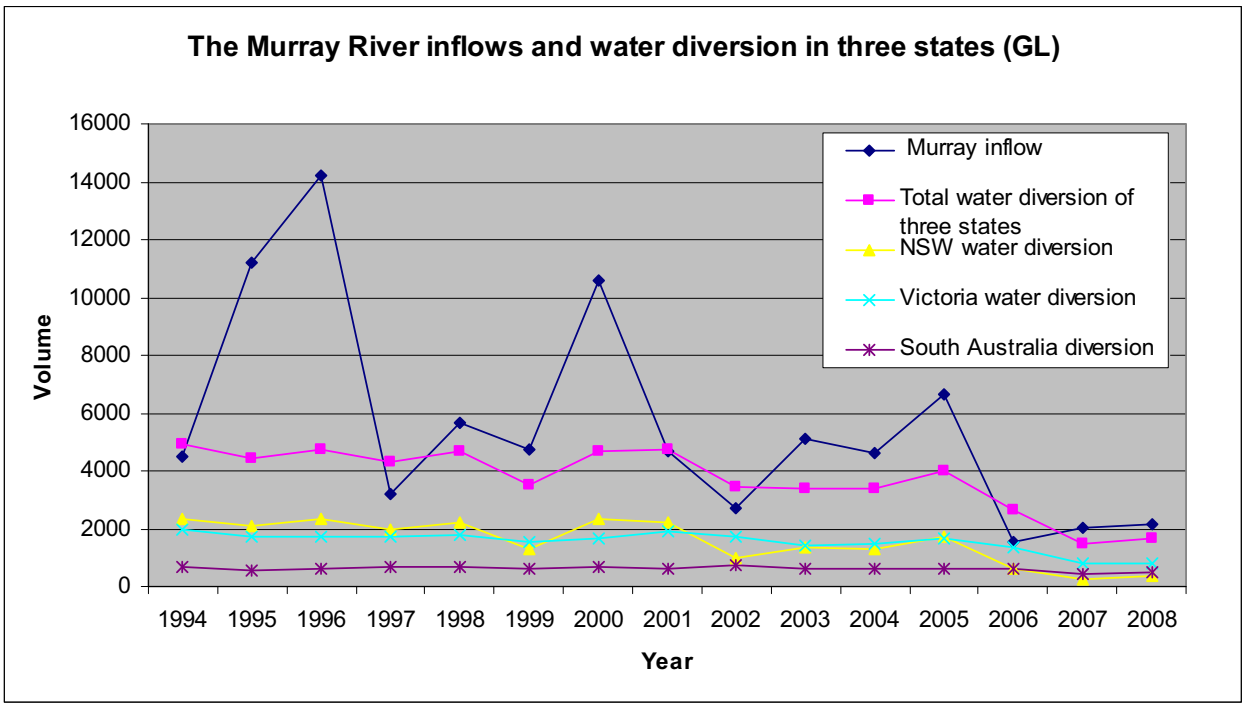
Figure 2: Flows at the Murray Mouth 1963-2009 (GL per year)



Data Source: Murray-Darling Basin Official Water System Database
Notes:

1. Flow is measured at the barrages near the Murray River Mouth.

Figure 3: Murray River Net Inflows and Water Diversions 1994-2008 (GL per year)



Data source: Murray-Darling Basin Official Water System Database

1. Net inflows are from the first column (Murray System Inflows — no Darling River or Snowy River inflows) in the Murray River inflows table.
2. Water use is the sum of Murray System diversions in NSW, in Victoria and South Australia.
3. Data is for the Murray River only and does not include other regions of the southern Murray-Darling Basin.

Government Water Policy Reforms and Initiatives in the Murray-Darling Basin 1994-2011

February 1994	The Council of Australian Governments (COAG) endorses a framework of initiatives for the water industry to run over a seven-year period that includes: - water pricing reform based on the principles of consumption-based pricing and full cost recovery; - elimination of cross subsidies and making other subsidies transparent; - clarifying water property; - facilitating and promoting water trading; - rigorous assessment of new rural water projects; and - reforming water industry institutions
1995	States implement an Interim Cap (made permanent in July 1997) based on 1993-94 levels of utilization, but (1) does not include groundwater and (2) Cap not based on what is sustainable. National Competition Council is responsible for assessing the progress of reforms.
Aug 2003	MDB Ministerial Council agrees to provide new funding of $500 million over five years to address overallocation in the MDB. The program begins in 2004 as the *Living Murray First Step* with the goal to deliver an average of 500 GL of water per year by 30 June 2009 to for the River Murray to provide water to six icon sites Including Murray River Channel).
June 2004	*Intergovernmental Agreement on a National Water Initiative (NWI):* It sets out reforms for best practice pricing and institutional agreements by all states, Commonwealth and ACT by: - promoting the economically efficient and sustainable use of water; - giving effect to the principles of user-pays; - achieving pricing transparency; - facilitating the efficient functioning of water markets; - implementation of comprehensive water plans to ensure environmentally sustainable level of extractions
2004	Establishment of the National Water Commission (NWC) to advise COAG and the Australian Government on national water issues and to monitor the implementation of the NWI.
April 2006	The *2005 National Competition Policy Assessment to Water Reform Progress* is released. The assessment finds that NSW, Victoria and SA have made insufficient progress in meeting their interstate water trading commitments for the southern MDB. The Australian Government decides to withhold $13.3 million worth of competition payments from NSW, $9.9 million from Victoria, and $3 million from SA.

Jan 2007	A *National Water Plan for Water Security* proposes a $10 billion, 10 point plan to improve water efficiency and address over-allocation of water in rural Australia. The plan includes: - a nation-wide investment in Australia's irrigation infrastructure to line and pipe major delivery channels; - the sharing of water savings on a 50:50 basis between irrigators and the Commonwealth Government leading to greater water security and increased environmental flows; - $3 billion to buy water entitlements and address once and for all water over-allocation in the Murray-Darling Basin; - a new set of governance arrangements for the Murray-Darling Basin; and - a sustainable cap on surface and groundwater use in the Murray-Darling Basin.
March 2008	The *Water Act 2007* commences. It is designed to ensure a national approach to water and: - establishes the Murray-Darling Basin Authority (MDBA); - requires the MDBA prepare the Basin Plan; - establishes a Commonwealth Environmental Water Holder to manage Commonwealth holdings of water entitlements; - ACCC to develop and enforce water charge and water market rules; and - existing water sharing plans to continue until they expire.
April 2008	*Water for the Future* – a $12.9 billion investment from the Australian Government – a 10-year initiative that builds on the *National Plan for Water Security* is announced. Under *Water for the Future,* the Australian Government commits $3.1 billion over 10 years to purchase water in the MDB (water buyback) and $5.8 billion to upgrade irrigation infrastructure.
July 2008	An *Intergovernmental Agreement on Murray Darling Basin Reform* is signed by First Ministers and follows up on a March 2008 MOU. In the agreement, Commonwealth commits up to $3.7 billion to state infrastructure priority projects but to be funded with due diligence to ensure 'value for money' and to deliver substantial and lasting returns of water to the environment.
Dec 2008	*Water Amendment Act 2008*, amends the *Water Act 2007* - role of ACCC is strengthened by providing water charge rules and the water market rules to all water service providers and transactions - Basin Plan to provide arrangements for meeting critical human water needs
June 2009	An agreement is reached between the Australian and Victorian governments to phase out the 4% cap on water trade from irrigation districts over five years.

Sept 2009	*Memorandum of Understanding with NSW and Commonwealth Government on Water Trade* (water entitlement purchasing in the MDB/water buybacks) - Allows NSW farmers to sell their water entitlements to the Australian Government (under moratorium from May 2009); and - Limits the sale of water entitlements for environmental purposes to the Federal Government until 2011-12 to a maximum of 200GL of general security entitlements.
Sept 2009	National Water Commission releases *Australian Water Reform 2009.* It advises the Prime Minister that "…the quality of water management in Australia has not been improving fast enough and governments need to redouble their efforts." And "…that while governments have been working hard to implement the NWI reforms progress has not been fast enough".
Dec 2009	Productivity Commission releases its Draft Research report *Market Mechanisms for recovering Water in the Murray-Darling Basin.* It concludes that "Purchasing water from willing sellers is generally the most cost-effective way…" and "Subsidising infrastructure is rarely cost effective in obtaining water for the environment, nor is it likely to be an effective and efficient way of sustaining irrigation communities"
Dec 2009	*Restoring the Balance in the Murray-Darling Basin* is able to secure 766 GL of water entitlements (approx. 500 GL of long-term cap equivalent) worth more than $1.2 billion.
Jan 2010	*Water Management Partnership Agreements between the Australian Government and NSW, Victoria, Queensland and the ACT*. The agreement commits the Australian Government to spend $3.7 billion on state priority water infrastructure projects in the Basin with due diligence.
July 2011	The Basin Plan establishes sustainable diversion limits to cap extractions in both surface and groundwater without: (1) compromising key environmental assets; (2) key ecosystem functions; (3) key environmental outcomes or (4) the productive base of the water resources. All state and catchment water resource plans (2014 in NSW and Victoria in 2019) must eventually conform to the Basin Plan.

Table 2: Change in net economic returns ($ million/year) with 2000-2001 and 2005-2006 agricultural surface water diversions in the Murray-Darling Basin at different water buyback scenarios (per cent reductions in agricultural diversions).

	No buy back	**10% reduction**	**20% reduction**	**30% reduction**	**40% reduction**	**50% reduction**
2000-2001 water diversions: Mean Net Economic Returns ($ millions)	1662.8	1590.7	1518.5	1446.4	1374.2	1302
2000-2001 water diversions: Net change to base case	**0.00%**	**-4.34%**	**-8.68%**	**-13.01%**	**-17.36%**	**-21.70%**
2005-2006 water diversions: Mean Net Economic Returns ($ millions)	1249.4	1173.8	1098.2	1022.7	947.1	871.5
2005-2006 water diversions: Net change to base case	**0.00%**	**-6.05%**	**-12.10%**	**-18.14%**	**-24.20%**	**-30.25%**

1. Net change is the proportional reduction in mean net economic returns relative to the no buy back scenario.

Source: Adapted from Grafton and Jiang (2010).

Table 3: Present Value (billion $) of Direct Losses from Reduced Water Diversions to Irrigated Agriculture in the Murray-Darling Basin

	10% reduction	20% reduction	30% reduction	40% reduction	50% reduction
Based on 2000-2001 water diversions	0.69	1.71	2.73	4.65	6.70
Based on 2005-06 water diversions	1.88	2.41	3.92	5.48	7.04

Notes:

1. Direct losses are reduced on-farm net economic returns. These would be fully compensated for with voluntary market-based water recovery.
2. Present value is calculated over a 50-year time horizon.

Source: Adapted from Grafton and Jiang (2010).

Table 4: Government expenditure in the Murray-Darling Basin under different water buyback scenarios (GL) assuming 2000-2001 agricultural surface water diversions

	10% reduction	20% reduction	30% reduction	40% reduction	50% reduction
Total Diversions	9132.68	8117.94	7103.19	6088.45	5073.71
Desired environmental flows	1014.75	2029.49	3044.23	4058.97	5073.71
Additional government expenditure (Billions) at $2,000/ML water entitlement in excess of $3.1 billion in the Water for the Future Package	-0.330	2.84	5.61	9.18	12.35
Additional government expenditure (Billions) at $1,522/ML water entitlement in excess of $3.1 billion in the Water for the Future Package	-0.705	1.71	3.82	6.54	8.95

Source: Adapted from Grafton and Jiang (2010).

End Notes

[1] The ACCC (2009) notes that only Victoria, and to a lesser extent New South Wales have implemented the 4 per cent rule via legislation. Until June 2009 when an exemption was granted to the Australian Government the rule also constrained the sale of water entitlements for environmental purposes. Administrative difficulties/barriers have resulted in no interstate tagged water entitlement trade in 2008-09. There are also limitations in terms of the rights held by irrigators because of the bundling of rights, and deficiencies in terms of market information (volume and price of trades) that reduce the efficiency of water markets. From May until September 2009 New South Wales had an embargo on the sale of water entitlements for environmental purposes and from July 2009 imposed a temporary embargo on allocation trade outside of New South Wales.

[2] The National Water Commission (2009b, p. viii) has expressed that it "…is increasingly concerned about the security of environmental water access entitlements and rules-based environmental water, particularly during drought. The Commission considers that water plans should clearly and transparently specify desired environmental outcomes and fully define environmental watering protocols to achieve them under all inflow scenarios (including sequences of dry years)."

[3] Sustainable diversion limits (SDLs) are to represent an environmentally sustainable level of take which, if exceeded, would compromise: (1) key environmental assets of the water resource; or (2) key ecosystem functions of the water resources; or (3) the productive base of the water resource; or (4) key environmental outcomes of the water resource.

[4] The Northern Victoria Irrigation Renewal Project aims to achieve water savings in the order of 425GL at a cost of $2 billion. Stage 1 will deliver 225 GL of saving at an estimated cost of $1billion of which 75GL will be allocated to the environment. In Stage 2, 200 GL of expected water savings will be delivered at a cost of $1billion. Stage 2 will allocate 100GL to the environment. Much of these water savings will be achieved by improving metering of water that does not provide more water to the environment and by reducing leakage that may actually reduce flows to the environment. Thus, at best, the Northern Victoria Irrigation Renewal Project is expected deliver 175GL of environmental water at a total cost of $2 billion or $11,429/ML.

[5] King and Louw (1998) developed a 'Building Block Methodology' (BBM) to determine in-stream requirement that accounts for geomorphology, water chemistry, and biotic data that is built into monthly blocks of water. The approach is currently in use in South Africa in Kruger National Park.

[6] As of the end of 2009 the Commonwealth Government had acquired about 800 GL of water at a total cost of just over $1.2 billion. Water entitlements for the environment have also been obtained under other initiatives such as Water for Rivers (approx. 200 GL of entitlements) and Rivers for Environmental Restoration Program (about 100 GL of water entitlements).

[7] A similar method to this has been used successfully in the past with the buyback of statutory fishing licences in Commonwealth fisheries in 2007. For further details, see http://www.daffa.gov.au/fisheries/domestic/fishingfuture/business_exit_assistance.