Australian Government

Productivity Commission

Market Mechanisms for Recovering Water in the Murray-Darling Basin

Productivity Commission Research Report

March 2010

ISBN 978-1-74037-308-1

This publication is available in hard copy or PDF format from the Productivity Commission website at www.pc.gov.au. If you require part or all of this publication in a different format, please contact Media and Publications (see below).

Publications Inquiries:
Media and Publications
Productivity Commission
Locked Bag 2 Collins Street East
Melbourne VIC 8003

Tel: (03) 9653 2244
Fax: (03) 9653 2303
Email: maps@pc.gov.au

General Inquiries:
Tel: (03) 9653 2100 or (02) 6240 3200

An appropriate citation for this paper is:

Productivity Commission 2010, Market Mechanisms for Recovering Water in the Murray-Darling Basin, Final Report, March.

The Productivity Commission

The Productivity Commission is the Australian Government's independent research and advisory body on a range of economic, social and environmental issues affecting the welfare of Australians. Its role, expressed most simply, is to help governments make better policies, in the long term interest of the Australian community.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

Further information on the Productivity Commission can be obtained from the Commission's website (www.pc.gov.au) or by contacting Media and Publications on (03) 9653 2244 or email: maps@pc.gov.au

Foreword

The water resources of the Murray-Darling Basin are crucially important not only for irrigated agriculture and local communities, but also for the environment. Allocating water across competing uses has long been a difficult policy challenge, particularly given rising demands, climatic variability and multiple jurisdictions within the Basin.

The Australian Government has recently assumed a greater role in managing the Basin's water resources. A Basin-wide plan is under development, while water is being recovered for the environment through multi-billion dollar programs directed at water purchasing and infrastructure.

This study responds to the Governments' request for the Commission to examine various aspects of water purchasing, including mechanisms for diversifying the current approach, synergies with the infrastructure program and identifying how impediments to better outcomes could be overcome. This has required us also to take into account the inter-dependencies between the water purchase program and other key elements of the Government's 'three pronged' strategy.

The Commission was greatly assisted in the conduct of its study by the many individuals, organisations and government agencies who made submissions, participated in public meetings and provided advice. Their input was particularly appreciated in view of the competing demands on their time from the activities of other government agencies related to the Basin.

The study was overseen by Commissioners Neil Byron and Judith Sloan, with a staff research team from the Commission's Melbourne office led by Paul Belin.

Gary Banks AO
Chairman

March 2010

Terms of reference

Productivity Commission Study into Mechanisms to Purchase Water Entitlements

Background

On 13 February 2009 the Australian Government agreed to request that the Productivity Commission conduct a study into alternative market-based mechanisms that could be used to diversify its water purchase program and secure access to the suite of entitlements necessary to restore balance to the use of the Murray-Darling Basin water resources in a timely manner.

The Restoring the Balance in the Murray-Darling Basin program currently uses an open tender process as the principal way of purchasing water entitlements from willing sellers to restore environmental flows and is being implemented over a ten-year time frame. Restoring environmental flows will provide more water for high value environmental assets, as well as protect against algal bloom outbreaks, salinity and other water quality risks that threaten the health of our rivers and the livelihood of our farmers and regional communities.

Scope of the Study

1. Review the mechanisms used nationally and internationally by governments to purchase water entitlements or similar property rights, including reverse tender processes.

2. Identify appropriate, effective and efficient market mechanisms that could be used to diversify the range of options to purchase water entitlements under the Restoring the Balance in the Murray-Darling Basin program to restore environmental flows.

3. The study would consider, but not be limited to, issues such as:

- the proposed pace of environmental water recovery and the depth of the water markets in the Murray-Darling Basin
- transaction and compliance costs for applicants and the Government

- impact on the water market, particularly where the Government may be the dominant buyer
- the implications of a developing water market and limited market price information
- potential to use existing or developing water exchanges, auction houses or on-line water trading platforms
- potential methods to maximise synergies between water purchase and the Sustainable Rural Water Use and Infrastructure program
- the capacity to use different mechanisms to purchase a mix of high, general and low security entitlements to meet identified environmental needs
- the requirements of the Commonwealth Procurement Guidelines and the *Financial Management and Accountability Act 1997*.

4. Identify impediments to new and established water purchase mechanisms and how these could be overcome.

The Commission is to consider the Restoring the Balance in the Murray-Darling Basin program guidelines, which specify the criteria used to assess sell offers and the conveyancing steps required to complete a water entitlement purchase.

In undertaking the study, the Commission is to consult widely with interested parties including Commonwealth and State Government agencies as well as industry and community groups.

The Commission is to produce and publish a draft report, and to complete its final report within six months of receipt of this reference.

Nick Sherry
Assistant Treasurer
[Received 24 July 2009]

ASSISTANT TREASURER
SENATOR THE HON NICK SHERRY

RECEIVED
21 OCT 2009
CHAIRMAN'S OFFICE

ASSISTANT TREASURER
15 OCT 2009

Mr Gary Banks AO
Chairman
Productivity Commission
PO Box 1428
CANBERRA CITY ACT 2601

Dear ~~Mr Banks~~, Gary

PRODUCTIVITY COMMISSION (THE COMMISSION) STUDY INTO MECHANISMS TO PURCHASE WATER ENTITLEMENTS (IN THE MURRAY DARLING BASIN)

Thank you for your letter dated 1 October 2009, seeking an extension for the reporting of the Commission study into mechanisms to purchase water entitlements in the Murray Darling Basin.

I note that further time is needed to allow regionally dispersed stakeholders to engage effectively with the study, and for the Commission to reflect on their evidence. I note too, that the consultation phase following the release of the draft report coincides with the lead up to Christmas, which may create difficulties in accessing many participants.

As such I agree to your request to extend the reporting date for the study from 24 January 2010 to 24 March 2010.

I look forward to seeing the reports in due course.

Yours sincerely

NICK SHERRY

PO Box 6022
Parliament House
CANBERRA ACT 2600

Telephone: 02 6277 7360
Facsimile: 02 6273 4125
http://assistant.treasurer.gov.au

Contents

Boxes

Figures

Tables

Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
APSC	Australian Public Service Commission
BOM	Bureau of Meteorology
CEWH	Commonwealth Environmental Water Holder
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CWCB	Colorado Water Conservation Board
CWT	Colorado Water Trust
DECCW	NSW Government Department of Climate Change and Water
DERM	Queensland Government Department of Environment and Resource Management
DEW	Queensland Government Department of Environment and Water
DEWHA	Australian Government Department of the Environment, Water, Heritage and the Arts
DRC	Deschutes River Conservancy
DSE	Victorian Government Department of Sustainability and Environment
EMR	Eligible Measures Register
EOI	Expressions of interest
EWA	Environmental Water Account (California)
EWG	Living Murray Environmental Watering Group
EWP	Environmental Watering Plan
EWR	Environmental Water Register

GL	Gigalitre
GS	General security
GVIA	Gwydir Valley Irrigators Association
HR	High reliability
HS	High security
IGA	Intergovernmental agreement
ISFP	Instream Flow Program (Colorado)
LTCE	Long term cap equivalent
MDBA	Murray-Darling Basin Authority
MDBC	Murray-Darling Basin Commission
MDBMC	Murray-Darling Basin Ministerial Council
MIA	Murrumbidgee Irrigation
ML	Megalitre
NCWCD	Northern Colorado Water Conservancy District
NIC	National Irrigators' Council
NSWIC	New South Wales Irrigators Council
NVIRP	Northern Victoria Irrigation Renewal Project
NWC	National Water Commission
NWI	National Water Initiative
NWMS	National Water Market System
PC	Productivity Commission
RERP	Rivers Environmental Restoration Program
RTB	Restoring the Balance
SDL	Sustainable Diversion Limit
SFMP	Stream Flow Management Plan (Victoria)
SKM	Sinclair Knight Merz
SRWUI	Sustainable rural water use and infrastructure
TLM	The Living Murray Initiative
VFF	Victorian Farmers Federation
WAP	Water Acquisition Program (California)

WED	Water Efficiency Division of the Department of the Environment, Water, Heritage and the Arts
WRP	Wetland Recovery Program
WSP	Water Sharing Plan

Glossary

Basin Plan	A plan being developed by the Murray-Darling Basin Authority, for the integrated and sustainable management of water resources across the Murray-Darling Basin, to be adopted by the Minister under the *Water Act 2007* (Cwlth).
Cap	An upper limit on the volume of water available for consumptive use from a waterway, catchment, basin or acquifer.
Capacity Sharing	An alternative water sharing system, which defines storage access in terms of a share of dam capacity, and inflows and outflows (which include deductions for evaporation and seepage losses).
Carryover	The option to hold in storage a portion of unused seasonal allocations for use at a later date.
Commonwealth Environmental Water Holder	An entity created under the *Water Act 2007* (Cwlth) to manage the water entitlements acquired by the Australian Government for environmental purposes.
Consumptive use	The use of water for private benefit including irrigation, industry, urban and stock and domestic use.
Conveyance losses	Water evaporation and seepage from surface water sources and man-made water transportation facilities, such as irrigation channels.
Covenant	In the context of water entitlements, a covenant is a condition placed on an entitlement that prevents its use under certain conditions.
Delivery capacity share	A share of an irrigation supply channel capacity (in a regulated system) or a watercourse capacity (in an unregulated system), specified as a percentage share or a volumetric supply rate at a particular time.
Economic efficiency	An activity is economically efficient if it maximises the wellbeing of the community through improving the way resources are allocated and used.

Environmental assets	This includes water-dependent ecosystems, ecosystem services and sites with ecological significance.
Environmental flow	A water regime provided within a river, wetland or estuary to improve or maintain ecosystems, where there are competing water uses and where flows are regulated.
Environmental manager	An agency or individual with managerial responsibility for the achievement of environmental objectives.
Exchange rate	The rate of conversion calculated and applied to water traded from one trading zone and/or jurisdiction to another. Can also be used to account for conveyance losses.
Exit fee	A charge (often per megalitre) imposed on the trade of a water entitlement out of an irrigation district.
Groundwater	Water that occurs below the earth's surface.
Groundwater recharge	The movement of water from the surface into a body of groundwater via percolation through the soil.
Irrigation infrastructure operator	An organisation that operates and/or owns an infrastructure network for the delivery of irrigation water within an irrigation district. Sometimes referred to as water utilities or water authorities.
Lease	In the context of a water entitlement, a transfer of an exclusive right to an entitlement (or a part of an entitlement) for a fixed term. Also referred to as term transfers in New South Wales and limited term transfers in Victoria.
Long-Term (Diversion) Cap Equivalent (LTCE)	Common volumetric measure that corresponds to the long-term average volume of water that will be recovered using a particular water recovery measure.
Market mechanism	A policy instrument that encourages behaviour through market signals, rather than through explicit directives.
Murray-Darling Basin Cap	The water cap established by the Murray–Darling Basin Commission to limit the volume of water that can be diverted from the rivers for consumptive uses.
Options contract	In the context of the water buyback, an options contract gives the right, but not the obligation, to purchase or sell a water entitlement at a specified price within a specified period of time.
Over-allocation	Refers to situations where, with full development of

entitlements in a particular system, the total volume of water able to be extracted by entitlement holders at a given time exceeds the environmentally sustainable level of extraction for that system.

OVERVIEW

Key points

- The Australian Government has an ambitious agenda for increasing the availability of water for the environment in the Murray-Darling Basin: water will be reallocated administratively through a Basin Plan; and water will be recovered through a ten-year $3.1 billion buyback of water entitlements, and a $5.8 billion investment in water saving infrastructure.
- The 2011 Basin Plan will ultimately allocate water between consumptive and environmental uses, in each catchment. The buyback aims to assist irrigators to adjust to the much lower diversion limits that are likely under the Basin Plan and to regain some water for the environment in the interim. The infrastructure program shares these broad objectives but also aims to help sustain irrigation communities.
- The buyback is occurring before sustainable diversion limits (SDLs) are set under the Basin Plan, and before the liability for policy-induced changes to water availability has been resolved. This is creating uncertainty in the minds of irrigators and affecting the efficiency of the buyback.
- SDLs must be based on scientific assessments of the amount of water that is required to avoid compromising key environmental assets and processes. Good science is a necessary but not sufficient basis for optimising the use of the Basin's water resources. The value people place on environmental outcomes, the opportunity cost of foregone irrigation, and the role of other inputs, such as land management, must also be considered. If the Water Act 2007 (Cwlth) precludes this approach, it should be amended.
- The same cost effectiveness tests should be applied to all water recovery options. Purchasing water from willing sellers (at appropriate prices) is a cost-effective way of meeting the Government's liability for policy-induced changes in water availability. Subsidising infrastructure is rarely cost effective in obtaining water for the environment, nor is it likely to be the best way of sustaining irrigation communities.
- Other water products (for example, seasonal allocations and options contracts) are potentially valuable in meeting short-term environmental needs.
- Tenders are sound purchasing mechanisms where active markets for water entitlements do not exist. But where active markets do exist, acquiring water directly from those markets is likely to be more efficient.
- The 4 per cent limit on out-of-area trade of water entitlements should be eliminated as soon as possible. Limits on the amount of entitlements that can be sold to the Commonwealth through the buyback should also be eliminated.
- Using the buyback to achieve distributional goals, system rationalisation or to manage salinity is likely to compromise its efficiency and effectiveness. Other more direct instruments should be used to address these issues.
- Governance arrangements for the recovery and management of water for the environment are fragmented. Greater coordination of water recovery and environmental watering by Basin jurisdictions is required.

Overview

Water shortages in the Murray-Darling Basin are placing considerable stress on many environmental assets in the Basin. From the 1950s to the 1990s, the share of available surface and groundwater diverted for consumptive uses, such as irrigation and domestic use, increased, leaving less water for the environment, even in normal conditions. A decade-long drought has further limited the amount available for the environment, and climate change is expected to exacerbate these problems in the future.

There is widespread recognition that some of the Basin's water resources need to be redirected to the environment. But questions remain about how much water should be recovered and from where, how it should be recovered, and how it should be used to achieve the best outcomes for the Australian community.

There are three main ways governments can recover water for the environment: purchase it from those who hold the property rights to use it now; invest in more efficient delivery systems and redirect the water savings to the environment; and/or change the rules regarding the sharing of water between competing end uses. While this study is predominantly about market mechanisms for obtaining water, all of these methods are currently in use in the Basin and the interactions between them are complex.

Until recently, water was allocated to the environment through administrative plans, prepared and implemented by the states. Interstate coordination was dependent on cooperation and adherence to a Basin-wide cap. Weaknesses in this approach led the Basin jurisdictions (the Commonwealth, NSW, Victorian, Queensland, SA and ACT governments) to agree to a referral of powers to the Commonwealth to enable it to draw up a binding Basin Plan, due for completion by mid-2011 (box 1). Among other things, this Plan must set (long term average) sustainable diversion limits (SDLs) for each catchment within the Basin and for the Basin as a whole. The states' subsequent water resource plans will have to be consistent with the Basin Plan.

Box 1 The Basin Plan will reallocate water to the environment administratively

To help rationalise the allocation of water within the Murray-Darling Basin, the Murray-Darling Basin Authority (MDBA) is required to develop and implement a Basin Plan by 2011. It will set (long-term average) environmentally sustainable diversion limits (SDLs)on quantities of surface water and groundwater extraction and the conditions under which such diversions can occur. It is widely expected that SDLs will be much lower than the status quo, to allow a substantially higher proportion of whatever water is available to be allocated for meeting ecosystem requirements.

A key part of the Basin Plan will be an environmental watering plan that will set environmental objectives and targets for water-dependent ecosystems across the Basin. This will govern the allocation of both water held by the Commonwealth Environmental Water Holder (a statutory position created under the *Water Act 2007* (Cwlth) to manage the water entitlements that the Commonwealth is currently acquiring) and other planned environmental water provided for under the Basin Plan.

The Basin Plan will set requirements that must be met under new state water resource plans to be introduced in 2014 in all affected jurisdictions except Victoria, which is scheduled to introduce its next water plan in 2019. Based on advice from the MDBA, the Minister must accredit these plans, but only if satisfied they are consistent with the Basin Plan. While SDLs will start to have effect from 2014 onwards, ‘temporary diversion provisions’ can be introduced to provide a five-year transition period.

In the meantime, the Australian Government’s water purchasing priorities have been guided by the findings of Basin-wide scientific studies on water availability and ecosystem health, information on the specific needs of particular environmental assets, and by the perceived difference between current levels of use and the anticipated SDLs, due to be published in draft form in 2010 and set in 2011.

Sources: DEWHA (2009b), MDBA (2009a).

For its part, the Australian Government has also embarked on a $3.1 billion program of purchasing water entitlements from irrigators, called Restoring the Balance (RTB), and a $5.8 billion program to upgrade irrigation infrastructure, called Sustainable Rural Water Use and Infrastructure (SRWUI).

The main feature of the RTB is a tender process (box 2). It commenced in 2007-08 and is scheduled to run until 2016-17. As at 31 January 2010, the Australian Government had purchased 797 gigalitres (GL) of entitlements of varying reliability, which is expected to deliver about 532 GL per annum on average (compared with Basin-wide, average inflows of over 10 000 GL per annum). As entitlements are purchased, they are passed across to a Commonwealth Environmental Water Holder (CEWH) for management. As at the end of

January 2010, the CEWH had allocated only 76 GL for environmental use in the Basin, partly because of low seasonal allocations.

Box 2 **The Restoring the Balance tender process**

The principal market mechanism used to date under Restoring the Balance is a sequential tender for water entitlements. The key features of this mechanism include:

- Repeated format — the tender is conducted over discrete rounds.
- Non-binding bids — the bids constitute non-binding expressions of interest by the potential water sellers. In the first three rounds, which were open for a considerable amount of time, fortnightly assessments of the bids received in the preceding two weeks were made. In the most recent round, a new format was adopted. The round was open for three weeks and bids were only assessed when it was closed.
- Reserve price — a benchmark market price is determined for each catchment and bids that are under that price are automatically accepted, and proceed to the due diligence process.
- Discriminatory price — successful participants in the tender are paid the price that they bid, rather than a uniform market clearing price.
- Sealed bids — the bids are not revealed to the market during or after the tender.

The design of the Restoring the Balance tender is similar to most past and current environmental water recovery tenders undertaken in Australia.

The scale and complexity of these initiatives are unprecedented in Australia, and although many other countries are facing similar dilemmas, there seem to be very few close parallels anywhere else in the world. However, while Australia is widely regarded as a world leader in moving to the sustainable management of water resources, there appears to have been insufficient forethought given to the design, scale and implementation of these initiatives.

The Australian Government asked the Productivity Commission to report on market mechanisms for recovering water in the Basin for the environment, and ways in which it could diversify its current approach. The Commission's general conclusion is that purchasing water from willing sellers at appropriate prices is a sound approach to meeting the Australian Government's commitment to obtain additional water for the environment. While the Commission has some suggestions on how the buyback could be improved, it considers that greater gains can be achieved by clarifying objectives, as well as further considering the merits of the different means by which water is being recovered and the links between them.

The Australian Government's objectives

To assess the effectiveness of these water recovery initiatives, it is first necessary to clarify what they were meant to achieve.

Drawing on the *Water Act 2007 (Cwlth)* the objective of setting SDLs within a Basin Plan can be summed up as restoring the management of the water resources in the Basin to a sustainable basis. It is an attempt to, among other things, '… set and enforce environmentally sustainable limits on the quantities of surface water and groundwater that may be taken from Basin water resources' (MDBA 2009a). And it takes a Basin-wide perspective.

The objectives of the RTB and the SRWUI programs can be gleaned from various statements made by the Australian Government and COAG:

- The RTB buyback has two objectives: to obtain entitlements to 'soften the blow' to irrigators of making the transition from current levels of diversion to the much lower SDLs anticipated under the Basin Plan; and to obtain water for the environment to meet short-term urgent needs in the meantime.
- The SRWUI program has the same objective of easing the transition to the Basin Plan. And there is also some similarity in that it should be a cost effective way of obtaining water for the environment (though in this case, this might be only achievable in the medium to longer term). But eligible projects must also '… secure a long-term sustainable future for irrigation communities, in the context of climate change and reduced water availability in the future' (Agreement on Murray-Darling Basin Reform 2008). More recently, a food security objective has also been used to justify this program.
- Both programs are required to provide value for money in recovering water.

The fact that the buyback and infrastructure programs have two objectives that are the same or similar — to ease irrigators' transition to lower levels of water availability and to recover water for the environment before the Basin Plan takes effect — facilitates comparison between them. But this is then complicated by the infrastructure program having the additional objectives of 'sustaining irrigation communities' and 'food security'.

Attempting to achieve multiple objectives with one instrument may compromise effectiveness and efficiency. The Commission has considered the best ways of achieving each objective in turn. The potential for compromise is illustrated well by the RTB's focus on purchasing only entitlements, a strategy much more suited to achieving the transitional objective than it is to meeting short-term environmental needs.

The risk assignment provisions

Much of the current policy framework affecting the Basin is built on the National Water Initiative (NWI), an agreement between all jurisdictions signed in 2004. The NWI contains a set of risk assignment provisions that were intended to give entitlement holders greater certainty over who would bear the risks of future reductions in the quantity or reliability of allocations. These provide an important backdrop to this study that helps put the buyback and infrastructure programs in perspective. The Murray-Darling Basin Authority (MDBA 2009e) has summarised these provisions as meaning that:

> … any reduction in size or reliability of a water allocation will be borne as follows:
>
> - by water entitlement holders, if the reduction is the result of seasonal or long-term changes in climate, or of periodic natural events such as bushfires and drought
> - by a government, if the reduction is the result of changes in that government's policy
> - by water entitlement holders and governments (according to a specific formula), if the reduction results from improvements in knowledge about the environmentally sustainable level of take of water.

All Basin jurisdictions were to incorporate these (or equivalent) provisions in their own legislation. The Australian Government has incorporated them in the Water Act, and has stated that it will meet its responsibilities (as far as practical) for policy-induced changes in water availability by purchasing entitlements and investing in water-saving infrastructure. Furthermore, the MDBA is required to spell out what proportion of the proposed reductions in water availability in the Basin Plan will be the Commonwealth's responsibility.

Notwithstanding these developments, there is confusion over when and how these provisions will apply and where the assignment of risk will fall. For one thing, the provisions were meant to apply only after water resource plans prepared by the states had addressed 'overallocation' and/or 'overuse'. However, the National Water Commission (NWC) notes that there is no agreement among the jurisdictions on what 'overallocation' means, and very few water resource plans introduced since the NWI explicitly address overallocation. If not addressed already, 'overallocation' and/or 'overuse' will be effectively addressed when new (Basin Plan-compliant) water resource plans begin from 2014 onwards. But how corrections for past 'overallocation' or 'overuse' will be distinguished from policy-induced changes is unclear.

What is also unclear is the extent to which the buyback and infrastructure programs will collectively meet the Commonwealth's obligations. Such is the substantial expenditure earmarked for these programs, that there must be some risk the

Commonwealth will end up compensating irrigators for risks they or the states had agreed to bear under the NWI.

The Commission shares the concerns raised by the NWC that the risk assignment provisions and their application by all governments urgently need clarification, and that this needs to be communicated in clear, simple terms. As the NWC (2009b, p. 200) notes, this '… will help water access entitlement holders better understand all possible changes to the security and reliability of their entitlements, and to make planning and investment decisions with confidence.' A clear distinction is required between those reductions in availability of water for consumptive use that are compensable — and which could be addressed through agreed water recovery measures including the buyback — and those to be made administratively without compensation.

The uncertainty surrounding these issues has implications for the efficient conduct of the buyback. Irrigators need to know if they should enter the buyback now, or risk the uncertain loss of an unspecified proportion of their water entitlements and/or less reliable seasonal allocations in the future.

Clarifying environmental watering priorities

Many environmental assets in the Basin need more water. Deciding which to water, when and with how much are questions that need to be addressed, not only in devising a sound watering plan but also in devising a sound purchasing plan that will maximise benefits to the Australian community.

The Basin Plan, and its subordinate water resource plans, will provide the framework for environmental watering in the medium to longer term. In the interim, the buyback has had to look elsewhere for guidance on which entitlements to purchase, and the CEWH has had to develop a separate watering plan.

In setting purchasing priorities, the Department of Environment, Water, Heritage and the Arts (DEWHA) has relied in large part on two existing Basin-wide scientific studies on water availability and ecosystem health (the CSIRO sustainable yields project and the MDBC Sustainable Rivers Audit), and other specific information where available. This may be a pragmatic approach, given information deficiencies, but because it does not address the ecological responses that might be achieved from watering different environmental assets, or the value the Australian community might place on those responses, it is an imperfect basis for setting watering, and hence purchasing, priorities.

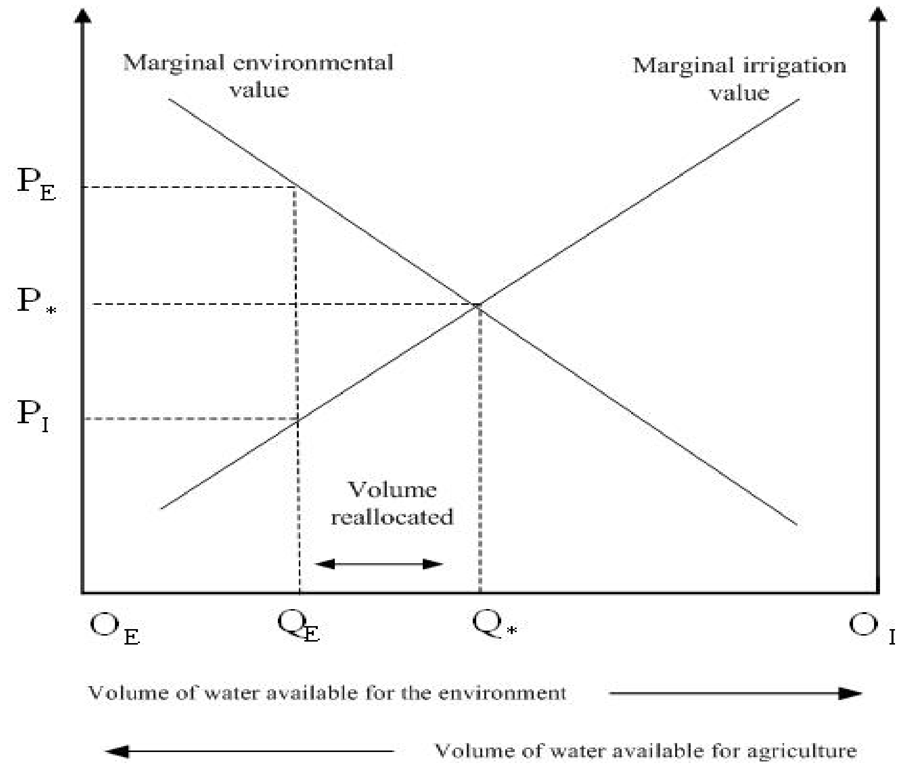
DEWHA has argued that it has been operating on a ‘no regrets’ basis in purchasing water, believing that the shortfalls in allocations to the environment in most catchments in the Basin were so substantial, that there was little risk of it buying too much, or the wrong water. But when consideration is given to the water already held by the CEWH and other environmental managers, and the quantities that stand to be recovered through the infrastructure program, a more cautious approach would now seem appropriate, at least until the Basin Plan is finalised. Indeed, there is potential for past and existing water recovery programs to recover average annual flows of more than 2500 GL. This is considerably more than was thought necessary to have a moderate chance of achieving a healthy river system only a few years ago.

The Basin Plan will ultimately provide much needed clarity through the determination of SDLs. But the Commission has some concerns about the way in which those SDLs are to be set, (and hence about using them to guide the RTB). According to the Water Act, they must be set using the best available scientific knowledge, and they must reflect an environmentally sustainable level of take. This is defined as the level of take that, if exceeded, would ‘compromise’ key environmental assets, ecosystem functions, environmental outcomes, or the productive base of the water resource. Interpretation of this statement is ambiguous. Avoiding ‘compromise’ would appear to establish a very high hurdle that could consign all other users to share whatever remains after meeting the environment’s needs, without regard to the opportunity costs. And as the MDBA acknowledges, decisions will need to be made about which parts of the environment or ecosystem are ‘key’ and which are not.

While good science is clearly important in setting the SDLs, so are the tradeoffs between consumptive uses and the environment — more water for the environment means less for irrigating crops or for domestic uses, and vice versa (box 3). Under the Water Act, the MDBA must advise on the expected socioeconomic consequences of setting SDLs. But the approach the MDBA is taking suggests this analysis might only influence how, when and where water is recovered, not how much. It appears that the MDBA has interpreted the Water Act to mean that it has little room for explicitly considering the opportunity costs of irrigation forgone in actually setting the Basin-wide SDL.

Further, while the Basin Plan is the vehicle by which better environmental outcomes are meant to be achieved, the only policy lever the MDBA has at its disposal is the allocation of water between the environment and consumptive uses. While recovering more water is in most cases a prerequisite for better environmental outcomes, other inputs, such as capital works to manage, control or re-direct environmental flows, and changes to land management practices, may also be required. Without consideration of these other inputs, the Basin Plan may need to allocate more water for achieving desired environmental outcomes than is otherwise needed.

Box 3 **Gains from transferring water to environmental use**



This figure represents a simplified model of water allocation between environmental and irrigation uses.

At the initial level of water allocations Q_E, the amount of water entitlements allocated to irrigators is O_IQ_E, while the amount of entitlements allocated for environmental use (either left in rivers or used to water environmental assets) is O_EQ_E. Before any transfer of water between uses occurs, the marginal value of water for environmental use at P_E (a measure of the marginal social benefit) is higher than the marginal value of water for irrigation use at P_I (the marginal product of water).

Gains would result from transferring water entitlements up until the point where the environmental share increases to O_EQ^*. At this equilibrium, P^* is the marginal value of water for both uses, and the optimal allocation of water resource has been achieved between environmental and irrigation uses. However, if the reallocation goes beyond this point, as could occur in the way SDLs are to be set, overall returns to the community would begin to diminish. The additional environmental benefit (while still positive) would be less than the benefits if that water had been used for irrigation.

In practice, the shape of the marginal environmental value curve is not known with certainty. This increases the risk of reallocating either too much or too little water to the environment (relative to the efficient allocation).

Getting the right balance between competing environmental assets, and between the environment and consumptive uses, requires knowledge of the relative values that the Australian community place on the various environmental, social and economic outcomes. This cannot be determined just on scientific grounds.

While some participants in this study have maintained that there is scope in the Water Act to achieve a balanced outcome, much relies on how the MDBA interprets the SDL provisions. A balanced outcome might be possible if 'key' assets are identified judiciously, and there is scope to water environmental assets at a less than ideal frequency (or water less of each), without 'compromise'. But there is no process for explicitly assessing these tradeoffs, and hence these outcomes are far from assured.

This issue is crucial to the efficient conduct of the buyback and the SRWUI programs. Given the potential for the SDLs to be set at levels that would recover more water than is optimal from a community-wide perspective, the Australian Government may inadvertently pass the point of 'no regrets' in operating its water recovery programs.

The Commission is not arguing against the case for allocating more water for the environment. This is patently necessary to improve the health of the Basin's environment. But the potential now exists for one misallocation of resources (too little water for the environment) to be replaced with another (higher than necessary social and economic cost). To the extent that there is scope to do so, the MDBA is encouraged to define SDLs in a way that has more explicit regard for the objects of the Water Act, which include that the Basin resources be managed in the public interest, and to optimise economic, social and environmental outcomes (ss. 3(a) and 3 (c)). If a strict legal interpretation of the SDL definition precludes this, the Water Act should be amended.

There is also a need for the MDBA to articulate how the trading of entitlements by the CEWH will affect SDLs. These limits need to be sufficiently flexible to allow the CEWH to trade in ways that make use of new information on how to improve environmental outcomes from watering. There is also a need to ensure that such trade does not affect the reliability of supply for unrelated third parties. Such third-party impacts could potentially arise because more or less entitlements would be sharing the same consumptive pool of water.

The Restoring the Balance program should not be used to achieve unrelated objectives

Many participants in this study want the RTB purchases targeted to certain locations to achieve other objectives including: ameliorating community adjustment pressures; managing the consequences of exiting irrigators leaving others to pay for the upkeep of the system (the 'Swiss cheese' effect); facilitating system rationalisation; and/or addressing irrigation-related externalities, such as salinity.

Targeting to address social and community issues

Some study participants favour government buybacks being geographically targeted to minimise, or at least soften, the impacts of the sale of entitlements on local communities. For example, it is sometimes suggested that buybacks should be concentrated in areas that are more resilient, perhaps due to a more prosperous and diversified local economy. These distributional arguments run counter to the intention of broader water reform, that aims to facilitate water being traded to its highest value use. Also, such targeting could be considered inequitable, because it would exclude willing sellers from non-targeted areas and, in any case, has the potential to be undone by post-buyback trade.

Any 'Swiss cheese' effects should be managed in other ways

Some irrigators wanting to remain in irrigated agriculture are concerned that the atomistic buybacks currently being pursued will produce a 'Swiss cheese' effect, with geographically-dispersed farms within a networked system moving out of irrigated agriculture. It is argued that this will leave fewer farmers from whom to recover the joint costs of water delivery. An alternative often proposed is to restrict the buyback to areas identified as having a low potential for continued irrigation, with a view to closing them down.

There would be some potential for atomistic buybacks to cause inefficiencies if they enabled irrigators to renege on existing commitments to contribute towards infrastructure-related capital costs. But irrigation infrastructure operators are able to levy termination fees that negate this potential. And not all who sell their entitlements surrender their delivery rights, preferring perhaps to continue irrigating using seasonal allocations, or to buy entitlements in the future. Furthermore, not all impacts will be negative, as the 'holes' created by a 'Swiss cheese' buyback may open up future opportunities for neighbouring farmers to diversify their operations.

Where the costs of servicing different irrigators varies considerably, implementation of more cost-reflective pricing and direct negotiations between irrigation infrastructure operators and irrigators, coupled with market pressures, should be the preferred approach. This would give the best chance of achieving the mix of system rationalisation and geographically-dispersed water sales that is efficient for each area.

Targeting the buyback to rationalise irrigation systems can create significant inefficiencies and inequities and should be avoided. Irrigators denied the opportunity of entering the buyback may be less efficient than those in targeted, low productivity areas, or face greater hardship. Equally, it does not follow that farmers in low productivity areas should have any *additional* pressure or incentive to exit.

Targeting water that causes environmental problems

Purchases could also be targeted to reduce environmental problems associated with irrigating in particular locations and/or in particular ways. Thus, water currently being used in areas known to produce highly saline return flows to rivers could be targeted. The Commission considers that a better approach would be to use regulations and/or pricing (for example, salinity credits) to achieve socially desirable patterns of water use. Again, targeted purchasing would be an ineffective 'second best' approach, unless rules were put in place to prevent water being traded back to the area after the buyback.

In the Commission's view, the buyback should not be compromised by attempting to achieve such objectives. A neutral, independent buyback actually assists (rather than impedes) adjustment processes by giving irrigators the opportunity to sell some or all of their water, and restructure their businesses.

Investing in irrigation infrastructure to recover water for the environment needs reconsideration

Recovering water for the environment through infrastructure upgrades requires that governments be provided with some or all of the water savings in return for their funding. As such, they are effectively buying water, but with the requirement that the payment they provide be used to invest in irrigation infrastructure.

Infrastructure upgrades are generally not cost effective

The Commission has examined the experience of Australian programs for recovering water through subsidising infrastructure, and concluded that they are generally much less cost effective and efficient than buybacks. For example, infrastructure projects financed under the Living Murray Initiative recovered water at a cost almost 40 per cent greater than the cost of market-based measures. With water becoming increasingly scarce, irrigators and irrigation infrastructure operators have had strong incentives to invest in water-saving projects, meaning most of the 'low hanging fruit' has been picked already. Indeed, the indications are that projects being considered under the SRWUI program are likely to be less cost effective than projects funded during the Living Murray Initiative.

Subsidising irrigation infrastructure projects that do not provide benefits additional to those accruing to irrigators is a poor use of taxpayer funds, relative to buybacks. The case for subsidising a particular irrigation infrastructure project would be stronger where it provided external benefits. For example, reducing leakages from distribution systems can decrease waterlogging and land salinisation problems for unrelated third parties. But these projects can also decrease return flows that otherwise might benefit downstream users, or increase downstream salinity, hence the net impacts would need to be considered on a case-by-case basis.

Other drawbacks

Other drawbacks of subsidising irrigation infrastructure investment include that it:

- is inconsistent with the cost recovery principles agreed to by governments under the NWI
- can lead to 'gold plating' assets that may subsequently become stranded
- is inequitable for those who have already made such investments privately at full cost.

Many participants in this study have emphasised the flow-on benefits of infrastructure expenditure for the local community, and used regional multipliers to illustrate the aggregate impact. But because the same expenditure could have had a similar impact if spent elsewhere in the economy, regional multipliers are not reliable indicators of net benefits to the broader community. Nor do they reveal anything intrinsic about the productive use of the funds; the same or similar regional impacts might be achieved from spending the funds on other projects. Paying well above the market price for water obtained through infrastructure upgrades, as has occurred through some past programs, imposes substantial costs elsewhere in the Australian community.

What about other objectives?

Other objectives attributed to the SRWUI program are that it helps sustain irrigation communities and enhances food security.

Subsidising irrigation investment may contribute to sustaining an irrigation community faced with declining access to irrigation water, but is only one, and probably a small, influence on rural communities. Drought and structural changes are much more significant influences. Any attempt to influence the future of regional communities would be better pursued through regional development policy that has regard for all of the drivers of change.

The potential for investing in worthwhile projects also needs to be considered. Some regions have already modernised their infrastructure so that there is little potential for using this policy instrument to achieve the desired objective. If investments do not meet basic cost-benefit criteria, they will just perpetuate a dependence on external support, delaying the adjustment these communities will inevitably have to face.

As to enhancing food security, the Commission notes that this objective sits uneasily beside Australia's status as a large exporter of food, and that it is difficult to see how it could be used as a guiding principle for investing in irrigation infrastructure.

The funds could be better used

Notwithstanding the Commission's concerns about the SRWUI program, it recognises that this program can be seen as the price the Australian Government was prepared to pay to make progress on important reforms, such as implementation of the Basin Plan and the buyback. The expenditure can also be seen as one way in which the Australian Government is meeting its obligations under the risk assignment provisions. Furthermore, some $4.4 billion of the $5.8 billion allocated to this program has been committed, subject to due diligence. But even so, there is scope to utilise better the remaining funds allocated (and possibly to claw back funds from projects currently being assessed) in the following way.

First, the Commission considers that projects implemented through the SRWUI program should be assessed by essentially the same criteria as those used for the buyback. The most important of these are cost effectiveness, and the ability to obtain verifiable quantities of water that can be delivered to valued environmental assets (after taking into account any detrimental third-party effects). Rigorous project approval processes need to be applied, and projects should generally only be approved where the cost per megalitre for water entitlements recovered is similar to the market price. Premiums should only be paid where there are demonstrable additional benefits to the community beyond the private benefits to irrigators.

Second, consideration should be given to diverting some of the SRWUI program funds to the buyback of entitlements, or to purchasing water through other means (for example, to address urgent environmental needs). Diverting funds to the RTB would be conditional upon clarification of the extent of the Commonwealth's obligations to supply compensation under the risk assignment provisions.

Third, the use of any remaining funds should be considered in the context of cost effectively addressing the objective of sustaining rural communities (to the extent this is necessary), or redirected to other government priorities that are more likely to achieve net benefits. It does not follow that investment in irrigation infrastructure is the only way of achieving regional development objectives. Investment in other forms of social and economic infrastructure may be more appropriate.

Matching instruments to objectives

The Commission has interpreted the Government's objectives in conducting the RTB to be twofold: to ease the transition to the lower levels of water allocated to consumptive use that are likely under the Basin Plan, and to provide some (urgently needed) water for the environment in the interim. Yet the Government is relying on a single instrument — purchase of entitlements — to achieve these goals simultaneously.

Addressing the transitional objective

While a focus on purchasing entitlements is a sound way of addressing this objective, there are different ways the Government could have gone about implementing its strategy. If the objective was purely and simply to aid the transition to the lower SDLs, the most appropriate method would have been to wait until the Basin Plan had been finalised, identify how much of the balance between current levels of entitlements and the SDL the buyback was going to acquire, and then commence its purchase program. This would have given the market clear signals and allowed a more efficient buyback.

But the Government chose to commence the rebalancing sooner rather than later and to provide immediate environmental benefits. The importance the Government places on the short-term needs of the environment may be illustrated by how much it has accelerated the buyback, bringing forward the planned expenditure to such an extent that approximately two-thirds of it will have been used before the Basin Plan is finalised. But despite this, the CEWH has so far only been able to provide some 76 GL for environmental watering to date, a very small amount given the alleged imbalances in the Basin and the stated urgency of addressing environmental needs. This illustrates the conflict between trying to address the short-term and long-term goals with the one instrument.

Addressing the needs of the environment

In terms of obtaining water for the environment, as and when it is needed, a broader portfolio approach is likely to be more efficient and effective than just relying on entitlements. In the short term, it would have also allowed the Commonwealth to address urgent environmental needs much more cost effectively. In the longer term, the CEWH will be able to trade entitlements accumulated through the buyback and use the proceeds to purchase a range of products, but in the short term has eschewed this option.

There are good reasons for the CEWH holding entitlements, but other products should also be considered (table 1). Entitlements give some assurance over future water deliveries (including through carrying over water), and by purchasing a mix of entitlement types, the CEWH will have some ability to match the flow regimes required for particular environmental assets. But this focus compromises the ability to meet short-term environmental needs. In the longer term, incorporating other products — seasonal allocations, options contracts, leases, purchasing changes to licence conditions and contracts to deliver specified environmental outcomes — could also improve the CEWH's flexibility in managing the changing needs of the environment.

Purchasing seasonal allocations would give additional flexibility in targeting environmental demands within and across seasons. Seasonal allocations could be used to fine-tune the flow regime needed for a particular environmental asset, which might not otherwise be possible with the portfolio of entitlements held. The alternative of purchasing entitlements and engaging in subsequent trade in seasonal allocations under those entitlements, will have greater transaction costs than simply acquiring allocations if and when required.

Table 1 **Application of water products in a portfolio to meet environmental watering needs**

Product	*Effectiveness*	*Efficiency*	*Most appropriate application*
Entitlements	Medium	Medium	Addressing constant known watering needs; using water in storage to address emergency needs and watering demands outside of irrigation seasons. Less efficient than seasonal allocations in addressing short-term needs.
Leases on entitlements	Medium	Medium	Addressing less certain environmental demands; replacing entitlements when there are administrative constraints on trade in entitlements.
Seasonal allocations	Medium-High	High	In the short term, addressing current urgent environmental needs, in the longer term addressing variable, uncertain environmental demands during the irrigation season.
Options contracts	Medium-High (long term)	Medium-High (long term)	As water markets develop in the longer term, replacing some of the entitlements and leases in the portfolio.
Covenants	Low	Low	In regulated systems (but rules-based approaches of options contracts might be more appropriate).
Changes to unregulated licences	Low-Medium	Low	To achieve shepherding of water through unregulated systems (might need to be implemented in conjunction with states).
Bundles of land and water rights	Medium	Low	When the same objectives could not be achieved through changes to unregulated entitlements or environmental services contracts (needs to be implemented in conjunction with states).
Environmental services contracts	Medium-High	Medium-High	Environmental assets on private land.

Irrigators have expressed concern about the Commonwealth entering this market as well. But the two markets are inextricably linked, and the impact on the prices of seasonal allocations will largely depend on how much water the Commonwealth needs in any one season, irrespective of whether it holds that water in the form of entitlements or seasonal allocations.

Options contracts would allow the Australian Government to purchase a right to take delivery of water under conditions specified in the contract (for example, to top up natural flows to achieve a flood), thereby also providing some flexibility. They have some advantages over purchasing entitlements by allowing the water to remain in the hands of irrigators until required. But there would appear to be little advantage in going down this path until future environmental demands are known with more certainty under the Basin Plan.

Leases could provide some short-term flexibility where budgets are constrained and could potentially allow the parties to circumvent some legal and administrative constraints on entitlement trade. But over the longer term, the transaction costs are likely to be higher than holding the equivalent amount of water as entitlements.

In many unregulated catchments (where entitlements are rules-based and not backed by storages), purchasing upstream entitlements can be futile if downstream irrigators have rights to capture passing flows. In these circumstances, environmental managers may need to negotiate with a group of irrigators to change their licence conditions (such as minimum pumping thresholds) in ways that would enable the environmental water to be shepherded to environmental assets.

Purchasing environmental outcomes may also have a niche role to play in managing water resources in the Basin, particularly where key environmental assets are on private land (for example, the Macquarie Marshes and Gwydir wetlands). This approach recognises water is an input to achieving desirable environmental outcomes and may need to be combined with other inputs, such as control of weeds and feral animals, and engineering works. But there can be problems in measuring performance and monitoring compliance.

Purchasing instruments other than entitlements might not make quite the same progress in achieving the Government's longer term adjustment objectives, but it would significantly enhance the cost effectiveness of achieving short-term environmental objectives. A given amount of expenditure will go much further in purchasing seasonal allocations or leases, for example, than entitlements. And there is little point in acquiring entitlements to provide ample water in the future if environmental assets are seriously degraded in the short term.

Matching instruments to objectives would suggest that the most appropriate approach would have been to use seasonal allocations (and other instruments) to meet short-terms needs (as some state governments have done), and then bring entitlements into the mix once the Basin Plan is set. It is not too late to adopt this approach.

The buyback could be improved

On-market purchases should be considered

Different market mechanisms can be used to purchase the various water products discussed above, but the options can depend on the existence of markets, and in some cases some mechanisms would be inappropriate. For example, tenders might be used to purchase entitlements, leases, options contracts and environmental outcomes, but may be too cumbersome for purchasing seasonal allocations.

Where active water markets exist, on-market purchases are likely to involve lower overall transaction costs, and be less disruptive to existing trading systems than the purchase of entitlements through a tender.

DEWHA has expressed reluctance to purchase entitlements in this way, citing three main reasons: the incomplete coverage of some exchanges; the absence of a standard contract; and the typically short period of time buyers are given to sign contracts. It argues that these contractual issues could make it difficult to undertake due diligence, and comply with other features of the Commonwealth Procurement Guidelines.

But these problems do not appear to be substantial. The limited coverage of some exchanges does not negate the possibility of making opportunistic purchases as and when suitable parcels of water come onto the market, besides which, the Commonwealth need not just operate through market intermediaries. Standing in the market and negotiating with irrigators is also a possibility. And it should be possible to both use a contract of its own design, and to exchange contracts promptly while making them conditional on clear title being demonstrated, to remove much of the risk to the Commonwealth.

The tender process could be improved

During the course of this study, DEWHA has changed the way it conducts its tenders. By far the largest tender to date ran for some nine months using a rolling tender design. Because irrigators could bid repeatedly, and information was shared informally within the market, price discovery occurred very quickly during this round, seemingly negating a key reason for choosing tenders over other market mechanisms. For the balance of the financial year 2009-10, DEWHA has chosen to run short sharp tenders each of three weeks duration, the first of which was limited to $90 million, the second to $120 million. Another key change is that bidders cannot submit bids that in total exceed their holding of entitlements (though they could, for example, put in two bids each of fifty per cent of their entitlements but at different prices).

Whether these changes represent a permanent shift in the way DEWHA intends to conduct the rest of the RTB tenders is unclear, but they are an improvement on previous rounds. The shorter duration, and different rules on tendering, should lead to speedier resolution of bids, and reduce the potential for gaming.

The Commission considers further improvements could be made. Even with the shorter tender period, the approach that DEWHA uses for settling contracts is unnecessarily drawn out. Some of the delays are due to state agencies approving trades, but some are also attributable to internal (DEWHA) delays in processing bids. Participants have expressed frustration with delays in the due diligence process and have also indicated that it may be duplicating some existing state processes. Exchanging conditional contracts of sale before the due diligence process commences would help create more certainty for irrigators.

Many participants in this study have been concerned about the asymmetry of information in the market place. Markets work best where all participants have access to robust information, other things being the same. Where a large new buyer enters the market (as has been the case with DEWHA under the RTB program) it can create uncertainty about the future price of water, particularly if other market participants have no information on the new level of demand for water.

As part of the tender, DEWHA does not publish its price benchmarks, but it also gives little indication of how much it is seeking to purchase. The recent tenders reveal the aggregate budget, the information on the catchments where DEWHA will be accepting bids, and the types of entitlements it is seeking. This information is still at a very broad level and gives potential bidders very little idea about how much is being sought in particular catchments. This can have detrimental impacts on bidder behaviour and distort the participation in the tender. It can also impact private trade in the water markets and create uncertainty for irrigators making decisions on future business investment.

DEWHA considers that it would not be appropriate to publish the targets it is using for conducting the tenders. Its reasons are that doing so would tend to pre-empt the development of SDLs (and the environmental watering plan) under the Basin Plan, and that the targets are being continually refined. A further reason for not publishing these targets would be that it might encourage collusion between bidders where the number of entitlement holders that could meet the target in a particular catchment is small.

The benefits to potential bidders of DEWHA publishing its targets are likely to be modest, given that the largest sources of institutional uncertainty in the market are what impact the Basin Plan will have on the availability of water, and hence its price, and the application of the risk assignment provisions. Some clarity will be achieved once the proposed Basin Plan is published and draft SDLs are released (and the extent of the government's obligations are explained). But even then, this might not easily translate into specific targets at the catchment level (where for example the SDL was expressed as a formula). So some uncertainty will still remain even after the Basin Plan is finalised in 2011.

While the case for publishing specific targets is relatively weak, there would be value in DEWHA at least articulating how it intends to adapt its purchasing strategy to approach the SDLs. This should include whether it intends to approach them proportionately, the types of entitlements it would be seeking, and how it might interpret any formulas the MDBA might apply to setting SDLs. It should also articulate how the quantities it will be seeking are affected by anticipated water recovery under other programs, including the SRWUI program.

Governance is a challenging issue

The buyback is occurring within a complex set of institutional arrangements involving all Basin jurisdictions. But the governance arrangements for the recovery and use of water for the environment are still unclear. While the MDBA (and the Commonwealth Minister) have been given unprecedented authority to develop a Basin-wide approach to water management, the only policy lever of any substance it has at its disposal is the allocation of water between consumptive and environmental use. In most respects, the Commonwealth is dependent on the states (and private managers of environmental assets) to achieve the environmental outcomes that it aspires to, including through adopting appropriate land management practices, and investing in complementary environmental infrastructure.

While the Basin Plan should result in the states implementing compliant state water plans, and the CEWH will be required to manage his/her water in accordance with those plans, there are still some grey areas. In particular, it is unclear how the CEWH will coordinate his/her water with the inputs of local managers (including private managers) and other holders of environmental water. Given that most of the knowledge on how to best manage environmental assets exists at the local level, the Commission supports contractual arrangements between the CEWH and local managers, where those managers are competent to manage the water, and have clear accountability for achieving environmental outcomes. There would also be benefits in providing better information summarising the existing provisions for environmental water in each catchment, and clarifying how RTB purchases take into account environmental water recovered under the SRWUI program, and environmental water provisions in state water sharing plans.

Overcoming impediments to the buyback

There are several impediments to the operation of markets for water that hamper a government's ability to recover water for the environment through the market.

While rural water markets in Australia are relatively well developed, many of the reforms called for under the NWI have stalled or are proceeding only slowly. For example, there are still substantial institutional differences between the states in the way entitlements are defined and traded, and in some areas water entitlements are yet to be unbundled from land. The Commission shares the concerns of the NWC about the slow progress in implementing these reforms and generally endorses its findings and recommendations with respect to Basin-related issues (NWC 2009b).

At a more specific level, the continued application of the 4 per cent annual cap on trade of entitlements out of an irrigation district has been seriously distorting irrigator-to-irrigator trade, the buyback, and structural adjustment. It is also a source of inequity between irrigators, and creates hardship for those caught by the cap and whose only real option is to capitalise their entitlements. Although permitted under the NWI, this limit has become a particular issue in Victoria.

The negotiated settlement between the Commonwealth and Victorian governments to allow exemptions for sales to the Commonwealth from selected areas is a step in the right direction, but the cap still constitutes a significant impediment. Attempting to micro-engineer the buyback to target particular areas is likely to be inefficient and inequitable. In the Commission's view, all states should eliminate this constraint from their policy framework as soon as possible.

Similarly, the agreement between the Commonwealth and NSW Governments to constrain the sale of NSW-based entitlements to the Commonwealth (made in exchange for lifting an embargo placed on all sales of water entitlements to the Commonwealth), unnecessarily constrains the buyback. It is reportedly leading to distortions in the market as irrigators rush to get their bids in. It too should be removed.

The ability to carry over water from one season to the next is a relatively recent practice in managing rural water resources in Australia, enhancing the ability of irrigators to meet variable demands. It will also be useful to environmental managers holding entitlements. The amount that can be carried over is limited for good reason, as it can have undesirable third-party effects. But it is not clear that the current limits are optimal. These limits should be reviewed, particularly to ascertain whether there would be net gains from wider adoption of arrangements, such as capacity sharing and 'spillable water accounts', that give entitlement holders an improved ability to carry over water.

But perhaps the most serious impediment to achieving a good outcome for the community is that, despite the best intentions of Basin jurisdictions in developing a coherent approach to water policy under the NWI (and the subsequent Murray-Darling Basin Agreement 2008), policy implementation is still somewhat fragmented. State governments still have to rein in overallocation and over extraction of water resources in the Basin, and all jurisdictions (the Commonwealth included) need to articulate better how they intend to address their obligations under an agreed framework for assigning liability for reductions in water availability. Adding to the uncertainty is that the Basin Plan will not be finalised until mid-2011.

An overall assessment

While the NWI established a blueprint for the management of Australia's water resources, the design, scale, implementation and sequencing of policy initiatives to recover and manage water for the environment in the Basin have not been ideal.

In the Commission's view, the objectives for recovering water should have been clarified before deciding on how and where water would be recovered. Under this approach, the buyback of entitlements — as a means of transitioning to the lower levels of water availability under the Basin Plan — should have commenced only after the Plan had been ratified (and the assignment of risk between irrigators and governments clarified). Urgent short-term needs could have been addressed through the purchase of seasonal allocations. And to the extent that they provide net benefits to local communities, investment in new irrigation infrastructure should have come after the buyback had given some indication of where the more viable areas were likely to be. Above all, sound cost-benefit analysis should have preceded intervention.

It is not possible to wind back the clock, but there is still much that Basin jurisdictions could do to provide greater institutional certainty for the recovery and management of water for the environment in the Basin. Using market mechanisms for recovering water for the environment is a sound approach. However, the buyback needs to operate within a coordinated institutional framework, which has been lacking to date. Greater care is also needed to ensure that the very substantial resources committed to the Basin produce the highest net returns for the taxpayer funds expended. As the measures are currently conceived and sequenced, the Commission fears that the benefits will not justify the substantial public expenditure and the socioeconomic dislocations imposed.

Findings and recommendations

Water use in the Murray-Darling Basin

FINDING 2.1

Current planning arrangements tend to assign a more than proportional cut to environmental water during dry periods. With climate change expected to increase the prevalence of dry conditions (particularly in the southern parts of the Basin), the environmental consequences of this could become increasingly significant. Accordingly, the prospect of climate change adds to the imperative to adjust the balance between environmental and consumptive uses of water in the Basin.

Development of water markets

FINDING 3.1

Water markets are well developed and active in the southern-connected Basin, but not in parts of the northern Basin, where entitlements are generally rules based rather than storage based.

FINDING 3.2

Market intermediaries, including brokers and exchanges, have developed alongside the market to facilitate increased trade.

Allocating environmental water

FINDING 4.1

Water recovered in the northern Basin can result in infrequent, but at times significant, environmental benefits for the southern parts of the Basin, given hydrological constraints. Water recovery within the northern catchments that are often disconnected should be driven primarily by environmental priorities within those catchments. Conversely, the southern Basin — including the Murrumbidgee, the Murray and the Goulburn rivers — is highly interconnected, allowing considerable flexibility in sourcing and delivering water for environmental purposes throughout these valleys.

FINDING 4.2

Decisions on allocating water between competing uses in the Basin should be based on good science. But the values the community attaches to alternative uses are also crucial in achieving the best outcomes for Australia. Difficult tradeoffs are required between different environmental outcomes, and between environmental and consumptive outcomes.

Recovering water through non-market means

FINDING 6.1

The Commission's interpretation of the Water Act 2007 (Cwlth) is that it requires the Murray-Darling Basin Authority to determine environmental watering needs based on scientific information, but precludes consideration of economic and social costs in deciding the extent to which these needs should be met. This means that the overall proportion of water allocated to the environment is to be determined without explicitly taking into account the Australian community's environmental preferences, the opportunity cost of foregone irrigation or the role of other inputs such as land management. There is a risk that this approach will impose unnecessarily high social and economic costs.

RECOMMENDATION 6.1

The Murray-Darling Basin Authority should set sustainable diversion limits (SDLs) in a way that balances environmental, social and economic tradeoffs. This approach would appear to be consistent with the objects of the Water Act 2007 (Cwlth), but may not be consistent with the specific provisions defining how SDLs are to be set. If it is inconsistent, the Water Act should be amended.

RECOMMENDATION 6.2

Some new information on how to improve environmental outcomes from watering will inevitably become available after the Basin Plan is made. To enable such information to be fully utilised, the Murray-Darling Basin Authority should ensure that the Basin Plan is sufficiently flexible to allow the Commonwealth Environmental Water Holder to trade water allocations and entitlements in ways that improve overall environmental outcomes.

FINDING 6.2

Considerable uncertainty exists about the application of the risk assignment provisions set out in the Water Act 2007 (Cwlth) in respect of compensation that might be payable to irrigators upon the implementation of the Basin Plan. This is impeding the ability of irrigators to plan for the future and is affecting the efficient conduct of the buyback.

RECOMMENDATION 6.3

All Basin jurisdictions should clarify how the risk assignment provisions in the Water Act 2007 (Cwlth) will apply to the reductions in water availability that are likely under the Basin Plan. This should occur as soon as possible.

FINDING 6.3

Purchasing water products from willing sellers is generally the most effective and efficient means of acquiring water, where governments are liable for the cost of recovering water for the environment.

FINDING 6.4

Funding irrigation infrastructure upgrades is generally not a cost-effective way for governments to recover water for the environment.

FINDING 6.5

Rather than having a $5.8 billion program focused predominately on infrastructure upgrades, it would have been more effective and efficient to:

- *use the sustainable diversion limits from the Basin Plan to determine the targets for reallocation in each catchment*
- *use the buyback program as the sole means of easing the transition to those targets*

- *consider establishing a much smaller program to assist irrigators and related communities adjust to a future with less water, through the most effective means available (not just subsidies for irrigation infrastructure).*

RECOMMENDATION 6.4

Rigorous approval processes should be applied to all projects under the Sustainable Rural Water Use and Infrastructure (SRWUI) program. In particular, projects should only be approved where:

- ***properly conducted cost–benefit analysis shows there to be net benefits***
- ***government contributions are commensurate with public benefits (excluding private benefits to irrigators).***

Applying such approval processes is likely to result in the SRWUI program's budget being underspent. This money should be reallocated to Restoring the Balance or to other government priorities.

Designing a portfolio of water products to meet environmental watering needs

FINDING 7.1

Purchasing seasonal allocations offers a transparent, flexible and low-cost means of addressing urgent, short-term environmental watering needs. Where practical, this product should be included in the portfolio of water products.

FINDING 7.2

Purchasing water entitlements in unregulated systems can provide environmental managers with different environmental watering possibilities to holding storage-backed entitlements. Although less reliable, holding entitlements in unregulated systems can help managers to restore environmental flows in river systems. However, their effectiveness and efficiency can be compromised by complexities involved in shepherding environmental water downstream. These third-party effects may need to be addressed through negotiating with groups of irrigators, or through administrative changes to environmental flow rules.

RECOMMENDATION 7.1

In recovering water for the environment, the Australian Government should develop a portfolio of water products, and not focus solely on entitlements. Other products (such as seasonal allocations, leases on entitlements, options contracts and contracts for environmental services) have advantages in specific contexts and should be considered.

Mechanics of the buyback

FINDING 8.1

Where active markets for water entitlements exist, acquiring water entitlements directly from those markets is likely to be more efficient than utilising a tender.

FINDING 8.2

Allowing irrigators to bid several combinations of entitlements and prices as part of a single bid could improve the efficiency of the tender.

FINDING 8.3

The efficiency of the conveyancing process could be improved by:

- *exchanging conditional contracts of sale before the due diligence process commences*
- *assessing the current due diligence process for potential duplication with current state approval processes and removing the sources of duplication*
- *the Department of the Environment, Water, Heritage and the Arts notifying tender participants of any delays in the process and the reasons for the delays.*

FINDING 8.4

Using the buyback to address indirect objectives (such as achieving distributional goals, system rationalisation or reducing the salinity impacts of water use) is likely to compromise the scheme. Other more direct instruments would generally achieve those objectives at lower cost.

FINDING 8 5

Adopting a rapid pace in the buyback of water entitlements before environmental needs are clearly identified could reduce the program's effectiveness and increase its cost to the community. It is likely that the buyback has proceeded at a faster than optimal pace to date.

Governance and institutional issues

RECOMMENDATION 9.1

In the short term, while the portfolio of water entitlements is being established, the Commonwealth Environmental Water Holder should be allocated an appropriate budget to purchase additional water products that best meet its immediate environmental objectives.

FINDING 9.1

Transparency and accountability in environmental water recovery under the Restoring the Balance (RTB) program would be improved by:

- *the Murray-Darling Basin Environmental Water Recovery Report including a summary of all existing provisions for environmental water by catchment. The summary should include environmental water set aside under state water sharing plans as rules-based flows and water entitlements, as well as environmental water entitlements recovered through government-funded water recovery programs.*
- *the Department of the Environment, Water, Heritage and the Arts clarifying how RTB water recovery targets in a catchment take into account environmental water to be recovered under the Sustainable Rural Water Use and Infrastructure program, and rules-based environmental water provisions in state water sharing plans.*

FINDING 9.2

Holdings of environmental water and the management of those holdings in the Murray-Darling Basin are fragmented between various state and local environmental water managers and the Commonwealth Environmental Water Holder (CEWH). Some institutional arrangements for coordinating the CEWH's environmental watering activities with other environmental water managers have been implemented. However, mechanisms for the full coordination of environmental water management are still evolving.

FINDING 9.3

Recovering water is not always sufficient to achieve desired environmental outcomes in the Basin. Other inputs, such as capital works to manage and direct environmental flows, and changes to land management practices, may also be required. Yet the Basin Plan, and the Australian Government's buyback and infrastructure programs, focus solely on recovering water. Better systems are needed to coordinate the mix of water purchases with other actions and inputs to achieve the desired environmental outcomes.

RECOMMENDATION 9.2

Where an effective and accountable local environmental water manager exists, and there are no significant spillovers from water use, the Commonwealth Environmental Water Holder should enter into an agreement that:

- ***delegates use of an appropriate quantity of its environmental water to that manager***
- ***requires the manager to coordinate the use of Commonwealth water with other actions and inputs that best achieve agreed outcomes.***

Overcoming impediments

FINDING 10.1

Restrictions on water trade in Victoria and New South Wales have the potential to impair the effectiveness and efficiency of the buyback:

- *Victoria's agreement to allow some exemptions to a 4 per cent limit on out-of-area trade of water entitlements is an improvement. But because the extra purchases can only occur from specified areas, the constraints decrease the cost effectiveness of the buyback, and increase adjustment problems for some regions.*
- *New South Wales' agreement to lift a blanket embargo on sales to the Commonwealth and replace this with annual volumetric caps is less distortionary than the Victorian restrictions, but it does limit options for conducting a faster buyback, should this be deemed necessary.*

RECOMMENDATION 10.1

The 4 per cent limit on out-of-area trade of water entitlements should be eliminated as soon as possible, rather than phased out by 2014 as currently scheduled. Limits on the amount of entitlements that can be sold to the Commonwealth through the buyback should also be eliminated.

FINDING 10.2

Irrigation infrastructure operators can reduce the risk that geographically-dispersed sales into the buyback will harm the competitiveness of their irrigation area by moving to more cost-reflective pricing for water delivery.

RECOMMENDATION 10.2

The National Water Commission should conduct a study into ways of expanding the ability of water users to carryover water, while adequately managing third-party impacts. This study should examine the suitability of capacity sharing, 'spillable water accounts' and other arrangements across different regions.

Concluding comments

FINDING 11.1

Without even implementing the Basin Plan, the amount of water that is likely to be recovered for the environment through existing programs is substantial. It will likely exceed the lower bounds of what some commentators — such as the Wentworth Group — have called for in terms of minimum flows necessary to achieve a moderate probability of achieving a healthy river system.

1 Introduction

Key points

- The Productivity Commission has been asked to report on market mechanisms that the Australian Government could use to diversify its water purchasing program.
- Under the broad framework of its Water for the Future Initiative, the Australian Government has been recovering water for the environment through:
  - the $3.1 billion Restoring the Balance in the Murray-Darling Basin (RTB) program. The RTB program commenced in 2007-08 and is primarily purchasing water entitlements from willing sellers through a tender process. As of 31 January 2010, the Australian Government had purchased 797 GL of entitlements of varying reliabilities at a cost of about $1.3 billion
  - the $5.8 billion Sustainable Rural Water Use and Infrastructure (SRWUI) program. The SRWUI is a ten-year program to subsidise investment in irrigation infrastructure intended to create water efficiency savings to be shared between irrigators and the environment.
- In addition to the RTB and SRWUI programs, the Murray-Darling Basin Authority is developing a Basin Plan that will administratively recover water for the environment by setting Sustainable Diversion Limits (SDLs) on water use in the Murray-Darling Basin (the Basin). It will also include an environmental watering plan that will set environmental objectives and targets for ecosystems across the Basin
- The objectives of the RTB and SRWUI programs are similar in that they both aim to ease the transition to lower SDLs likely under the Basin Plan, and obtain water entitlements for environmental needs. The SRWUI program has the additional objectives of securing a long-term sustainable future for irrigation communities and helping to provide for food security.
- The Commission considered the effectiveness and efficiency of market mechanisms in the context of all possible methods for recovering water, including administrative methods, and subsidising investment in irrigation infrastructure.
- The Commission also considered the purchase of water products other than water entitlements, including seasonal allocations, options contracts and leases, but recognises that the approach taken should depend on the objectives being pursued.

Notwithstanding recent heavy rains in parts of the Murray-Darling Basin, water shortages are placing considerable stress on the environment, agriculture, and regional and rural communities. To help alleviate the pressure on the environment, Australian governments have been collectively and individually acquiring water through various means. For its part, the Australian Government has commenced buying entitlements from irrigators on a large scale, through a program called Restoring the Balance in the Murray-Darling Basin (RTB). It is also investing in water saving infrastructure through a program called Sustainable Rural Water Use and Infrastructure (SRWUI), and it is developing a Basin Plan to recalibrate water use in the Basin.

The Australian Government has asked the Commission to undertake a study into alternative market mechanisms that it could use to diversify its RTB water buyback program.

1.1 What the Commission has been asked to do

The Productivity Commission has been asked to report on market mechanisms for recovering water in the Basin. This includes identifying appropriate, effective and efficient mechanisms that could be used to diversify the range of options to purchase water entitlements under the RTB program. It is also required to review mechanisms used nationally and internationally to purchase water (and to this end has reviewed programs that have been operating in Australia and the United States in appendixes B and C respectively), and identify impediments to the use of water purchase mechanisms and how these could be overcome.

In undertaking the study, the Commission has been asked to consider a number of issues including:

- the proposed pace of environmental water recovery and the depth of the water markets in the Basin
- transaction and compliance costs for participants in the buyback and the Government
- the impact on the water market, particularly where the Government may be the dominant buyer
- the implications of a developing water market and limited market price information
- the potential to use existing or developing water exchanges, auction houses or on-line water trading platforms

- the potential methods to maximise synergies between water purchase and the SRWUI program
- the capacity to use different mechanisms to purchase a mix of high, general and low security entitlements to meet identified environmental needs
- the requirements of the Commonwealth Procurement Guidelines and the *Financial Management and Accountability Act 1997* (Cwlth).

The full terms of reference are in the front of this report.

1.2 The Commission's approach

The Government has asked the Commission to consider the effectiveness and efficiency of market mechanisms to purchase water entitlements, which requires clarity of the program's objectives and an understanding of the reasons why it was designed as it was. The Commission is also required under its Act to consider the community-wide impacts of the issues it reviews. As such, the Commission has felt it necessary to take a broad approach to the scope of this study by considering:

- market mechanisms for recovering water for the environment in the broader context of all possible methods for recovering water, including administrative methods and subsidising investment in water saving infrastructure, such as through the SRWUI program
- the case for using not only various market mechanisms (such as tenders) but also for purchasing water products other than water entitlements, including seasonal allocations, options contracts and leases.

The interaction between different approaches to recovering water can have considerable implications for efficiency and effectiveness. Obtaining water through purchases or by investing in water saving infrastructure needs to be seen in the context of the Basin Plan — which will ultimately apportion water between consumptive and environmental uses — and the other objectives the Government has in mind.

The Commission's approach to interpreting the meaning of effectiveness and efficiency is important to the scope of the study.

Effectiveness refers to how well the outputs of the Australian Government's purchasing program achieve the stated or implied objectives. A first step in identifying effective mechanisms is, therefore, to clarify objectives. This is important in matching policy instruments to objectives to achieve the best possible result. Where there are multiple objectives it may be more effective to have multiple policy instruments. Effectiveness is often measured in terms of cost, that is as cost effectiveness. This can involve comparisons of the cost of alternative methods of achieving the same or similar outcomes. Alternatively, it could involve comparisons of the effect produced by alternative methods that have the same or similar cost. Effectiveness is an important criterion in this study, as there are many environmental needs for water and different options for delivering that water.

Efficiency refers to maximising the net benefit to the community of the purchasing program. It involves having regard to all of the costs and benefits, including the environmental and social impacts. In this project, the most efficient outcome would occur where the net benefits of applying water to competing end uses was maximised, having regard to any adjustment costs that might be involved. Market-based mechanisms for recovering water have the potential to improve efficiency by acquiring water from willing sellers and applying it to a more valuable end use from the community's perspective. The interaction between efficiency and effectiveness can be important. For example, water may be recovered efficiently through a market mechanism, but this may not be effective if the water cannot easily be delivered to a valued environmental asset.

The Commission's analytical framework is addressed in more detail in chapter 5. The objectives of the main methods for recovering water are discussed below.

1.3 Background to the study

The availability and use of water have always been topical policy issues, none more so than where the Basin is concerned. In the initial stages of the development of the Basin, little specific regard was given to the environment; the focus was more on the use of rivers for navigation, and as a source of water for irrigation and urban development. While some recognition was given to the need to maintain base flows, environmental needs tended to be otherwise met only when dams spilled and water was abundant.

The shortfall to the environment has been explicitly recognised since the late 1980s. But it has been compounded over the last decade by a prolonged drought that has decreased inflows into the rivers and streams, meaning much less water is available for any purpose. And increasingly, it seems that climate change induced reductions are likely to make droughts more prevalent in the future. Market failures in the provision of environmental goods, and the competing priorities of the Basin jurisdictions, add to the challenges of managing the Basin's water resources.

Ideally, water would be allocated among competing uses and jurisdictions to maximise the returns to the whole community. Water used in agriculture or for urban purposes has benefits for the community, but so does the restoration and maintenance of the environment. The development of markets for water is helping improve the efficient allocation of water among irrigators and between agriculture and urban users. But without government intervention, water allocations to the environment are likely to be severely compromised. In both of these respects — the development of markets, and the more explicit recognition of the environment's needs — water policy has developed substantially over the last 20 years (box 1.1).

Box 1.1 **Development of Murray-Darling Basin water policy**

While agreements about sharing the Basin's water resources date back to the 1915 River Murray Waters Agreement (between the Commonwealth, NSW, Victorian and SA Governments), it was not until the 1980s that environmental issues started to be addressed at a Basin-wide level. The emergence of irrigation-induced environmental problems that were beyond the control of any one jurisdiction — including impacts on water quality and land salinisation — emphasised the need for an inter-jurisdictional approach. This led to the adoption of the Murray-Darling Basin Agreement in 1987 and the eventual participation of all Basin jurisdictions.

This Agreement aimed to promote and co-ordinate planning and management of the water, land and other environmental resources of the Basin, and established new institutions including the Murray-Darling Basin Ministerial Council, and the Murray-Darling Basin Commission (MDBC). However, while it set out procedures to be followed for natural resource management and water distribution, among other things, its implementation relied on the cooperation of the jurisdictions (MDBC 2009).

The next step in water reform occurred in 1994, when the Council of Australian Governments (COAG) agreed to the Water Reform Framework (subsequently incorporated into National Competition Policy). Under this framework, governments committed to a number of reforms, including more explicitly allocating water specifically for use by the environment, and a range of market-based measures (COAG 1994).

In 2003, COAG agreed that there was a need to extend its 1994 water reform agenda, and in June 2004 the Commonwealth, NSW, Victoria, Queensland, SA, the ACT and the NT Governments signed the Intergovernmental Agreement on a National Water Initiative (NWI) (the Tasmanian Government joined the Agreement in June 2005 and the WA Government joined in April 2006).

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

(Continued next page)

Box 1.1 (continued)

NWI reforms aim to:

- achieve nationally compatible characteristics for secure water access entitlements
- implement statutory-based water planning
- introduce statutory provision for environmental outcomes and water to meet those outcomes
- improve environmental management practices
- return all currently over-allocated or overused systems to environmentally sustainable levels of extraction
- remove barriers to trade in water
- assign the risk arising from future changes in the availability of water
- implement water accounting to meet the information needs of water systems including for planning, monitoring, trading and environmental and on-farm management
- improve water use efficiency and innovation in urban and rural areas
- recognise the connectivity between surface and groundwater resources.

It was not until a referral of powers by the states and the passage of the *Water Act 2007* (Cwlth) that powers to manage the water resources of the Basin were consolidated under Australian Government control. This created the necessary institutional structure to provide for the statutorily enforceable Basin Plan now being developed by the Murray-Darling Basin Authority (MDBA). The Act also:

- created a semi-independent Commonwealth Environmental Water Holder
- established the MDBA (which absorbed the MDBC)
- charged the Bureau of Meteorology with the task of publishing the National Water Accounts and periodic reports on water resource use and availability
- extended the remit of the Australian Competition and Consumer Commission (ACCC) to include rural water market rules and water charge rules.

In 2008, all Basin jurisdictions (the Commonwealth, Queensland, NSW, Victorian, SA and the ACT Governments) signed the Agreement on Murray-Darling Basin Reform 2008 (the Basin Agreement), which, among other things:

- affirmed the new governance arrangements for water planning in the Basin
- allocated the initial round of Commonwealth funds for infrastructure-based water recovery projects under the SRWUI program and the purchase of water entitlements under the RTB program
- established due diligence criteria for the Australian Government's investment in SRWUI irrigation infrastructure projects
- expanded the ACCC powers over water market and charge rules.

The reforms and water recovery programs enacted under the Act, and through the Basin Agreement, combine to form the main rural water components of the Australian Government's Water for the Future Initiative.

Recovering water for the environment

Recovering water for the environment can be achieved in three main ways:

- by administratively changing the rules by which water is allocated among competing uses through state water sharing plans (chapter 6). These are called rules-based or administrative methods. Now that the Australian Government has the necessary powers to implement a Basin Plan, the next generation of water sharing plans will need to be certified by the Commonwealth Minister for Water as consistent with the Basin Plan, as they expire and are replaced (box 1.2)
- by investing in water-saving infrastructure (chapter 6). Such projects might include irrigation delivery infrastructure, and on-farm infrastructure
- by purchasing water through market mechanisms, including tenders and on-market purchases (chapters 7 and 8).

Box 1.2 **The Basin Plan is central to water recovery in the Basin**

To help change the allocation of water within the Murray-Darling Basin, the Murray-Darling Basin Authority (MDBA) is required to develop and implement a Basin Plan by 2011. It will set (long-term average) environmentally sustainable diversion limits (SDLs) on quantities of surface water and groundwater extraction and the conditions under which such diversions can occur. It is widely expected that SDLs will be much lower than the status quo, to allow a substantially higher proportion of available water to be allocated for meeting ecosystem requirements.

A key part of the Basin Plan will be an environmental watering plan that will set environmental objectives and targets for water-dependent ecosystems across the Basin. This will govern the management of water held by the Commonwealth Environmental Water Holder and other planned environmental water provided for under the Basin Plan.

The Basin Plan will set requirements that must be met under new state water resource plans to be introduced in 2014 in all affected jurisdictions, except Victoria, which is scheduled to introduce its next water plan in 2019. Based on advice from the MDBA, the Commonwealth Water Minister must accredit these plans, but only if satisfied that they are consistent with the Basin Plan. While SDLs will start to have effect from 2014, 'temporary diversion provisions' can be introduced to provide a further five-year transition period.

In the meantime, the Australian Government's water purchasing priorities have been guided by the findings of Basin-wide scientific studies on water availability and ecosystem health, information on the specific needs of particular environmental assets, and by the perceived difference between current levels of use and the anticipated SDLs, due to be established in 2011.

Sources: MDBA (2009a; 2009b).

Basin states have, to varying degrees, been developing water sharing plans that define environmental objectives and establish statutory provisions for environmental water through rules-based flows and environmental entitlements. Some Basin states have also established environmental water managers to manage state environmental water (NWC 2009a) (chapter 2).

In addition, a number of water recovery programs have been established to recover and, in some cases, manage water for specific environmental assets in the Basin. The most notable example is the Living Murray Initiative, under which 500 GL of average annual flows is being obtained, through a mix of infrastructure investments, water buybacks and regulatory changes to improve environmental outcomes at six 'icon' sites along the River Murray. Other smaller water recovery programs have also been operating concurrently with the Living Murray Initiative to recover water for environmental flows (chapter 2 and appendix B).

Water recovery under the Water for the Future Initiative

The two largest components of the Australian Government's Water for the Future Initiative — the Restoring the Balance in the Murray-Darling Basin program and the Sustainable Rural Water Use and Infrastructure program — focus on water recovery in rural areas.

Restoring the Balance in the Murray-Darling Basin program

Under the RTB program, the Australian Government has committed $3.1 billion from 2007-08 to 2016-17 to purchase water entitlements from willing sellers in the Basin (table 1.1). The program has used a mix of purchasing arrangements, the principal instrument being a series of tenders. This is to be complemented by 'irrigator-led group proposals'. The Australian Government has also acquired entitlements under the RTB program through partially funding state government purchases of land and water in the northern Basin and 'exit grant packages for small block irrigators'[1] (DEWHA, sub. 56, p. 6).

[1] A condition of the exit grant packages was that entitlements had to be offered for sale (and accepted) in a subsequent tender. Applications for exit grants closed at the end of June 2009.

Table 1.1 **Budgeted expenditure for the RTB program**[a]

Financial years	*Budgeted expenditure*		
	Original[b]	*1st revision*[c]	*2nd revision*[d]
	$m	$m	$m
2007-08	50	45.5	45.5
2008-09	157	612.6	432.5
2009-10	466	464.0	1 237.8
2010-11	468	509.6	254.4
2011-12	346	445.1	249.5
2012-13	..	506.8	510.5
2012-13 to 2016-17	1 633	..	..
2013-14 to 2016-17[e]	..	516.4	369.8

[a] Budgeted funding comprises departmental funding and administered funding. [b] Figures sourced from Hyder Consulting (2008). [c] Revised budget figures from DEWHA (pers. comm., 14 August 2009). [d] Revised budget figures from DEWHA (sub. 85, p. 26). [e] PC estimate derived from total program expenditure. **..** Not applicable.

Source: *Appropriation (Water Entitlements) Act 2009* (Cwlth); DEWHA (Canberra, pers. comm., 14 August 2009); DEWHA (Canberra, pers. comm., 21 November 2009); Hyder Consulting (2008).

The tenders

The principal mechanism used in the 2007-08 and 2008-09 rounds of the RTB program was a rolling tender, under which the Department of Environment, Water, Heritage and the Arts (DEWHA) invited holders of entitlements to bid the price and quantity of entitlements they were willing to sell (chapter 8). Bids were assessed against common criteria (chapter 4) throughout the tender period. If bids were considered to be value for money, in compliance with the program guidelines and subsequently passed due diligence, DEWHA proceeded to an exchange of contracts.

Four rolling tenders have now been completed. The first tender occurred in 2008 and purchased approximately 24 GL of entitlements of varying reliability. Subsequently, three further tenders were conducted in 2008-09, one focusing on the southern part of the Basin, the other two on the northern part of the Basin. Although these tenders closed at the end of June 2009, trades are still being settled. As at 31 January 2010, 797 GL of entitlements of varying reliabilities had been recovered (DEWHA 2009j).

In December 2009, it was announced that DEWHA would run three new tenders in the first half of 2010 in the southern connected Basin using a modified tender design (Garrett 2009). In particular, each tender would be open for only three weeks, would face an explicit budget constraint, and bids would be assessed at the close of the tender round (chapter 8). The first of the newly designed tenders ran from 11 January to 29 January 2010. No data on purchases are available as yet.

Although purchases have been made throughout the Basin, one single purchase stands out. This was the purchase of a package of water entitlements amounting to 240 GL of varying reliability for $303 million from the Twynam Agricultural Group.

Irrigator-led group proposals

The irrigator-led group proposal component of the RTB program allows groups of irrigators to develop a coordinated bid to sell water to DEWHA, which could lead to the decommissioning or reconfiguration of shared off-farm infrastructure that is causing high losses of water. The Australian Government is inviting irrigators to work with their irrigation operator and other directly affected parties to develop these proposals. It expressed its interest in purchasing not only the entitlements, but also any share of the conveyance water savings that become available. The Australian Government may make a contribution to infrastructure costs, where this contributes towards the objectives of the Water for the Future Initiative (DEWHA 2009c).

The Commission understands that several proposals have been discussed but none have yet come to fruition. The Australian Government has not set a deadline for the receipt of irrigator-led proposals.

Purchases of land and water

Under a purchase of land and water component of the RTB program, DEWHA is partly funding state government purchases of irrigation properties and their water entitlements in the northern Basin. The most notable example of this to date was the purchase of Toorale station in September 2008 for $23.75 million (chapter 7). This property held 14 GL of unregulated water entitlements from the Warrego and Darling Rivers, along with rights to harvest water from the floodplain. The NSW Government has taken responsibility for preserving the land, and the rights to take water have been transferred to the Australian Government (DEWHA 2009d).

Small Block Irrigators Exit Grant Package

The Small Block Irrigators Exit Grant Package[2] was designed to assist Basin irrigators with blocks of 40 hectares or less to exit the irrigation industry, while remaining in their communities. The package included a one-off grant of up to $150 000 for eligible irrigators if they agreed to leave irrigation and abide by certain conditions (including that they sell all of their irrigation entitlements to the Australian Government through the RTB tender) (DEWHA 2009e). Applications for the exit grant package closed at the end of June 2009. DEWHA reports that as at 31 December 2009, 16.8 GL of entitlements had been recovered with a total of 21.2 GL expected to be recovered (sub. 85, p. 26).

Water purchases to date

The combined outcome of the RTB program has, to the end of 31 January 2010, yielded just under 797 GL of entitlements of varying reliabilities at a cost of approximately $1.3 billion (table 1.2) (DEWHA 2009j).

Because it is not particularly meaningful to sum the purchases of entitlements of different reliability, DEWHA also presented the results in terms of the expected average annual volume of water that should become available. This suggests that, on average over the long term, around 532 GL per year should be available from holding this bundle of entitlements. This compares to long term average inflows into the Basin of around 11 000 GL per year (chapter 3) and a Living Murray Initiative assessment that found increased environmental flows of 1500 GL per year — combined with improvements in structural, operational and water quality management — would provide considerable 'whole-of-river and local ecological habitat benefits in the southern Basin' (chapters 4 and 11).

Nominally, over 549 GL of entitlements have been sourced from New South Wales, or about 69 per cent of the total volume of entitlements purchased. In long term equivalent terms, the purchases from New South Wales amount to just over 317 GL, or about 60 per cent of the corresponding total.

Around 90 per cent of water entitlements purchased under the RTB program have come from three of the four high priority catchments identified under the RTB tender assessment criteria in 2008-09 (the Gwydir, Macquarie and Southern Connected Murray System catchments).

---

2 The grant is funded through the SRWUI program but eligibility is ultimately dependent on applicants selling their water to the Australian Government through the RTB tender.

Table 1.2 **Entitlements secured under the Restoring the Balance program as at 31 January 2010**[a]

Catchment	*Entitlement type*	*Purchases*[b]	*Expected average annual volume of water*[c]	*Average price paid per ML*[d]
		ML	ML	$
New South Wales				
Gwydir	General security	88 520	31 867	2 242
	Supplementary	16 324	3 102	**na**
Barwon-Darling[e]	Unregulated	30 381	30 381	**na**
Namoi	General security	5 777	4 448	2 057
Macquarie	General security	61 215	25 710	1 266
	Supplementary	1 888	397	161
Lachlan	High security	300	300	**na**
	General security	81 671	34 302	692
Murrumbidgee	General security	64 359	41 190	1 118
	Supplementary	20 821	2 915	218
Murray above choke	General security	145 785	118 086	1 320
Murray below choke	General security	28 803	23 330	1 276
Murray below choke	High security	318	302	2 279
Other	Various	3 210	961	**na**
Total		**549 372**	**317 291**	
Victoria				
Campaspe	High reliability	5 051	4 799	2 375
Goulburn-Broken	High reliability	81 137	77 080	2 391
	Low reliability	9 590	3 356	195
Lodden	High reliability	1 029	987	2 383
Ovens	High reliability	50	48	**na**
Murray above choke	High reliability	35 954	34 156	2 188
	Low reliability	5 940	1 426	191
Murray below choke	High reliability	59 358	56 390	2 377
	Low reliability	5 450	1 308	200
Other	Various	851	317	**na**
Total		**204 409**	**179 856**	
Queensland				
Border rivers	Medium security	6 832	2 255	2 276
Total		**6 832**	**2 255**	
South Australia				
Murray	High security	36 116	32 504	2 384
Total		36 116	32 504	
Basin total		**796 729**	**531 905**	

[a] For contracts exchanged as at 31 January 2010. [b] Includes purchases from 2007-08 and 2008-09. [c] DEWHA's calculation of the expected average seasonal allocation to a given water entitlement. Equivalent to the Living Murray Initiative's Long Term Cap Equivalent measure. [d] Average prices paid in 2008-09. [e] Includes entitlements acquired from Toorale Station. **na** Not available.

Source: DEWHA (2009j).

The reliability profile of the Australian Government's portfolio of water entitlements acquired under the RTB program is heavily weighted to general and high security entitlements. In long term equivalent terms, the NSW general security entitlements are expected to provide approximately 279 GL (52 per cent) of average annual flows while the NSW, Victorian and SA high security entitlements are expected to deliver average flows of 206 GL (39 per cent) per year (table 1.2) (DEWHA, 2009j).

Water deliveries to date

In 2008-09, the Commonwealth Environment Water Holder (CEWH) undertook its first environmental water actions, distributing 11 GL of water across 10 wetlands and floodplains in the Basin. As of 30 January 2010, the CEWH had delivered a further 65 GL of water to 18 sites (DEWHA 2010).

Sustainable Rural Water Use and Infrastructure program

The SRWUI program encompasses various component programs, most of which subsidise investment in irrigation infrastructure projects to generate water efficiency savings (chapter 6). Water entitlements to the recovered water are shared between the Australian Government and its project partners (usually irrigators and irrigation water providers). The projects may invest in state or private off-farm infrastructure or private on-farm systems. The Australian Government has allocated $5.8 billion to the SRWUI program over ten years under the Water for the Future initiative. SRWUI component programs include:

- State Priority Projects — the 2008 Intergovernmental Agreement on the Murray-Darling Basin earmarked $3.7 billion for state infrastructure projects and established a set of due diligence criteria the Australian Government would use to assess projects for implementation. Most projects have yet to pass the due diligence process.
- Irrigation Modernisation Planning Assistance — helps irrigation water providers develop modernisation plans for their districts. The program is ongoing until 29 October 2012 unless available funds are spent.
- On-Farm Irrigation Efficiency Program — up to $300 million to assist irrigators in the Lachlan and southern connected system modernise on-farm irrigation infrastructure. Applications closed 17 November 2009.
- Private Irrigation Infrastructure Operator Program in New South Wales — up to $650 million to assist private irrigation infrastructure operators modernise and upgrade irrigation infrastructure. Applications closed 27 November 2009.

- Private Irrigation Infrastructure Operator Program in South Australia — up to $110 million to fund irrigation infrastructure efficiency improvements. Applications close 8 April 2010.
- Menindee Lakes and Aquifer Recharge — up to $400 million to reduce evaporation and improve water efficiency at Menindee Lakes to secure Broken Hill's water supply and return up to 200 GL per year to the environment. As at January 2010, implementation studies were ongoing.
- Water Meter Test Facility Upgrading and Accreditation — a program to improve water metering and monitoring in the Basin (DEWHA, sub. 56).

1.4 Clarifying objectives

The effectiveness of any government policy or program needs to be assessed against its stated or implied objectives. In this study the objectives of the Water for the Future Initiative and its two major components — the RTB and the SRWUI programs — need to be considered. The stated aims of Water for the Future include using water wisely, securing water supplies for all Australians and supporting healthy rivers (DEWHA 2009f).

Restoring the Balance program

The stated objectives for the RTB program vary depending on the policy documentation referred to. One recurring theme is that the program is intended as a means for easing the transition to the lower diversion limits expected under the Basin Plan. But it is also apparent that the Government expects the buyback to provide water for the environment to meet short-term needs. DEWHA has also stated that purchases should 'represent value for money' (DEWHA 2009n).

The dual objectives — obtaining water for the environment in the short term in a cost effective manner and easing the transition to lower levels of water under the Basin Plan — are evident in a statement by the Minister:

> A significant part of the Australian Government's plan for reform is to purchase water entitlements, from willing sellers, to help restore the rivers and water resources of the Basin and to ease the transition to the lower diversion limits expected under the Basin Plan. (Wong 2009d)

The short term needs are sometimes described as being urgent or immediate. For example, a DEWHA Fact Sheet stated that:

> … excessive consumptive use and declining river health are urgent priorities and these are to be addressed immediately by the Restoring the Balance in the Murray-Darling

> Basin program. The goal of Restoring the Balance in the Murray-Darling Basin is to purchase water entitlements so that the water allocated to them can be used for the environment. This will improve the health of the Basin's rivers, wetlands and floodplains. (DEWHA 2010)

A slightly different picture again emerges from DEWHA's submission to this study in which the Department states that the program's objective is 'to achieve a permanent rebalancing of the system' implying that this is the only objective (sub. DR85, p. 19). This has some parallels with the idea of transitioning to the Basin Plan but seems to go further, as if to imply that the RTB will by itself achieve the rebalancing that the Basin Plan is designed to achieve.

The overall picture is one of multiple, poorly defined, and at times, conflicting objectives. For the purposes of this report the Commission has concluded that the objectives that might reasonably be ascribed to the program are:

- to help ease the transition to the lower levels of water availability likely under the Basin Plan
- to provide some water for the environment, particularly to meet short-term needs
- to obtain water cost effectively.

Sustainable Rural Water Use and Infrastructure program

In explaining the SRWUI, DEWHA states that investment will be principally directed towards projects that:

> 1. deliver substantial and lasting returns of water for the environment
> 2. secure a long-term future for irrigation communities …
> 3. deliver value for money in the context of the first two tests. (DEWHA 2009l)

This statement appears to be derived from the 2008 Agreement on Murray-Darling Basin Reform (the Basin Agreement) (box 1.3), and, as such, might be implied to summarise the government's objectives in implementing this program.

The first point to note about these objectives is that like the RTB program, there is a focus on obtaining water for the environment in a cost-effective manner. Given that the intention is to allocate the recovered water to the environment as entitlements, this objective is similar to that of the RTB program. The second is that investment should help secure a long-term future for irrigation communities, in the context of climate change and reduced water availability in the future (box 1.3). Again this is meant to be done cost effectively.

The reference to reduced water availability hints at the importance of the SRWUI program as a transitional measure to the lower levels of water availability expected to result from the imposition of the Basin Plan, and hence might be considered to have a similar purpose to the RTB program. Indeed, the Minister has indicated that, like the RTB, the SRWUI program is also a transitional measure (Wong 2009d).

Box 1.3 **The objectives of investing in State Priority Projects**

The objectives of the Sustainable Rural Water Use and Infrastructure program can be imputed from the 2008 Agreement on Murray-Darling Basin Reform, which states that the objectives of Australian Government investments in 'Priority Projects' are to:

(a) implement water saving infrastructure projects;

(b) return water to the environment and restore river health; and

(c) adapt to climate change in an environment of reduced water availability. (clause 4.9.1)

These are given meaning by the investment principles also set out in that agreement:

(a) projects must be able to secure a long-term sustainable future for irrigation communities, in the context of climate change and reduced water availability in the future;

(b) projects must deliver substantial and lasting returns of water to the environment to secure real improvements in river health; and

(c) projects must be value for money in the context of the first two tests. (clause 4.10.1)

Source: Agreement on Murray-Darling Basin Reform 2008.

But the Basin Agreement also states that securing a long-term future for irrigation communities should be '… in the context of climate change …' (clause 4.10.1). How this should be interpreted is debatable. One interpretation might be that the intention is at least in part to underwrite the risks to irrigators from climate change by subsidising investment in water-saving infrastructure. But another interpretation would be that the reference to climate change is a reference to the water availability benchmark against which the claimed water savings of projects must be measured.

For the purposes of this report, the Commission imputes that one of the objectives of the SRWUI program is the same as that applying to the RTB program, namely, that it should ease the transition to the lower levels of water that will be available under the Basin Plan. There is also some similarity in that the SRWUI program should be a cost effective way of obtaining water for the environment, though in this case, in recognition of the lead times involved in investment in capital goods, this might be only achievable in the medium to longer term. Then there are the additional, but ill-defined, objectives of securing the long-term sustainability of irrigation communities and underpinning 'food security' (Wong 2009b).

Basin Plan

As noted, the Basin Plan will provide the institutional framework for an administrative reallocation of water, through the imposition of sustainable diversion limits at the Basin-wide and catchment levels (through state water plans).

The purposes of the Basin Plan are set out in the *Water Act 2007* (Cwlth). Both the purposes of the Basin Plan and the objectives of the Act set up some seemingly conflicting requirements. The objectives of the Act include that the Basin be managed in the 'public interest' (s. 3(a)). And the purposes of the Basin Plan include that it provide for, inter alia, '… the use and management of the Basin water resources in a way that optimises economic, social and environmental outcomes' (s. 20(d)). But the Basin Plan must also provide for '… the establishment and enforcement of environmentally sustainable limits on the quantities of surface water and ground water that may be taken from the Basin water resources (including by interception activities)' (s. 20(b)).

One interpretation of these clauses might be that environmental sustainability would be consistent with a use of the water resources that gave the greatest overall return to the community. But the MDBA has stated that SDLs will take into account '…the best available science, and the precautionary principle' and that '… SDLs will be set at levels … at which water in the Basin can be taken from a water resource without compromising key environmental assets, key ecosystem functions, key environmental outcomes or the productive base of the water resource' (MDBA 2009a, p. 7). The implication seems to be that the primary objective of the Basin Plan is to manage the Basin resources in a way that will promote environmental sustainability defined in a technical sense (chapter 6).

Clarifying objectives helps develop a conceptual framework for addressing issues raised during this study, including identifying the best policy instrument(s) for achieving particular objectives. While these issues are taken up in greater detail in chapter 5, it is worthwhile highlighting some of the internal tensions that can be created by trying to address multiple objectives with one instrument. Thus the government has placed considerable emphasis on recovering water through the acquisition of water entitlements, and while this helps address the objective of transitioning to the lower SDLs expected under the Basin Plan, it potentially conflicts with the objective of providing water for the environment in the short term. There is therefore a need to distinguish between appropriate responses for achieving different objectives in both the short term and the long term.

1.5 Conduct of the study

The terms of reference for this commissioned study were received from the Assistant Treasurer on 24 July 2009. Under the terms of reference, the Commission was to report within six months of commencing the study and publish the report. On 15 October 2009, the Assistant Treasurer agreed to extend the reporting date for the study to 24 March 2010.

To ensure broad community input and transparency, the Commission consulted and invited feedback in the following ways:

- After the study was announced, the Commission advertised nationally and promoted the study on its website.
- A circular was mailed to people and organisations that the Commission considered might be interested in the study. Subsequent circulars were sent to those who had expressed an interest in the study to keep them updated on progress.
- Informal discussions were held with a wide range of organisations and individuals.
- In July and August 2009 a series of meetings and round tables were held in Brisbane, Sydney, Canberra, Melbourne and Adelaide to canvas particular issues and options for reform.
- An issues paper was released on 19 August 2009 to assist interested parties in preparing submissions to the study.
- In August and September 2009, a series of meetings were held in rural centres in southern Queensland, New South Wales and Victoria to canvas issues and options for reform. In February 2010, an additional series of public roundtables and meetings were held in New South Wales, Victoria, South Australia and Canberra to receive feedback on the draft report.
- The Commission received 57 submissions prior to releasing the draft report, and 34 submissions between the draft report and the final report.
- The Commission hosted a blog site from December 2009 to late February 2010 that attracted 22 comments and suggestions.

The Commission thanks all study participants for meeting with Commissioners and staff, facilitating visits to many industry sites and making submissions to the study (appendix A).

2 Water use in the Murray-Darling Basin

Key points

- The availability of water throughout the Murray-Darling Basin (the Basin) varies from region to region, reflecting diverse topographic and climatic conditions.
- Rainfall is less variable and, on average, higher in the south and east of the Basin than in the north and west. As a result, the south-east section of the Basin has consistently greater surface water availability than the north-west.
- The growth of storage capacity in the Basin has allowed irrigation to develop, notwithstanding the variability of inflows into Basin rivers. This has altered the natural flow regimes of these rivers.
- Overall, groundwater accounts for a small percentage of water used in the Basin, but is significant in some regions.
- The current level of consumptive water use in the Basin (including recent rises from a growth in floodplain and groundwater harvesting) is putting pressure on water dependent ecosystems, particularly those experiencing extended dry conditions.
- Climate change is expected to reduce the long-term availability of water throughout the Basin, particularly in the south-east.
- At present, available water is allocated to consumptive use in state water plans and must comply with the Cap. Consumptive water in the Basin is mainly used for irrigated agriculture.
- Current water planning arrangements result in proportionally less environmental water in periods of dry conditions.

The terms of reference for this study ask the Commission to examine market mechanisms that might help achieve the Australian Government's objective of reallocating water from consumptive to environmental uses. This chapter provides background information on water availability in the Murray-Darling Basin (the Basin), as well as how the water is allocated to both consumptive and environmental uses.

2.1 Water availability

The Basin covers an area of approximately 1.06 million square kilometres, approximately 14 per cent of Australia. Based on long-term averages, the Basin receives around 530 000 gigalitres (GL) in rainfall each year, of which 94 per cent is evaporated or transpired by plants, 2 per cent is taken up by soils or groundwater, and 4 per cent becomes runoff or stream flow (ABS 2008b). This section explores water availability throughout the Basin, by examining patterns of rainfall, as well as availability of surface water and groundwater.

Rainfall

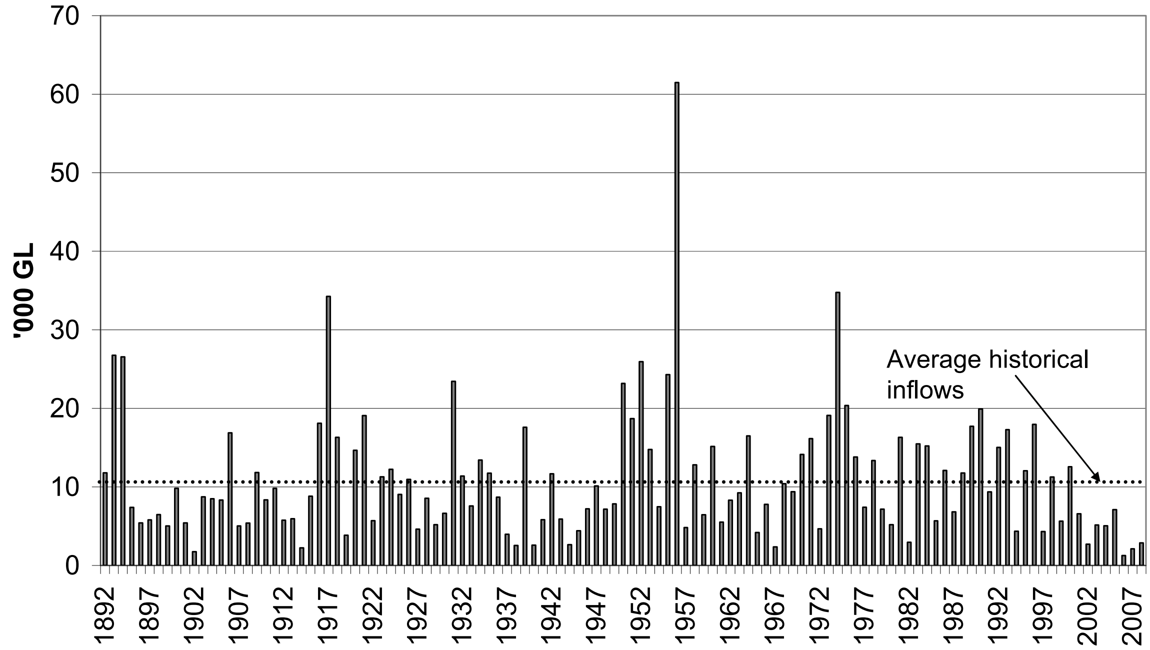
Rainfall in the Basin differs greatly between regions, with the east being significantly wetter (up to 2000 mm per year at the wettest point) than the west (around 200 mm per year) (Kirby et al. 2006). Rainfall in the north is more variable and tends to fall in summer, with large episodic falls of short duration typical. Rainfall in the south occurs mainly in the winter and is less variable. Variance of rainfall over time is a key feature of rainfall patterns in the Basin, with large swings across the seasons, years, and decades. These patterns affect the availability of surface water and groundwater.

Surface water

At any time, the stock of surface water available throughout the Basin is dependent on the amount held in storage, as well as the recent pattern of inflows into the Basin's river systems, lakes and wetlands. The variable nature of inflows (figure 2.1) is due largely to the variability of rainfall. Currently, the Basin is experiencing a period of very low inflows, with the past ten-year period the lowest on record, and with nine of the last ten years below average (MDBA 2009j). However, there have been other extended periods of dry conditions, notably around 1900 and 1940. These inflows also vary from region to region.

Average temperatures run in a strong gradient, from a high in the north-west, to a low in the south-east. This means that relatively more rainfall in the north-west is evaporated and transpired reducing runoff in this region. The combination of higher rainfall and lower evapotranspiration means most runoff is generated in the upland catchments of the south-east, particularly the headwaters of the Murray, Murrumbidgee and Goulburn rivers (figure 2.2). The Darling and its tributaries account for less than 10 per cent of total flow, even though their catchments extend over approximately twice the area of the Murray and its tributaries (MDBC 2008c).

Figure 2.1 **Murray system inflows (including the Darling), 1892–2008[a]**



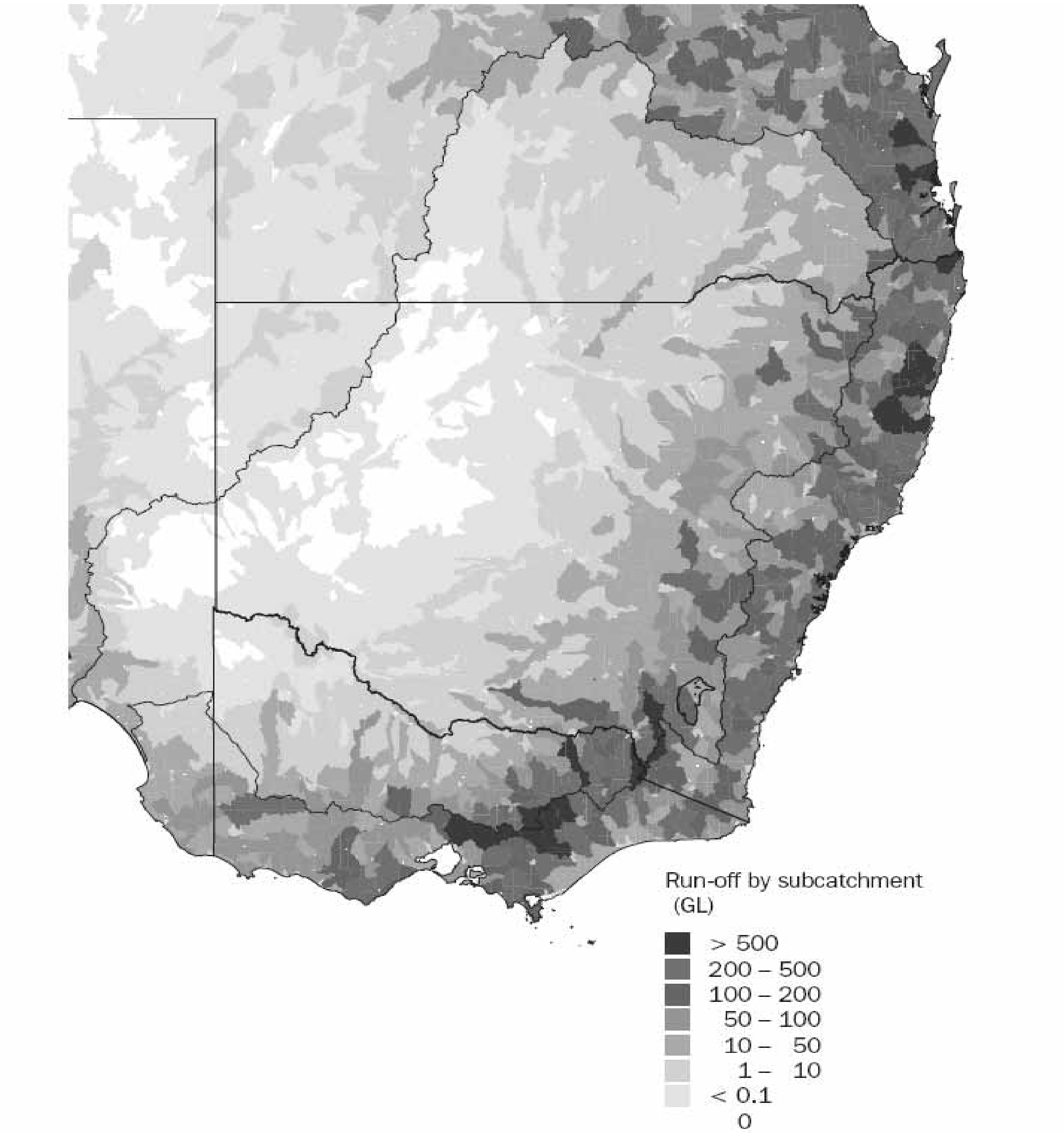
[a] Excludes any Snowy Scheme releases into the Murray. The data are generally sourced from tributary models, based on current conditions and the current level of development. The models are steady state (with no increased regulation or extraction through time). Observed data are used where modelled data are unavailable (post 2000).

Source: MDBC (2008 unpublished).

The Basin also becomes flatter in the west, and some rivers have distributaries (river branches that flow away from the main channel) ending in terminal wetlands. Examples include the Willandra Creek system of distributaries from the Lachlan River and the Narran River distributary of the Culgoa River. Some rivers and streams (such as the Avoca and Wimmera in the south-west and the Paroo in the north-west) also fail to reach the Murray and the Darling respectively, except in periods of exceptionally high rainfall.

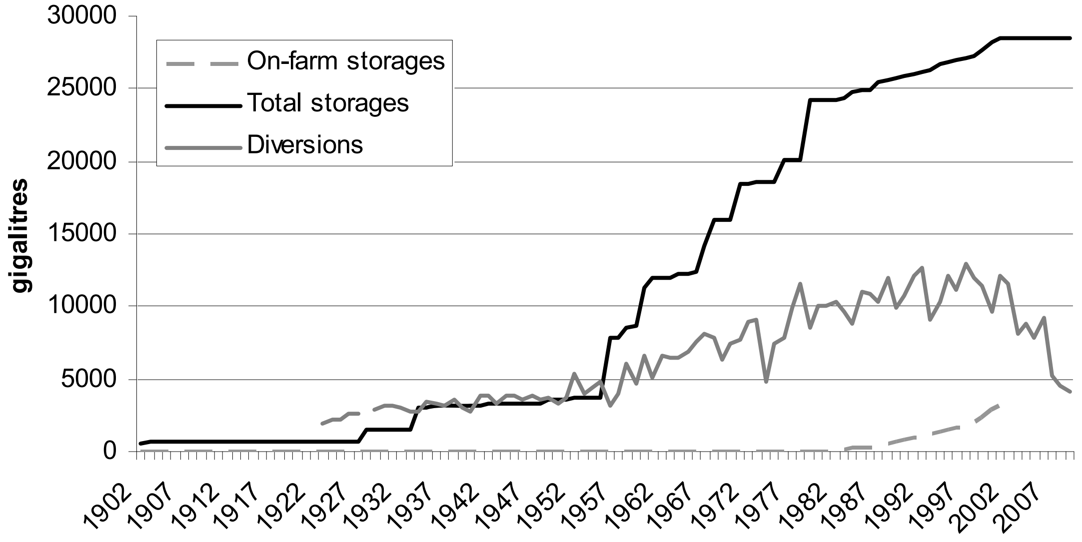
To help manage variability in the availability of water, considerable public and private investment has been made in water storages (figure 2.3). Most storages in the Basin were built from the mid 1950s to 1990, with large storages (over 1000 GL) built at Dartmouth, Hume, Eildon, Burrendong, Blowering, Copeton, Wyangala and Burrinjuck. Public storages in the Basin have a total capacity of 22 611 GL, which accounts for 79 per cent of the total storage capacity throughout the Basin (MDBA 2009g). However, there are also some large on-farm storage facilities, particularly in the Eastern Mount Lofty Ranges of South Australia, and the northern Basin. The growth of storages over time has allowed greater capture and use of inflows for consumptive purposes, as well as intertemporal management of the resource. In Australia intertemporal management is desirable both within a year and between years, owing to the variability of rainfall. The ability to manage flows in this manner has altered natural flow patterns (figure 2.4).

Figure 2.2 **Mean annual runoff in the Murray-Darling Basin, 2008**



Source: ABS (2008b).

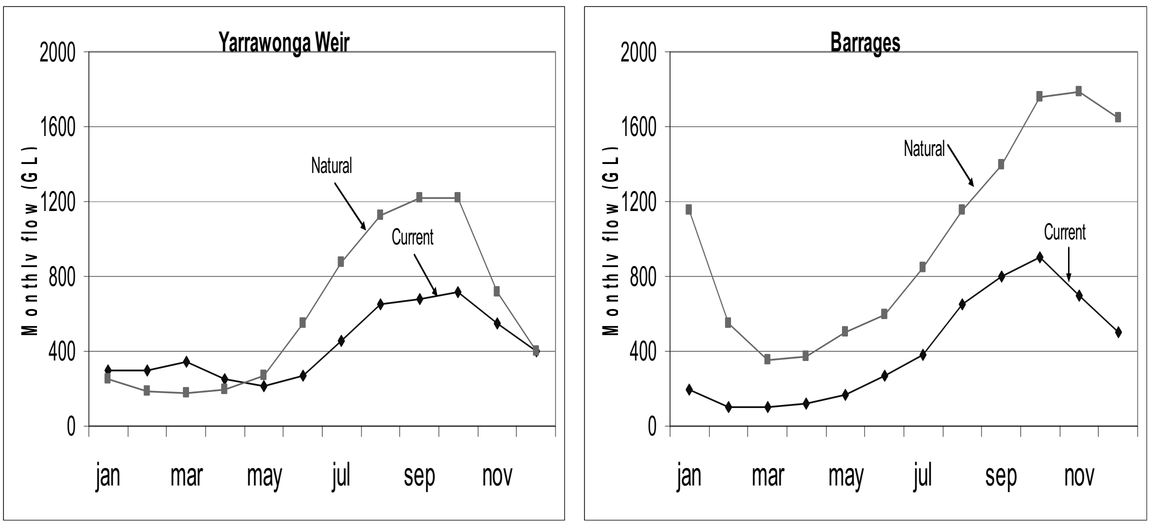
Figure 2.3 **Growth in storages and diversions over time**[a]



a Total storages excluding barrages, weirs and the Snowy Catchment.

Source: MDBA, Canberra, pers. comm., 8 Oct 2009.

Figure 2.4 **Natural and current development flows at Yarrawonga Weir and the Barrages**[a]



a Under historic climate.

Source: CSIRO (2008b).

Surface water availability is also influenced by climate change and groundwater use (both discussed here), as well as factors such as afforestation, bushfires, and changes to irrigation management and return flows (PC 2006). Furthermore, inter-catchment transfers occur from the Snowy River to the Murray and Murrumbidgee, and from the Glenelg River to the Wimmera River in Victoria. These transfers average 1200 GL per year (Kirby et al. 2006).

Groundwater

Groundwater is water located beneath the ground surface in underground streams and aquifers. The volume and quality of groundwater in the Basin is variable, reflecting variations in landscape, geology, and recharge conditions.

In 2005-06, 1069 GL of groundwater was extracted, which accounted for 14 per cent of water used for agriculture in the Basin (ABS 2008b). Most of this extraction occurred in New South Wales (71 per cent), with the largest extractions in the Murrumbidgee (218 GL), Namoi (185 GL) and Lachlan (144 GL) catchments. Groundwater use tends to be higher in dry years, as farmers substitute groundwater for surface water.

The use of groundwater has grown substantially in recent years and the CSIRO (2008a) claims that current extraction rates can not be maintained in some catchments, including: the Condamine; Border Rivers; Lower Namoi; parts of the Lower Macquarie; parts of the Lower Lachlan; the Upper Lachlan; and the Mid-Murrumbidgee. It further claims that, without a change in policy, the situation is expected to deteriorate further, since current groundwater management plans forecast groundwater extraction to increase to 3956 GL per year by 2030 (CSIRO 2008a). This represents an approximate doubling of groundwater use across the Basin. At this level of extraction, groundwater use would represent 24 per cent of the total water use in the Basin on average, with a higher fraction in dry periods.

The availability of surface water is affected by the use of groundwater, with around one quarter of current groundwater extraction believed to be reducing surface water availability (CSIRO 2008a). This is equivalent to around 4 per cent of the Basin's surface water use. This reduction is not uniform and the impact of groundwater extraction on surface water availability in a given area, depends on the nature of connectivity between groundwater and surface water. Some rivers (like the Condamine-Balonne, Namoi and Lachlan) gain water from groundwater, while others (like those in the alluvial valleys of the southern Basin) lose water to groundwater. Future projected growth in extraction of groundwater is expected to occur mainly in aquifers that are connected to rivers, such as the Upper Lachlan and the Mid-Murrumbidgee (CSIRO 2008a). This would exacerbate the effect of climate change by further reducing surface water availability in these regions.

To mitigate these risks, the National Water Commission has recommended that, 'unless and until it can be demonstrated otherwise, surface water and groundwater resources should be assumed to be connected, and water planning and management of the resources should be conjunctive' (NWC 2009b, p. 36). This is the opposite of the way in which connectivity has been managed to date. In many areas, the sustainable level of diversions for groundwater systems will be addressed, for the first time, in the forthcoming Basin Plan (box 1.1).

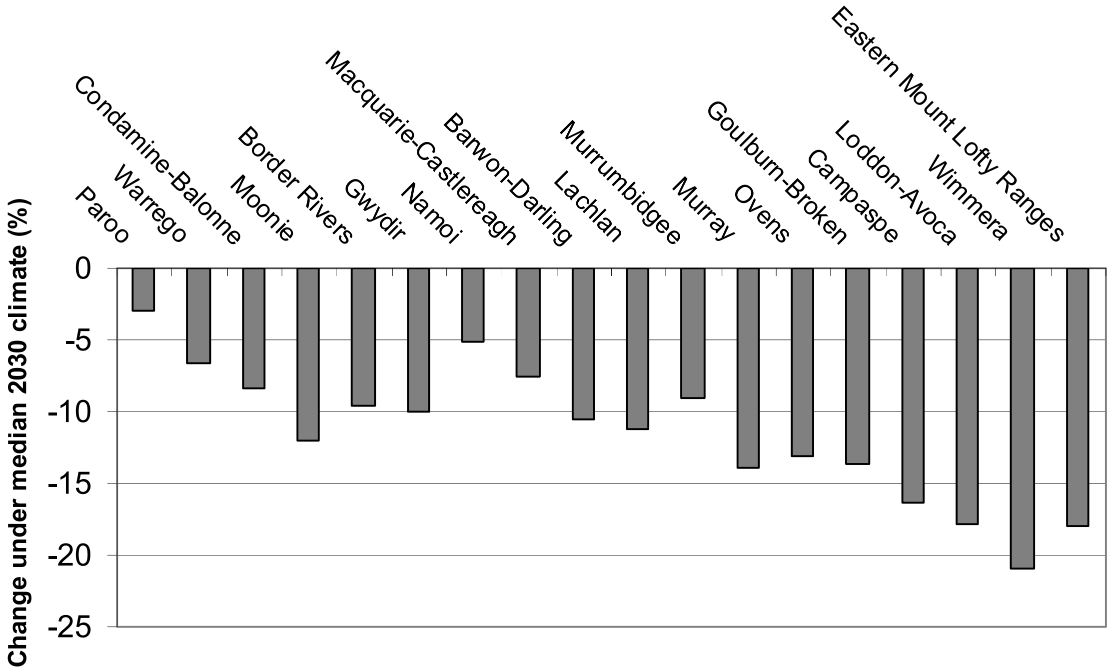
Climate change

Future availability of surface water and to a lesser extent, groundwater, may be reduced due to climate change. If average temperature increases, as is forecast, evaporation and transpiration will increase and runoff will decrease. There is greater uncertainty about future rainfall patterns, but most climate models project decreases across the Basin. Furthermore, changes in these variables are likely to affect the frequency of bushfires, which will in turn alter water availability. Bushfires have the effect of increasing runoff at first (since there is no interception by vegetation), but runoff decreases as new vegetation grows and uses more water than mature vegetation.

CSIRO (2008a) projections indicate that winter rainfall is likely to be lower across the entire Basin in the future, and summer rainfall may increase, particularly in the north. Uncertainty about the magnitude of these effects results in more uncertain rainfall effects in the northern Basin under climate change. For the northern Basin, around half of the scenarios modelled indicate a decrease in rainfall in the future. For the southern Basin, and particularly in the southernmost parts, practically all scenarios indicate that rainfall will decrease in the future.

The way in which these changes to rainfall will translate to changes in surface water availability is uncertain, and the uncertainty increases the further out the projection. Projections for the median climate change scenario suggest an 11 per cent decline across the Basin — 9 per cent in the north and 13 percent in the south — by 2030 (catchment level declines are detailed in figure 2.5).

Figure 2.5 **Change in average surface water availability by region**
Projections for median 2030 climate



Source: CSIRO (2008).

Changes in recharge to groundwater due to climate change will largely mimic the expected geographical pattern of changes in rainfall, with larger declines in the south-east than in the north (CSIRO 2008a).

2.2 Allocations for consumptive use

The amount of water assigned to consumptive use throughout the Basin is determined by rules set in state water plans. These plans are required to be consistent with the Murray-Darling Basin Cap (box 2.1), which since the mid 1990s has set a cap on surface water diversions for consumptive use. The water available under each plan is assigned to holders of water entitlements, including bulk-level water authorities, irrigation companies or trusts, and some individual irrigators. Most of this water is used for irrigation, with a small share going to households, mining and other industries.

Box 2.1 **The Cap**

In June 1995, the Murray-Darling Basin Ministerial Council (the Council) completed an audit of water use in the Murray-Darling Basin (the Basin), demonstrating that increased diversions of water for consumptive purposes had significantly exacerbated river health problems, including:

- reduced flows at the bottom end of the Murray
- a contraction in the area of healthy wetlands
- declines in native fish species
- increased salinity levels and outbreaks of algal blooms.

The audit found that if diversions continued to grow, further deterioration would have been likely, along with reduced reliability of water supply for irrigators (particularly during drought).

To mitigate this, the Council agreed to impose a limit or Cap on water diversions within the Basin. An interim Cap was imposed in June 1995, and following an independent review of equity issues (Setting the Cap: Report of the Independent Audit Group), a permanent cap for New South Wales, Victoria and South Australia was implemented from 1 July 1997. The Council formalised the operating rules for the Cap under Schedule F of the *Murray Darling Basin Agreement 2000*. Following the Intergovernmental Agreement reached in July 2008, the Murray-Darling Basin Agreement was amended and incorporated into the amended *Water Act 2007* (Cwlth).

For New South Wales and Victoria, the Cap restricts diversions to the volume that would have been diverted under 1993-94 levels of development. For South Australia, diversions are capped at 440.6 GL, and Queensland and the ACT must cap at a modelled level based on historic conditions. Under these operating rules, the cap volume for all states varies year to year, based on conditions at the time.

Implementation of the Cap is the responsibility of each state and the ACT. However, an Independent Audit Group conducts an annual audit of the diversions in every designated Cap valley of the Basin, comparing observed diversion against annual targets determined by valley Cap models. There are no explicit penalties in the case of a breach of the Cap in any Cap valley. However, should such a breach occur the relevant minister of the state government concerned is required to report to the Council, on the reasons why the breach occurred, and the actions taken to ensure that diversions are brought back in line with the Cap. Despite this, the Cap has been breached in various Cap valleys on numerous occasions (MDBC 2001 to 2005; 2006b; 2007c; 2008d; MDBA 2009n).

The Cap was designed to halt the growth in diversions, but does not aim to achieve sustainability. New limits on diversions using sustainability as a guiding principle, are being set as part of the Basin Plan (chapter 4).

Irrigation

The Basin is Australia's most significant agricultural region. In 2005-06, it accounted for 39 per cent of farms and more than 39 per cent of the gross value of Australia's agricultural production (ABS 2008b). In the same year, the Basin's irrigated agricultural sector accounted for 44 per cent of Australia's gross value of irrigated agricultural production, and around 12 percent of the gross value of all agricultural production.

Irrigated agriculture is the dominant user of water in the Basin, accounting for 83 per cent of total water used in 2004-05, with a further 13 per cent consumed in conveyance losses (ABS 2008b). Most of this water is used in four types of agricultural activities:

- irrigated pasture (including dairy), mainly situated in the southern Basin. Pastures are often flood irrigated for much of the year, with an average of 3.5 megalitres (ML) per hectare applied in 2005-06
- rice, grown primarily in the Murray and Murrumbidgee catchments. Rice is usually flooded for about three months in summer, with an average of 12.3 ML per hectare applied in 2005-06
- perennial horticulture and grapes, grown throughout the Basin but mainly in the Lower Murray, Mallee and Murrumbidgee. Sprinkler or micro-systems, such as drip or mist irrigation, are used with an average of 4.7–5.5 ML per hectare applied in 2005-06
- cotton, predominantly grown in northern catchments, used an average of 6.4 ML per hectare in 2005-06 (ABS 2008b).

The volume of water used for each of these activities varies from year to year (table 2.1). This variance is larger for annual crops, such as cotton and rice, where the area planted expands opportunistically when water is available.

To a large extent, the geographical location of these agricultural activities reflects the pattern of surface water availability, climatic conditions and storage capabilities. For example, where the water needed to crop is variable, opportunistic production of rice, cotton and other annual crops is common.

The nature of water licences in each area is also linked to water availability, climatic conditions and available storages. The way in which licences are specified also affects the geographical spread of different agricultural activities (chapter 3).

Table 2.1 **Water consumption by agricultural product**
Murray-Darling Basin, 2004-05 and 2005-06

	2004-05		*2005-06*	
	Consumption	*Share of agricultural water use*	*Consumption*	*Share of agricultural water use*
	GL	%	GL	%
Irrigated Pasture	2 371	33	2 571	34
Rice	619	9	1 252	16
Cereals (excl. Rice)	844	12	782	10
Cotton	1 753	24	1 574	20
Grapes	510	7	515	7
Fruit (excl. Grapes)	399	6	413	5
Vegetables	152	2	152	2
Other Agriculture	546	8	461	6
Total	7 204	100	7 720	100

Source: ABS (2008b).

Households, mining and other industries

Water consumption for households, mining and other industries is relatively small in the Basin, with households accounting for 2 per cent, mining 0.2 per cent, and other industries 1.6 per cent, of the use in 2004-05. The allocation of water for households is a high priority throughout the Basin. The use of Murray water for Adelaide is a particularly prominent example, and a five-year non tradeable rolling allocation of 650 GL over a five year period (notionally 130 GL per year) is set aside for this purpose under the Cap.

2.3 Allocations for the environment

The distinction between allocations for the environment and allocations for consumption is problematic. In many water sharing plans water that is not used for consumptive purposes is said to be environmental water. However, ‘non-consumptive use’ water covers evaporation and other system losses (including some of those incurred specifically in meeting consumptive use requirements, such as conveyance), and hence it would be misleading to regard it as all being environmental water. Conversely, water that is being stored for consumptive purposes, or that is being used as conveyance water, can provide some environmental benefits. The distinction is made more difficult given that irrigators may choose to use some of the consumptive water allocated to them to water private wetlands and return flows can be used downstream by environmental users.

Currently, there are two main types of allocations for the environment in the Basin:

- rules-based environmental water, generally set out in water resource plans
- environmental water entitlements, generally set out in water resource plans, or acquired from irrigators or irrigation infrastructure operators, through purchase or investment in water savings.

Rules-based environmental water

Rules that provide for environmental water are included in the documentation of the Cap, and in state and catchment level water plans. While the Cap is not set to achieve any specific environmental objectives, it does limit extractions, leaving any residual water for non-consumptive purposes, including environmental purposes.

State and catchment level water resource plans for surface water usually include rules that result in some base environmental flows. The types of rules that are used include minimum flow and water level rules. In regulated systems, these rules are often met through releases from storages. In unregulated systems, 'cease to pump' conditions and limits on extraction rates are used. Rules to achieve consistency with the Cap requirements are also commonly included in state and catchment level water plans (box 2.2). In groundwater plans, rules relating to water levels and salinity thresholds are commonly in place.

The specific rules relating to matters like minimum flows and the Cap rules are not additive. In some cases, it is the Cap that determines the amount of non-consumptive use water in a catchment, and the specific rules determine how a proportion of that water is used. In other cases, the specific rules go beyond what is required by the Cap (that is, the Cap is not binding).

While rules-based water currently provides most of the environmental flows throughout the Basin, the practice of assigning specific entitlements of water to the environment, is becoming increasingly important.

Environmental water entitlements

State and catchment level water plans for surface water may also include the provision of entitlements for environmental use. These may be held and used where and when required. For example, the rules in the Murrumbidgee Regulated River Water Source provide for three types of Environmental Water Allowances (allocations) based on certain inflow and use conditions, that can be used for environmental purposes, at the discretion of an Environmental Water Allowance

Reference Group. Alternatively, they may be assigned for use on a specific water dependent ecosystem. For example, entitlements of 100 GL per year (50 GL from both Victoria and New South Wales) are set aside in water sharing plans, for use in the Barmah-Millewa Forest.

Box 2.2 **Rules-based environmental water in the regulated Murrumbidgee**

The Murrumbidgee River is one of the main tributaries to the Murray River, draining an area of 84 000 square kilometres in the south-west of New South Wales. From its source in the Snowy Mountains to its junction with the Murray it is 1600 kilometres long, with 1200 kilometres of that regulated by storages.

The water sharing plan for the regulated parts of the Murrumbidgee commenced on 1 July 2004 and runs for 10 years. This plan, like all water sharing plans in New South Wales, must be consistent with the overarching state water sharing plan set out in the *Water Management Act 2000* (NSW).

The plan sets out four main rules that return water to the environment:

- a long term extraction limit (that ensures compliance with the Cap) set at 44 per cent of yearly flows
- the release of up to 560 ML per day from Blowering Dam, and between 300 and 615 ML per day from Burrinjuck Dam, depending on inflow to the storages
- the additional release of a percentage (dependent on climatic conditions and storage levels) of Burrinjuck Dam's inflows between 22 April and 21 October
- a minimum flow of at least 300 ML per day to be maintained downstream of Balranald Weir.

Source: DIPNR (2004).

Commonwealth, State and Territory Governments have in recent years also introduced a range of measures designed to recover entitlements for environmental purposes. These programs usually recover water through either the purchasing of entitlements, as is occurring under the Restoring the Balance program, or the funding of infrastructure projects that produce water savings, as is occurring under the Sustainable Rural Water Use and Infrastructure program (both programs are discussed in chapter 1). Other government programs (some discussed more fully in appendix B) that have recovered water in this manner include:

- the Living Murray Initiative, which aimed to recover 500 GL (long-term cap equivalent (LTCE)), by 30 June 2009. The program was funded by both the Australian Government ($400 million) and the Basin states (excluding Queensland) ($300 million). The program recovered water through the purchase of entitlements, 99-year leases, and water savings from infrastructure upgrades (both on and off farm)

- Water for Rivers, which aims to recover 282 GL (LTCE) (70 GL for the Murray River and 212 GL for the Snowy River), by 30 June 2012. The program is funded by the Commonwealth ($75 million), New South Wales ($150 million), and Victorian ($150 million) Governments. The program recovers water through the purchase of entitlements, and water savings from infrastructure upgrades (both on and off farm)
- the Rivers Environment Restoration Program, incorporating New South Wales Riverbank, which aims to improve the condition of specific rivers in New South Wales. The program is funded by the Commonwealth ($72 million) and New South Wales ($102 million) Governments, of which $147 million is available for water purchases
- the Northern Victorian Irrigation Renewal Project which, among other things, aims to recover 175 GL (LTCE) for the environment, by 2012. Stage one of the project is funded by the Victorian Government ($600 million), Melbourne Water ($300 million) and Goulburn-Murray Water ($100 million), with stage two funding of up to a further $1 billion to be provided by the Australian Government, subject to due diligence assessments. The program recovers water through water savings from infrastructure upgrades in the Goulburn-Murray Irrigation District.

The entitlements that are recovered represent environmental water that is additional to that which is implicit in the Cap requirements. For example, if the Cap limited diversions in a catchment to 100 units and then 2 units of water were purchased for the environment, the new limit would be 98 units.

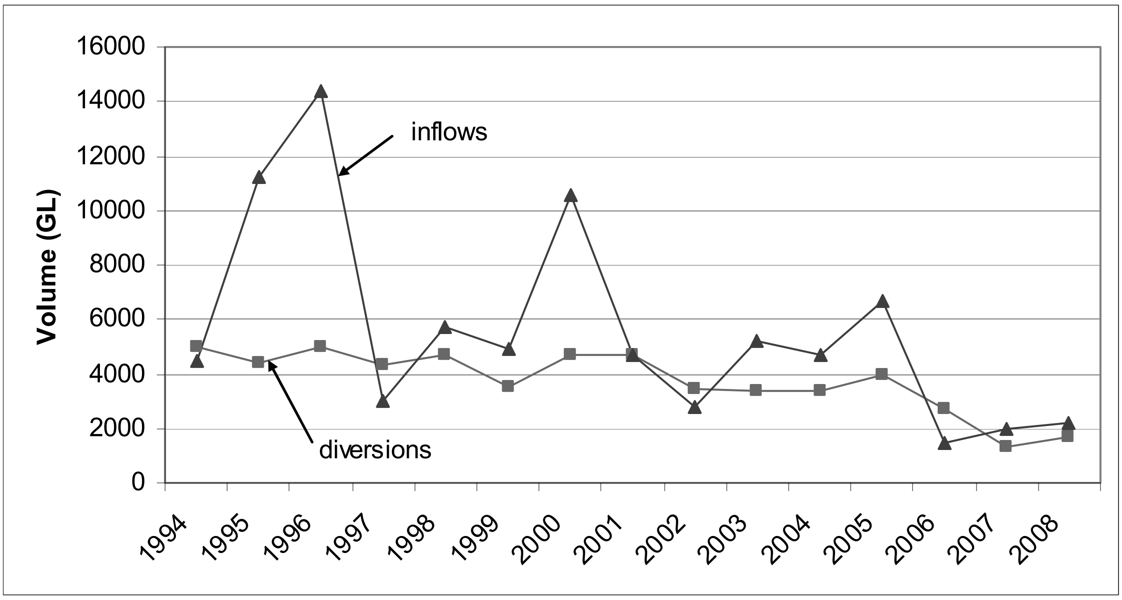
Where water is recovered through entitlements, environmental water managers must manage the seasonal allocations that arise from the entitlements in each year. These may be local organisations such as the aforementioned Water Allowance Reference Group in the Murrumbidgee, or Commonwealth and State government agencies. The Australian Government's environmental water manager, known as the Commonwealth Environmental Water Holder, is located within the Department of the Environment, Water, Heritage and the Arts.

Variation of environmental water

Given that environmental allocations have generally been the residual after consumptive needs have been met, water for the environment has generally declined as irrigated agriculture has expanded in the Basin. The Cap effectively brought an end to this dynamic (except for groundwater, as discussed below). However, it happened to be introduced close to the start of a long dry period that has continued through much of the Basin, to the present time.

This has dramatically reduced the environmental benefits that would otherwise have resulted from the Cap (and from subsequent water recovery efforts), in part because the existing arrangements generally give a more than proportional cut to environmental water during dry periods (figure 2.6).

Figure 2.6 **Murray River inflows and total diversions for NSW, Victoria and SA**[a]



a Data is for the Murray system only and does not include other systems.

Source: Imputed from Grafton (sub. DR81).

The National Water Commission (NWC 2009b) points out that current water plans do not adequately address water sharing arrangements in very dry conditions. The situation has been exacerbated by recent state government suspensions of water plans, and by borrowing from environmental allocations, so that consumptive needs can be met (NWC 2009b). Furthermore, the volume of water for the environment also declined following the introduction of the Cap, due to an increase in groundwater extraction and floodplain harvesting (MDBC 2000). To the extent that groundwater is connected to surface water, and that floodplain harvesting reduces flow in waterways, growth in the use of these forms of water decreases the amount available for the environment.

Climate change is expected to increase the frequency of dry periods in the future, which makes the tendency for the current arrangements to allocate a greater than proportional cut to environmental water in such periods more significant. The CSIRO (2008a) estimated that under current water sharing arrangements, the projected median 2030 decline of 11 per cent in surface water availability (Basin-wide), would result in a 4 per cent reduction of surface water use. This modest decline in use would be made possible by a steep decline in environmental water.

These arrangements are set to change once the Basin Plan establishes new sustainable diversion limits that will replace the Cap (chapters 4 and 6). These will be based on analysis of what is sustainable rather than the level of historic use, and will also cover the use of groundwater.

FINDING 2.1

Current planning arrangements tend to assign a more than proportional cut to environmental water during dry periods. With climate change expected to increase the prevalence of dry conditions (particularly in the southern parts of the Basin), the environmental consequences of this could become increasingly significant. Accordingly, the prospect of climate change adds to the imperative to adjust the balance between environmental and consumptive uses of water in the Basin.

3 The development of water markets

> **Key points**
>
> - In recent times, the market for water in the Murray-Darling Basin has developed to the point where large volumes of water are being traded. However, at a regional level, markets vary substantially and in some parts remain relatively underdeveloped.
>   - Water trade is relatively more developed in the regulated systems of the southern-connected Basin, than the more hydrologically isolated systems of the north, that have relatively fewer storages.
> - Water is traded primarily though buying and selling seasonal allocations and, to a lesser extent, entitlements. So far, the water market has not developed extensive use of options, leases or other derivatives.
> - Water trade delivers benefits though the efficient reallocation of water among competing consumptive uses.
> - Market intermediaries, including brokers and several exchanges, have emerged as the market has grown. These have helped facilitate a rise in trade volumes, and a fall in the transaction costs of trading.
> - The price of seasonal allocations is influenced by the on-farm production decisions of irrigators to buy or sell an additional unit of water.
> - The price of an entitlement is based on the expected value of the future seasonal allocations of water to be delivered against the entitlement.
> - The fees and charges for water delivery have a strong effect on irrigators' decisions to buy or sell, and as such, influence the market price of both seasonal allocations and entitlements.

The state of water markets in the Murray-Darling Basin (the Basin) is an important consideration when reviewing the current buyback arrangements under Restoring the Balance (RTB). The Commission's terms of reference require it to consider 'the implications of a developing water market and limited price information' for government purchasing, and how the Government, as the dominant buyer, may impact upon the water market. The Commission is also asked to consider the 'potential to use existing or developing water exchanges, auction houses or on-line water trading platforms'.

This chapter provides background on the development of water markets that will be used in later chapters for assessing the efficiency and effectiveness of different market mechanisms, and for identifying impediments to recovering water.

3.1 History of water markets in the Basin

The irrigation schemes of the early twentieth century aimed to intensify agriculture and increase population in the dry hinterland of the Basin. Raising the productive capacity and population of these regions was generally supported under the banner of 'nation building' (Crase 2009). With growing capacity and little water scarcity, there was no great impetus for the creation of water markets and the institutional and legal arrangements that arose in this period were not well suited to their development. For example, water licences were attached to land title, and each jurisdiction developed different arrangements for water licensing.

From the early 1980s, water scarcity led to increasing recognition of the potential benefits of trade. Trade volumes grew steadily over time, but particularly after the 1994 Council of Australian Governments (COAG) water reforms. These reforms required, among other things:

- implementation of a comprehensive system of water entitlements and seasonal allocations, backed by the separation of water rights from land (a necessary condition for trade), with clear specification in terms of ownership, volume, reliability, transferability and, if appropriate, quality
- cross-border trade to be facilitated and trading arrangements to be consistent
- delivery pricing reform based on user pays and the principle of full cost recovery.

COAG incorporated the water reform framework into the 1995 National Competition Policy. However, it was largely left to individual jurisdictions to decide how to implement these reforms, and progress was variable.

The introduction of the Basin Cap (chapter 2) in 1995 also encouraged the growth of trade. The Cap had the effect of requiring irrigators to meet requirements for additional water through the market rather than administratively. While the Cap stimulated trade, it also resulted in the activation of previously unused or rarely used water entitlements, known as 'sleeper' or 'dozer' rights. These rights were traded and used, allowing diversions to increase in the short run and reducing the security of other users' water entitlements, by reducing subsequent seasonal allocations.

Interstate trade was made possible in 1998 when the Murray-Darling Basin Ministerial Council established a Pilot Interstate Water Trading Program.

The institutional and legal settings of the current water market

Under the National Water Initiative (NWI), Basin states agreed to facilitate the broadening and deepening of the water market by:

- removing barriers to trade in water and minimising transaction costs
- implementing nationally-compatible characteristics for secure water entitlements
- introducing water accounting to meet the information needs of different water systems including for planning, monitoring, trading, environmental management and on-farm management.

Many of the specific reforms are legislatively enshrined in the *Water Act 2007* (Cwlth). Schedule 3 (Clause 3), sets out the Basin water market and trading objectives, which are:

> (a) to facilitate the operation of efficient water markets and the opportunities for trading, within and between Basin States, where water resources are physically shared or hydrologic connections and water supply considerations will permit water trading; and
>
> (b) to minimise transaction cost on water trades, including through provision of good information flows in the market, and compatible entitlement, registry, regulatory and other arrangements across jurisdictions; and
>
> (c) to enable the appropriate mix of water products to develop based on water access entitlements which can be traded either in whole or in part, and either temporarily or permanently, or through lease arrangements or other trading options that may evolve over time; and
>
> (d) to recognise and protect the needs of the environment; and
>
> (e) to provide appropriate protection of third-party interests.

The ACCC was assigned new functions under the Act. These include: advising the Minister for Climate Change and Water on water charging rules and water market rules; monitoring compliance with and enforcing these rules; and advising the Murray-Darling Basin Authority on water trading rules as part of the Authority's development of the Basin Plan (box 3.1).

Box 3.1 Water market, water charge and water trading rules

Water market rules

The water market rules developed by the ACCC commenced on 23 June 2009 and came into full effect on 1 January 2010. These rules allow irrigators to 'transform' water entitlements held against irrigation infrastructure operators into separately held statutory water entitlements. The water market rules ensure that irrigation operators, who hold irrigation rights collectively for a particular region (this arrangement is typical in New South Wales and South Australia), do not prevent or unreasonably delay irrigators from transforming their licence into a statutory water entitlement. Once a licence is transformed into a statutory water entitlement, it can be traded.

Water charge (termination fees) rules

The termination fee rules took effect from 23 June 2009. These rules require termination fees to more accurately reflect costs, encourage efficient service delivery and promote water trade. Unless otherwise approved by the ACCC, the maximum termination fee that can be imposed upon irrigators is 10 times the annual access fee.

Water charge (infrastructure charges) rules

The ACCC's final advice on water infrastructure charge rules was provided on 26 June 2009. It recommended that large infrastructure operators that are not owned by members, be required to seek regulatory approval for their charges. It also recommended that member-owned and smaller operators be subject to regulations that address issues such as transparency and discriminatory pricing.

Water charge (planning and management information) rules

The final advice on water charge planning and management information rules was provided on 10 July 2009. It recommended state government departments and agencies publish details of water planning and management charges. It also proposed the establishment of a voluntary reporting framework to report more broadly on water planning and water management activities, costs and charges.

Water trading rules

The ACCC provided draft advice to the Murray-Darling Basin Authority in December 2009, and will provide final advice in March 2010. The rules will guide the Authority in setting trading rules in its Basin Plan. The rules will seek to remove inappropriate barriers to trade, while providing appropriate protection for third-party interests.

The Act also gives the Bureau of Meteorology (BOM) the task of collecting and publishing water information, with the goal of increased transparency, confidence and understanding of water information. The publications will include a National Water Account, which will report on the type, volume and location of entitlement, the details of trades and of allocation announcements, and information about on-farm storage, unregulated and groundwater licenses. Additionally, the BOM is developing the Australian Water Resource Information System, which will provide periodic reports on water resource use and availability, as well as real-time water reporting services and water availability forecasts. The BOM will also set and implement national standards for water information.

3.2 The benefits and costs of water trade

Markets promote the efficient allocation of water between irrigators, and between irrigators and other consumptive uses. However, market failures can mean that water for environmental service provision will be undersupplied by private agents (chapter 4). Those that value the water least have an incentive to sell to those that value it the most. Access to the market can help individual irrigators adapt to changing circumstances. This can lessen the impact of seasonal fluctuations in water availability, aid in adapting to climate change, or facilitate entry to, and exit from, irrigation industries.

There may, however, be some costs associated with trade (other than transaction costs). Trade in water alters the spatial characteristics of water use, storage and delivery, which can result in negative externalities such as:

- congestion (in delivery capacity), which can result in delays in delivery for other users or environmental damage due to altered flow regimes
- deterioration in the quality of water, such as increases in salinity or nutrient levels, due to altered flow regimes or return flow patterns
- changes in the condition of neighbouring land, such as water logging or salinity, due to changes in water application patterns.

Externalities can also be positive, for example, where trade between two parties ameliorates existing problems with congestion, water quality or salinity.

The magnitude of these externalities is difficult to estimate, however, and limited work has been done on quantifying these effects. Heaney et al. (2005) found the external effects to be small and localised, and concluded that they are likely to be resolvable through property rights solutions. This would enable trade to deliver the expected benefits.

The substantial net benefits from trade for irrigators, particularly in times of drought, have been demonstrated in modelling exercises by Peterson et al. (2004). This model estimated that ‘moving from no trade to intra- and interregional trade together more than halves the impact of the reductions in water [by mitigating the losses in the activities most reliant on water for production] on the gross regional product (GRP) of the southern [Murray-Darling Basin]' (Peterson et al. 2004, p. x). Similarly, the work of Mallawaarachchi and Foster (2009, p. 30) found that:

> The water trading system in the Basin enabled many irrigators to survive consecutive years of drought with varying levels of impact. The benefits of water trade into South Australia estimated in this study indicate South Australian irrigators gained around $31 million in 2007-08. In the absence of trade these irrigators, who are mainly horticulture farmers, would have been severely impacted.

Qualitative analysis by Frontier Economics (2007) on various case study regions, also found evidence that the theoretical gains from trade are confirmed by the experience of those that engage in trades. In particular:

- Without temporary trade the dairy industry would have fared much worse than it did during the past 10 years of drought.
- Even with temporary trading many dairy enterprises collapsed as a result of the extraordinarily low seasonal allocations of 2002-03 and 2006-07. Permanent trading meant that those farmers left farming with more money than they otherwise would have had.
- Without temporary trading many existing horticultural enterprises in the Goulburn system would not have survived the extraordinarily low seasonal allocations.
- Many mixed farms survived the low seasonal allocations by selling water on the temporary market, thus making more money than they would have done by growing crops. (Frontier Economics 2007, p. xiii)

3.3 Trade in entitlements and allocations

At present, water is traded mostly through buying and selling water entitlements (sometimes called permanent trade), and seasonal allocations (sometimes called temporary trade). So far, the water market has not developed extensive use of options, leases or other derivatives (chapter 7).

The system of entitlements and allocations

One of the key commitments under the NWI is to implement nationally compatible characteristics for water entitlements (referred to as water access entitlements). The consistent definition of entitlements across jurisdictions is desirable as it decreases transaction costs (for example, search costs) and broadens the water market, thereby facilitating a more efficient allocation of water across a larger group of users. Even where trade is not feasible, compatibility facilitates financial and risk comparisons and thus capital flows and optimal patterns of investment. Compatibility is also useful if a Basin-wide approach to water management, data collection, reporting and policymaking, is sought. Although progress has been made, the National Water Commission's (NWC) latest biennial report on the progress of implementing the NWI, notes that the commitment to implement nationally compatible characteristics for water entitlements is not complete (box 3.2).

Box 3.2 **Progress in implementing a consistent system of entitlements**

The National Water Commission's (NWC) biennial report on the progress of implementing the National Water Initiative (NWI), found that while all Basin states had made significant progress in incorporating consistent water entitlement frameworks into legislation and policy, all states still have entitlements that remain embedded in pre-existing legislation, and do not meet many of the characteristics outlined in the NWI. For example, some entitlements are not unbundled from land and hence are not separately tradeable.

Most of the reforms to introduce NWI-consistent water entitlements have been implemented in the larger (by volume) regulated surface water systems. Although this covers a large proportion of water use, there are many regions where entitlements are yet to be converted. For example, research undertaken on behalf of the NWC found that while the majority of water use (by volume) in New South Wales is covered by water entitlements, 87 per cent of total water licences (by number) have not been converted. The main reason given for this slow progress is that the legislative conversion of water entitlements is strongly linked to the rollout of water plans, which have been slow to be implemented.

Source: NWC (2009b).

The definition of a water entitlement under section 4 of the *Water Act* 2007 (Cwlth) is a 'perpetual or ongoing entitlement, by or under a law of a state, to exclusive access to a share of the water resources of a water resource plan area'. Under the same Act, a water allocation is defined as 'the specific volume of water allocated to water access entitlements in a given water accounting period'. Water entitlements differ according to the jurisdiction concerned and whether the water supply is regulated (backed by storage) or unregulated (based on river flows).

In regulated systems, entitlements are associated with one or more water storage facilities, and within operational constraints, irrigators can determine when water is released and the nature of its use. Seasonal allocations in these systems are made available through regular allocation announcements from the relevant authority. The volume of the allocation depends on:

- current and expected water availability
- storage level

- the amount of entitlements issued (and their reliability)
- other water commitments and management decisions.

The rules for determining an allocation are often contained in the relevant water plan.

Entitlements in regulated systems are distinguished by the degree of reliability attached to them. However, the degree of reliability attached to similarly-named entitlements can vary across catchments. Generally speaking, high reliability entitlements had, in the past, been expected to yield 100 per cent of their nominal volume in seasonal allocations 90 per cent of the time or more. Further, they receive seasonal allocations before any water is delivered against lower reliability entitlements. There are differences in the terminology used across states, as well as the types of entitlement reliability (table 3.1). At the Basin level, the majority of water entitlements (and the greatest quantity of entitlements by megalitre (ML)) are general or low reliability entitlements.

Table 3.1 **Terminology and reliability types of entitlements**

Regulated systems of the Murray-Darling Basin

Jurisdiction	*Name of water entitlement*	*Name of water allocation*	*Reliability types*
New South Wales	Water access licence	Water allocation	High security, general security and supplementary
Victoria	Water share	Water allocation	High reliability and low reliability
Queensland	Water allocation	Seasonal water assignment	High security, medium security and low security
South Australia	Water access entitlement	Water allocation	High security

Source: NWC (2009b).

In contrast to regulated systems, entitlements not backed by storages yield water based solely on intra-seasonal conditions. Water can only be accessed once pre-determined flow conditions are met. The ability to take water from an unregulated source is generally subject to a number of restrictions on extraction. Examples include:

- restrictions on the timing of extractions, whereby the entitlement allows water to be taken in a specific season or time period. For example, winterfill licences, which allow diversions from May to November
- minimum passing flow (or cease to pump) rules, where users are prohibited from extracting when the river falls below a certain level

- maximum allowable daily extraction rate
- maximum extraction volume.

The trading process

Unlike many commodity markets, the water market requires that trade be approved before the transaction can proceed. This process requires intermediary parties such as regulators, registries and conveyancers. Each Basin state administers its own trading rules and administrative processes for the trade of water within their state (box 3.3). However, a trade generally requires two parties (or an intermediary acting on their behalf) to apply to the relevant approval authorities, whereupon a decision is made on whether the trade can occur based on the relevant trading rules.

Interstate trade requires the approval of the relevant authorities in each state. After the trade is approved by each jurisdiction, the parties are notified. Trade in seasonal allocations is able to take effect once the purchaser's account is credited. Trade in entitlements is mainly facilitated through tagged trading arrangements. Tagged trading means that the entitlement is 'tagged' to its source and receives seasonal allocations based upon the water available and the conditions at that source. The source of the entitlement is unchanged by subsequent trades.

Trades in seasonal allocations are simpler to process and require fewer approvals than the trades of entitlements. A change in ownership of an entitlement requires the additional administrative process of settlement, whereby each party and any financial institutions involved will check the title (often done by an appointed solicitor) of the asset before exchange. Where there is a mortgage or other encumbrance on the title, this would need to be discharged, and correspondingly where the purchaser is entering into a mortgage, this would need to be registered on the title. Furthermore, once any trade in entitlement is approved, the transaction would need to be recorded on the relevant state registry.

Extent of water trade

The volumes of trade in entitlements and seasonal allocations suggest an active market for water in the Basin (figure 3.1). Basin-wide trade figures for 2008-09 are not available (the Murray Darling Basin Authority will release its Water Audit Monitoring report for 2008-09 mid-year). However, the NWC reports trade figures (including groundwater and intra-system trades in NSW) for the southern connected Basin, and reports 1080 gigalitres (GL) of trade in entitlements of varying reliability and 1739 GL of allocation trade in 2008-09. While DEWHA projected 772 GL of purchases for 2008-09, a total of only 64 GL of the entitlement trade in that year can be attributed to the RTB (and 24 GL of those purchases were transactions that carried over from 2007-08). This represents 3.9 per cent of the total entitlement trade in the Basin (NWC 2009b).

Of Australia's 32 051 trades in seasonal allocations and entitlements in 2008-09, trade in the southern connected Basin accounted for 60 per cent of entitlement trade and 81 per cent of seasonal allocation trade (by volume in GL) (NWC 2009b). The gross value of nationwide trade in 2008-09 was $2.2 billion in entitlements and $606 million in seasonal allocations (NWC 2008).

Although current market arrangements have permitted significant water trading activity, a number of constraints result in thin, underdeveloped markets in some regions. Chapter 10 discusses some of the administrative and institutional constraints that persist, despite continuing reform. In addition, constraints may be due to hydrology or lack of infrastructure.

Box 3.3 Basin state approval processes

New South Wales

All trades in seasonal allocations are processed by State Water. Trade in entitlements within a water source does not require regulatory approval. Transactions involving a change in location need to be approved by the Department of Water and Energy.

Victoria

Trade in seasonal allocations within the service boundary of an authorised Victorian water authority does not require regulator approval. Trade in allocations between regions governed by different authorities, and any trade in entitlements, must be approved by the relevant authorised Victorian water authorities. The authorities notify each other once the trade is approved, and then notify the parties involved.

Queensland

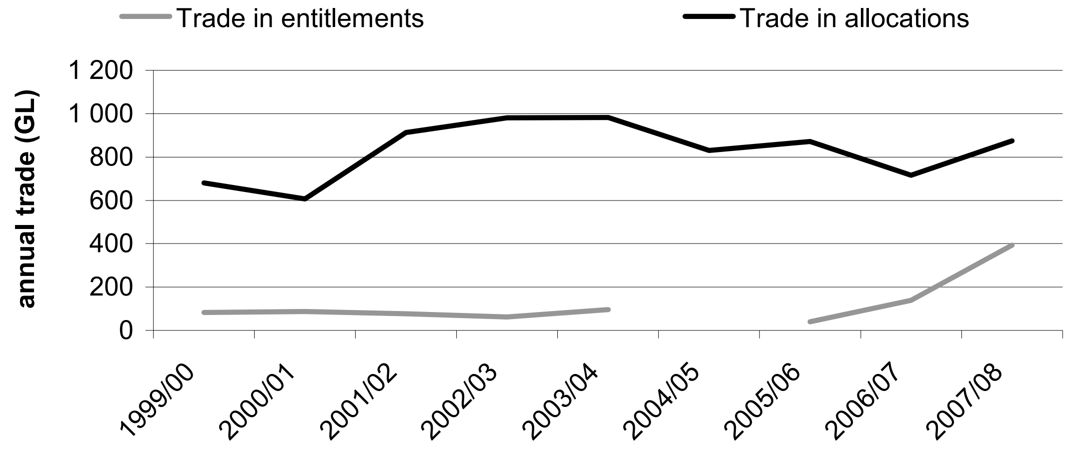
All trade in seasonal allocations are processed by SunWater. Trade in entitlements for regulated sources must be approved by the Department of Environment and Resource Management (DERM). In unregulated systems, if an entitlement is to be transferred, DERM must be notified, upon which a certificate acknowledging the proposed trade will be issued.

South Australia

All trade in seasonal allocations and entitlements must be approved by the Department of Water, Land and Biodiversity Conservation.

Source: ACCC (2009c).

Figure 3.1 **Basin-wide trade in entitlements and allocations**[a, b, c]



[a] No figures available for trade in entitlements in year 2004-05. [b] Does not include ground water trade or intra-system trades in NSW. [c] Entitlement trade does not include the 24 GL purchased under RTB, since these trades were not finalised until 2008-09.

Sources: MDBC (2001–2005; 2006b; 2007c; 2008d); MDBA (2009n).

Connectivity and trade

The ability to trade is limited by the hydrological connectivity between the buyer and the seller. For a trade to occur consideration must be given to:

- the ability to deliver water from the storage or to adjust water accounts to facilitate trade (for example, back trade)
- the level of conveyance losses
- the existing capacity and delivery constraints.

The ability to deliver water from one system to another is generally set out in water trading rules, through the use of trading zones. Water trading zones are often used to clarify the trading rules and to simplify the administration of trades. Each water resource plan area may have a number of water trading zones, some of which may be on the same river. The regulated southern-connected system — including the Murray, Victorian regulated tributaries and the Murrumbidgee River — is operated as one connected system. It is assumed that all trading zones within this system are hydrologically connected (ACCC 2009c). By comparison, the northern Basin is dominated by unregulated systems, or regulated rivers controlled by a single storage, so trading zones in these regions are often discrete (SKM 2009a).

Large conveyance losses can hamper delivery from one site to another and preclude trade. In the southern-connected system, a minimum flow is maintained to meet critical human needs throughout the Basin, including supplying South Australia. Most losses are associated with these requirements, and additional flows tend to incur only small losses. The system is operated using a number of storages, and as such, it is difficult to determine the path of the water from a particular storage to an extraction point. When a trade occurs within the system, no change is made in delivery to reflect conveyance losses. In contrast, the intermittent flows of the northern Basin make accounting for conveyance losses more important, if somewhat problematic.

The ability to facilitate a trade may also be limited by capacity constraints that limit the volume of water that can move between two zones. Capacity constraints result from either physical or environmental restrictions on the volume of flow that can pass a certain point in a river, channel or pipe. These constraints are usually dealt with through trading rules, by creating separate trading zones upstream and downstream of the constraint, and limiting trade between the zones. The most significant river channel constraint in the Basin is the Barmah Choke, where limits on flow from the Upper Murray to the Lower Murray are in place to prevent unseasonal flooding of the Barmah Forest. The capacity of the Barmah Choke is 8500 ML/day at Barmah (MDBC 2008b).

Trade in the regulated systems of the Basin

A well-functioning market with multiple transactions and participants is aided by the presence of large volumes of water, backed by infrastructure to store and deliver that water. Indeed, the majority of tradeable entitlements are on issue in the regulated systems of the Basin (table 3.2), where the majority of trade (in both entitlements and seasonal allocations) occurs (NWC 2008).

Interstate trade in both entitlements and seasonal allocations is more administratively complex and is currently conducted according to agreements between Basin states. The Murray-Darling Basin Agreement establishes the rules for trade in the southern-connected systems of New South Wales, Victoria, South Australia and the ACT. Trade between Queensland and New South Wales operates on a very limited basis at present, although scope for trade between Queensland and other states will increase (particularly in the Border Rivers) as the necessary institutional arrangements are developed (ACCC 2009c). In Queensland, trading is restricted to within geographic areas supplied by a particular water supply scheme. Trading is not possible between schemes (NWC 2008).

Presently, interstate trading in entitlements is almost nonexistent, with no trades occurring in the 2008-09 season and only one trade of 200 ML (between New South Wales and Victoria) occurring in 2007-08 (NWC 2009a). However, the interstate trade in allocations is relatively strong, accounting for 28 per cent of trades by volume (up from 15 per cent in 2007-08) in 2008-09.

Table 3.2 **Tradeable water entitlements on issue[a], 2007-08**

	Regulated systems		*Unregulated systems*		*Groundwater*	
	Number	Nominal volume (GL)	Number	Nominal volume (GL)	Number	Nominal volume (GL)
NSW	10 401	8 464	1 345	110	2 867	1 004
Victoria	37 260	3 550	7 704	162	6 236	490
Queensland	10 893	3 142	1 018	349	369	76
SA	3 703	980	223	1	5 719	215
ACT	27	64	0	0	114	1

a Figures are for the entire state including non-Basin jurisdictions.

Source: NWC (2008).

Trade in unregulated systems

Trade in unregulated systems is small relative to trade in regulated systems in the Basin. This is largely because water diversions in these catchments are a small proportion of total water use in some states (table 3.2). However, it is also due to the difficulty in trading water within and between unregulated systems because of:

- physical limitations in transferring water from one user to another (both upstream and downstream) where flows are not controlled by infrastructure or storages and there is potential for substantial conveyance losses
- the potential for water traded downstream to be extracted by third parties
- impacts of individual trades on third parties and the environment
- limited information on water access rights required to facilitate trade (for example, maximum extraction rates, daily pumping rates and monitoring of flow variability)
- high transaction costs associated with managing, monitoring and ensuring compliance with water trading within a region or between regions.

Currently, water trading markets are not generally well established in unregulated systems in the Basin, although trading zones exist already in some parts of the Basin (SKM 2009b). Consistent with the *Water Act 2007* (Cwlth), the Murray-Darling Basin Authority will establish and enforce rules for trade in unregulated systems as part of the water trading rules, which may facilitate trade in the future.

FINDING 3.1

Water markets are well developed and active in the southern-connected Basin, but not in parts of the northern Basin where entitlements are generally rules based rather than storage based.

Trade in groundwater

Groundwater trades are usually assessed on an individual basis and are usually restricted to within the same management zone or aquifer. The recent drought and low surface water availability has seen a rapid growth in groundwater trade (ACCC 2009c). For example, Goulburn-Murray Water approved 130 groundwater trades for the 2006-07 season, a 250 per cent increase from the previous year (NWC 2008). However, the relatively small volumes of entitlements issued (table 3.2) mean that the market for groundwater trade is relatively thin in many management zones.

The current presumption in many jurisdictions of zero connectivity between groundwater and surface water (NWC 2009b), precludes trade between these sources. However, should this presumption be reversed, and conjunctive management of the two resources be introduced (as is recommended by the NWC 2009b), this would facilitate greater trade in groundwater systems.

Market intermediaries

The growth and evolution of water markets in the Basin has been accompanied by the development of intermediary market services, such as water brokers and water exchanges. By 2007, trading through market intermediaries accounted for around 80 per cent of trades, with the remainder being privately negotiated, principally in Victoria and Queensland (The Allen Consulting Group 2007). Intermediaries have also been used extensively to undertake applications to the tender rounds of RTB, with around 57 per cent of offers (by value) submitted to DEWHA through a broker or solicitor (sub. DR85). To this point, the market for intermediary services has developed without specific restriction or regulation (The Allen Consulting Group 2007). There are competing platforms and methods of arranging trade in water entitlements or seasonal allocations across the Basin.

Brokers and exchanges active in the Basin

As there is no registry for water brokers, it is difficult to estimate the number of brokers currently operating (The Allen Consulting Group 2007). There are a few full-time specialist water brokers such as Waterfind, but most firms practice water broking in addition to another business such as real estate, consultancy, or financial advice. Additionally, some brokers are contracted to exchanges such as Waterexchange, or work directly for an exchange as part of the services offered by that exchange (for example, Watermove and SunWater Exchange).

Presently, numerous water exchanges, using different methods of operation, operate throughout the Basin (table 3.3). The National Stock Exchange of Australia (NSX) runs the most prominent of these, known as Waterexchange, which operates in the same manner as a stock exchange, on a system of posted sell and buy bids. There are also a number of exchanges that operate with a pooled system. This involves a pool of buyers and sellers in each trading zone being gathered over a set time period. A price for each pool is calculated and all successful buyers and sellers within the pool receive this price. The pool price will be greater than or equal to the highest bid of any successful seller, and less than or equal to the lowest bid of any successful buyer. Some firms, such as Waterfind, also negotiate private trades between buyers and sellers.

Table 3.3 **Principal water exchanges**

Exchange	*Ownership*	*Regions Serviced*	*Products Traded*	*Method of Operation*
Watermove	Victorian Government (operated by Goulburn-Murray Water)	Southern NSW and Victoria	Entitlements and allocations	Weekly Pool
Waterexchange	The National Stock Exchange of Australia (NSX)	NSW, Victoria and SA	Allocations and forward contracts	Posted sell and buy bids
Waterfind	Private Firm	NSW Victoria and SA	Entitlements and allocations	Negotiated trades between buyers and sellers
Sunwater Exchange	Queensland Government (operated by Sunwater)	Queensland	Allocations	Pooled price system
Watermart	Coleambally Irrigation Corporation (acting as a broker for Waterexchange)	A service for Coleambally Irrigation Corporation customers	Entitlements and allocations	Posted sell and buy bids
Murrumbidgee Water Exchange	Murrumbidgee Horticulture Council	NSW	Allocations	Posted sell and buy bids
Murray Irrigation Exchange	Murray Irrigation Limited	NSW	Entitlements and allocations	Posted sell and buy bids

Source: NWC (2008).

The role of intermediaries

Market intermediaries perform a significant proportion of trades and fulfil important functions in the market. Intermediaries reduce transaction costs for their clients by matching buyers and sellers across disparate locations and sources. Furthermore, they may reduce the costs associated with searching for information about trading rules, obtaining regulatory approvals and finalising any administrative requirements for transfer of ownership.

The widespread use of intermediaries suggests the expertise of such parties is valued by market participants. The existing exchanges and brokers could be utilised should on-market purchases be pursued as an alternative to the tender process, as part of the buyback.

FINDING 3.2

Market intermediaries, including brokers and exchanges, have developed alongside the market to facilitate increased trade.

Exchanges and some brokers may also provide market information that is accessible to all participants. Efficient markets require up-to-date information on trades so that market participants can make informed decisions. At present, all trades are required to be recorded on state-based registries. However, each of these registries is different, both in terms of the way they operate and the information supplied. Consequently, the current system has so far ‘generally not provided the information required to fully inform water trading decisions’ (NWC 2009b, p. 149). The fragmented exchanges and poor reporting standards of the state registries are in contrast with other commodity markets. COAG has committed to the development of a National Water Market System and the Australian Government has recently announced funding of $56 million for the project (Wong 2009a) (box 3.4).

Brokerage fees

The brokerage fees paid for any particular trade depend upon the level of service provided by the broker. Typically, brokers offer a wide range of services, from matching of buyers and sellers through to settlement, conveyance and registration of the trade. Brokerage fees typically take the form of a percentage of the sale price for both the seller and the buyer, with a minimum (and sometimes a maximum) charge per transaction specified. For example, Watermart charges a fee of 2.5 per cent of each transaction, with a minimum charge of $50 (Watermart 2009).

Box 3.4 **The National Water Market System**

In November 2008, COAG committed to improving access to, and dissemination of, market information through the development of a National Water Market System. The system is being developed by the Department of the Environment, Water, Heritage and the Arts in conjunction with representatives of state governments, the Bureau of Meteorology and other Australian Government departments, including the National Water Commission. The system will be a national portal to each state registry. The state registries will be enhanced and a common registry will be in place for New South Wales, South Australia, Tasmania, the Northern Territory and the ACT. The system will provide water market information on elements such as price and volume of sales, show individual licence water account information and provide information to the Bureau of Meteorology for the National Water Account. In time, the portal may be further developed to provide an access point for initiating transactions. The first element, the national portal, is due to be completed by April 2010.

3.4 Pricing of water

As noted above, water is traded primarily through buying and selling of either seasonal allocations or entitlements. The prices of each are determined by different, but linked factors.

Price of seasonal allocations

The market for seasonal allocations is driven largely by the demand and supply conditions within that season. Irrigators make the decision to buy or sell seasonal allocations based on a number of variables, reflecting their particular circumstances. Individual preferences, access to information, attitudes to risk and liquidity considerations may all be important. The value of a seasonal allocation to an irrigator, will depend on how it can be used within the season and access to carryover rights. It will also depend on:

- expected yields and commodity prices, the costs of other inputs, and the scope to substitute other inputs in the short term
- fees and charges paid for delivery
- transaction costs.

In a well functioning market, the price will reflect the opportunity cost of using that water elsewhere. In any given season, this will depend on the timing and nature of announcements regarding allocations, the prevailing weather conditions and expectations about future conditions. The marginal value that an individual places on surface water will depend on their ability to substitute to water saving technologies, or other water sources, such as groundwater or floodplain harvesting.

Average seasonal allocation prices can vary considerably during the year and from year to year (figure 3.2).

Price of entitlements

The value of an entitlement to an irrigator is derived from the expected value of the seasonal allocations that the entitlement delivers into the future. The price of entitlements is less affected by short-term fluctuations in supply and demand and tends to reflect the expected net present value of the seasonal allocations the entitlement is expected to yield over the long term, as well as some risk premium. This means the value of an entitlement is influenced by longer term trends in prices and other economic variables (for example, interest rates and exchange rates). In general, the price of entitlements follows the same trends as allocations but with less volatility (Bjornlund and Rossini 2007). The prices of entitlements will vary depending on their location and reliability (table 3.4), and where trading constraints limit demand for entitlements in a particular region the price will be affected (Chapter 10).

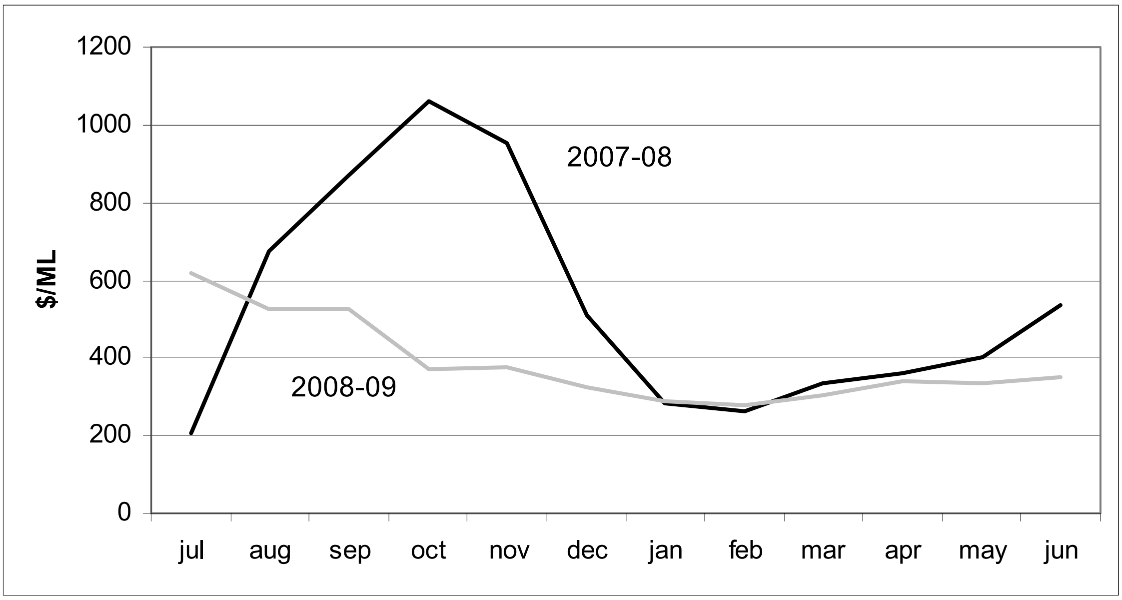
Table 3.4 **Allocation and entitlement prices for selected entitlement types, 2008-09**

Entitlement type	*Average allocation price*	*Average entitlement price*
	$	$
NSW Murray HS[a]	363	2 564
NSW Murray GS[b]	363	1 095
NSW Murrumbidgee HS	343	3 100
NSW Murrumbidgee GS	343	1 284
SA Murray HS	352	2 380
Vic Greater Goulburn HR[c]	370	2 228
Vic Murray HR	340	2 174

[a] High Security. [b] General Security. [c] High Reliability.

Source: Waterfind (2009).

Figure 3.2 **Average seasonal allocation prices for the southern-connected Basin, 2007-08 and 2008-09[a]**



[a] This data is supplied by Waterfind in good faith, with the following disclaimer: Every effort is made to ensure accuracy and timeliness. However, no responsibility is accepted for any errors or omissions in this information, nor for any loss or damage arising from its use.

Source: Waterfind (2009).

3.5 Delivery fees and charges

The fees and charges that an irrigation operator levies on customers are a factor in an irrigator's decision to buy or sell seasonal allocations or entitlements. Accordingly, the manner in which delivery fees and charges are set can have important implications for the functioning of water markets and the buyback.

Current structure of fees and charges in the Basin

Irrigation infrastructure operators in the Basin typically charge irrigators fees for administration, storage and delivery. Private diverters (irrigators that divert directly from the river) typically pay administrative costs and for storage in regulated systems. Those irrigators on an irrigation network are typically charged an additional two-part tariff comprised of a fixed access fee and a variable consumption charge based on the volume of water delivered (Appels, Douglas and Dwyer 2004). The fixed access fee is often associated with the provision of infrastructure, including the capital costs associated with maintaining and upgrading the irrigation network. A number of methods exist for allocating fixed costs across network users. The most common is the number or volume of entitlements held (ACCC 2009a), but other options include assignment of costs per hectare, per property, per connection, per service point, and based on size of delivery share. The variable fee is often associated with the physical delivery of water (or the use of delivery capacity), including pumping and other costs that vary with the volume of water delivered.

These fees and charges are often the same for all users in a district. This is sometimes known as postage stamp pricing (chapter 10). However, some operators differentiate their charges between local zones. While this arrangement more accurately reflects the relative costs of storing and delivering irrigation water in a particular zone, fees and charges are the same for all users within that zone. For example, all irrigators in the Shepparton zone of Goulburn-Murray Water that have a delivery right of 2 ML/day pay a fixed annual fee of $7334.84 ($112 for service and 2 x $3611.42 for infrastructure access) and a variable charge of $8.85 for every ML of allocation delivered, regardless of the costs of service provision to the irrigator's property (table 3.5).

Implications for trade and the buyback

The structure of the two-part tariff typically charged by an infrastructure operator will affect an irrigator's decision to trade. Necessary for the efficient distribution of entitlements and seasonal allocations is a fee structure, where the fixed charge an irrigator faces reflects the fixed cost of infrastructure provision to that irrigator, and the variable charge faced by that irrigator reflects the marginal cost of delivering water to that irrigator. Where fees and charges are not cost reflective in this manner, trade may be distorted. For example, where infrastructure operators set the variable proportion of delivery charges higher than marginal cost, the incentive to trade seasonal allocations out of the district is strengthened. This could result in a less than optimal amount of irrigation and an increase in the risk of stranded assets (Goesch 2001).

Table 3.5 **Water delivery fees and charges for Goulburn-Murray Water, 2009-10**

Goulburn-Murray Irrigation District

Area	*Service*	*Infrastructure access*	*Infrastructure use*
	$/property	$/ML/day	$/ML
Shepparton	112.68	3 611.42	8.85
Central Goulburn	112.68	2 963.73	6.76
Rochester	112.68	2 345.76	7.12
Pyramid-Boort	112.68	1 797.26	6.92
Murray Valley	112.68	2 385.00	7.62
Torrumbarry	112.68	2 571.90	7.41
Woorinen	112.68	3 373.18	20.00

Source: Goulburn-Murray Water (2009a).

In response to these issues, the *Water Act 2007* (Cwlth) requires the ACCC to provide advice to the Minister on water charge rules that aim to produce consistency in the way in which charges are set throughout irrigation areas in the Basin. These charges are to have regard to the NWI principles of user pays, transparency of pricing for storage and delivery, and cost recovery for water planning and management. The advice on Water Charge (Infrastructure) Rules was finalised in June 2009.

An efficient buyback recovers water from where it is least valued. Where fees and charges are set efficiently, that is, they reflect the cost of service provision, price signals enable individuals to make efficient decisions about how much water to demand or supply. Inefficient fees and charges will alter an individual's willingness to pay, or willingness to accept payment for water. This distorts the price of seasonal allocations and entitlements on the market and can compromise the efficiency of the buyback (Chapter 10).

4 Allocating environmental water

Key points

- Allocating water to improve environmental outcomes in the Murray-Darling Basin is difficult and complex.
- Recently, too little water has been allocated to the environment. In many locations, the benefits from governments buying water for the environment could exceed the costs, if well implemented.
- Determining environmental allocations and water recovery targets that maximise community benefits is hampered by incomplete information on ecological responses to environmental watering.
- The ability to deliver water for environmental benefit at priority locations depends on hydrological connectivity, conveyance losses and the potential for water to be intercepted by other users.
- Environmental outcomes depend not only on the volume of water allocated to river systems and other environmental assets, but also on the timing and quality of allocations, as well as the implementation of land management practices.
- Setting the environmental objectives of water recovery in a way that maximises the wellbeing of the community requires prioritisation of environmental outcomes in a way that reflects people's preferences.

This chapter discusses the rationale for government involvement in acquiring water for the environment and assesses the information and criteria being used to guide the purchase of water entitlements under the Restoring the Balance (RTB) program. It looks at the challenges in setting environmental priorities as part of the buyback, including incorporating community preferences. It also identifies the spatial and temporal characteristics that influence the capacity of the water rights being recovered to deliver environmental benefits across the Basin.

4.1 Why is water use in the Basin a policy issue?

Water is diverted for a broad range of consumptive uses, including for household and agricultural uses. This includes irrigation of annual crops, permanent plantings and pasture to feed livestock. However, water can also benefit the community if it is used for the provision of environmental services — that is, if it is allowed to remain in river channels and to flow into wetlands and estuaries. These benefits can take many forms, including enjoyment of healthy river valley ecosystems, improved water quality and water-dependent recreational activities.

The volume of water flowing through the rivers and tributaries of the Murray-Darling Basin (the Basin) has reduced significantly in recent times. The allocation of water to consumptive uses increased until the mid 1990s. This has contributed to changes in seasonal flow regimes across the Basin and a reduction in the volume and frequency of flows to many wetlands including the Lower Lakes, and through the Murray mouth. This has been exacerbated by prolonged drought (chapter 2). The average period between environmentally beneficial flooding has more than doubled for a number of floodplain forests and wetlands, with some wetlands not receiving flows for over a decade (CSIRO 2008a). These changes in river flows result in a number of environmental effects (box 4.1).

Box 4.1 **Environmental effects of altered river flows**

Altering river flows can result in a number of changes in environmental conditions:

Hydrology — River flow variability may change in terms of volume, seasonality and velocity. This can result in atypical drought or flooding events, the loss of lateral connectivity of rivers (to floodplains), the loss of longitudinal connectivity (between upstream and downstream reaches), or the creation of new water bodies (for example, weirs).

Habitat — Physical changes to river channels, such as disconnection from habitats can result in atypical drying of wetlands, potentially causing degradation of habitats.

Water quality — A decline in water quality over time and/or in particular locations may result in increased risk of toxic algal blooms, increased sedimentation and acidification associated with exposed soils. Water use may result in highly saline return flows to river systems.

Biota —– Changes in the condition of habitats result in changes to the distribution and diversity of species of flora and fauna, changes or interruptions to fish movement pathways, potential loss of native species and increased spread of exotic pest species.

Sources: PC (2006); Robson et al. (2009).

Such environmental effects are causing deterioration in the health of the Basin’s water-dependent ecosystems, including a decline in the populations and conditions of native flora and fauna and a threat to the health of environmental assets, including several sites listed under the Ramsar Convention. Changes in hydrology and water quality may also have detrimental impacts for downstream water use by irrigators and tourism operators. Multiple threats to river health exist aside from reductions in water flows, such as a loss of water connectivity due to structural changes, changes in managing floodplains, habitat destruction and the introduction of exotic weeds and pests. However, of these threats, changes to flow regimes have the most significant effect on the ecological condition of the River Murray system (SRP 2003).

Given that there is a limited supply of water that can be sourced from the Basin, choices must be made about how much to allocate to consumptive uses, and how much should be retained as environmental flows.

The economic rationale for government intervention

The existence of market failures can provide an economic rationale for governments to intervene in the market for environmental services. Governments might intervene where property rights for the environment are not well defined. As a result, the actions of water rights holders could create environmental externalities that would not ordinarily be taken into account in decision making by private agents. This might include, for example, irrigation-induced salinity, and nutrient pollutants that adversely affect ecosystems and reduce the quality of water for downstream users. There may also be a case to preserve environmental assets that have some public good characteristics. For example, flora, fauna or scenery are environmental services that are to some degree, non-rival and non-excludable in consumption, and hence are generally underprovided by the market.

However, the role of private agents in providing some environmental services should not be overlooked. Groups, such as conservation groups or private trusts, may provide some level of environmental services based on altruistic motivation. For example, in the western United States, voluntary conservation trusts have been established, with the larger trusts having acquired substantial volumes of environmental water. In 2006 the Freshwater Trust held around 390 megalitres (ML) per day of environmental flow rights (appendix C). In comparison, while some Australian charities — such as Healthy Rivers Australia — accept donations to improve environmental outcomes in the Basin, these do not play as large a role in providing environmental water as private trusts do in the United States. This might be because there are a large number of enthusiastic recreational fishers in the United States, and it is easier for them to organise charities than in Australia where environmental interests are less concentrated. It may also be because Australia has a culture of relying on governments to provide many environmental services.

The existence of market failure demonstrates that market provision is unlikely to be efficient, but it does not suggest that government intervention will necessarily improve efficiency. ‘Government failure’ may arise because politicians and public servants lack relevant knowledge, or because their incentives are not aligned with the public interest. Whether governments should intervene on efficiency grounds is an empirical issue, and depends on the costs and benefits of the specific intervention proposed, taking both market and government failure into account.

In this instance, the Commission believes that too little water has been allocated to the environment, and that in many locations the benefits from governments buying water for the environment will exceed the costs, if well implemented.

Getting the balance right

There has been much concern in recent years about reallocating water to the environment and setting diversion limits at environmentally sustainable levels. The way in which sustainability is defined is important because it has implications for the setting of sustainable diversion limits (SDLs) under the new Basin Plan and water recovery targets (chapter 6). However, there are divergent views on how to define environmental sustainability.

The Murray-Darling Basin Commission (2008c) suggested that a river system can be considered 'healthy' when its character, biodiversity and functions are sustained over time, as demonstrated by its resilience in the face of environmental changes including climate change, resource exploitation or other impacts of human activity. Natural conditions might have the highest ecological integrity, but this may not be the optimum or desired condition in all cases, because a departure from natural conditions might be necessary to secure other important social and economic values.

In 1992, all levels of government in Australia adopted a National Strategy for Ecologically Sustainable Development to guide the management of Australia's ecological and economic resources. The core objectives of this strategy were:

- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations
- to provide for equity within and between generations
- to protect biological diversity and maintain essential ecological processes and life-support systems.

This approach recognised that ecologically sustainable development has implications for broader concerns of welfare and equity, and hence that tradeoffs between different objectives may sometimes be required. This framework is useful in deciding how sustainability should be considered within the context of allocating water to the environment. The Commission's view is that sustainable water use is not inconsistent with maximising the net benefits (or wellbeing) to the community. This requires consideration of all benefits and costs of different options for using water, including all relevant private and social impacts (including impacts on the environment).

The efficient allocation of water resources occurs when the marginal net benefits of water are equated across all uses, including consumptive and environmental uses. Ideally, the reallocation of water, whether through the buyback or through the Basin Plan, should have this objective in mind (box 4.2).

However, governments must make resource allocation decisions based on imperfect knowledge of the benefits and costs of different water uses. In most jurisdictions, water resource plans, prepared in accordance with the relevant state legislation, are used to meet a number of policy objectives, including provision of environmental water allocations. Such non-market allocative processes do not always effectively reveal preferences or transparently weigh up different community values of water use, a concern expressed by Murrumbidgee Irrigation (sub. 39, p. 2).

Tradeoffs between environmental and consumptive uses of water should be based on informed processes and transparent public consultation, and where possible, an assessment of the benefits and costs of competing uses of water. Further, environmental managers need to be able to choose the right combination of water and other inputs (for example, engineering works, alternative land use and weed and pest control strategies) to maximise environmental outcomes (section 4.5).

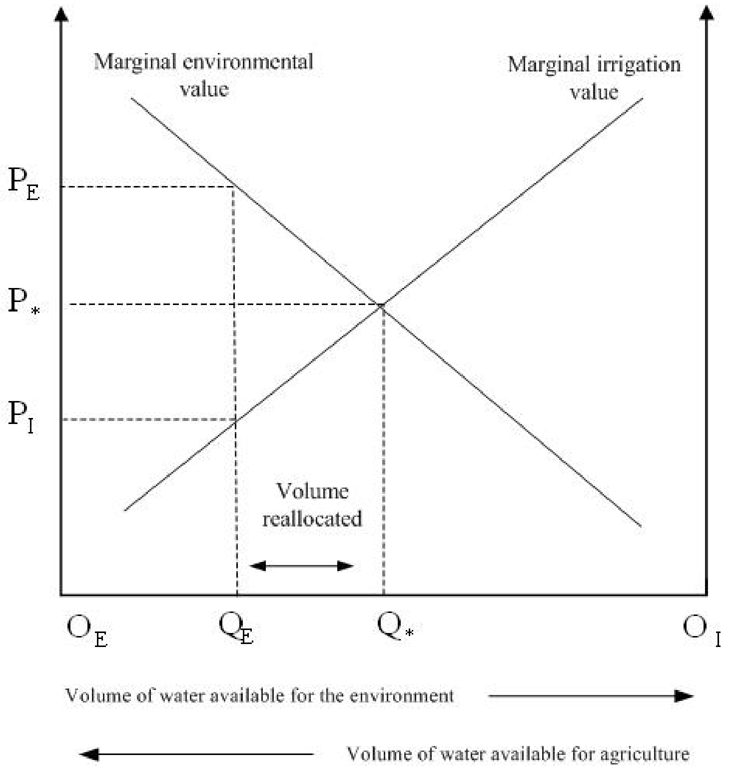
4.2 How is the Australian Government deciding on environmental priorities?

This section focuses on water recovery under RTB. The Australian Government is also setting sustainable diversion limits through the Basin Plan, which will determine the volume of water available for the environment in the long run (chapter 6). Key environmental resource allocation decisions that must be made under RTB include:

- How much water should be recovered?
- Where that water should be sourced?

The related question of ‘what type of water rights should be acquired to meet environmental needs?’ is addressed in chapter 7.

Box 4.2 **Gains from transferring water to environmental use**



The figure represents a simplified model of water allocation between environmental and irrigation uses and could represent the whole basin or a particular catchment. At the initial level of water allocations Q_E, the amount of water entitlements allocated to irrigators is O_IQ_E, while the amount of entitlements allocated for environmental use (either left in rivers or used to water environmental assets) is O_EQ_E. Before any transfer of water between uses occurs, the marginal value of water for environmental use at P_E is higher than the marginal value of water for irrigation use at P_I.

In this example, gains would result from transferring water entitlements until the point where the environmental share increases to O_EQ^*. At this allocation, the price P^* is the marginal value of water for both uses and the optimal allocation of water resources has been achieved between environmental and irrigation uses.

In practice, the shapes of these curves are rarely known with certainty, with the marginal environmental value curve being especially difficult to estimate. This increases the risk of reallocating either too much or too little water to the environment (relative to the efficient allocation).

Assessment process

The Department of the Environment, Water, Heritage and the Arts (DEWHA) uses interim water recovery targets in each catchment, which will apply until sustainable diversion limits are announced. DEWHA's targets are intended to ensure that water acquisitions address overall system health as well as the health of key environmental assets, and that the resulting portfolio of environmental entitlements is consistent with what it anticipates will be required under the Basin Plan.

The interim water recovery targets are based on scientific assessment of the 'environmental watering needs' of Basin catchments (table 4.1). In conducting this analysis, DEWHA draws on:

- the Sustainable Rivers Audit, which assesses the health of riverine ecosystems (box 4.3)
- the Sustainable Yields Project, which examines existing water availability, and risks to water availability, such as climate change
- various studies that estimate the watering needs of particular catchments or environmental assets.

Once 'environmental water needs' have been estimated, DEWHA takes into account the volume of water that will likely be provided to the environment through water sharing plans and other environmental water recovery projects, such as the Sustainable Rural Water Use and Infrastructure Program and The Living Murray.

In establishing interim water recovery targets, DEWHA consults with the Murray-Darling Basin Authority, which has confirmed (according to DEWHA) that the approach DEWHA is taking in determining catchment purchase priorities 'is broadly consistent with the approach the Authority is taking to developing the Basin Plan' (sub. DR85, p. 10). DEWHA also discusses water recovery targets with the Commonwealth Environmental Water Holder (CEWH) to ensure that purchases are directed to the greatest environmental need.

Finally, DEWHA considers the impact of delivery constraints, such as:

- the management arrangements and infrastructure required to deliver and use the water entitlement for environmental benefit
- whether the entitlement is able to provide water when it is needed
- possible water losses through seepage, evaporation and extraction by other licensed users
- the relevant state legislation and water sharing plan which govern the use of the water entitlement and provide security over the property right (sub. 56).

Table 4.1 **Scientific assessments of river health and water availability in the Murray-Darling Basin**

Catchment	*MDBC Sustainable Rivers Audit Health Rating*[a]	*Historical average surface water availability*[b]	*Diversions based on current development and historical climate*	*Forecast decline in surface water availability by 2030*[c]
		GL/year	%	%
Northern Basin				
Paroo	Good	445	0	3
Border Rivers	Moderate	1 208	34	10
Condamine-Balonne	Moderate	1 363	53	8
Moonie	Moderate	98	34	11
Barwon-Darling	Poor	2 088	11	11
Gwydir	Poor	782	41	10
Namoi	Poor	965	37	5
Warrego	Poor	420	12	6
Macquarie-Castlereagh	Very poor	1 567	24	7
Southern Basin				
Ovens	Poor	1 776	1	13
Murray	Poor - very poor	11 162	36	14
Eastern Mount Lofty Ranges	**na**	120	5	18
Campaspe	Very poor	275	36	16
Goulburn-Broken	Very poor	3 233	50	14
Lachlan	Very poor	1 139	28	11
Loddon-Avoca	Very poor	285	32	18
Murrumbidgee	Very poor	4 270	53	9
Wimmera	Very poor	219	55	21

a SRA ratings are composite measures of a range of indicators of river health (box. 4.3) **b** Based on the climate from mid-1895 to mid-2006 and the current level of water resource development. **c** Based on a median scenario of future climate change and likely future water resource development (including expected growth in farm dam capacity, commercial forestry plantations and groundwater extraction). **na** not available.

Sources: CSIRO (2008a); MDBC (2008c); Productivity Commission estimates.

Entitlement types that have been assessed to be of high risk include those that involve overland flow licences that are remote from a large volume channel, and small volume channels, particularly when separated from a high value environmental asset by a dam. The issue mainly concerns NSW unregulated rivers and supplemented and unsupplemented rivers in Queensland.

This process generates a list of water recovery targets and priority catchments. In the 2008-09 tenders the following list of priorities was assigned to catchments in the Basin:

- higher priority catchments — Southern connected Murray System, Lower Condamine Balonne, Gwydir and Macquarie
- moderate priority catchments — Border Rivers, Barwon (Upper Darling), Lachlan, Upper Condamine and Namoi
- lower priority catchments — Moonie, Paroo/Warrego and Castlereagh.

Box 4.3 **Murray-Darling Basin Commission Sustainable Rivers Audit**

The Sustainable River Audit (SRA) is an assessment of the health of river ecosystems in the Basin, involving systematic collection and analysis of biophysical data from locations in 23 designated valleys. Environmental indicators, grouped as themes, are used to assess the condition of key ecosystem components, and condition assessments are combined to indicate ecosystem health.

Condition assessments are made relative to a reference condition that is a measure of conditions as they would be in the absence of significant human intervention. The reference condition represents the river ecosystem in good health, but is not necessarily a target for management. Depending on how much the condition of ecosystem components differs from the reference condition, ecosystem health is rated on a five-point scale, ranging from good to extremely poor.

In the SRA Report for 2004–07 (the first of a series of three-yearly reports), three themes were utilised — fish, macroinvertebrates and hydrology. These themes were chosen for their significance in river ecosystems, their sensitivities to interventions and their linkages to other features of river ecology. Of the 23 river valley ecosystems studied, only the Paroo Valley was in good health. The Border River and Condamine Valleys were judged to be in moderate health. Seven other valleys were in poor health and 13 in very poor health. In nine of the valleys, the proportion of alien fish outweighed native fish species, and most valleys showed reduced macroinvertebrate diversity. A high proportion of sites identified as being in poor hydrological condition were on the main channels of the Basin's principal rivers, particularly in lowland zones. As hydrological assessments accounted for the effects of climatic conditions, the results reflect long-term water resource development impacts on flow regimes, rather than the effects of prevailing drought.

The next report, due in 2011, will include two additional themes: vegetation and physical form. Future reports will also describe trends, showing how river ecosystem health changes from one SRA to the next, and over longer periods of time.

Source: MDBC (2008c).

A catchment's priority is reviewed as water purchases approach water recovery targets. For example, as a result of the substantial purchases already made in the Gwydir, it has been reclassified as a lower priority catchment, and DEWHA has decided to 'cease making any further purchases in the Gwydir catchment for the time being' (sub. DR85, p. 9).

While DEWHA is using water recovery targets, it does not believe that it would be appropriate to release this information. These transparency issues are discussed in chapter 8.

How will Restoring the Balance water be used?

The CEWH's environmental watering priorities are guided by the objectives of:

- avoiding the loss of threatened species
- avoiding irretrievable damage or catastrophic events
- providing drought refuges to allow recolonisation following drought.

While the CEWH uses different criteria to RTB for setting environmental watering priorities, the CEWH will be required to allocate water in accordance with the Basin Plan and DEWHA will prioritise further water purchases in accordance with the Plan. Hence, once the Basin Plan is implemented, the environmental watering objectives should converge.

So far, environmental watering using the Commonwealth's water holdings (as well as water recovered by other programs including The Living Murray Initiative and Riverbank) has largely targeted the protection of 'iconic' sites. Many of these are identified under the Ramsar Convention on Wetlands of International Importance (box 4.4). However, the Ramsar sites are just a small proportion of the 30 000 wetlands in the Basin (CSIRO 2008a).

Analysis of the Restoring the Balance assessment process

Some of the ways used by DEWHA to determine environmental watering priorities are sound, given the constraints involved. In particular, it makes sense for it to continue to consult with the Murray-Darling Basin Authority to reduce the risk of 'overshooting' the sustainable diversion limits, and to work with the CEWH to ensure the portfolio of water products matches the CEWH's environmental watering objectives.

Box 4.4 **Ramsar wetlands**

The Convention on Wetlands of International Importance (signed in Ramsar, Iran 1971, known as the Ramsar Convention) aims to halt the worldwide loss of wetlands and to conserve those that remain. A diverse range of natural and human-made habitats are classified as wetlands under the Ramsar convention, including rivers, swamps, marshes, lakes and other bodies of water.

Under the Ramsar criteria, a wetland should be considered to be of international importance if it:

- is a representative, rare or unique wetland
- is important for conserving biological diversity (it supports vulnerable, endangered, or critically endangered species or threatened ecological communities by providing refuge during adverse conditions)
- supports significant populations of waterbirds and indigenous fish.

As a Contracting Party to the Ramsar Convention, Australia has committed to taking steps to protect the ecological character of listed sites, and is required to meet obligations in terms of reporting, management, planning and provision of supporting information on Ramsar wetlands. These obligations are implemented at the national level through the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) and associated regulations, policies and funding programs. Currently there are 65 Australian Wetlands of International Importance listed under Ramsar. Sixteen of these are in the Murray-Darling Basin.

Australian Ramsar wetlands in the Murray-Darling Basin

Wetland name	*Location*	*Area (ha)*
Fivebough and Tuckerbil Swamps	NSW	689
Gwydir Wetlands	NSW	823
Narran Lake Nature Reserve	NSW	5 531
NSW Central Murray State Forests	NSW	84 028
Paroo River Wetlands	NSW	138 304
The Macquarie Marshes	NSW	18 726
Barmah Forest	Victoria	28 515
Gunbower Forest	Victoria	19 931
Hattah-Kulkyne Lakes	Victoria	955
Kerang Wetlands	Victoria	9 419
Lake Albacutya	Victoria	5 731
Currawinya Lakes	Queensland	151 300
Coorong and Lakes Alexandrina and Albert	South Australia	140 500
Banrock Station Wetland Complex	South Australia	1 375
Riverland	South Australia	30 600
Ginni Flats Wetland Complex	ACT	343

Sources: BMT WBM (2007); DEWHA (2009d).

It is also reasonable to draw on existing scientific studies. However, the value of these studies in allocating environmental water is often limited. For example, while the sustainable rivers audit assesses the health of a riverine ecosystem, it does not estimate the ecological response to environmental water. There is no reason why a less healthy ecosystem should always receive more water. It could be that the poor condition of an ecosystem is due to an introduced fish. The strategies for dealing with this may require management of the flows (for example, to encourage native fish spawning), rather than applying more or less water. In this instance, the additional environmental water might have little impact on the health of the ecosystem and the water might be better used elsewhere.

Ecological response assessments are potentially more valuable. In 2003, a scientific reference panel concluded that an additional environmental allocation of 1500 GL per year — combined with improvements in structural, operational and water quality management (for example use of regulators and weir pool raising) — would provide considerable 'whole-of-river and local ecological habitat benefits' (SRP 2003). This involved using the Murray Flow Assessment Tool to assess ecological responses of habitat condition under different flow scenarios for various locations along the River Murray, both in-channel and on the surrounding floodplains and wetlands. The panel considered that any recovery in river health would be likely to occur over many decades.

However, even with the best scientific knowledge, this approach could be seriously flawed. Understanding ecological responses to environmental watering is necessary, but without valuing the ecological responses and the costs of achieving those responses, virtually nothing can be said about whether an environmental watering will increase the wellbeing of the Australian community (section 4.6). Participants have expressed a range of views on DEWHA's purchase criteria (box 4.5).

4.3 Challenges in setting environmental priorities

There are many factors to consider in setting environmental priorities across the Basin to inform decisions about recovering water. This includes an understanding of the relationship between changes in environmental flows and ecological responses.

Box 4.5 Participant views on the Restoring the Balance purchase criteria

Irrigators are very concerned at the impact of a 'no regrets' policy and the fact that the government has set no volumetric target for its buyback other than a dollar figure. It would appear that the government has not identified exactly what the environmental needs are, what volume or water product it therefore needs to purchase, and what the likely impact of those purchases might be on remaining irrigation communities ... The NIC sees significant risk to the Commonwealth and to irrigators in the 'no regrets' policy through the potential to overshoot purchases, particularly in individual valleys, if not across the entire Basin … an interim purchasing strategy ought be developed that identifies a bandwidth for key environmental assets. (NIC, sub. 24, p. 2)

The CEWH is developing a framework for prioritising the use of the Commonwealth's water which will aim to protect ecological processes as well as ecological assets … So far no similar framework for prioritising where water should be acquired to meet the watering objectives is being developed. The 'strategic approach' used by RTB in 2008-09 was broad enough to include all Victorian water shares, irrespective of location or reliability. (Environment Victoria, sub. 23, p. 1)

Gwydir Valley Irrigators Association can support “no regrets” purchases in principle, but the problem is the government has not published any “no regrets” targets, or even the basis that it has used to set targets internally … Without that information, and the justification for the targets set, it is really impossible to determine when “no regrets” ceases to be the case. (GVIA, sub. 29, p. 4)

The potential to invest in different catchments, differences in the opportunity costs of water purchases and non-uniform environmental outcomes may support a more targeted approach as experience is gained. As such, the ‘no regrets’ presumption should be the subject of on-going review … (NSW Government, sub. 51, p. 4)

In broad terms, environmental water allocations have two main uses. The first is to preserve or improve the health of rivers and streams by maintaining hydrological flows that provide for desirable levels of river health. This can be achieved by controlling the volume, variability and velocity of flows to flush sediment and prevent algal bloom outbreaks, acidification and turbidity. The second is to water environmental assets, such as floodplains and riverine and estuarine wetlands. These measures will help to preserve the biodiversity of species, including:

- the condition of species of native flora: for example, river red gum forests, wetlands and black box vegetation
- populations of various species of native fauna (fish, birds and macroinvertebrates) by preserving feeding patterns of migratory birds and fish movement pathways, and providing critical water refuges for species during drought periods.

There are many competing environmental uses of water in the Basin, creating challenges for allocating a given amount of water. This may potentially result in too few resources being devoted to the achievement of too many environmental projects, some of widely different merits (Pannell 2008a). Indeed, environmental managers may attempt to rescue too many environmental assets with the effect of actually saving few. Setting environmental objectives in a way that maximises the benefits of water recovery may require some prioritisation of environmental outcomes and specific assets. This may involve consideration of:

- which assets face the greatest threat or experience the highest levels of degradation relative to others
- whether the threat or degradation will be reduced significantly as a result of environmental watering (based on ecological responses to environmental flows discussed further in this section) and whether this could be achieved at reasonable cost
- the degree to which other inputs might be required to produce desired outcomes
- which environmental assets the community considers most valuable (relative to consumptive uses of water) in terms of:
  - conservation value — sites that are necessary to provide critical drought refuges for rare or endangered species
  - social and cultural values — those that provide recreational benefits or have significance for Indigenous communities (community preferences are discussed in section 4.6).
- the potential for complementary watering actions that deliver multiple environmental outcomes in interconnected systems of the Basin. For example, opportunities to divert water to some wetlands will result in substantial return flows to rivers with downstream environmental benefits or additional water for downstream irrigators.

Ecological responses to flows and environmental tradeoffs

Making environmental allocation decisions in a way that maximises benefits cannot be achieved without understanding relationships between environmental flows and ecological outcomes. The responses of ecosystems and their component plant and animal species, depend on the volume and timing of flows. In naturally variable systems like the Murray-Darling Basin, promoting wet and dry cycles may be beneficial for biological diversity.

Measuring the ecological responses to flows can be difficult given that river systems have a large range of environmental attributes that interact in complex ways. There have been some attempts to estimate the ecological responses to different flow regimes for some parts of the Basin, including the FLOWs method used for determining environmental water requirements in Victoria (SKM 2002) and the Murray Flow Assessment Tool (SRP 2003).

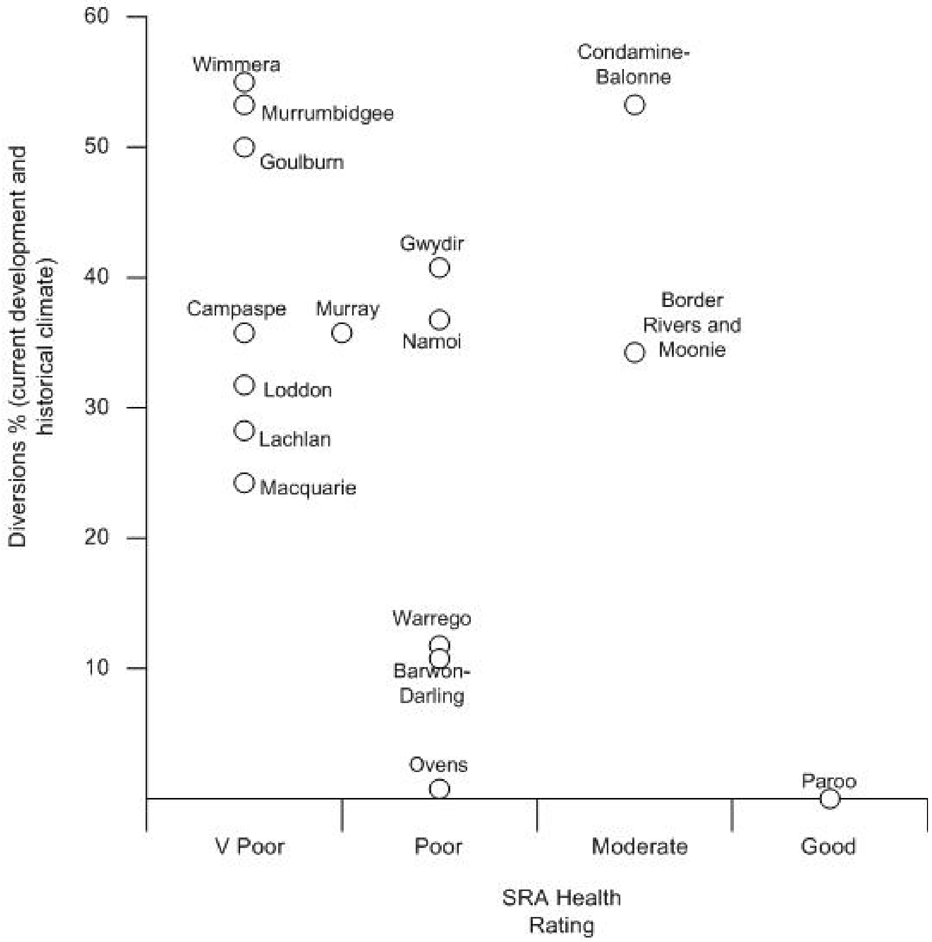
Studies that link flow volumes to quantifiable ecological responses have tended to focus on indicators of habitat condition for various species (Horne et al. 2009). Such indicators can show how habitat condition changes with additional water and hence can be used to construct environmental response curves.

Ecological responses can be examined at the level of environmental assets or entire catchments. The complexities of catchment ecological responses can be seen from scientific assessments of river health and water availability (box 4.6). The analysis shows that the amount of water diverted (as simulated by the CSIRO) from a catchment is not, by itself, a sufficient indication of river health across the Basin.

Ecological response functions are the first step towards building marginal benefit functions. The second step is to estimate willingness to pay for environmental outcomes. The environmental marginal benefits that result from increasing quantities of environmental water allocation (the demand curve) will vary between different sites. For example, some wetlands may only experience ecological responses from the application of water beyond a large volume threshold (figure 4.1 (a)). Others may respond to initial watering but with diminishing marginal benefits as additional water is applied (figure 4.1 (d)). The shape of the environmental benefit curves will significantly affect tradeoffs between environmental assets and also between environmental and consumptive use.

In some cases concentrating water recovery efforts to target particular environmental assets will be to the detriment of others. A triage approach to prioritising environmental assets has been considered as part of managing ecosystems during drought (Gorddard et al. 2009). Under this approach, environmental assets would be identified according to different categories: those in relatively good condition; those that have suffered degradation and will respond positively to watering; and those that are so degraded that recovery would not be feasible or practical given the high costs involved.

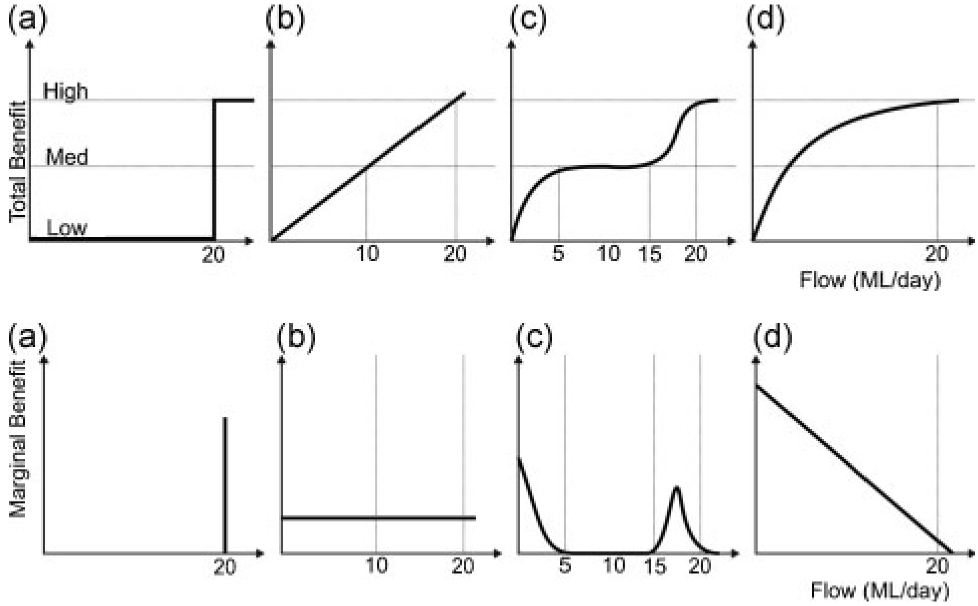
Box 4.6 **Ecological responses at the catchment level**



The MDBC and CSIRO assessments of river health and water availability suggest that, in general, high environmental allocations are neither sufficient nor necessary for river health. The Ovens catchment has a 'poor' health rating along with diversions of one per cent, demonstrating that high environmental allocations have not been sufficient to generate reasonable river health in that catchment. The Condamine-Balonne catchment has the second highest health rating of any catchment, 'moderate', while sustaining the second highest level of diversions at 53 per cent. This demonstrates that high diversions are not necessarily associated with poor river health in that catchment, at least not when river health is measured as it was in the SRA study. More comprehensive measures of river health may show a different outcome.

Sources: CSIRO (2008a); MDBC (2008c).

Figure 4.1 **Examples of possible environmental response curves**



Source: Horne et al. (2009).

An environmental asset that has suffered little or no degradation at the present time could be subject to significant threats in the future if watering actions are not taken immediately. The benefits of environmental watering may be maximised by concentrating resources on preserving these assets while ceasing or reducing the application of water to others. In some cases partial recovery of environmental assets to an earlier state, rather than full recovery, might be a realistic goal, given factors such as high costs of water delivery, the need to adapt to climate change and social values (Pannell 2008c). Sometimes it might be efficient to focus water on refuge sites and not water all of the asset. For example, environmental managers might build structures that allow only part of a wetland to be watered.

The problems in the Coorong and Lower Lakes highlight the complex choices that must be made about managing changes in the condition of environmental assets and environmental trade-offs (box 4.7).

There can be other types of tradeoffs between environmental objectives as part of environmental water delivery decisions. For example, the pulsing of large flows quickly to enhance natural floods may provide a wetland with a much needed flooding but can have adverse effects such as the release of cold water flows that threaten fish survival. It could also cause rapid rises and falls in river height that may erode river beds or channels and destroy biota and plants, leading to reductions in food for native fish (Robson et al. 2009).

Box 4.7 **The Coorong, Lower Lakes and Murray mouth**

The Coorong, Lower Lakes and the Murray mouth region comprise one of Australia's largest wetland systems. Lakes Alexandrina and Albert are large connected freshwater lakes that comprise the Lower Lakes. The River Murray flows into Lake Alexandrina, which in turn is separated from the Coorong by a series of barrages constructed in the 1930s. Flows from Lake Alexandrina to the Coorong can be controlled by opening gates in the barrages. The region is listed as a Ramsar wetland and is designated an 'icon site' under The Living Murray program.

Consumptive water use in the Murray-Darling Basin has reduced average annual stream flow at the Murray mouth by over 60 per cent between 1895 and 2006. In addition, it has increased the proportion of time for which flow at the Murray mouth ceases and doubled the average period between the flood events that are required to flush the Murray mouth. This has resulted in a build-up of silt in the Murray mouth. Unprecedented low water levels in Lake Alexandrina (and its tributaries) and Lake Albert have uncovered large areas of previously saturated acid sulphate soils, which, when exposed to air, result in acidification. Changes in water quality and flows have contributed to vegetation toxicity and a decline in fish and waterbird species, with adverse impacts not only on the environment but also on agricultural production and recreational activities.

A range of actions have been implemented in response to the current situation including dredging to keep the mouth open, revegetation trials to address acid sulphate soils and pumping fresh water between the lakes. The Commonwealth and SA Governments are considering a range of options for long-term management of the region, with the Commonwealth providing funding support under the Murray Futures program. These options include providing more fresh flows to the Lakes, keeping the Murray mouth open by connecting the Coorong to the sea and managing specific threats such as salinisation. The SA Government has proposed, as a last resort, the construction of a temporary weir near Wellington to secure water supplies for Adelaide under drought conditions. This is expected to contribute to reduced flows to the Lower Lakes and declining water quality.

A Senate inquiry in 2008 found that the situation in the Coorong and Lower Lakes is not unique as there are many sites across the Basin suffering severe environmental degradation, and future decisions to allocate scarce environmental water need to take into account environmental and other tradeoffs.

Sources: Brookes et al. (2009); CSIRO (2008a); DEH (2009); SCRRAT (2008).

Although environmental managers might seek to prioritise some environmental outcomes, it is important to recognise that parts of the Basin are a series of interdependent, connections and processes. As stated by Environment Victoria:

> An understanding of the connectivity of the river system should be at the base of any plan to prioritize water purchase or environmental watering. There is a tendency to see rivers as a series of disconnected assets or drought refuges, particularly under a drying climate when water is in short supply. If a river system is to survive and thrive, it is essential that it retains both lateral and longitudinal connectivity. In other words, it

needs enough water for fish and other animals to migrate along it, and to retain connection to its floodplains, which serve as the larders of the river system. To do this, it is essential to provide all components of the scientifically recommended flow regime, not just the low flow and cease to flow components. (sub. 23, p. 1)

Maintaining the health of some environmental sites that are highly valued for their biodiversity also requires maintaining the health of hydrologically-connected sites and river reaches and their dependent processes (DEWHA 2009a).

4.4 Temporal and spatial characteristics of environmental water demands

The criteria used by DEWHA to guide water purchases under the RTB program include some assessment of the capacity to deliver environmental water. Both temporal and spatial characteristics, discussed in this section, influence the flows required to deliver environmental benefits to rivers and wetlands across different parts of the Basin.

Temporal characteristics

The main temporal characteristics of the Murray-Darling Basin that cause natural variation in stream flows are climate variability, extreme wet events, long wet periods and drought (Kirby et al. 2006). The hydrological flows required to meet environmental watering needs can be categorised into two types. The first are annual base flows that promote system-wide health of the Basin and maintain ecological processes by flushing out, and preventing build-up of nutrients and acidification in river ways and provide longitudinal connectivity in the system. The second are the more irregular flows that aim to simulate or enhance natural seasonal floods to wetlands by increasing their peak or duration. The health of many ecosystems in the Basin depends on periodic inundation rather than consistent annual flows.

Creating flooding events is generally not achievable due to the high river levels that are required before an area can be flooded with overbank flows. Therefore, environmental managers might attempt to enhance natural flooding events. The CSIRO (2008) have forecast that under certain climate scenarios by 2030, the duration of the dry periods between environmentally beneficial flooding events will increase for most floodplain wetlands. Under this scenario, opportunities to ‘piggyback’ off natural flooding events will be greatly reduced. But the ability to hold carryover rights may enhance the ability of environmental managers to generate the volumes of water necessary to top up natural flooding events (chapter 10).

Spatial characteristics

Hydrological conditions vary across the Basin, creating difficulties in delivering water to environmental assets. A number of factors influence flow variability and the quantity of surface and groundwater resources in a catchment area:

- climate variation (in rainfall and levels of evapotranspiration)
- hydrological connectivity between locations across the Basin
- surface water characteristics such as topography
- surface water and groundwater connectivity
- land use changes (that impact on stream runoff and recharge to aquifers)
- variations in storages and flow diversions.

Hydrological connectivity between surface water systems varies across the Basin, so that water recovered in one location may not be deliverable to another location, or may result in substantial conveyance losses. For example, CSIRO hydrological modelling estimated that a ML of water purchased from the Gwydir catchment in the upper reaches of the northern Basin would be expected to only yield about 0.17 ML at the mouth of the Murray River, assuming pre-development conditions and historical conditions (table 4.2).

Given such hydrological constraints, water purchases in some parts of the northern Basin may improve the condition of some terminal wetlands but can not be relied on to result in significant environmental benefits in the southern-connected Basin. This was pointed out by a number of study participants:

> … the Gwydir Valley Irrigators Association estimates that Commonwealth and NSW Government purchases of water in the Gwydir of some 86,000 ML equates to almost 20 per cent of entitlements in the Valley … Gwydir ends in terminal wetlands and only in very wet years does it contribute to the rest of the Basin — to a large degree it is a closed system. (NIC, sub. 24, pp. 2-3)
>
> … a key concern is whether the water purchased will be able to reach the specific environment that it is intended for. The availability of conveyance water is a key consideration in this respect. For example, a purchase of supplementary access water in the northern part of the Basin is unlikely to contribute to changes in environmental attributes in the Lower Lakes. (South Australian Government, sub. 52, p. 6)

Table 4.2 **Average surface water delivery efficiencies between locations across the Murray-Darling Basin**

Region	*Maximum flow (GL/y)*	*End-of-system[a] (proportion)*	*Menindee (upstream of lakes)[a] (proportion)*	*Murray mouth[a] (proportion)*
Paroo	445	0.77	..	..
Warrego	423	0.16	0.07	0.03
Condamine-Balonne	1 298	0.43	0.33	0.18
Moonie	98	0.98	0.74	0.34
Border Rivers	905	0.92	0.62	0.32
Gwydir	782	0.48	0.33	0.17
Namoi	888	1.00	0.76	0.36
Macquarie	1 460	0.48	0.35	0.17
Castlereagh	107	0.68	0.50	0.25
Barwon-Darling				
Bourke	3 484	0.84	0.84	0.46
Menindee	2 944	1.00	1.00	0.54
Lachlan	1 139	0.25	..	..
Murrumbidgee	3 842	0.69	..	0.61
Ovens	1 776	1.00	..	0.70
Goulburn-Broken	3 233	1.00	..	0.75
Campaspe	275	1.00	..	0.75
Loddon	201	0.61	..	0.45
Avoca	84	0.30	..	..
Wimmera	219	0.08	..	..
Eastern Mount Lofty Ranges	122	0.99	..	..
Murray	14 493	0.84	..	0.84

[a] Numbers indicate the fraction of surface water available in the region that would reach the end-of-system gauge in each region, assuming without-development conditions under the historical climate from mid-1895 to mid-2006. Efficiencies will differ between wet and dry years and between regions depending on connectedness of the river network. '..' indicates where no efficiencies are estimated because the location is downstream of the region or because estimation was not possible.

Source: CSIRO (2008a).

The extent to which hydrological connectivity limits the transfer of water between locations will vary depending on climatic conditions, rainfall events and the amount of conveyance water already in the system. There have been recent cases where water from the northern Basin has been successfully delivered to the southern Basin for environmental watering. In 2008, water entitlements purchased from Toorale station by the Australian and NSW Governments were used to enhance flows to the Murray (box 4.8). In January 2010, the New South Wales and South Australian governments agreed to allocate at least 148 GL of flood water from northern New South Wales to the Lower Lakes (Keneally and Wong 2010).

Box 4.8 **Delivery of the Toorale allocation for environmental use**

In September 2008, the NSW Government purchased Toorale Station for $23.75 million. Under an agreement with the NSW Government, the Australian Government made a substantial financial contribution to this purchase in return for the Toorale water entitlements to extract up to 14 GL of water from the Darling and Warrego Rivers, along with rights to harvest water from the floodplain. The water rights were to be transferred to the Commonwealth Environmental Water Holder (CEWH). These entitlements and floodplain harvesting rights are expected to return an average of 20 GL to the Darling River each year and up to 80 GL in flood years.

A large rainfall event in February and March 2009 provided flows in the Darling and Warrego Rivers that would collectively provide inflows of 190 GL to the Menindee Lakes storages, if they were not diverted. At the time, the NSW Government had control of Menindee Lakes under the Murray-Darling Basin Agreement. Under a trial, 11.4 GL of water that would have otherwise been stored or diverted on Toorale Station was accredited to a Water Access Licence issued to the NSW Water Administration Ministerial Corporation and was allowed to continue downstream to the River Murray via the Menindee Lakes.

To determine the proportion of the 11.4 GL that would reach the River Murray, the NSW Department of Water and Energy estimated the losses associated with various stages of the transfer. This included transmission losses from Toorale to the Menindee Lakes (1 GL lost in seepage or evaporation), evaporation losses in the Menindee Lakes (0.5 GL) and transmission losses from Menindee Lakes to the River Murray (1.1 GL). In total, of the original 11.4 GL attributable to Toorale, 8.7 GL was calculated as reaching the River Murray.

Additional flows from the Darling River into the Murray River are shared between New South Wales, Victoria and South Australia under the Murray-Darling Basin Agreement. However, in the case of the 8.7 GL of water from Toorale Station, New South Wales (7.2 GL) and South Australia (1.5 GL) agreed to make this water available to the CEWH for environmental watering.

Sources: ACCC (2009a); DWE (2009).

By comparison, the delivery efficiency of incremental flows in the southern-connected Basin are much higher due to more reliable and much greater amounts of conveyance water, meaning that additional environmental flows will result in relatively less evaporative losses. This illustrates the complexities in delivering water for environmental use that are related to hydrological connectivity between locations in the Basin and the potential for transmission losses.

FINDING 4.1

Water recovered in the northern Basin can result in infrequent, but at times significant, environmental benefits for the southern parts of the Basin, given hydrological constraints. Water recovery within the northern catchments that are often disconnected should be driven primarily by environmental priorities within those catchments. Conversely, the southern Basin — including the Murrumbidgee, the Murray and the Goulburn rivers — is highly interconnected, allowing considerable flexibility in sourcing and delivering water for environmental purposes throughout these valleys.

In some parts of catchments or river systems, capacity constraints and topographical features present physical constraints on water flows and trade between locations. As noted in chapter 2, the Barmah Choke restricts the capacity of flows through the River Murray. However, the Murrumbidgee and Goulburn Rivers both join the Murray downstream of the Choke and, therefore, provide alternative opportunities for providing environmental flows downstream.

The relationship between surface and groundwater sources in the Basin is generally not well understood and groundwater is inconsistently managed. Rivers may receive flow from groundwater sources or may leak water to aquifers, although most rivers are gaining flows. As noted in chapter 2, use of groundwater has increased significantly in recent years. Where groundwater extraction reduces inflows to rivers and, hence, surface water availability, it can compromise the capacity of surface water entitlements purchased by environmental managers to actually deliver environmental benefits.

The way land is used can result in water being diverted or intercepted, potentially affecting the ability to deliver water for environmental use. For example, plantation forestry and regrowth after bushfires may affect inflows to rivers. Both the construction of large farm dams and floodplain harvesting may reduce the extent of overland flows to wetlands or reduce return flows, a concern expressed by the Australian Floodplain Association:

> Unregulated water is currently extracted from Australia's floodplains via overland flow, channels/levees and floodplain harvesting. For there to be an effective environmental outcome for the Murray Darling Basin catchments which are largely floodplain riverine systems, current structures on floodplains that take water need to be accurately mapped, and the water that is taken monitored and measured. (sub. 30, p. 2)

In summary, the capacity for environmental allocations to deliver water to environmental assets is affected by:

- hydrological connectivity of river systems to environmental sites

- potential losses from evaporation and leakage and amount of conveyance water required to transfer water
- impacts of land use and groundwater extraction (the potential for environmental water delivery to be intercepted by other users)
- capacity of storages (to release pulsed flows in environmentally beneficial volumes).

Therefore, achieving environmental outcomes across different areas of the Basin depends on more than the quantity of water that is allocated. These factors are important considerations as part of choices under the RTB program and the Basin Plan. Responses to environmental demands may need to be coordinated to take into account spatial and temporal considerations, given that watering actions in one part of a river system can have implications elsewhere. Monitoring environmental responses is important to evaluate, improve and prioritise various watering actions.

4.5 Environmental watering and land management

Environmental outcomes depend not only on the volume of water that is left to flow through river systems, but also on environmental managers using other inputs to produce environmental outcomes. This can involve engineering works, specific watering strategies and land management practices.

Engineering works are often required to divert water to specific locations for environmental use by using weirs, regulators, pumps or channels to provide control over the volume and variability of water flows to specific locations.

A range of environmental watering actions have been implemented along the River Murray systems and key tributaries including:

- varying flows within river channels and releasing flows from storages
- providing natural wetland watering and drying regimes (including drawing down from weir pools to promote drying cycles of wetlands that are typically inundated, and raising some weir pools to water wetlands that are typically dry)
- pulsing and flushing water flows to disperse salt and blue-green algae and move sediment from water bodies like the Murray mouth
- managing in-stream structures to allow fish passages (Gippel 2003).

Land management practices can be as important as increasing water flows for improving outcomes for environmental assets. This includes controlling the spread of exotic species that threaten native species, preventing weed infestation and control of farming practices that have adverse environmental effects. The Australian Conservation Foundation (sub. 41, p. 3) commented that it will become increasingly important to address other threats to the Basin (aside from water flow shortages) such as livestock control, weeds and feral animals. Measures, such as fencing and revegetation, can be important to prevent these threats. As part of an investigation into river red gum forests in the River Murray, the Victorian Environmental Assessment Council (2008) found that domestic stock grazing generally adversely affects environmental values, including biodiversity, water quality and soil condition. Accordingly, the Council recommended that domestic stock grazing be excluded from public land in a defined area, with limited exceptions.

Structural works such as pumps and regulators, can be used to deliver environmental water and achieve outcomes with much less water compared with that required for overbank flows. For example, structural works proposed for Linsday Island are expected to reduce the amount of water required to flood these areas from 1000 to around 90 GL for each watering event (DSE 2009).

The purchase of water is likely to be more effective and efficient in achieving specific environmental outcomes if purchasing decisions are not made in isolation from decisions about works, specific watering actions and land management practices (discussed further in chapter 9).

4.6 Assessing the benefits and costs of environmental watering

The buyback reveals the opportunity cost of water to irrigation but what is unknown are the benefits of using that water to restore or maintain environmental assets.

Conceptual issues

It is common for people to say that the science implies a certain policy response. For example, the Wentworth Group (2008) suggest that:

> If we are to maintain healthy rivers and provide high quality water to produce food, our analysis suggests that the consumptive use of water across the Murray Darling Basin may have to be cut by between 42 and 53 percent below the current cap. (p. 1)

Does this mean that the government should recover at least 4000 GL of water? In this instance, science can provide necessary information on the impacts of reallocating 4000 GL to the environment — the different outcomes that are possible, and the probabilities associated with those outcomes — but the science can not say that an allocation of an additional 4000 GL to the environment has any normative basis. While 4000 GL would generate better environmental outcomes than 3000 GL, it would generate worse agricultural outcomes (reduced agricultural income). The science can not determine whether the environmental benefits of reallocating additional water outweigh the agricultural losses, yet understanding these complexities is fundamental to maximising the wellbeing of the Australian community. Community wellbeing could be higher with an environmental allocation that delivers something less (or more) than 'river health', as defined by the Wentworth Group.

A similar issue arises when allocating environmental water among environmental assets (wetlands, forests, rivers, ecosystems, and so on). For example, suppose there is just enough water to flood a wetland that will increase the population of an endangered bird species, or another wetland that will increase the population of an endangered frog species, but not both. There is no scientific basis for assigning water under these circumstances. From an economic efficiency perspective, the question is whether the community will benefit more from the increase in the number of the birds or frogs. This highlights the importance of taking preferences and values into account (box 4.9).

Box 4.9 **Participant views on incorporating community preferences**

Some study participants have expressed concern about the lack of information about community preferences considered as part of purchasing decisions under Restoring the Balance:

> The concern is however that governments are entering the market without adequate knowledge of what they are buying and the strength of the community's preferences for that good. First, the biophysical information relating water purchases to environmental outcomes is mostly poorly defined. Second, there have been only a small number of community demand estimation studies that have focussed on the environmental benefits of rivers. (Bennett, sub. 7, p. 1)
>
> As now conceived and implemented, the buyback program allows no opportunity for expression of individual, group or local preferences for environmental projects — nor financial contributions. (Watson, sub. 11, p. 1)
>
> There should be a defendable scientific multi stage approach to determine a range of environmental outcomes supported by broad community input. (The Goulburn Valley Environment Group Inc., sub. 21, p. 1)

Economics provides a conceptual framework for allocating water to maximise the overall benefits to the community (section 4.1), as well as quantitative methods to better understand the benefits and costs of different water allocations.

Quantitative methods

Where there is a water market, the cost of allocating water to the environment is generally easy to measure. The market price reflects the marginal value of water to irrigators and other consumptive users. Unless there are substantial distortions, or price changes as a result of the buyback, the expenditure on buying water allocations and entitlements in the market provides a reasonable estimate of the cost to the community of withdrawing that water from agricultural uses (Boardman et al. 2001). By contrast, it can be exceedingly difficult to measure the benefits of allocating water to the environment (box 4.10). This is because these values are generally not revealed by markets.

Box 4.10 **Conceptual issues in economic valuation**

Economic valuation is inherently anthropocentric — an environmental change that makes no contribution to people's wellbeing (taking future generations into account) would not be considered. Economics takes a 'triple-bottom-line' approach. Healthier rivers might increase agricultural incomes and benefit indigenous communities who have a cultural attachment to the river. These benefits are given equal conceptual standing, as are non-use values, such as the benefits that people receive from knowing that an ecosystem is healthy (even if they never visit). Community values are based on an aggregation of individual values.

There are a number of ways to formally estimate non-market values:

- Simulation modelling might be used to estimate physical changes in river salinity as a result of increased environmental flows, and subsequent changes in agricultural income.
- Revealed preference methods use statistical analysis to estimate non-market values from peoples' behaviour. For example, under the travel cost method, basic survey data — how often do you visit a site, where do you come from, and so on — can be used to estimate the recreational value of an environmental asset.
- Stated preference studies, like contingent valuation and choice modelling, people are presented with a hypothetical situation where they are asked to make tradeoffs between the condition of an environmental asset and other things. For example, someone might be asked how much additional tax they would be prepared to pay to return a wetland to its natural condition.

While these methods have been applied widely[1], they suffer from a number of limitations. Simulation models and revealed preference methods can not estimate 'non-use values'. In addition, simulation models typically require detailed and complex hydrologic, agronomic and economic information. Revealed preference methods rely heavily on statistical inference, which can sometimes be unreliable, while stated preference methods suffer from the hypothetical and sometimes unfamiliar nature of the problem presented to survey respondents.

Another limitation is that non-market valuation studies are generally situation-specific. For example, a simulation modelling project might examine the impact on agricultural incomes (via water quality) of a 100 GL allocation to an environmental ecosystem. However, the benefits from a 200 GL allocation may not be immediately obvious. How these benefits might change over time is also unclear. More importantly, the benefits associated with a change in the condition of an environmental asset may not reveal much about the benefits associated with changes in the condition of other environmental assets. This matters because there are thousands of environmental assets in the Basin, and hence, understanding the benefits of changes to, say, 20 environmental assets through non-market valuation is likely to be of limited immediate value to decision makers in their larger water allocation task.

Non-market valuation can be expensive and should only be conducted when the benefits of undertaking such analysis are likely to justify the costs. This is most likely when making decisions regarding key environmental assets, such as the Lower Lakes, where the gains from improved decision making are likely to be substantial. Non-market valuation could also be worthwhile where it contributes to a better understanding of the value of other environmental changes. Quantitative methods like meta analysis can be used to partially overcome the situation-specific nature of non-market valuation studies by examining why some environmental changes are more valuable than others. This allows the analyst to apply the values from one situation to another, with appropriate adjustments for any differences.

While non-market valuation has serious drawbacks, and is unlikely to eliminate the need for people to use sound judgment in allocating environmental water, it can help decision makers better understand the benefits and costs of environmental watering. The government might also be able to collect information on various proxies (for non-market values). For example, it might assemble existing information on the number of visitors to environmental assets in the Basin, or survey people in Basin towns about what environmental assets they value most highly. While not generating numerical estimates, this would nevertheless help

1 See Dyack et al. (2007) and Bennett (2008) for recent applications to the Basin.

decision makers, and might be less expensive and more comprehensive than ‘formal’ non-market valuation studies.

Multi-Criteria Analysis (MCA) is an alternative to cost-benefit analysis. Under MCA, a decision maker typically assigns weights to different environmental outcomes, resulting in a (environmental) benefits index. For example, a thousand frogs might be worth one point, while a thousand birds might be worth two points. With these assumptions, a project that saves two thousand birds would be preferred to a project that saves three thousand frogs. Unlike cost-benefit analysis, the values used in MCA are imposed by the decision maker, and may not sufficiently take community preferences into account. That said, it may be more transparent than existing systems.

What does this mean in practice?

Defining environmental priorities requires scientific information on the ecological responses to different environmental watering regimes. This is a necessary initial step to understanding the benefits of environmental watering to the community. Horne et al. (2009) argue that, while there are difficulties in determining the response curves to environmental flows, it is worth persevering because even relatively crude assessments should lead to improved outcomes compared with current environmental allocation methods. Analysis of the benefits and costs of proposed watering actions should be undertaken to prioritise competing environmental uses of water, with consideration given to community preferences for different environmental outcomes (box 4.11).

FINDING 4.2

Decisions on allocating water between competing uses in the Basin should be based on good science. But the values the community attaches to alternative uses are also crucial in achieving the best outcomes for Australia. Difficult tradeoffs are required between different environmental outcomes, and between environmental and consumptive outcomes.

Box 4.11 **A hypothetical cost-benefit analysis**

Suppose that the government is considering devoting 100 ML of entitlements to a wetland. If the market price of entitlements is $2 500 per ML, the estimated cost would be $250 000.

On the benefits side, the science might suggest that the allocation would maintain the wetland's condition, while it would die without the additional water. It might also improve the health of the local river, but no quantitative information is available. Suppose that around 35 per cent of people in the local town nominated the wetland as an important environmental asset, while a non-market valuation study estimated the recreational benefits of a similar wetland to be $100 000.

In this framework, the benefits and costs (both quantified and unquantified) might then be considered alongside the governments' other objectives, and a decision made.

5 Assessment framework

Key points

- The relative merits of the policy options for recovering water for the environment should be assessed against a common assessment framework incorporating the criteria of effectiveness and efficiency.
- Effectiveness reflects how well a policy mechanism achieves its objectives and is assessed using the following policy design criteria: clearly formulated objectives; targeting of the objectives; and budgetary cost effectiveness. The institutional and social impediments to implementation will also influence effectiveness.
- Efficiency involves maximising the wellbeing of the community through improving the way resources are allocated and used. It can be presented in a cost–benefit framework, where the costs and benefits are broadly defined to include environmental and social impacts. Efficiency also has a dynamic dimension.
- Efficiency may be improved by reducing the transaction and opportunity costs of the acquisitions, while maintaining or increasing effectiveness.
- Water recovery policy is likely to create winners and losers at both the sectoral and regional levels. However, the distributional effects are complex, difficult to disentangle from external factors, and often ambiguous.
- The impact of the water buyback on water markets will be largely determined by the volume of water shifted from consumptive to environmental use. However, other factors also play a role, including: the transparency in the setting of policy objectives and the Government's purchasing activity; the choice of a purchase mechanism that minimises transaction costs; and the pace of the buyback.

This chapter outlines the range of policy options for recovering water that will be considered in subsequent chapters and presents a common assessment framework that will be applied in assessing their merits.

5.1 Breaking down water recovery into policy design questions

A policy to recover water for the environment could be conceptualised as a set of policy design questions that would apply broadly to all forms of water recovery. The issues that need to be resolved are:

- **The volume, frequency and location of the water needed to meet environmental demands** — this involves identifying and prioritising environmental demands and incorporating these into the valuation of the water to be acquired (chapter 4).
- **Choice of product** — this involves deciding what property or contractual right should be acquired to deliver the environmental objectives. The range of options includes:
  - acquiring an existing water product, such as water entitlements and seasonal allocations, or developing and acquiring new water products, such as options contracts or contractual variations to water licence conditions
  - acquiring environmental outcomes directly, through contracts for environmental services (chapter 7).
- **Design of the acquisition mechanism** — this involves determining the method and geographic locations of the water recovery. Possible acquisition methods include:
  - administrative approaches to acquiring water
  - targeting a particular method for water recovery, such as investment in irrigation infrastructure
  - market-based approaches using mechanisms, such as existing market exchanges or various forms of tenders (chapters 6 and 8).
- **Determining the sequencing and pace of the acquisition** (chapters 6 and 8).
- **Determining appropriate governance arrangements for the various components of the policy** (chapter 9).

In order to assess the relative merit of the various policy options, a common assessment framework is required. In developing the framework, the Commission has predominantly used the criteria of effectiveness and efficiency, but has also considered the social and spatial distribution of the likely impacts.

5.2 Effectiveness

Effectiveness refers to how well a policy mechanism achieves its intended outcome, and can be assessed using the following criteria:

- clearly formulated objectives
- accurate targeting of the objectives
- budgetary cost effectiveness
- institutional or social impediments to implementation of the policy option that might impede effectiveness.

Clearly formulated objectives

In order for a policy to be effective and efficient it needs to be underpinned by clear, measurable objectives (the perceived objectives of the Australian Government's programs for recovering water were discussed in chapter one). The objectives should be formulated in a way that does not unduly restrict the range of options to address them, but be sufficiently specific to allow direct targeting and subsequent assessment of the policy.

Another important requirement is that the objectives are internally consistent. When it is impossible to achieve the objectives simultaneously, the necessity of tradeoffs between those objectives should be acknowledged and some guidance needs to be given on how to approach those tradeoffs. For example, if a policy has dual objectives of maximising environmental benefits and facilitating structural adjustment, it can be unclear how conflicts between these objectives should be resolved, and where the balance between the environmental and social outcomes should lie.

Targeting of the objectives

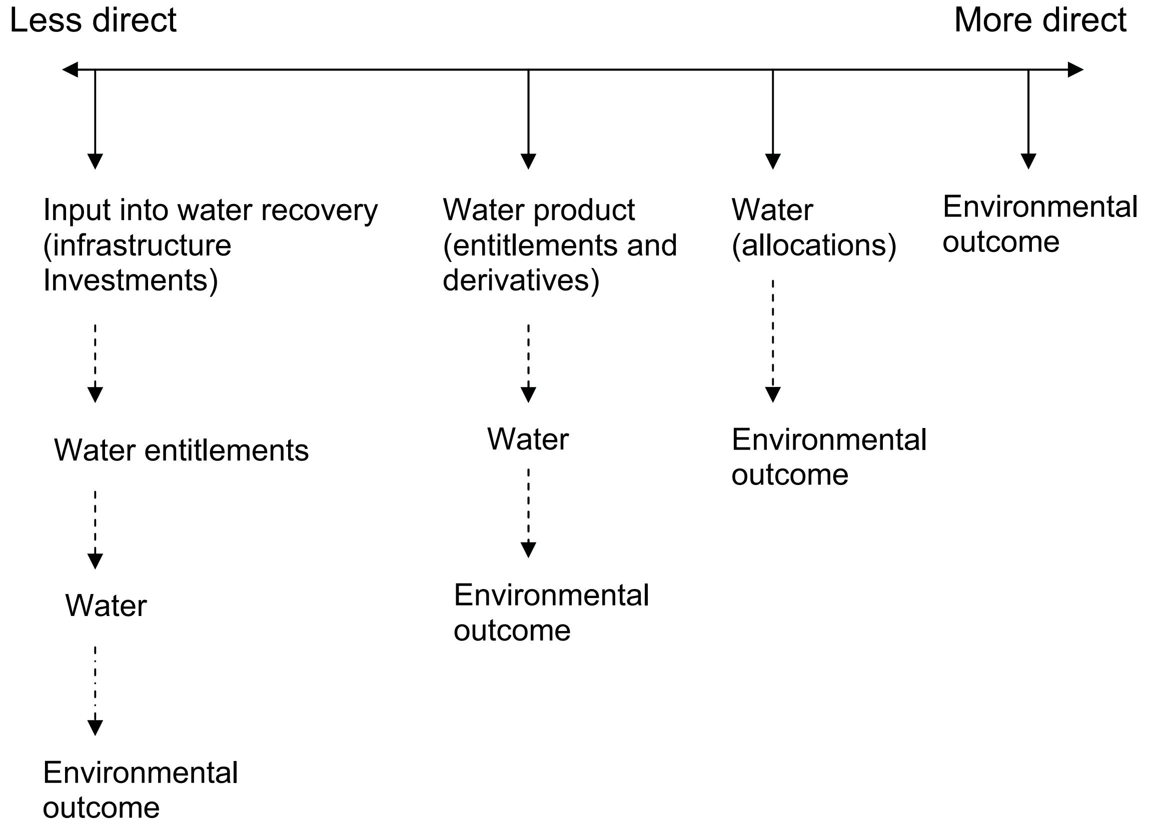
Matching policy instruments to policy objectives

When a policy has multiple unrelated objectives an issue arises of whether these should be addressed through a single policy instrument, or whether multiple instruments are needed. In some cases a policy instrument may contribute to the achievement of several objectives. However, that policy instrument is unlikely to be the most effective and efficient way of addressing each of those objectives. Typically, a more direct approach of matching individual policy instruments to specific objectives is more effective and efficient. Where a policy instrument is used to pursue several unrelated objectives, its effectiveness and efficiency in achieving each of those objectives should be assessed against more direct policy instruments.

Direct targeting of outcomes

Water could be recovered for the environment through a range of means, some of which are more directly linked to the environmental outcomes than others (figure 5.1).

Figure 5.1 Alignment of the policy output with the environmental objectives



Focusing the policy on inputs that are only indirectly linked to the policy objectives could reduce effectiveness because of uncertainty about the causal linkages between the policy and the objectives, and the contribution of other factors to the outcome. For example, the achievement of an environmental outcome through the acquisition of water could be undermined by other factors such as land management practices. This is not to say that the closest alignment of the policy output with the outcome would necessarily be preferred in all circumstances. There may be implementation difficulties or costs associated with such an approach that could make it impractical.

Spatial and temporal targeting

To achieve an environmental outcome, the acquisition of the water (or similar) product should target the location and timing of the environmental demand. Spatial targeting depends on the location of water acquisitions (keeping in mind the hydrological connectivity and the potential for the same water to deliver environmental benefits in two or more locations).

Temporal targeting depends largely on the choice of product and the mechanism of acquisition. For example, some water products might be best matched to environmental demands that are constant over time, while others could be better aligned with periodic and highly variable environmental demands. The time taken to finalise the acquisition, both due to the choice of product and the mechanism of acquisition, also influences the effectiveness of temporal targeting. For example, some water products, such as infrastructure improvements, take longer to deliver water than others, such as seasonal allocations. Similarly, various acquisition methods differ in their timeliness.

Effect of uncertainty — the need for adaptive management

Various aspects of environmental water recovery are characterised by considerable uncertainty. There is uncertainty about:

- the environmental science, including the location and extent of environmental problems to be addressed and the causal links between the time and form of environmental watering and environmental outcomes
- deliverability of water to areas of environmental need, due to hydrological and institutional constraints
- how the community values particular environmental outcomes
- future climatic conditions that could influence the volume and economic value of the water allocated to consumptive and environmental uses.

In view of this, much of the water recovery policy will need to respond to new knowledge as it arises. It is, therefore, important that the water recovery policy remains flexible by:

- allowing for an iterative approach to reducing uncertainty through experimentation
- minimising the consequences of mistakes that result from imperfect knowledge, by facilitating timely and low-cost adjustment in response to new information.

The pace of water recovery could influence the capacity of the policy to engage in and benefit from experimentation. The choice of water products influences the cost and timeliness of adjusting to new knowledge.

Budgetary cost effectiveness

Budget constraints mean that budgetary cost effectiveness is an important consideration in selecting between the available options. Budgetary cost effectiveness is improved by reducing the financial cost to a government of acquiring a unit of environmental benefit (thus releasing budget funds to acquire additional benefits).

Institutional impediments to implementation

The effectiveness of particular water acquisition options depends on whether there are any institutional or social constraints to their implementation. Potential institutional impediments include the various administrative and legal constraints on trade imposed by the irrigation infrastructure operators and jurisdictions, and the implications of the way the water property rights are defined.

In most instances the preferred approach is to address directly any institutional constraints on trade (chapter 10). However, where this can not be done in a timely manner, a second-best approach of addressing these constraints is through the design of the water recovery policy. For example, the geographic targeting, pace of the acquisitions, and the choice of product (where the constraints apply to particular products, such as water entitlements) may be affected.

The institutional settings governing property rights have a direct bearing on the choice of product and could also influence the mechanism of acquisition. For example, acquisition of volume-based water products may be an ineffective, or at least insufficient, strategy in the Northern Basin, where many entitlements are flow based. And different acquisition mechanisms may be needed to acquire water in regulated and unregulated systems.

A separate institutional consideration is the governance structures applying to the water acquisition policy itself. Effective governance requires that:

- the responsibility for components of the policy task is allocated to agencies best equipped to deliver them, taking into account the relevant skills, expertise and administrative costs, as well as potential conflicts of interest
- adequate arrangements are in place to ensure accountability.

The choice of governance model may have substantial implications for the way the water recovery policy is implemented (chapter 9).

Social impediments to implementation

Water recovery policy may also generate some adverse regional or sectoral impacts (discussed below), which could lead to social resistance to the policy. In the case of water purchases from willing sellers, this may manifest itself in few willing sellers or in sellers demanding a price premium. In the case of administrative acquisitions, social resistance might give rise to litigation (for example, due to disputes over compensation). The potential capacity of the water acquisition policy to address distributional issues — which may be a source of possible social resistance — is discussed in chapter 8. Nevertheless, some of this resistance could also be reduced by improving other aspects of the policy. For example, greater community acceptance might be achieved by clear formulation and communication of the objectives of water acquisitions, particularly if some of those objectives are consistent with community preferences, and other supporting instruments are used more directly to address social issues.

5.3 Efficiency

An efficient policy is one that maximises the wellbeing of the community through improving the way resources are allocated and used. One way to assess efficiency is through a cost–benefit analysis. The costs and benefits should be broadly defined to incorporate all benefits and costs including environmental and social impacts. Maximising the net benefit involves acquiring water for environmental use up to the point at which the benefit of acquiring an additional unit of water is equal to the cost of shifting that water from its current use. In practice, this task is difficult, due to information problems, in particular poor scientific knowledge and the difficulty of revealing the community's willingness to pay for environmental benefits. Because of this, in some cases, analysis may need to be limited to assessing the relative efficiency of policy alternatives.

Benefits

Chapter 4 describes the various types of environmental benefits that could result from water acquisitions and identifies the difficulties in valuing the environmental benefits to determine the efficient balance between environmental and consumptive uses of water.

It is important that any water acquisition policy recognises that the environmental benefits to the community of acquiring water depend on a multitude of factors (some of which have been identified in chapter 4) and that these are incorporated to the greatest practical extent in the decision to acquire the water.

Environmental benefits can also be increased through addressing the policy design criteria for achieving effectiveness, formulated above. Much of the discussion in subsequent chapters will focus on this avenue for increasing environmental benefits.

Another way of improving the efficiency of the policy is through reducing its cost to the community, for a given quantity of benefit.

Costs

The costs to the community of water acquisitions can be broadly categorised into transaction and opportunity costs.

Transaction costs

Transaction costs are the costs incurred by the relevant parties in initiating, negotiating and finalising transactions. The nature of the costs depends on whether the water is acquired through a market-based instrument, or administratively, and whether the water is acquired directly, or through investment in infrastructure.

In the case of water purchases, transaction costs include the administrative costs incurred by the Australian Government in setting up and running the purchase scheme, the administrative costs of the relevant state government agencies and utilities in processing conveyance applications, and the negotiation and conveyance costs to the current holders of water rights. The costs are primarily influenced by:

- the type of product acquired — costs could vary depending on:
  - whether the product is permanent (requiring a single transaction) or temporary (requiring multiple ongoing transactions)
  - whether the product is currently traded in the market (allowing the utilisation of existing institutions and knowledge) or new (creating the need to educate the participants)
  - how complex the product is and how prone it is to information asymmetries (these could give rise to wasteful rent-seeking during negotiation).
- the purchase mechanism and the governance arrangements underpinning the acquisition.

In the case of administrative acquisition of water rights, transaction costs include:

- the cost to the Government and affected water right holders of negotiating compensation, where applicable (including the potential litigation costs)
- the cost to the Government of administering the acquisition.

In the case of less direct water acquisitions undertaken outside of the water market, such as through infrastructure investments, the transaction costs include:

- the administrative costs to the Government of assessing proposals and monitoring and enforcing compliance with successful proposals
- the administrative costs of the relevant state planning and environmental agencies in assessing applications
- the cost to the relevant parties of preparing proposals, and (if the proposal is successful), the costs of obtaining planning approvals and of demonstrating compliance with the terms of the proposal.

Opportunity costs

Opportunity costs are the value of the best alternative use of resources that are foregone in pursuing a policy. In the context of water purchases for the environment, the opportunity cost would be the value of that water in its most valued alternative use. In efficient markets, this would be reflected in its market price. In the case of indirect water acquisitions, such as through infrastructure upgrades, the opportunity cost would be the financial cost of the investment.

Several factors will influence the opportunity costs of water acquisitions including:

- the volume of the water acquired
- type of product acquired — costs would vary depending on:
  - whether the product acquired is a water product, an input into the recovery of water (such as infrastructure investment) or a composite of the water and other contractual or property rights (such as in joint acquisitions of water entitlements and land or in direct acquisitions of environmental outcomes)
  - whether the product is temporary or permanent in nature and whether it is flexible in adjusting to new knowledge about the costs and benefits of the water
  - whether the parties to the transaction value any other characteristics of the water product that are not related to the volume of water. For example, high reliability water entitlements are often valued by irrigators as a price risk management tool against fluctuations in water prices

- the mechanism of acquisition — assuming the environmental and other benefits are not affected by the choice, the water should be acquired from those that place the lowest value on their water. The ability to identify such water users is largely dependent on the design of the acquisition mechanism
- pace of water acquisition — a slower pace of acquisition may improve adjustment opportunities for the sellers (particularly if they have fixed assets) and hence, reduce the cost to them of parting with their water rights
- the presence of third-party effects — shifting the water from consumptive to environmental use may result in external costs or benefits that are not reflected in the market price of the water. These may include environmental effects such as salinity impacts.

While the acquisition of water by the Government may impose greater than optimal opportunity costs on the community at the outset, over time some of these costs may be mitigated through subsequent trade in the water market. For example, if the Government purchases water from sellers who value water more highly than others in the market, those sellers would be likely to engage in secondary trade to buy back water from those that place a lower value on it. This would ensure that the water again moves to its highest value use, subject to the transaction costs of trading. Similarly, if a greater than optimal volume of water is acquired, the Government may subsequently sell some surplus water back on the market. Nevertheless, such secondary trade would likely be subject to delays and various transaction costs, particularly in catchments that have a thin water market. It is, therefore, desirable for the Government to seek to minimise the opportunity cost of the water acquisitions at the outset.

Achieving dynamic efficiency

Dynamic efficiency refers to achieving an efficient allocation of resources over time. There are two contexts in which dynamic efficiency is relevant to water recovery policy:

- the degree to which the Government influences community expectations of future policy — the sovereign risk component
- the degree to which the policy facilitates or hinders the future ability of the community to adapt to changed economic and climatic conditions.

In the case of the former, it is important that community investment decisions are informed by the best possible knowledge of current and future Government policy. This underscores the importance of clearly defined and transparent policy objectives. It is also important that the Government considers the implications of its policy on long-term community perceptions of sovereign risk. For instance, an uncompensated compulsory acquisition of a privately-held asset may come at low administrative cost and may even be efficient in the short run. However, this policy is likely to adversely affect the private incentives for future investment in similar assets.

In the case of the second point, Government policy should not work against or introduce any impediments to future structural adjustment. The status quo should not be automatically pursued as an end objective, because the existing economic structure is unlikely to be the most efficient one under future (unknowable) conditions.

Coordination of policy mechanisms to improve effectiveness and efficiency

Coordination of the various policies that recover water for the environment in a way that maximises their synergies is important to achieve effectiveness and efficiency. There are two potential approaches to coordination. Under the first approach, the existing mix of the policy mechanisms is assumed to be fixed, and coordination for the most part involves managing the geographic location and pace of implementation of those mechanisms. The weakness of this approach is in the assumption that the instruments in the current mix are compatible and that the current set of policy instruments is optimal.

Under an alternative approach, which is preferred by the Commission, coordination of the implementation of the different instruments is preceded by an assessment of all of the policy instruments against a common assessment framework. This approach is itself likely to improve the compatibility of the different policy instruments. It would allow the identification of the most effective and efficient policy instruments, potential fields of application of particular instruments, and the efficiency and effectiveness tradeoffs between the instruments.

5.4 Distribution of impacts

A policy to recover water could impose costs on particular groups in the community even when it leads to an overall net community benefit. If one of the objectives of government policy is the achievement of an equitable distribution of costs and benefits in the community, the distribution of the impacts of the policy becomes an important consideration. This section outlines the distribution of impacts on the various affected groups including irrigators, regional communities and the broader community.

Impacts on irrigators

The impacts of water recovery on irrigators differ depending on whether the water is recovered through a buyback, through administrative means, or via investment in irrigation infrastructure.

The impacts on irrigators from a buyback

The buyback of entitlements could impact individual irrigators in three ways. First, a policy to purchase water for the environment from current holders of water entitlements introduces an additional demand on water and hence, would increase the price of water (whether in the form of water entitlements or seasonal allocations). The impacts on particular irrigators of this price increase are complex and ambiguous. Whether an individual irrigator benefits or incurs a cost depends on their initial permanent water holding and on whether the water acquisition changes their activity in the water market from being a net purchaser to a net seller of water.

Thus, the buyback could impose a cost on irrigators that held few entitlements and relied largely on purchasing seasonal allocations. However, for irrigators that relied largely on their entitlements prior to the buyback, the buyback presents a clear opportunity to benefit from the higher price of their asset. This opportunity would be particularly important for the many irrigators currently facing cash flow problems and/or the pressures of high debt levels.

The second impact arises from irrigators exiting their irrigation area and potentially increasing the cost of servicing fixed infrastructure for irrigators that remain in the system. (In an extreme scenario, the remaining irrigators may not be able to meet the increased cost and so would exit the system, leaving irrigation infrastructure assets stranded.) However, these costs would be mitigated by the termination fees levied by infrastructure operators (chapter 10) and the ability to decommission some infrastructure following a reduction in delivery needs.

Finally, some of the environmental benefits arising from water recovery policy, such as improved productivity due to better water quality, would be local in nature. These would accrue largely to the irrigators, rather than the broader community.

The impacts on irrigators from administrative acquisition of water

The impacts on irrigators whose water is administratively acquired will depend on whether those irrigators are compensated and to what extent. Where there is no compensation, a cost will be incurred by irrigators whose water holdings have been reduced, while for compensated acquisitions, the impact would depend on the size of the compensation relative to the value of the water to the irrigator.

The acquisition would reduce the volume of water available for consumptive use and increase the price of water entitlements and seasonal allocations in subsequent private trade. As in the case of the buyback, the impacts from this price increase on particular irrigators would depend on their remaining water holding and on whether the increase in the price is sufficient to influence them to sell their water in the water market.

Further, similarly to the buyback, there may be increased infrastructure costs faced by remaining irrigators, and there may also be localised environmental benefits captured by irrigators, from improved water or soil quality.

The impacts on irrigators from investments in infrastructure

The distribution of the impacts on irrigators from water recovery through investments in infrastructure could differ from that of direct water acquisitions (whether administrative or market based). To the extent that the investments are subsidised and participation is voluntary for the irrigators (or irrigation infrastructure operators), those that participate would be expected to derive a benefit. The size of this benefit would depend on whether the Government subsidy includes a premium over what the irrigator would have been willing to accept to undertake the investment.

Impacts on regional communities

Irrigators are a part of regional communities, so the positive and negative impacts (as well as all the uncertainties associated with them) on irrigators are a part of the regional level impacts.

In addition to the direct impacts on irrigators, there could be indirect impacts on regional businesses that service irrigated agriculture and that are likely to experience a reduction in demand for their services if there is a contraction in irrigated agriculture due to reduced supply or higher cost of irrigation water. These negative impacts may lead to flow-on effects, where other businesses providing inputs into the production of the initially-affected business are also adversely affected.

There may also be benefits accruing to regional communities from irrigators investing some or all of the proceeds from the sale of their water back into the region, either in the form of increased consumption or as business investment. In addition, some of the environmental benefits of the acquisitions, such as an increase in the recreational value of environmental assets, may be experienced at the regional level. If the flow-on effects of the negative impacts are included in assessments of regional impacts, the flow-on effects of these benefits would also need to be included (appendix D).

Overall, much of the impact of water acquisition on regional communities is indirect and ambiguous and depends on:

- the net impact on irrigated agriculture in the region
- the share of irrigated agriculture in aggregate regional production
- the extent to which irrigated agriculture relies on regional production for its inputs
- how the proceeds from selling water and/or compensation are used
- the distribution of the environmental benefits of the acquisition.

Impacts on the broader community

Water recovery policy will result in both costs and benefits for the broader community. Taxpayers will cover the budgetary cost of the water acquisitions, (including the cost of raising the tax revenue). The benefits to the broader community will be in the form of the environmental benefits generated by the acquisitions.

To summarise, assessing the distribution of the impacts from environmental water recovery is complex. There could be both positive and negative impacts at the irrigator and regional levels and much would depend on factors outside of the control of the water recovery policy.

5.5 Impact on the water market

The terms of reference for this study require the Commission to consider the impact of the buyback on water markets. Of importance is whether and how the design of the buyback can be modified to mitigate any adverse impacts. The relevance of the various aspects of the design of the buyback is outlined below.

Choice of water product

The water markets have given rise to a range of water products, and new products may be developed as a consequence of the buyback. However, the underlying asset behind all of those products is the right to take and use water. In this context, the prices of all products that give rights to the same water will be interconnected, and will move together, depending on changes to the supply of, and the demand for, water. Consequently, it is the volume of the water acquired for environmental use at any given time, relative to the water available, that would have the biggest influence on prices in water markets, not whether the water was acquired through a particular product.

For example, the purchase of a water entitlement yielding a series of seasonal allocations into the future, would have a similar effect on the prices of all water products to a yearly acquisition of the same volume of water in the seasonal allocation market. This is because in the two cases, the same volume of water would be shifted from consumptive to environmental use.

Choice of purchase mechanism

The key factor influencing water prices is the volume of water shifted from consumptive to environmental use, and the choice of purchase mechanism in the buyback is unlikely to directly affect the prices in the water markets. However, the design of the buyback mechanism can still have an indirect effect by influencing the transaction costs faced by market participants. If the buyback introduces substantial uncertainty about the current market price of water (for example, through utilising a mechanism that keeps prices secret and delays the execution of trades) this could increase transaction costs for all buyers and sellers in the water markets. Conversely, a buyback that utilised existing market platforms could 'deepen' the markets (improving the information about the current price of water) and foster the development of private intermediaries and exchanges. This could reduce the transaction costs of all market participants (chapter 8).

Pace of the buyback

One feature of the buyback that could influence the impact on water markets is the pace of the purchasing. A faster pace could hamper the ability of the irrigators to adjust their production practices to using less water, particularly if those irrigators have fixed assets that would need to be abandoned as a consequence. In turn, this may result in irrigators demanding a higher price for the water they sell (chapter 8).

The need for transparency

Finally, as in other markets, the expectations of participants in the water market play a significant role in the functioning of the market, and it is important that the buyback accurately informs those expectations. This would necessitate the greatest possible transparency from the Australian Government in formulating and communicating to the market the environmental watering demands, and the extent to which particular purchases of water address those demands.

6 Recovering water through non-market means

Key points

- Water for the environment can be recovered through market means (for example, purchases from willing sellers) or non-market means (for example, uncompensated administrative decisions, compulsory acquisition and funding infrastructure upgrades). The best approach to take varies according to the circumstances.
- Current arrangements require water users to bear the cost of reductions in water availability in some cases, including where climate change reduces inflows. Uncompensated administrative decisions to reduce consumptive use of water are appropriate in these cases.
- Recovering water through compulsory acquisition does not appear to offer any significant advantages over purchasing water from willing sellers in regulated systems, but it does have disadvantages (including that it does not target irrigators who value their water least). Compulsory changes to entitlement conditions, accompanied by compensation, may have a role to play in unregulated systems.
- The *Water Act 2007* (Cwlth) appears to require the overall proportion of water allocated to the environment to be determined without explicitly taking into account the values that the Australian community places on environmental outcomes, the opportunity cost of water or the role of other inputs such as land management.
- Decisions about irrigation infrastructure investments and their funding are best left to irrigators, irrigation infrastructure operators and their financiers.
- Funding infrastructure upgrades is generally not a cost-effective way for governments to recover water for the environment. It is also likely to be inefficient and inequitable.
- Government programs to recover water through funding infrastructure, such as the Sustainable Rural Water Use and Infrastructure (SRWUI) program, can cause a range of problems, including: upgrading infrastructure that subsequently becomes underutilised; and decreasing reliability for water users downstream from the project area (by limiting return flows).
- Rigorous approval processes should be applied to all projects under the SRWUI program. This is likely to result in the budget being underspent. This money should either be reallocated to Restoring the Balance or to other government priorities.

While this study is primarily about market-based mechanisms for recovering water for the environment, it is important also to consider non-market approaches for two reasons. First, the Restoring the Balance program is being implemented within a broader policy agenda that includes non-market water recovery (through government funding for infrastructure upgrades and the Basin Plan). This chapter looks at the implications of these broader plans for market-based water recovery.

Second, the terms of reference ask the Commission to identify effective, efficient and appropriate market mechanisms for purchasing water entitlements. To meet these criteria, a market mechanism needs to be superior to other methods, including non-market methods that could be used instead. Accordingly, this chapter assesses non-market approaches and identifies the circumstances under which it is appropriate to use them.

6.1 Administrative approaches

In Australia, governments set the rules for the operation of water markets and one aspect of this is specifying environmental water allocations. As explained in chapter 2, this is achieved at present mainly through a cap on water extractions from the Basin and state-based water plans (in some cases these plans provide entitlements for specific environmental assets). The amount and proportion of water allocated to the environment via these processes vary according to how wet the year is and other factors. This section discusses altering these rules to recover extra water for the environment.

Recovering water through administrative approaches

Once a decision has been made to increase the amount of water for the environment, there are various types of administrative approaches that can be used to reduce the consumptive use of water. These are summarised in table 6.1 and those relating to regulated and unregulated river systems are explained in greater detail below.

In regulated systems, the simplest approach is to allocate less water per entitlement in years when water is scarce, or in all years if that is deemed necessary. This would result in seasonal allocations being lower on average than they would have been otherwise, because a smaller pool is shared across a given number of entitlements. This approach reduces the average reliability of entitlements, but not necessarily the maximum quantity that can be delivered against them. For example, the original maximum might still be achieved in wet years (figure 6.1, option 1). Note that climate change may result in the reliability of entitlements decreasing without any administrative recovery of water.

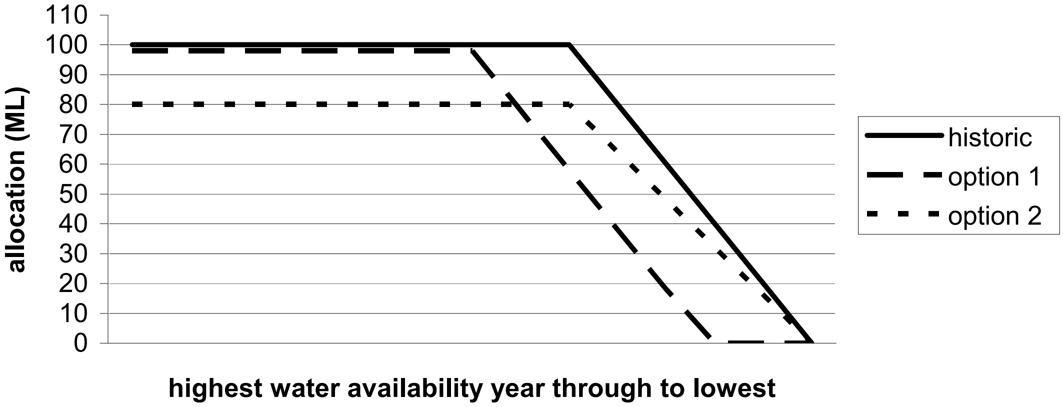
Table 6.1 **Administrative approaches to recovering water**

Type of system	*Possible administrative approaches*
Regulated river systems	• allocate less per entitlement (eg. when water is scarce) • reset entitlements to a lower level (with or without transfer of entitlements to the environment)
Unregulated river systems	• change flow-based rules • reset entitlements to a lower level
Overland flows	• place greater restrictions on the structures that can be built to harvest overland flows • introduce or tighten licence controls on the volume of water that may be harvested
Groundwater	• reset entitlements to a lower level

A second approach is to adapt to a reduced consumptive pool by resetting entitlements to a lower level. For example, a 100 megalitre (ML) entitlement could be reset to 80 ML. Entitlements would then be allocated a quantity of water each year that was lower than it would have been if the resetting had not occurred (figure 6.1, option 2). One variation on this approach is to transfer a proportion of consumptive-use entitlements to an environmental manager. These environmental entitlements would then be allocated water according to the same rules applied to other entitlements. This method, when combined with compensation, is usually what is meant by compulsory acquisition of water entitlements.

Figure 6.1 **Options for administratively recovering water**[a]

Regulated systems



[a] In this example, prior to recovery there is 100 ML of entitlement and allocations of 100 per cent in about 70 per cent of years. Note that variations on the two options shown are possible.

The first option, which reduces entitlement reliability, and the second, which reduces the maximum entitlement volume, can be calibrated so as to provide the same average split between consumptive and environmental water, but with some year to year differences. The choice between them, therefore, would normally be made taking into account which option resulted in the most fit-for-purpose entitlements for irrigators and the temporal variations in environmental water demand. For example, if irrigators were generally of the view that the reliability they were accustomed to was well suited to their businesses they would tend to favour the second option.

The approaches that could be used in unregulated systems are somewhat different. Water entitlements (or licences) in such systems are supplied from the flow of rivers (rather than from water held in storages) and are generally subject to flow-based rules governing when and how much water can be taken. One approach to recovering water in these systems is to make the flow-based rules more restrictive. For example, increasing the flow rate or river height at which water is allowed to be taken, or by creating multiple flow-rate thresholds. An alternative is to reset the volumetric limits of entitlements in a similar way to that described above for regulated systems. For unregulated systems, however, this only reduces consumptive use (and increases environmental flows) in some years. This is because holders of such entitlements are usually only able to take close to their full entitlement quantity in relatively wet years, due to the flow-based rules.

For each of the administrative approaches described, there are further options relating to:

- timing — should changes be made immediately or delayed until the scheduled expiry of water plans?
- compensation — should compensation be paid to entitlement holders, and if so, how much?
- targeting — should the approach be applied equally across all entitlement holders, or targeted based on: location; use to which water is currently being put; or other criteria?

Plans to use these approaches

Administrative approaches have been used to recover water for the environment to a limited extent in recent years. The National Water Commission reported that such approaches have been used successfully in South Australia to address overallocation and overuse (NWC 2009b). Another example is the Goulburn-Murray Water Recovery package, which has been assessed as recovering 120 gigalitre on a long-term cap equivalent basis. As explained in box 6.1, this was a complex arrangement that involved the creation of a new type of water entitlement, a proportion of which was allocated to the environment, and compensation (some of which was provided in the form of upgrades to infrastructure). As discussed in chapter 2, there are also recent examples of governments reducing allocations of water to the environment through administrative decisions to suspend water plans.

For the next few years, the focus will be on recovering water through purchases and infrastructure upgrades under Water for the Future. Administrative approaches are, however, likely to be used as the Basin planning process unfolds.

The Basin Plan will set sustainable diversion limits (SDLs) for each of the water resource plan areas that make up the Basin (the boundaries of these areas often align with catchment boundaries). The Basin Plan (through the SDLs) will set the water recovery task, but will not specify the means for recovering water. At present, water purchases and infrastructure upgrades are being used in anticipation that there will be substantial gaps between current diversions and the new SDLs. This underpins the 'no regrets' approach adopted by the Department of the Environment, Water, Heritage and the Arts (DEWHA):

> Water entitlements are being purchased using a conservative 'no regrets' approach ahead of the Basin Plan being introduced. This is being done by directing purchases to catchments with the highest environmental need whilst also ensuring that water is not acquired in excess of the estimated reduction in diversions required by the new lower sustainable diversion limits expected in the Basin Plan. (sub. 56, p. 4)

Box 6.1 **Goulburn-Murray Water Recovery Project**

The Goulburn-Murray Water Recovery Project in Victoria involved the creation of a new tradeable, low reliability, water entitlement to replace 'sales water', which was previously made available through administrative decisions. This change was designed to provide greater certainty for irrigators when making investment decisions. Twenty per cent of this new entitlement has been allocated to the environment as a water recovery measure under The Living Murray Initiative. This equates to an estimated increase in water available to the environment of 120 gigalitres per year on a long-term cap equivalent basis. Much of this water will be available to the environment in wetter years (to date no water has been provided). The cost of implementing this measure ($43 million) includes offsets negotiated with stakeholders, such as upgrades of headworks.

Source: MDBC (nd).

The proposed Basin Plan will guide water recovery efforts (including the water purchases that are the focus of this study) from its release in mid-2010. More definitive guidance will be available when the first Basin Plan is approved by the Commonwealth Minister for Water, due in 2011.

Approval of the Basin Plan will not trigger an immediate requirement for diversions to be brought into line with the new SDLs. This is not required until new state water resource plans (which must be consistent with the Basin Plan) are implemented from 2014 (and 2019 in Victoria). Even then, the Basin Plan allows for 'temporary diversion provisions', which may allow diversions to be above the SDLs for a further period of up to 5 years.

Statements by the Commonwealth Minister for Water imply that the water recovered through Water for the Future is unlikely to fully cover the gap between current diversions and the new SDLs (Wong 2009d). This is consistent with the expectations of those study participants who expressed a view on this matter. It is this remaining gap that seems likely to be, at least partly, recovered through administrative means.

At present, there is no definitive information on how this remaining gap will be addressed and decisions on this may not be made until after the Basin Plan is finalised. However, the risk assignment provisions contained in the *Water Act 2007* (Cwlth) go some way to defining the options that may be used (box 6.2). These provisions allow the risks (and by implication, the costs) associated with the gap between current diversions and the new SDLs to be apportioned between water users, state governments and the Australian Government. As discussed later, water recovery through administrative means, without compensation, is appropriate where water users have already agreed to bear the risks.

What are the implications of these plans for market-based water recovery?

The preceding discussion implies that Restoring the Balance is largely a program to assist irrigators and communities with the transition to the Basin Plan. The main implications of this for water purchasing are examined below.

Any deficiencies in the Basin Plan's SDLs will be inherited by the purchase program

Given that DEWHA intend to use the Basin Plan to guide future purchasing decisions, any deficiencies in the plan's SDLs will affect the effectiveness and efficiency of Restoring the Balance. Having examined the available information on

Box 6.2 **Risk assignment**

The National Water Initiative (NWI) contains a risk assignment framework for future reductions in the availability of water for consumptive use. This framework was to apply after states had addressed known overallocation and/or overuse through their water planning processes. The following part of this framework (sometimes referred to as the 'specific NWI risk assignment provisions') is included in the *Water Act 2007* (Cwlth).

> 48. Water access entitlement holders are to bear the risks of any reduction or less reliable water allocation, under their water access entitlements, arising from reductions to the consumptive pool as a result of:
>
> (i) seasonal or long-term changes in climate; and
>
> (ii) periodic natural events such as bushfires and drought.
>
> 49. The risks of any reduction or less reliable water allocation under a water access entitlement, arising as a result of bona fide improvements in the knowledge of water systems' capacity to sustain particular extraction levels are to be borne by users up to 2014. Risks arising under comprehensive water plans commencing or renewed after 2014 are to be shared over each ten year period in the following way:
>
> i) water access entitlement holders to bear the first 3% reduction in water allocation under a water access entitlement;
>
> ii) State/Territory governments and the Commonwealth Government to share one-third and two-thirds respectively reductions in water allocation under water access entitlements of between 3% and 6%; and
>
> iii) State/Territory and Commonwealth governments to equally share reductions in water allocation under water access entitlements greater than 6%.
>
> 50. Governments are to bear the risks of any reduction or less reliable water allocation that is not previously provided for, arising from changes in government policy (for example, new environmental objectives). In such cases, governments may recover this water in accordance with the principles for assessing the most efficient and cost effective measures for water recovery [these principles are set out in a later clause].

The Water Act specifies that these provisions are to be read in conjunction with the July 2008 Agreement on Murray-Darling Basin Reform, which stipulates that for Basin states that choose to apply the above framework, the Commonwealth will assume all of the risk associated with 'new knowledge' above the first 3 per cent (which remains the responsibility of entitlement holders). As this implies, Basin states can choose not to apply this framework. They can do this through the following clause in the NWI.

> 51. Alternatively, the Parties [the governments who have signed the NWI] agree that where affected parties, including water access entitlement holders, environmental stakeholders and the relevant government agree, on a voluntary basis, to a different risk sharing formula to that proposed in paragraphs 48 - 50 above, that this will be an acceptable approach.

The National Water Commission reported:

> New South Wales and the Commonwealth (in the context of the Murray–Darling Basin) are the only jurisdictions that have adopted the specific NWI risk assignment provisions. Queensland and the ACT have stated that they intend to amend legislation to adopt the NWI provisions as a result of recent changes to the *Water Act 2007*. Other jurisdictions have adopted (or intend to adopt) alternative risk assignment approaches, or have not yet decided their approach. (NWC 2009b, p. xi)

how the SDLs will be set, the Commission's main concern in this regard is the lack of a suitable tradeoff framework.

The objects of the Water Act (s. 3), in part state:

> The objects of this Act are … to promote the use and management of the Basin water resources in a way that optimises economic, social and environmental outcomes

However, the Water Act (s. 23) requires the Murray-Darling Basin Authority (MDBA) to set SDLs that 'reflect an environmentally sustainable level of take', where this is defined as follows.

> environmentally sustainable level of take for a water resource means the level at which water can be taken from that water resource which, if exceeded, would compromise:
>
> (a) key environmental assets of the water resource; or
>
> (b) key ecosystem functions of the water resource; or
>
> (c) the productive base of the water resource; or
>
> (d) key environmental outcomes for the water resource. (s. 4)

The Commission's interpretation is that, despite an apparent conflict with the objects of the Act, this means that the allocation of water between environmental and consumptive uses in the Basin will be determined largely on the basis of scientific assessments of what is required to avoid compromising key environmental assets, ecosystem functions, environmental outcomes and the productive base. While the Commission has not sought legal advice on this interpretation it appears to be consistent with the MDBA's issues paper on SDLs (MDBA 2009c). This paper explains that socioeconomic factors will be considered in decisions on the timing of environmental water provision and on the contribution of each valley, but there is no suggestion that these factors will be taken into account in determining the overall allocation of water between environmental and consumptive uses.

As discussed in chapter 4, scientific assessments of how ecosystems and water quality respond to different watering regimes are extremely important, but are an insufficient basis on which to make decisions about environmental water allocations.

More water for the environment means less water for consumptive use and decisions about this tradeoff should take into account the valuations and preferences of the Australian community. As discussed in chapter 4, this is challenging as it requires an assessment of how highly the community values particular environmental outcomes so that these can be weighed up against the opportunity costs of foregone agricultural production. Nonetheless, it is necessary to do this if the net benefits to the community from the Basin's water resources — broadly defined to include environmental and social outcomes — are to be maximised. The ‘science’ has no normative content about what should be done, but rather provides information about the consequences of different choices.

This important, but limited, role for science is widely recognised, including by many in the scientific community. For example, an expert reference panel who reported to the Murray-Darling Basin Ministerial Council on environmental flows and water quality requirements for the River Murray system stated:

> It was not the role of the Expert Reference Panel, or scientists in general, to decide upon the compromise between the competing values of production, ecosystem services and the natural environment. (Jones et al. 2002, p. 4)

There may be no major problem in using scientific information alone to set the minimum environmental flows necessary to maintain basic ecosystem functions (for example, the prevention of a serious and ongoing decline in water quality). Beyond this, ignoring preferences is likely to serve the community poorly, for example in situations where:

- deciding not to water some relatively low value, or irreversibly degraded, environmental sites could enable high value consumptive uses to be undertaken
- there are significant recreational, aesthetic and/or cultural values that are not recognised in scientific assessments.

While many submissions on the draft report broadly agreed with the Commission’s assessment of this issue (Gwydir Valley Irrigators Association, sub. DR69; Murray River Group of Councils, sub. DR74; National Irrigators’ Council, sub. DR65; National Farmers Federation, sub. DR88; SA Government, sub. DR90), two objections were raised. The first, raised by DEWHA, relates to the role of Parliament:

> The Department considers that the procedure set out in the Water Act 2007 for allocating water between environmental needs and consumptive users is a reflection of community preferences in that it is a procedure mandated by Parliament. (sub. DR85, p. 17)

The inference is that the community’s preferences, as expressed in the Act and endorsed by Parliament, are to allocate water to the environment above all else, and that it is inappropriate for the Commission to question this. The Commission’s role and independence (established by Parliament), however, frequently require it to question whether provisions contained in Acts are in the public interest.

Overall, the Australian community seems to have a clear preference for redirecting some water in the Basin to the environment, but it also benefits from irrigated agriculture, and will have preferences for watering some environmental assets over others. People also have preferences concerning the future of rural settlements.

Satisfying these preferences in a way that maximises net benefits requires consideration of tradeoffs and is what sound water policy should be all about. It is incumbent on the Commission, with its charter to provide policy advice in the public interest, to raise concerns when legal and institutional arrangements threaten to compromise this.

It is also not clear that the government of the time intended the outcome that now appears to be unfolding. Statements by the National Farmers Federation (NFF) are relevant in this regard:

> … in NFF direct representations made to the then Minister for Environment and Water Resources regarding changes to the provisions for the Basin Plan to ensure that social and economic considerations had equal weighting in the Bill, the Minister advised that this wasn't necessary as the Basin Plan must comply with the objects of the Act which were clearly to provide equal weighting and consideration of social, economic and environmental issues. (NFF 2009, pp. 7–8)

The second objection is that the Commission may have misinterpreted the Water Act and that, in fact, social and economic factors will be given an appropriate role in setting SDLs. This view seems to be expressed by the MDBA, which draws attention to the object of the Act referred to above. However, the MDBA go on to say:

> The MDBA will ensure that environmental water requirements and socioeconomic impacts are considered together, with the social and economic analysis being used initially to inform how, where and when water can be delivered to meet environmental requirements at least social and economic cost. (sub. DR87, p. 2)

This statement is consistent with the Commission's understanding, and serves to confirm rather than dispel the concern that environmental and consumptive benefits will not be considered within a tradeoff framework designed to optimise net benefits to the Australian community. This is unless the word 'initially' implies that the social and economic analysis will somehow be used later on in determining tradeoffs. In simple terms, it seems the MDBA will use social and economic analysis in determining 'how, where and when' environmental water will be sourced, but not in determining 'how much' will be provided.

In consultations for this study, it has also been suggested to the Commission that the best available science will not be able to precisely define environmental water requirements and that, therefore, the MDBA will need to exercise considerable judgement in setting SDLs. It is further argued that in this process the MDBA is likely to weigh up environmental, social and economic factors in coming to a position on questions such as which environmental assets are 'key', what is required to avoid them being 'compromised' and what is needed to avoid compromising the productive base of the water resource. This might involve accepting that environmental assets should be watered on a less than ideal frequency where the consumptive benefits of this outweigh the environmental cost.

While it seems highly likely that there will be some scope for judgement, the Commission has found no indication in statements by the MDBA that social and economic factors will play a significant role in making these judgements. In the Commission's view it is highly desirable that they should, but the process needs to be transparent and a robust tradeoff framework, designed to maximise net benefits to the Australian community, applied. The Commission encourages the MDBA to take this approach to the maximum extent permitted under the Water Act.

Another aspect of the tradeoff between environmental and consumptive uses of water relates to land management. In the development of the Basin Plan, the MDBA does not appear to be required to consider whether:

- continuation of current land management practices will compromise the environmental assets (regardless of how much water is applied)
- land management practices that do compromise environmental outcomes are appropriate (that is, whether the net benefits from this management exceed the benefits of moving to a more environmentally-oriented management regime)
- steps are likely to be taken to bring about a change in land management.

Failure to consider these issues could result in public money being spent to recover water that does not achieve significant environmental benefits. The potential for this to occur is perhaps greatest where environmental assets are on private land. Cotton Australia stated:

> One of our fears would be delivering water to high value environmental assets that are privately owned e.g. Macquarie Marshes and Gwydir Wetlands. This would only encourage overstocking and further degradation and distress for these and similar areas. (sub. 25, p. 2)

The Commission acknowledges that requiring the MDBA to consider these additional issues in developing the Basin Plan would add an extra layer of complexity to what is already a very difficult task. The reality, however, is that not considering them may result in a substantial waste of public funds and unwarranted disruption to rural communities for little (if any) environmental benefit.

FINDING 6.1

The Commission's interpretation of the Water Act 2007 (Cwlth) is that it requires the Murray-Darling Basin Authority to determine environmental watering needs based on scientific information, but precludes consideration of economic and social costs in deciding the extent to which these needs should be met. This means that the overall proportion of water allocated to the environment is to be determined without explicitly taking into account the Australian community's environmental preferences, the opportunity cost of foregone irrigation or the role of other inputs such as land management. There is a risk that this approach will impose unnecessarily high social and economic costs.

RECOMMENDATION 6.1

The Murray-Darling Basin Authority should set sustainable diversion limits (SDLs) in a way that balances environmental, social and economic tradeoffs. This approach would appear to be consistent with the objects of the Water Act 2007 (Cwlth), but may not be consistent with the specific provisions defining how SDLs are to be set. If it is inconsistent, the Water Act should be amended.

There is choice as to how inter-valley environmental water contributions are determined

Many environmental sites in the Basin could be supplied with water recovered from more than one catchment. For example, the Coorong and Lower Lakes could be supplied from the Murrumbidgee, Murray, Goulburn-Broken and a range of other catchments. The Basin Plan is required to set SDLs for each catchment and in doing this, decisions will need to be made on how much water each is to contribute to such environmental sites. An issues paper released by the MDBA states that social and economic consequences need to be considered in determining these contributions (MDBA 2009c). The MDBA plans to conduct socioeconomic analysis of the communities in the Basin, in part, to inform this consideration.

The difficulties in using such an approach is illustrated by the following hypothetical example. Imagine that there are two catchments, A and B, that could each supply a downstream environmental site. Analysis finds that there are likely to be negative social and economic consequences from reducing diversions in each of these catchments, but that they are more pronounced in catchment A than in B. This finding could be used to support a decision to take most or all of the required water from catchment B. If this were done, the decision would be likely to be strongly contested by communities in catchment B, who might not only question the accuracy of the analysis but also the appropriateness of a central authority deciding that socioeconomic conditions in one area should suffer in order to protect another area.

An alternative approach would be to allow the buyback to determine the contribution that each catchment makes to supplying the environmental needs of downstream sites. This would require the environmental benefit per unit of water from each catchment to be determined and used in setting the prices that would be accepted in the buyback. For example, if water from one catchment incurred greater evaporative losses before reaching the site, the price offered in this catchment would be lower than for the others (other things being equal).

This market-based approach has appeal because of its potential to recover water to achieve environmental objectives at least cost to the Australian community. There are, however, reasons against giving this role to the buyback, including that:

- the potential for the buyback to produce a more efficient outcome is undermined by barriers to trade that vary across jurisdictions (discussed in chapter 10)
- it would mean that some Basin communities would need to wait longer before knowing how much water the government's activities will remove from their region.

The Commission considers the second of these disadvantages to be particularly important because consultations for this study indicate that irrigators and rural communities want to know the SDLs for their catchment as soon as possible, so they can plan for the future with greater certainty.

Accordingly, while having the MDBA determine the contribution that each catchment makes to supplying the environmental needs of downstream sites is unlikely to be economically efficient, it may be the best available method.

The Commission, however, is not convinced that incorporating socioeconomic analysis into this determination is helpful. Where water from multiple catchments can provide approximately equal environmental benefits it may be that pro rata contributions (possibly based on natural flows) is the most equitable approach. Subsequent trade between catchments would tend to limit the efficiency cost of this approach, as it would allow water to be reallocated to higher value uses where this is possible.

Alignment between water purchasing and the Basin Plan is needed to avoid inequitable results between regions

To date a much greater proportion of water entitlements have been purchased in some areas, such as the Gwydir Valley, than others, such as the Condamine-Balonne region. Some study participants are concerned that areas where little purchasing has occurred could be subject to steep administrative cuts in water extractions when the new SDLs come into force (Brimblecombe, sub. 12; National Irrigators' Council, sub. 24). That is, that these areas will not have fully benefited from the buyback as a transitional measure. For example, the National Irrigators' Council stated:

> … while the Gwydir Valley has provided rich pickings for the buyback, at the other end of the scale no purchases have been made from the mid and upper Condamine region in Queensland and very few entitlements have been purchased from the Border Rivers area. This leads to concern that those areas may be disadvantaged if their new Sustainable Diversion Limit (SDL) is cut significantly under the Basin plan. (sub. 24, p. 3)

The lack of purchases in the Condamine-Balonne region can be explained by delays in implementing the Resource Operations Plan for the region and other factors (chapter 10). Once these impediments are overcome, it would be expected that Commonwealth water recovery could proceed. Accordingly, slow progress in purchasing in particular catchments is not necessarily an indication that entitlement holders located there will be disadvantaged in the longer term.

Taking a Basin-wide perspective, a DEWHA submission to this study stated:

> The Department is likely to review the approach to purchasing, particularly the environmental watering priorities guiding purchase decisions, when the proposed Basin Plan is released in 2010. (sub. 56, p. 9)

This suggests that users in particular catchments are unlikely to face disproportionately high administrative cuts (relative to other catchments) as a result of the pattern of purchasing under the buyback.

Unwarranted constraints on adaptive management need to be avoided

Once the Basin Plan's SDLs and the Environmental Watering Plan are in force, they will largely override the influence of the Restoring the Balance purchases on environmental outcomes. This is not entirely the case, however, because active management of entitlements and any other water products held by the Commonwealth Environmental Water Holder (CEWH) could be used to improve environmental outcomes over and above what is achieved by the Basin Plan.

One aspect of this is that, as new information becomes available on environmental responses to different watering regimes and on the value placed on particular environmental outcomes, it should be possible for the CEWH to improve overall environmental benefits through trade. This could involve:

- selling water allocations or entitlements in one catchment and purchasing them in another where the environmental benefits are expected to be greater
- selling allocations in one year and buying them in a later year to supplement a natural flooding event
- selling allocations when the price is high and buying them when the price is lower
- selling entitlements and buying options contracts.

These are examples of adaptive management, the importance of which is discussed in chapter 5.

The Water Act includes provisions that enable the CEWH to trade to improve environmental benefits, in certain circumstances. The extent to which these provisions will be able to be exercised, however, may depend on how trading by the CEWH interacts with the SDLs.

Water held by the CEWH will not be limited by the SDLs — in other words, it is outside the SDLs (MDBA 2009c). Accordingly, water sold by the CEWH to consumptive users may go from being outside the SDLs to inside the SDLs (and vice versa for water purchased). There are a range of possibilities for how these trades might be treated in order to avoid third-party impacts and other adverse consequences.

One option, that in the Commission's view should be avoided, is disallowing trades on the grounds that they would be inconsistent with the Basin Plan. The Basin Plan will be developed using the information available at the time. Inevitably, new information will be gained over time and insisting on the Basin Plan taking precedence over the trading opportunities of the CEWH would prevent full use of this information to improve environmental outcomes. The resolution of this issue is likely to lie in building an appropriate degree of flexibility into the Basin Plan.

RECOMMENDATION 6.2

Some new information on how to improve environmental outcomes from watering will inevitably become available after the Basin Plan is made. To enable such information to be fully utilised, the Murray-Darling Basin Authority should ensure that the Basin Plan is sufficiently flexible to allow the Commonwealth Environmental Water Holder to trade water allocations and entitlements in ways that improve overall environmental outcomes.

How do these plans rate using the assessment framework?

As stated above, there are no major plans to use administrative approaches to recover water over the next few years, but they may be used when state water resource plans are introduced from 2014.[1] How does this approach rate against the assessment framework detailed in the previous chapter? Under what circumstances should administrative approaches be favoured over water purchases and vice versa?

Administrative approaches without compensation

In determining the appropriate means of recovering water for the environment, it is necessary to establish who is to bear the cost. Where governments are responsible, water recovery approaches that may be appropriate include voluntary or compulsory water purchases. Where entitlement holders are to bear the cost, some type of administrative approach without compensation is the appropriate option. The NFF (sub. DR88) equated water recovery without compensation to theft by the government. However, this is at odds with what has been agreed under the National Water Initiative (NWI).

The risk assignment provisions contained in the Water Act are likely to play an important role in determining how the costs associated with achieving the reductions in consumptive use required under the Basin Plan, are to be shared across water users and governments. The MDBA is required to use these provisions in quantifying the Australian Government's responsibilities, and these will be set out in the Basin Plan. The Basin states are taking different approaches to risk assignment and, in some cases, are developing their own approach as allowed for under the NWI (box 6.2).

---

[1] In this context, the Basin Plan is taken to be a means for setting targets for water recovery, rather than an administrative approach to recovering water.

The Water Bill 2007 Explanatory Memorandum states:

> The Commonwealth will meet its responsibilities as far as is practical by investing in works and measures to reduce water wastage and improve the efficiency of consumptive water use and water delivery and by purchasing entitlements. (p. 23)

It might be inferred from this that the Australian Government plans to meet its responsibilities largely through recovering water via the Restoring the Balance and SRWUI programs, but the government has not explicitly acknowledged this.

At present, neither the quantity of water to be recovered or the proportion to be assigned to the Australian Government is known, as the Basin Plan is still being developed. What is known is that the Australian Government plans to pay for the recovery of a considerable quantity of water directly through purchases and indirectly via infrastructure upgrades. A relevant question to ask, therefore, is whether this is consistent with the legislated risk sharing provisions.

It seems that this question cannot be definitively answered because there is considerable uncertainty about how risks are to be assigned. This is partly because the approach to risk assignment that will be taken by the Basin states is not fully resolved. More importantly, there is uncertainty about how the risk assignment provisions in the Water Act are to be interpreted.

The NWI states that these provisions were intended to be applied after known overallocation and/or overuse had been addressed by the states. It is unclear, however, the extent to which this has occurred, and the extent to which the Basin Plan will resolve this overallocation. Untangling this issue is difficult because, as the National Water Commission notes, there is no agreement among jurisdictions on what overallocation means and very few water resource plans introduced since the NWI explicitly address overallocation (NWC 2009b).

Accordingly, there is potentially a large slice of the water recovery that will be required under the Basin Plan that could be attributed to 'overallocation', or alternatively could be assigned to either 'policy change' or 'new knowledge'. The former is a state issue and, at least in some cases, state-based water legislation allows overallocation to be addressed without compensation (NWC 2009b). Reductions in the water available for consumptive use due to policy change (under the Basin Plan) would be a Commonwealth issue and is compensable. Risk assignment for reductions due to new knowledge about a water systems' capacity to sustain particular extraction levels is different again (box 6.2).

The uncertainty surrounding these issues has implications for the efficient conduct of the buyback. In consultations for this study, many participants expressed views similar to the following:

> Irrigators remain uncertain about entering a tender to the buyback when the loss of an unspecified amount of water allocation on a permanent basis will occur when the Basin Plan is finalised. (Western Murray Irrigation, sub. DR76, p. 3)

FINDING 6.2

Considerable uncertainty exists about the application of the risk assignment provisions set out in the Water Act 2007 (Cwlth) in respect of compensation that might be payable to irrigators upon the implementation of the Basin Plan. This is impeding the ability of irrigators to plan for the future and is affecting the efficient conduct of the buyback.

RECOMMENDATION 6.3

All Basin jurisdictions should clarify how the risk assignment provisions in the Water Act 2007 (Cwlth) will apply to the reductions in water availability that are likely under the Basin Plan. This should occur as soon as possible.

Because of the current uncertainty regarding risk assignment, it is possible that the Australian Government's water recovery activities (through its water purchasing and infrastructure programs) in the lead up to the Basin Plan will exceed its obligations. This would amount to paying for water recovery that irrigators and/or state governments had agreed was their responsibility.

The current approach of acquiring a considerable quantity of water through compensated means, therefore, may err on the side of generosity towards entitlement holders. On the other hand, it might be considered reasonable because:

- it helps maintain confidence in the property right arrangements for water and this confidence is necessary for long-term investment in irrigated agriculture
- the use of administrative approaches without compensation would probably need to be delayed until new state water plans are introduced, and this delay could have serious environmental consequences.

It will be fortuitous, however, if the budgets allocated to the Restoring the Balance and SRWUI programs recover a quantity of water that aligns closely with the quantity needed to meet the Australian Government's responsibilities overall. This is because the budgets were set before the MDBA even began the process of developing the Basin Plan and setting SDLs. If these budgets prove inadequate, the government will need to allocate further expenditure either to recover water or compensate water users for reduced (or less reliable) allocations (a process anticipated in the Water Act). If the expenditures are in excess of what is required, the Australian Government may bear costs that should have been borne by water users and/or state governments.

It is clear that entitlement holders should bear risks associated with reductions in water availability due to climate change. Purchasing a water entitlement does not guarantee access to a set quantity of water each year. The nature of these property rights is that allocations depend on inflows to river systems and other factors. Where there is year-to-year variability in inflows, allocations can be affected, something that is well understood by irrigators. The same applies where there are longer term variations in inflows, whether this is due to human-induced climate change, or other causes such as bushfires. This is unambiguously recognised in the legislated risk assignment provisions.

Administrative approaches with compensation

Some commentators have argued that even if recovering water through administrative means warrants compensation, this may still be better than using voluntary water purchases (Young and McColl, sub. 5). Leaving aside issues that arise only in unregulated systems, the two main (interrelated) arguments for this are that it would be quicker, and cause less disruption to water markets and the irrigation sector.

Theoretically, a move to a lower level of water extraction could be made quickly through compulsory acquisition of a proportion of all entitlements. However, this outcome could also be achieved through voluntary acquisitions, as indeed the Australian Government's now greatly accelerated buyback appears intent on achieving (chapter 8).

There would also appear to be no reason to expect that a quick voluntary buyback would be more disruptive to water markets and the irrigation sector than compulsory acquisition. Voluntary purchases tend to recover water from those irrigators who value their water least, while compulsory acquisitions are indiscriminate in this regard. Accordingly, compulsory acquisitions would be expected to be followed by a higher level of trade as some irrigators sought to regain some or all of the water acquired, prompting others to choose to leave irrigated agriculture. This might be perceived as being disruptive to the market.

In any case, there is a question mark over whether recovering water is best done quickly. On the plus side, faster-paced water recovery is likely to achieve environmental benefits more quickly. On the negative side, it is likely to cause greater adjustment pressures for rural communities and businesses that service irrigated agriculture. Fast-paced water recovery is also likely to be more expensive for governments. These issues are discussed more fully in chapter 8.

While compulsory acquisition in regulated systems appears to have no significant advantages over voluntary acquisition, there are disadvantages. First, water is recovered from those who value their water most as well as those who value it least, without discrimination. Second, some irrigators are likely to be, or feel that they have been, made worse off. By their nature, voluntary sales do not produce this result for those selling. Another disadvantage is that the level of compensation could be subject to dispute and this may be played out in lengthy and costly court cases.

FINDING 6.3

Purchasing water products from willing sellers is generally the most effective and efficient means of acquiring water, where governments are liable for the cost of recovering water for the environment.

In unregulated systems, administrative water recovery accompanied by compensation does have some potential advantages. Water trading is generally not well established in unregulated parts of the Basin (chapter 3). One reason for this is that changing the location of extraction (or trade from an extractive use to a non-extractive use) can interact with the flow-based rules that govern water extraction in ways that have significant third-party impacts.

For example, trade can lift the flow rate immediately downstream of the seller (from what it would otherwise be) and this can allow entitlement holders located there to legally extract more water. If the buyer is located a considerable distance downstream (or the buyer is an environmental manager who wants the water delivered to a downstream site) the water purchased might not reach them. Accordingly, purchasing water for the environment in these systems can be ineffective, unless there is an ability to 'shepherd' the water past other users so that it reaches its intended destination.

Administratively changing the flow-based rules for all entitlements in a system can overcome this problem. If all users face more restrictive rules regarding when they can extract water, and the rate of extraction, there will be more water left in the system for environmental purposes (providing it was the original rules and not overall limits on the volume of extraction that was previously limiting extraction).

Flow-based rules currently play an important role in meeting environmental objectives in unregulated systems in the Basin. Where improved environmental outcomes are sought, making these rules more restrictive (and providing compensation where appropriate) may, in some cases, be the best option. Chapter 7 provides a full discussion of these issues.

6.2 Infrastructure upgrades

Funding irrigation infrastructure upgrades that produce water savings is a non-market approach to water recovery that features prominently in the Australian Government's Water for the Future plan. The study terms of reference requires the Commission to consider how to maximise synergies between water purchasing and the government's infrastructure program.

Recovering water through infrastructure upgrades

Investment in irrigation infrastructure can take many forms, including lining channels, installing automated water management systems, and laser grading paddocks used for irrigation. These investments can reduce the amount of water needed to grow crops and pasture, and provide a range of other benefits, such as labour savings. Irrigation infrastructure operators and farmers have strong incentives themselves to invest in cost-effective irrigation infrastructure projects as a normal part of running their businesses.

Governments can also become involved in funding or co-funding irrigation infrastructure projects. This does not in itself recover any water for the environment. For example, a farmer benefiting from government funding might be left with water that is surplus to what is needed to complete their normal irrigation program, but could choose to either sell this water to another farmer, or use it to irrigate more land. For governments to recover water for the environment through infrastructure upgrades, they need to gain ownership of some or all of the water savings in return for the funding they provide. Where they do this, governments are effectively buying water, but with the requirement that the payment they provide be used to invest in irrigation infrastructure.

Infrastructure upgrades frequently produce water savings at the farm or irrigation district level. Due to hydrological realities, however, these savings can be at least partly at the expense of downstream water users and/or ecosystems (box 6.3). These broader effects need to be taken into account when assessing the merits of recovering water through infrastructure upgrades.

Box 6.3 **Issues in assessing water savings**

From the perspective of an individual irrigator, or an irrigation infrastructure operator, it can be reasonably straightforward to define and measure water savings that arise from upgrading irrigation infrastructure or changing management practices. For example, if an on-farm infrastructure upgrade means that a given crop can be grown with 70 megalitres (ML) of water instead of 100 ML, the irrigator has achieved a 30 ML water saving. Similarly, if lining a channel means that an operator only has to release 105 ML, rather than 135 ML, of water to supply users with 100 ML, the operator has achieved a 30 ML saving.

Complexities arise, however, when water savings are looked at from a catchment perspective (as is necessary in managing the Basin's water resources). In the examples given, the 30 ML of water 'saved' might otherwise have ended up as a mix of return flows to a river, recharge to groundwater, water entering a local wetland and evaporation. Not all of these represent true savings at the catchment scale.

Reducing return flows does not generally represent a saving from a whole-of-catchment perspective as this water would have been available for other uses. In some cases, however, return flows are of low quality and so reducing them is not always to the detriment of downstream users. Also, reducing groundwater recharge may or may not be a true saving, depending on whether the groundwater is accessible and/or saline (there may also be delays in the water becoming available for reuse). Reducing flows to a local wetland is not a saving if that water would have improved the condition of a site that is valued by the community (although it may be that the water could have been used to produce a greater benefit if applied to a different site and/or at a different time). This leaves reduced evaporation as the only component that is clearly a saving from a catchment perspective.

As an additional complexity, any water savings achieved through upgrading infrastructure may be reduced from what was expected if the infrastructure becomes underutilised as a result of climate change and/or water being traded out of the area.

A number of studies point to the need to understand these complexities when examining claims for how much water can be saved through actions such as upgrading irrigation infrastructure, and related claims that water is being wasted or that water use can be made more efficient (Crase and O'Keefe 2009; Molle and Turral 2004; Perry 2007; PC 2006). Two overlapping themes in this literature are that: water savings achieved within one area often reduce the amount of water available downstream; and apparent water savings can prove to be illusory when examined at the appropriate scale.

One study, Qureshi et al. (2010), estimated the reductions in return flows that were likely to arise when water for the environment was recovered through irrigation infrastructure subsidies in the Murrumbidgee catchment. They found that failure to account for changes to return flows could lead to substantial overestimates of water savings (25 per cent in one scenario, higher in others). They also found that the degree

(Continued next page)

Box 6.3 (continued)

of overestimation was higher when the apparent water savings were shared between irrigators and the environment (such sharing is a common feature of Sustainable Rural Water Use and Infrastructure projects).

Improving the accuracy of water metering is another activity that is sometimes claimed to save water. Introducing more accurate metering will result in water users extracting less water against a given set of allocations, if the previous metering tended to understate water use. This brings about a reallocation of water rather than water savings. Those water users whose meters have been replaced get less water (and so will produce less, unless they enter the market to buy replacement water) while more water is available in the system for other uses, including environmental uses. While there can be good reasons for introducing more accurate water metering, achieving water savings is not among them.

Plans to use this approach

In recent years, Australian governments have relied heavily on infrastructure upgrades as a means of recovering water for the environment. During the course of the Living Murray Initiative, however, high costs and long delays experienced when using this approach eventually led to a switch towards greater use of market-based measures (appendix B). The lessons learned from the Living Murray Initiative appear to have had some influence on the design of the Water for the Future plan, with substantial funding allocated to market-based water recovery. Still, a substantially greater sum has been allocated to recovering water through infrastructure upgrades under the SRWUI program.

The $5.8 billion SRWUI program is focused mainly on reconfiguring and upgrading irrigation infrastructure to increase water use efficiency in rural Australia, predominately in the Basin (table 6.2). The objectives of the program are to:

- deliver substantial and lasting returns of water for the environment
- secure a long-term future for irrigation communities
- deliver value for money in the context of the first two tests.

DEWHA report:

> More than $4.4 billion has been committed to date under SRWUIP to significant state-based water infrastructure projects and investment, most of which in return for a share of water savings, in modernisation of privately owned irrigation operations in the Murray-Darling Basin. This figure includes election commitments funded under the National Partnership Agreement on Water for the Future, as agreed by First Ministers. (sub. DR85, p. 12)

Table 6.2 Components of the Sustainable Rural Water Use and Infrastructure program[a]

Project or program	Funding ($ m)	Description
State priority projects[b]		
NSW: project 1	up to 650	Upgrades to private irrigation operators infrastructure
NSW: project 2	up to 137	Piping stock and domestic supply systems
NSW: project 3	up to 300	Modernising on-farm infrastructure
NSW: project 4	up to 221	Water metering scheme
NSW: project 5	up to 50	Modifications to floodplain infrastructure
Vic: project 1	up to 1000 or 90% of project value	Northern Victoria Irrigation Renewal Project Stage 2
Vic: project 2	up to 103	Sunraysia Modernisation Project
Qld: project 1	up to 115	Community level irrigation planning and infrastructure investment
Qld: project 2	up to 40	Upgrade Sunwater's water delivery systems
Qld: project 3	up to 5	Feasibility study on using coal seam gas water
SA: project 1	up to 120	Integrated pipelines project
SA: project 2	up to 100	Improve river management
SA: project 3	up to 110	Upgrade irrigation infrastructure
SA: project 4	up to 200	Lower Lakes and Coorong Recovery project
ACT: project 1	up to 85	Salt Reduction Strategy project
Other components		
On-Farm Irrigation Efficiency Program	300	Assistance to irrigators in the southern-connected Basin to modernise on-farm irrigation infrastructure
Menindee Lakes Project	up to 400	Project to reduce evaporation, secure Broken Hill's water supply and protect the environment
Strengthening Basin Communities	up to 200	Grants to local governments for community-wide planning for a future with less water and investing in water saving initiatives
Water Meter Test Facilities	Up to 7	Provision of water metering test facilities

[a] This table includes the main elements of the SRWUI program. It does not include a number of smaller projects. [b] Project amounts are in principle with funding subject to due diligence assessment.

Sources: COAG (2008a); DEWHA (2009l); DEWHA (unpublished).

Funding for the state-based projects mentioned (known as 'state priority projects') is subject to a 'due diligence' assessment of their social, economic, environmental, financial and technical aspects (COAG 2008a).

What are the implications of these plans for market-based water recovery?

Coordination becomes important

If buybacks were conducted in the absence of a government program to recover water through irrigation infrastructure upgrades, market incentives would be expected to effectively coordinate the mix of water recovery activities. Irrigators (and irrigation infrastructure operators) could look at all options for freeing up water to sell it into the buyback. These might include: changing to less water intensive crops; investing in water saving infrastructure; and exiting irrigated agriculture. Each irrigation business could decide whether to sell water after weighing up the costs, benefits and risks of each option.

The existence of a very large infrastructure program, such as the SRWUI program, introduces the need for governments to ensure proper coordination. The two main issues here are sequencing water purchasing and infrastructure upgrades, and dealing with proposals that seek to access funds from both programs.

Sequencing is important so as to avoid the inefficiency of upgrading infrastructure that subsequently becomes underutilised or made redundant. This outcome could be avoided in the following ways.

- In the main, committing to infrastructure projects only after a majority of water purchasing has been completed. It would seem that this outcome is at least being partly achieved due to lengthy lead times in developing infrastructure proposals and the acceleration of the buyback.
- Subjecting project proposals to rigorous assessment that considers possible impacts of the buyback and the SDLs on the value of the upgraded infrastructure.
- Ensuring that unwarranted premiums are not paid for water recovered through infrastructure upgrades. Avoiding such premiums increases the incentives for irrigators and irrigation infrastructure operators to craft proposals very carefully, taking into account the risk of future underutilisation.

Avoiding unwarranted premiums is also important for proposals with both infrastructure and water purchase components. Premiums create an incentive for proponents to overstate the level of water savings that will be achieved through infrastructure works. This creates difficulties in assessing and monitoring proposals. There is also a risk that premiums could be used as an arbitrage opportunity, with successful applicants effectively selling water to the government at a premium price and then re-entering the market to purchase replacement water at the market price.

How do these plans rate using the assessment framework?

Study participants expressed a diverse range of views on the merits of governments recovering water through infrastructure upgrades. The Victorian Farmers Federation (sub. 31) advocated using infrastructure upgrades to recover all of the required water if possible, and only purchasing water as a last resort. Watson (sub. 11, p. 2) had a very different view, arguing that '[t]he case for public provision of the essential capital equipment, off-farm and on-farm, of the irrigation industry, ostensibly part of the private economy, is tenuous'. This section uses the framework outlined in chapter 5 to assess the plans to recover water through the SRWUI program.

Budgetary cost effectiveness

Recent experience is that the cost per ML of government efforts to recover water for the environment through infrastructure upgrades is highly variable, but in most cases exceeds the cost for recovery through purchasing. For example, a progress report on the Living Murray Initiative shows that infrastructure projects recovered water at an average cost of around $2200 per ML compared to $1700 per ML for market purchases, in both cases on a long-term cap equivalent basis (appendix B, table B.3). The majority of infrastructure projects recovered water at a cost that was nearly 50 per cent higher than the average cost for recovery through market purchases.

Because most SRWUI projects are in the planning stage, it is uncertain what their cost per ML of recovered water will be. As shown in table 6.2, some are state priority projects and the due diligence criteria that are to apply to these appear to suggest that budgetary cost effectiveness will be given appropriate attention. The criteria include:

> … projects must have a suitable dollar per megalitre benchmark against local/regional water market prices and represent cost- and time-effective strategies for achieving water savings. (Agreement on Murray-Darling Basin Reform, 3 July 2008, p. 55)

Information available on the largest project, the Northern Victoria Irrigation Renewal Project (NVIRP) Stage 2, however, seems to be at odds with the due diligence requirements. The website for this project suggests that for a contribution of up to $1 billion, the Australian Government will receive a half share in 200 GL of expected water savings (NVIRP nd). This means that if the full $1 billion is contributed, the government will contribute $10 000 for each ML recovered for the environment. NVIRP point out that the overall unit cost of water savings is much less, at $5000 per ML (sub. DR68). By comparison, high reliability Goulburn water entitlements were purchased under the Restoring the Balance program during

2007-08 and 2008-09 at an average price of $2382 per ML (equivalent to $2507 per ML on a long-term cap equivalent basis).

In cost-effectiveness terms, this implies that the Australian Government may pay up to four times as much for recovering environmental water through infrastructure upgrades than through water purchases. In other words, a premium of up to $7500 per ML may be paid for recovering water through infrastructure upgrades under the SRWUI program. (The offsetting benefits to irrigators and rural communities are discussed below.) Premiums of this magnitude greatly reduce the environmental benefits that can be obtained from a given level of government funding. For premiums to be warranted they need to provide at least commensurate benefits in addition to those from water recovery in a way that meets public policy objectives.

Several participants objected to the use of the NVIRP example, as they regarded it as extreme, implying that premiums paid for other SRWUI projects would generally be much less (Coleambally Irrigation Co-operative Limited, sub. DR77; NSW Irrigators' Council, sub. DR72). In the Commission's view, NVIRP is of particular interest because it is the largest SRWUI project. Also, while it seems likely that premiums for many other projects will be less, no specific examples of this were provided in submissions. Even where premiums are lower, they would still need to be matched by benefits to be warranted.

FINDING 6.4

Funding irrigation infrastructure upgrades is generally not a cost-effective way for governments to recover water for the environment.

Economic efficiency

Many submissions from irrigators and irrigator groups emphasised that government funding for infrastructure upgrades can produce a range of benefits in addition to water recovered for the environment (box 6.4). The existence of such benefits means that it is possible that an infrastructure upgrade could be economically efficient even if its budgetary cost effectiveness as a water recovery measure was poor.

This would occur if the overall benefits of investing in the upgrade exceeded the costs, from a community-wide perspective. This would require the premium paid by the Australian Government to be exceeded by:

- private net benefits for irrigators/irrigation infrastructure operators (net of the value of the entitlements transferred to the Commonwealth); plus

- external benefits (in addition to the environmental benefits from the acquired environmental water).

Box 6.4 **Participant views on the benefits of government funded infrastructure upgrades**

Victorian Farmers Federation

When Governments invest in infrastructure, the community maintains the economic benefits and the environment receives the water savings without damaging the important economic contribution of agriculture. (sub. DR78, pp. 9–10)

National Farmers Federation

The Commission's discussion regarding infrastructure, and its draft findings against infrastructure investment clearly do not or under-consider the wider benefits of infrastructure investment. As an example, a large program of on farm investment may be used as a means of support to drought ravaged communities. Farmers have mothballed farms and so it is the perfect opportunity to undertake significant change. Service providers who have lost business due to the drought (e.g. chemical sprayers) could have been diverted to laser levelling. Investment in locally produced and/or supplied infrastructure could keep local economies operating as well as local employment. There is considerable flow on benefits for the Commonwealth in terms of retention of services to rural communities and decreased costs for Commonwealth funded assistance programs (e.g. unemployment benefits). (sub. DR88, p. 10)

NSW Irrigators' Council

… a full and complete analysis of the [benefits of infrastructure works] … must be undertaken prior to a conclusion — and recommendation — being reached. In particular, we submit that an understanding of the value of the retention of rural productivity, employment and social benefits associated therewith be obtained forthwith. (sub. DR72, p. 8)

Murrumbidgee Irrigation

Water savings projects, when taking into account broader implications of asset redundancy and loss of economic activity can be more cost effective depending upon the nature and cost of the projects. (sub. DR86, p. 6)

Western Murray Irrigation

Western Murray Irrigation concurs that the payment of a premium per ML of water recovered is a form of subsidisation but also an incentive for irrigators to participate. The market price is a fair indicator, however, to encourage water use efficiency and water recovery a small premium to reflect net benefits to the community should be considered. (sub. DR76, p. 3)

Queensland Government

Queensland considers that, while investment in infrastructure may be less efficient than direct purchases of water entitlements, there may also be social benefits that are harder to quantify. (sub. DR75, p. 3)

Department of the Environment, Water, Heritage and the Arts

The Department believes that the benefits flowing from investing in rural water infrastructure include benefits beyond those considered in the draft report. (sub. DR85, p. 12)

If an investment was economically efficient purely on the basis of private benefits, this begs the question as to why irrigators or irrigation infrastructure operators would not have undertaken it without government involvement. In consultations for this study, the Commission was frequently told that water scarcity over the last decade had prompted those in the irrigation sector to look for every conceivable means of saving water cost effectively. For example, Cotton Australia reported that an environmental management program for growers has achieved 'huge improvements in water use efficiency' (sub. 25, p. 2).

Some participants have suggested that worthwhile irrigation infrastructure investments have gone unrealised because many irrigators are not able to access capital to undertake them, due to drought or other reasons (for example, Coleambally Irrigation Co-operative Limited DR77). In a recent inquiry, the Commission 'found no evidence that farmers' access to capital differed in any significant way from that faced by other small businesses', notwithstanding widespread drought conditions over recent years (PC 2009, p. XXXI). In the Commission's view, there is no failure in capital markets that would warrant government funding of irrigation infrastructure projects ahead of any other infrastructure. Governments could, however, help create an environment that was more supportive of private investment in irrigation infrastructure by reducing uncertainty about future water policy settings.

DEWHA argued that the case for government funding was related to:

> … [irrigation infrastructure operators'] … reluctance to impose adequate user charges to maintain the infrastructure in the face of protests from water users. These issues have seen some systemic market failures in infrastructure provision for at least three decades. (sub. DR85, p. 13)

It may be that some operators have failed to properly maintain their infrastructure, but this does not constitute a market failure. Even if it was considered a market failure, the solution is the imposition of the correct prices on irrigators, not large-scale scale subsidy of infrastructure upgrades, funded by taxpayers.

Given that knowledge about irrigation investments resides primarily with private agents, it seems unlikely, to say the least, that governments could identify billions of dollars worth of worthwhile projects that have been overlooked. If governments do have information unavailable to some irrigators, providing information, for example, through extension services, would be likely to be a more efficient policy approach than subsidies (Pannell 2008b).

This leaves the possibility of investments being economically efficient due to external benefits that cannot be captured by the private agents who might invest in them. But infrastructure works can also produce external *costs* and these also need to be considered. An example is lower return flows to rivers reducing water availability for downstream users (box 6.3). Due to these external costs, the private incentives for investing in water saving infrastructure upgrades are sometimes higher than is socially optimal, even without a government subsidy.

Where it is believed that an infrastructure project may be economically efficient, this can be tested through cost–benefit analysis. When conducted properly, such analysis provides a means of weighing up all of the costs and benefits of a project, both private and external. Table 6.3 lists the main types of costs and benefits that should be included.

Several submissions argued that in addition to the costs and benefits shown in table 6.3, flow-on (or multiplier) benefits from infrastructure investments should also be taken into account. For example, the National Irrigators' Council argued:

> … from a taxpayer perspective, maintaining efficient and vibrant irrigation systems provides flow-on benefits for the rest of the community, particularly in employment. (sub. DR65, p. 6)

In a similar vein, Cotton Australia, contended:

> Infrastructure investment can help to maintain productivity and allows regional economies to thrive on the back of the 3.5 times multiplier that irrigated agriculture provides. (sub. 25, p. 7)

In the Commission's view, such benefits are often believed to be higher than they are in reality. Sometimes this is because flow-on benefits are acknowledged but not flow-on costs.

For example, government investment in irrigation infrastructure could in some cases allow an existing food processing plant to continue operation, or encourage a new plant to be built. In this sense, the income generated by the plant is dependent on the infrastructure investment, but in generating this income additional costs are also incurred. If the plant was not maintained or built, resources would generally move to other beneficial activities. Most existing or prospective employees of the plant would in all likelihood find or retain alternative employment and at least some of the capital tied up in the plant would be used elsewhere. In some cases resources will move to another region and this has implications for the distribution of costs and benefits.

This is not to say that there are never any flow-on benefits from irrigation infrastructure investments, but rather that looking at gross, rather than net, benefits greatly overstates them. The idea of multiplier effects (whereby a new project multiplies its benefits by increasing demand in associated industries) is similarly flawed, because it ignores the fact that resources can be put to other beneficial uses.

Table 6.3 **Main types of costs and benefits associated with government-funded infrastructure upgrades**

Type of cost or benefit	*Description*	*Comment*
Costs		
Government project-related costs	The cost to government of funding the project. This could include project assessment, management, construction, administration and monitoring costs.	Costs associated with assessing and monitoring projects can be significant and it is important that these are included in addition to the funding provided for on-ground works.
Irrigator project-related costs	The cost to irrigators and/or irrigation infrastructure operators of the project. This could include costs associated with meeting government requirements for information and monitoring. Some project management and construction costs might also be borne by irrigators.	The transactions costs associated with meeting the requirements of government programs can be significant.
Costs from changes to hydrology	Irrigation infrastructure projects can change hydrology in ways that impose costs on other water users and the environment.	Such costs, particularly from reductions in return flows, can be substantial (box 6.3)
Benefits		
Environmental water	Environmental water recovered by the project is typically in the form of an entitlement that is transferred to the government.	The transferred entitlement should be valued at the current market price, or the value of the environmental improvement expected from the water, whichever is lower.
Irrigation water	A proportion of water savings created by the project are sometimes retained by irrigators.	This water should be valued at its market price (or an appropriate proxy if there is no functioning market). Water 'savings' from more accurate metering should not be included (box 6.3).
Other direct benefits to local irrigators	These could include reduced operational costs (eg. from automating gates) and improved service (eg. from reducing water ordering times).	
Benefits from changes to hydrology	Benefits from changed hydrology may relate to reductions in highly saline return flows or improving the condition of a wetland.	The Barren Box Storage and Wetland project is an example of an upgrade that appears likely to have produced such benefits (Murrumbidgee Irrigation nd).

It is also important to recognise that allocating government funds to one project means that these funds are not available for alternative uses that might also generate flow-on benefits. There is often no strong reason to suppose that the flow-on benefits from the project under consideration will be larger than those associated with a different project, or with returning the funds to taxpayers.

For these reasons flow-on effects should generally not be included in the weighing up of overall project costs and benefits (but may be useful in identifying the distribution of costs and benefits). The case for including them in cost–benefit analysis is strongest where there are substantial barriers to resources moving to other uses (Boardman et al. 2001). If they are included, care needs to be taken to ensure that net, rather than gross, benefits are included. Australian Government publications, such as the *Handbook of Cost Benefit Analysis*, provide guidance on this issue (Commonwealth of Australia 2006).

While no formal cost–benefit analyses were submitted to this study, Iplex (sub. DR60) and Crane Group (sub. DR61) drew attention to studies that they claimed demonstrated the economic viability or cost effectiveness of government funded irrigation infrastructure projects (box 6.5 and 6.6). While these reports are generally internally consistent, and include a number of conclusions with which the Commission would agree (such as the need to consider all of the costs and benefits of infrastructure projects), they do not appear to support these claims.

Box 6.5 **ACIL Tasman (2008) Australia's Working Rivers**

This report identifies a range of government funded irrigation infrastructure projects for which the cost per megalitre (ML) of water recovered is in excess of the resulting private benefits but less than private and social (or external) benefits combined. The implication is that these projects are not privately financially viable, but are economically viable from a social (or government) perspective.

The report states that one of these, the Wimmera Mallee water supply system project, had a water recovery cost in excess of $4500 per ML long-term cap equivalent. Private benefits are estimated at $2000 per ML, with social (or external) benefits of over $2500 per ML. ACIL Tasman, however, did not analyse the social benefits in order to come up with this estimate, nor did it source the estimate from any such analysis. Rather, it observed the gap between the cost of the project and the private benefits and inferred that, since governments had decided to fund the project, they must have come to the conclusion that the social benefits were at least large enough to cover this gap. Given this methodology the Commission does not support Iplex's (sub. DR60, p. 2) contention that the report 'shows investment in water infrastructure is economically viable'.

(Continued next page)

Box 6.5 (continued)

At a broader level, the report calls for immediate action to investigate infrastructure projects as a means of managing the risk of the government paying too much under the buyback. Underlying the concern about this risk is the notion that entitlement holders are likely to be reluctant to participate in the buyback tenders, resulting in a steep bid curve (meaning that the government would need to pay high prices to meet its target). Since the report was written, events have played out quite differently. The tenders have been very heavily subscribed and bid curves have been relatively flat. In addition, substantial resources have been put into investigating infrastructure projects, but there has, so far, apparently been little success in identifying economically viable projects. In any case, the risk at issue could be adequately managed through altering the pace of the buyback (chapter 8).

Box 6.6 **ACIL Tasman (2009) Regional economic effects of irrigation efficiency projects**

This report builds on ACIL Tasman (2008), with the emphasis being on regional economic benefits from irrigation infrastructure investment, both during the construction phase and subsequently. The report states that the 'scope of the exercise and the available data did not allow for strong conclusions to be drawn as to the overall net value of the projects — nor was this the purpose of the study' (p. viii).

The main case study included in the report examines the benefits and costs of the proposed infrastructure upgrade of Lake Wyangan, near Griffith in New South Wales. ACIL Tasman estimate the costs of the project to be $56 million. Taking the upper bound estimate of water saving, the value of water savings from the project was estimated to be $23 million. Other direct benefits include around $1 million in reduced maintenance costs, as well as unquantified benefits from improved service and supply flexibility, and other environmental benefits. Thus, without considering flow-on effects, the estimated costs of the project exceed the benefits by $32 million, less unquantified direct benefits.

The report also estimates national flow-on (or indirect) benefits of $144 million, $16 million of which accrue to the region concerned. Of course, if these benefits could be added to the direct costs and benefits, overall benefits would exceed costs. The report, however, does not do this and with good reason — estimates of the flow-on costs that would need to be also included to make this calculation valid are not made.

Therefore, this report does not provide evidence that the proposed infrastructure upgrade provides net benefits to the Australian community and this is acknowledged in the report. What the report does, is examine regional benefits, which are relevant to understanding the distribution of costs and benefits of infrastructure projects. The report's claim that government funded infrastructure investments can produce flow-on benefits for the region in which they are made is uncontroversial.

Distribution of costs and benefits

The equity of the distribution of costs and benefits of irrigation infrastructure projects is also a relevant consideration. A large proportion of the costs are often borne by the broader community through taxation (some costs may also be borne by downstream water users). Water recovered for the environment through these projects can produce improved environmental outcomes that also benefit the Australian community (albeit that particular groups and regions may benefit more than others). The other benefits produced, however, generally accrue predominately to the irrigators serviced by the upgraded infrastructure, with some flow-on benefits to related businesses and nearby towns.

It is possible, therefore, for an irrigation infrastructure project to involve a significant transfer from taxpayers to irrigators in a particular locality. In effect, the Australian community pays for part of the cost of infrastructure that benefits irrigators.

This is inconsistent with the NWI, under which, Australian governments have agreed to recover the full cost of water storage and delivery services through the prices charged to users of rural and urban water systems. The Commission endorses this aspect of the NWI, which essentially puts irrigators in the same position as most other Australian businesses in being required to pay for their inputs. It also avoids inequities that can arise when subsidies are provided to some irrigation areas but not others.

The SRWUI program, therefore, is likely to produce an inequitable distribution of costs and benefits, unless steps are taken to avoid unwarranted transfers from tax payers to the irrigation sector. Transfers could be avoided by ensuring that the private benefits to irrigators and irrigation infrastructure operators are matched by private contributions towards the project. Such a requirement also guards against the private benefits being overstated for the purposes of gaining project approval.

What about rural communities?

It is argued earlier that the social and economic values provided by irrigated agriculture, including those accruing to rural communities, should be taken into account in the allocation of water between consumptive and environmental use. Once these decisions have been taken, however, the role of governments should be to assist individuals and communities to adjust to change, rather than to try to preserve the status quo. As argued in a recent Commission inquiry report, change is an ongoing feature of rural Australia:

> Over the last 100 years, small rural towns have felt the impact of bigger and better machinery, farm amalgamations and the reduced need for on-farm labour …. Better roads and vehicles have made it easier for farmers to conduct their commerce in larger regional centres. Reliance on agriculture is falling in many rural areas relative to other economic activities. Growth from 'sea change' and 'tree change' is altering some rural profiles. (PC 2009, p. XXXVIII)

The Commonwealth and state governments have a range of policies to assist individuals and communities to adjust to changes in economic conditions and government policies. These include support for training and job search services, the social security safety net and the redistributive aspects of the tax system. There are also regional development policies that aim to promote business and industry development in changing environments. In addition to such generally available policies, governments sometimes implement measures to assist industries or communities to adjust to specific government reforms or economic changes.

Given its objectives, the SRWUI program can be seen as a hybrid measure to help achieve reform (recovering water for the environment) and assist with adjustment to the reform (securing a long-term future for irrigation communities through their adjustment to having less water for consumptive use).

Accordingly, it could be argued that despite the negative consequences of paying premiums to recover water through infrastructure upgrades discussed above, some premium is warranted to assist communities that depend on irrigated agriculture to adjust to a future with less water. The validity of this argument depends on:

- the case for providing specific adjustment assistance being sound
- subsidies for infrastructure upgrades being superior to other means of providing such assistance.

Is specific adjustment assistance warranted?

The scale of the impacts of reduced water availability on rural communities is an important consideration when deciding whether specific adjustment assistance is warranted. Where impacts are small it would be expected that individuals and communities would be able to adjust, assisted in some cases by the generally available government policies described above.

Appendix D examines the available quantitative evidence on the likely economic impacts of reductions in irrigation water on communities in the Basin. It concludes that uncompensated reductions clearly have a negative affect on regional economies, but that water buybacks could have a negative or positive impact. The most robust modelling available estimates that the buyback will result in a small *increase* in real consumption in most southern Basin regions (Dixon et al. 2009).

The NSW Irrigators' Council (sub. DR72) argued that such modelling results defy common sense and expressed concern that the Commission accepted them. In fact, the Commission is aware that such modelling is based on a range of assumptions that may not always be accurate, and so does not accept that the results are necessarily good proxies for real-world outcomes. That said, the analysis by Dixon et al. (2009) appears to be more robust than analysis by RMCG (2009), which shows significant negative effects on regional economies (Appendix D estimates that RMCG's results imply that a 30 per cent reduction in irrigation water would result in roughly a 3 per cent reduction in gross regional product). This is mainly because the RMCG analysis has features which make it less useful for understanding the current situation in the Basin. For example, it does not account for buyback payments (which are a very real benefit to some members of regional communities) and uses very high regional multipliers without sound justification (appendix D).

In the Commission's view a balanced assessment of the various modelling results is that they indicate that a specific adjustment assistance package, operating across the entire Basin, is not warranted, at least where reductions in water availability are achieved through purchasing. The modelling results are, however, broad averages for large regions and there may be particular towns that suffer significant negative economic and social effects.

As discussed earlier, the reductions in water use that will be required by the Basin Plan are likely to be achieved through a mix of compensated and uncompensated means. The compensated reductions are occurring now, while the uncompensated component is likely to occur when state water resource plans that are consistent with the Basin Plan are introduced from 2014. The MDBA reported that they will:

> … assess the socioeconomic implications of any reductions in the long term average sustainable diversion limits and provide a report to the Murray–Darling Basin Ministerial Council along with the proposed Basin Plan. Governments will use this information to consider appropriate responses to social and economic impacts of the Basin Plan. (MDBA 2009k, p. 11).

In summary, the case for specific policies to assist individuals and communities to adjust to water reductions brought about by acquisitions of water for the environment appears to be weak. If any such assistance is provided, it would be best to target it to communities that are particularly affected. There may be a somewhat stronger case to provide assistance where uncompensated water recovery is undertaken. There are plans to assess this case when the size of these reductions in diversion limits are known.

This discussion has focused on recovery of water for the environment and not the impact of the latest drought. There is no doubt that many farmers and rural communities across the Basin have experienced hardship as a result of the latest prolonged drought. At present, governments provide various types of drought support and the Commission made recommendations for reform in this area in early 2009 (PC 2009).

Are subsidies for infrastructure upgrades the best form of assistance?

When viewed as a structural adjustment assistance measure, subsidies for infrastructure upgrades have two important characteristics. First, the benefits they provide go mainly to irrigators in areas judged to have infrastructure projects that are worth supporting. This may not align well with areas that most warrant adjustment assistance. Second, they tend to reinforce the dependence of communities on irrigated agriculture.

On the latter issue, Environment Victoria commented:

> At present many incentives exist for Victorian farmers to remain in irrigation and improve their efficiency as governments invest $2 billion in infrastructure upgrades. Similar incentives do not exist for farmers and communities to transition away from irrigation to less water intensive industries … (sub. 23, p. 7)

Given that water availability is expected to decline and become more variable, reinforcing dependence on irrigated agriculture is unlikely to be a sound strategy for all areas. In fact, subsidies may impede autonomous adjustment away from such dependence.

These characteristics tend to reduce the efficacy of using subsidies for irrigation infrastructure as a form of adjustment assistance and highlight the need for their use to be assessed against alternatives. Possible alternatives (some of which are already being funded under Water for the Future) include:

- grants to local governments for community-wide planning for a future with less water
- grants to irrigation infrastructure operators to investigate rationalisation and modernisation options
- grants to irrigators for professional advice and training
- investment in other social and economic infrastructure.

What about food security?

The Commonwealth Minister for Water has indicated that the SRWUI program also has a food security objective:

> Central to our plan to getting the Murray-Darling Basin back onto a sustainable footing is investing in irrigation infrastructure to help our farmers and regional communities and protect food security. (Wong and MacDonald 2009)

At present, Australia exports around 60 per cent of all of its agricultural output in addition to providing the large majority of the food eaten by Australians (ABARE 2008). This is indicative of a very high level of food security. Also, the SRWUI program is only likely to make a small difference to Australia's agricultural production and general food prices, given that:

- irrigated agriculture in the Basin accounted for about 12 per cent of the gross value of Australia's agricultural production in 2005-06 (ABS 2008b)
- achieving the SDLs with the SRWUI program, rather than through buybacks and administrative reductions alone, is likely to increase the quantity of irrigation water in the Basin by only a modest proportion (perhaps around 5 to 10 per cent)
- the nature of the buybacks and opportunities for water trade will tend to result in the least profitable irrigation activities being reduced as water availability decreases
- food production will continue to be influenced by price signals, including those resulting from a decline in water availability.

Accordingly, Australia's high level of food security is very unlikely to be significantly influenced by the SRWUI program.

What about political reality?

A possible objection to moving away from the large subsidies to irrigators that appear likely to result from the SRWUI program is that they are simply the price that needs to be paid to achieve reform. That is, the program was needed to convince the states to agree to a truly Basin-wide approach to water planning and to elicit the irrigation sector's support for increasing environmental water allocations. But what the above analysis shows is that unless subsidies are kept to modest levels, the consequences are likely to be detrimental to the community as a whole. Subsidies not only transfer wealth from taxpayers to irrigators, they are also likely to lead to wasteful and inefficient investment.

The existence of such inefficiencies suggests that there may be better ways to accommodate political goals. An approach put forward by Grafton is to combine the Restoring the Balance and SRWUI programs and to spend these funds to ensure value for money in recovering environmental water. This would increase the quantity of water recovered for the environment and, therefore, could reduce or eliminate any uncompensated reduction under the Basin Plan. Accordingly, he argues that this 'would greatly assist farmers and their communities to autonomously adjust to lower diversions' (Grafton, sub. 81, p. 14). This approach would provide compensation to all irrigation areas affected by reduced diversions, including areas that would have had little prospect of benefiting from the SRWUI program because they had already upgraded their irrigation infrastructure.

Where to from here?

Ideally, there would be one government fund for purchasing water for the environment, rather than separate infrastructure and water purchase programs. As argued by Grafton and Jiang:

> A key reason for [the] 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 [irrigation water use] efficiency improvements whether it is the least costly method or not. (sub. 18, p. 4)

Similar arguments apply to irrigation infrastructure operators.

If there were one fund for water recovery, there might also be a case for some funds to be allocated to assist irrigators and related communities adjust to a future with less water. All forms of assistance, including subsidies for infrastructure projects, could then be considered on their ability to contribute to adjustment.

FINDING 6.5

Rather than having a $5.8 billion program focused predominately on infrastructure upgrades, it would have been more effective and efficient to:

- *use the sustainable diversion limits from the Basin Plan to determine the targets for reallocation in each catchment*
- *use the buyback program as the sole means of easing the transition to those targets*

- *consider establishing a much smaller program to assist irrigators and related communities adjust to a future with less water, through the most effective means available (not just subsidies for irrigation infrastructure).*

The roll out of the SRWUI program is, however, well underway and so the challenge is to find the best way forward from here. For the reasons discussed above, the SRWUI program, in its current form, has the potential to be ineffective, inefficient and inequitable. To minimise these problems rigorous project approval processes need to be applied.

Only projects that are reasonably expected to produce net benefits to the Australian community, and for which the government contribution is commensurate with public benefits should be approved. In practice this will usually mean that government funding should be no more than the value of the water recovered for the environment. The intention to take this approach should be clearly conveyed to irrigators and irrigation infrastructure operators to avoid them putting time and effort into project proposals that have little chance of being accepted.

RECOMMENDATION 6.4

Rigorous approval processes should be applied to all projects under the Sustainable Rural Water Use and Infrastructure (SRWUI) program. In particular, projects should only be approved where:

- ***properly conducted cost–benefit analysis shows there to be net benefits***
- ***government contributions are commensurate with public benefits (excluding private benefits to irrigators).***

Applying such approval processes is likely to result in the SRWUI program's budget being underspent. This money should be reallocated to Restoring the Balance or to other government priorities.

7 Designing a portfolio of water products for environmental watering

Key points

- There is no 'one size fits all' solution in the choice of water products to address environmental watering needs in the Murray-Darling Basin. Different products are needed for different circumstances.
- Restricting the water recovery to water entitlements is likely to reduce the effectiveness and efficiency of environmental watering policy.
- Water entitlements are most suited to meeting constant environmental demands, as well as providing a means of keeping water in storage to address emergency needs and watering demands outside irrigation seasons.
- Seasonal allocations are well suited to addressing immediate environmental needs in the short term and, in the longer term, can be used to target variable and uncertain environmental needs during the irrigation season.
- Leases on entitlements are a viable substitute for outright purchases of entitlements, and offer some advantages due to their flexibility.
- Options contracts are potentially a more effective and efficient way of delivering environmental objectives than outright acquisition of entitlements. However, the case for using this product before the environmental demands are clearly formulated, is weak.
- Covenants on entitlements are a relatively ineffective and high cost method of achieving environmental outcomes.
- Purchases of changes to licence conditions in unregulated systems will often be an ineffective and high cost method of delivering environmental outcomes. Group proposals or administrative approaches might be necessary to address such impediments.
- The acquisition of land and water packages is generally a high cost way of achieving environmental outcomes.
- Contracts for environmental services could be an effective and low cost way of delivering environmental outcomes on private land.

As discussed in chapter 1, one of the objectives of the Restoring the Balance (RTB) program is to obtain water for the environment. The choice of water products will influence the effectiveness and efficiency of environmental water recovery. This chapter applies the effectiveness and efficiency criteria developed in chapter 5 to analyse the relative merits and potential application of the following products:

- water entitlements
- leases on water entitlements
- seasonal allocations
- options contracts
- covenants on entitlements
- changes to licence conditions in unregulated systems
- land and water packages
- contracts for environmental services.

7.1 Purchasing of entitlements

Entitlements are one of the two most commonly traded water products (along with seasonal allocations) in the Murray-Darling Basin (the Basin). Environmental water purchasing programs to date have almost exclusively relied on the acquisition of water entitlements (appendix B).

The focus of RTB has also been on acquiring water entitlements, with significant volumes of entitlements of varying reliability already purchased in different locations (chapter 1).

Effectiveness

Targeting

The targeting of environmental objectives through the purchasing of entitlements is likely to be difficult.

First, the factors influencing the volume of water allocated under an entitlement will often differ from the factors influencing environmental water demands (chapters 2 and 4). Consequently, the timing and size of the environmental demand may be poorly aligned with the availability of water under an entitlement. For example, some environmental demands may be countercyclical to water availability (more water is demanded by the environment in seasons when the allocations accruing to entitlements are low) while others are cyclical (more water is demanded when the allocations are high). The environmental watering needs are often dependent on rainfall over several previous years while entitlements yield allocations largely on the basis of the current season's rainfall. Also, some environmental watering needs are very sporadic, while most entitlements would yield a relatively reliable supply of allocations in non-drought years.

The Australian Government may have some capacity to develop a portfolio of entitlements of varying reliability that align with particular environmental demands. Freebairn and Quiggin (2006) demonstrated that being able to acquire entitlements of different levels of reliability significantly improved the ability to target particular water demands. Indeed, past and present water recovery programs, including RTB, have acquired a mix of entitlements of varying reliability, although the reliability weightings differ between programs (appendix B). The Department of the Environment, Water, Heritage and the Arts (DEWHA, sub. DR85, p. 8) argued that, in undertaking 'no regrets' purchasing under Restoring the Balance, it 'consults with the MDBA [Murray-Darling Basin Authority] on implementation of the RTB program and endeavours to prioritise water purchasing in a way which will result in a portfolio of environmental entitlements which is consistent with the direction and content of the Basin Plan'. However, DEWHA has not provided the Commission with any evidence that would enable an assessment of whether and how it has targeted a particular mixture of entitlements to align with specific environmental demands.

The strategy of purchasing a portfolio of entitlements places very high information demands on the Australian Government and requires:

- an ex-ante assessment of the timing and volume of future water allocations accruing to particular entitlements
- an ex-ante assessment of the timing and size of future environmental water needs, taking into account future climatic conditions and the contribution of other factors to the environmental outcome.

This implies that for variable and uncertain environmental demands, there will be periods in which the entitlement holding will be poorly aligned with the actual environmental needs.

Second, despite recent improvements, trade in entitlements is still subject to significant delays (chapter 10), making it an ineffective strategy for addressing short-term variations in environmental demands or engaging in adaptive management.

Diversification strategies

The uncertainty surrounding the allocations under particular entitlements and the variability of particular environmental demands may be reduced by adoption of some diversification strategies. Diversification could be pursued through:

- purchasing a portfolio of entitlements from different but connected systems — this may produce a more predictable stream of annual water allocations
- using a particular entitlement holding for watering a diverse set of environmental assets — an aggregate of several environmental demands is likely to be less variable and hence more predictable than each of the components.

Both of those strategies will likely be applied to some extent to improve the effectiveness of the buyback. However, several factors are likely to limit the effectiveness of diversification:

- Due to deliverability constraints in some parts of the Basin (chapter 4), there is limited substitutability between entitlements in different locations for meeting a particular environmental demand, and there is limited substitutability of environmental demands that could be met by a particular entitlement. In some cases, such as in parts of the Northern Basin, diversification may not be possible at all.
- There is likely to be some correlation between allocations under different entitlements (limiting the gains from diversifying the entitlement holding) and between different environmental demands (limiting the gains from diversifying environmental demands). For example, a prolonged drought affecting the entire Basin has increased many environmental water demands and reduced most allocations.
- There is no 'clean slate' in environmental watering needs. At the outset of the buyback, there were many environmental assets requiring urgent watering (chapter 4). Meeting these short term needs will likely require a different portfolio of entitlements to what will be needed in the longer term.

Thus entitlements are best suited to meeting environmental demands that are known at the time of the purchase and are relatively constant over time.

Benefits from storage rights

An important feature of the type of entitlements DEWHA has sought and purchased is the ability to manage the storage of the water over time.[1] Carryover provisions allowing entitlement holders to store some of their allocation for future use have been introduced in most systems. This may give the Commonwealth Environmental Water Holder (CEWH) some ability to accumulate water in storages, allowing timely release in the future when the environmental need arises or is identified. This capacity to access water across years could also allow the CEWH to meet short-term environmental needs arising outside the irrigation season, when the ability to purchase water is extremely limited. Most irrigation infrastructure operators allow delivery of stored water between seasons, although this right is typically subject to maintenance work not being undertaken at the time. The National Farmers' Federation disputed the importance of out of season access to water for watering environmental assets:

> Irrigation seasons usually run from August to end of April. This leaves only around three months from late autumn to winter. Typically this time is used to run regulated rivers low in an effort to 'mimic' natural flows. In particular, it provides an opportunity to establish stream bank vegetation. The proposal [of] using this for environmental flows has two drawbacks – it will increase system losses … and for the southern Basin, water environmental assets at the wrong time. (sub. DR88, p. 12)

More generally, there are constraints on carryover rights — for example, the carryover limit is 50 per cent of the nominal entitlement volume in Victoria and New South Wales (NWC 2009b). These limits are imposed to address third-party effects arising from storing the water, such as the risk of storage overflows.

An alternative way of improving the temporal flexibility of water entitlements is by assigning the rights to storage to entitlement holders via a capacity sharing scheme (chapter 10). However, these systems have only begun to emerge in the Basin and their relevance to the buyback (at least in the short term) is limited.

Institutional and administrative impediments

A number of institutional constraints apply specifically to trade in entitlements. These include:

- a 4 per cent limit on net annual trade out of an irrigation area
- some property rights in water being poorly defined:

[1] DEWHA has generally shown little interest in purchasing 'rules based' entitlements and has focused on storage-based entitlements.

– some water entitlements are still bundled with land
– some rights to water are bundled with delivery and use rights
– some irrigators are constrained in their ability to separate their share of a bulk entitlement (where the entitlement accruing to a district is defined in bulk terms)

- trades can take a long time to settle.

These impediments are discussed in chapter 10. In most instances, the preferred approach is to reduce the constraints. However, in some cases the constraints may be difficult to remove in a timely manner. In those cases, the purchasing strategy may need to accommodate the constraints by switching to a different water product.

Efficiency

Transaction costs

The trading of entitlements is associated with significant transaction costs for both parties. The categories of transaction costs include:

- government taxes, fees and charges
- approval times
- brokerage fees
- irrigation infrastructure operator fees (PC 2006).

The Allen Consulting Group (2006, p. 19, cited in PC 2006) estimated that the government and brokerage components of transaction costs associated with straight forward trades of entitlements in Queensland and New South Wales constituted 3.5 per cent of the value of the trade.

In addition, sellers of entitlements may bear other conveyance costs such as the cost of discharging a mortgage on the entitlement. Several participants indicated that the buyback was resulting in the acquisition of water from financially distressed sellers (National Irrigators' Council, (sub. 24); National Farmers' Federation, (sub. 50)), potentially elevating the importance of this category of costs.

A significant component of the transaction costs is likely to be fixed for each transaction. For example, some fees are levied on a transaction (rather than water volume or value) basis. Thus, the transaction costs per megalitre are lower for larger transactions.

Another key consideration in the context of the buyback, is the extent to which subsequent adjustment to the portfolio is required in future years to improve alignment with environmental watering needs. Transaction costs rise if the entitlement portfolio poorly targets the environmental demands. As discussed earlier, this is a significant risk where the environmental demands are not already clearly identified.

Opportunity costs

The cost of an environmental water portfolio consisting entirely of entitlements would be greater than necessary if the water allocated under those entitlements was not required for environmental watering in some periods. This is likely to be the case for meeting environmental demands that vary over time.

Scoccimarro and Collins (2006) presented a case study on the costs of meeting the periodic and highly variable environmental demands in the Gunbower Koondrook Perricoota Forests using different water products. They found that the budgetary cost of acquiring entitlements was $200 million, compared to a cost of $19 million, if the Government combined entitlement acquisitions with trade in allocations to achieve exact alignment with the environmental demand.

This estimate is likely to overstate the true cost of sourcing water through entitlement purchases because it did not take account of the various ways of improving the accuracy of targeting of environmental demands through entitlements. Using a particular entitlement to target several environmental demands in different years and carrying over unused water would reduce the opportunity costs of the water. However, even taking these factors into account, the cost of meeting environmental demands solely through entitlement purchases is likely to be high.

As discussed earlier, uncertainty about future environmental demands and the future allocations of water under entitlements makes it difficult to align the entitlement holding with the environmental demands, and there are constraints on reducing the variability through diversification. Carryover provisions could reduce the cost of the entitlement portfolio. However, in the above case study, a very significant carryover provision of 150 per cent of the entitlement volume only reduced the cost by around 50 per cent.

Scoccimarro and Collins (2006) concluded that to reduce the cost of meeting the environmental demand, an entitlement holding would need to be combined with significant subsequent trade in seasonal allocations. There is a provision under the

Water Act 2007 (Cwlth) allowing the CEWH to trade seasonal allocations. However, this power appears to be limited (discussed later).

Another component of the cost of buying entitlements for the environment is the risk premium attached to this product by irrigators. Of the two major water products currently being traded — entitlements and seasonal allocations — seasonal allocations exhibit by far the biggest fluctuation in prices over time (chapter 3). Risk averse irrigators seek to insure themselves against this price risk by holding some water entitlements. The price of entitlements (particularly high reliability entitlements) may attract a risk premium in addition to the value of the water available under the entitlement. The estimates by Scoccimarro and Collins (2006) show the internal rate of return on entitlements in the New South Wales and Victorian Murray regions to be 6 per cent, compared with the opportunity cost of capital of 7 per cent (implying a risk premium of 1 per cent).

On the other hand, the Australian Government is generally better able to absorb the price risk than an individual irrigator, due to the size and diversity of its aggregate expenditure. Consequently, it may be able to take advantage of this and reduce the opportunity cost of the buyback in the longer term by purchasing products that carry a higher level of price risk, avoiding the risk premium built into the market price of entitlements by irrigators.

To summarise, the informational demands of aligning a water entitlement with an environmental demand are significant, thereby limiting the effectiveness of environmental watering that relies exclusively on entitlements. The delays in executing transactions could also render the strategy ineffective for engaging in adaptive management. This inflexibility will manifest itself in a high opportunity cost of holding water that is occasionally surplus to environmental demands. Targeting could be improved, and the opportunity cost of the water reduced, by subsequent trade in seasonal allocations accruing to the entitlements (and the CEWH has some ability to engage in such trade). However, this would increase transaction costs if significant future adjustment is required to the entitlement holding to improve its alignment with environmental needs. Used on their own, entitlements are likely to be most effective in targeting known and constant environmental demands, and in providing a means of storing water for use in emergencies and outside irrigation seasons, when water can not be sourced from trade.

7.2 Purchasing of seasonal allocations

Seasonal allocations are (along with water entitlements) one of the two widely traded water products in the Murray-Darling Basin (chapter 3). However, they have been rarely utilised in past and current environmental water buybacks. There are some exceptions, for example the Riverbank program, where seasonal allocations can be acquired to meet urgent environmental needs.[2]

Submissions to this study indicate a range of views on whether the Government should purchase seasonal allocations for the environment. The Gwydir Valley Irrigators Association (sub. 29), the Queensland Farmers' Federation (sub. 35), and Murrumbidgee Irrigation (sub. 39) supported such purchases in some circumstances. On the other hand, the National Irrigators' Council (sub. 24) opposed the purchase of allocations at the initial stages of the buyback, while the NSW Irrigators Council (NSWIC, sub. 32) considered that this strategy would impose significant costs on irrigators, rural and broader communities.

Effectiveness

Targeting

Compared with water entitlements, the acquisition of seasonal allocations has several advantages in the targeting of environmental watering demands. First, allocation trades are executed more quickly than entitlement trades (chapter 3). This allows some flexibility to engage in adaptive management, rather than having to anticipate future environmental demands. Second, in contrast to entitlements, the purchase is of a known volume of water, improving the ability of the manager to align the allocation with the environmental demand. The certainty of obtaining the purchased volume of water also makes allocations a suitable product for targeting any immediate environmental needs that have accumulated in the Basin. Third, the temporary nature of seasonal allocations allows better targeting of highly variable or sporadic environmental demands. A case study of the purchase of physical water to stimulate a rare bird breeding event in the Narran Lakes illustrates the potential effectiveness of temporary water purchases (appendix B). The temporary nature of allocations also allows some experimentation in the face of scientific and economic uncertainty. Fourth, it is very unlikely that the CEWH or anyone else can create an 'over the bank' flood event for wetlands using just what they have in storages, from

2 However, even in that program, the ability to purchase seasonal allocations is limited, because the acquisitions can only be funded with the proceeds from the sale of unneeded allocations that accrued to entitlements held by the environmental manager (appendix B).

entitlements, even with substantial carryover. Hence, some purchases of seasonal allocations may be required to go with the release of water held under entitlements.

Nevertheless, there are some constraints on the capacity to target environmental demands through the purchasing of seasonal allocations. While transactions are generally timely, using the water already held in storage under an entitlement is an even more expeditious option. In some cases, where the water is required on very short notice and finding sellers of seasonal allocations is difficult, keeping some water in storage under an entitlement may be more practical. There are also some constraints on the periods during which water could be sourced and used. There is very limited water trade between irrigation seasons and the ability to keep an allocation in storage between seasons is also likely to be limited. For example, Goulburn-Murray Water (2009b) does not allow carryover of seasonal allocations unless the irrigator also holds or leases a water entitlement in the system. Thus, seasonal allocation purchases may be more effective in targeting environmental demands arising during the irrigation season.

Institutional and administrative impediments

Trade in seasonal allocations is generally subject to fewer impediments than the trade in entitlements (chapter 3).

Some participants argued that acquiring seasonal allocations under the RTB could be inconsistent with the terms of the National Water Initiative. The Australian Conservation Foundation observed:

> The water is not available in perpetuity and hence does not strictly fulfil the NWI criteria for environmental water … (sub. 41, att. 2, p. 5)

There does not appear to be a specific requirement for the environmental water recovery to be undertaken through acquisitions of permanent water products, in either the National Water Initiative, or the Agreement on Murray-Darling Basin Reform. Further, if the objective is to achieve environmental outcomes in perpetuity, there are other means of insuring this outcome. For example, a permanent budget can be allocated for ongoing acquisitions of seasonal allocations.

Efficiency

Transaction costs

Transaction costs for trade in seasonal allocations include:

- state government fees

- brokerage fees
- approval times (PC 2006).

In dollar terms, the cost of a trade in seasonal allocations is significantly lower than that of entitlements (chapter 3). However, a valid comparison of the transaction costs needs to take into account that the purchase of an entitlement involves a single transaction, while recovering water through seasonal allocations would involve repeated trade into the future. The Allen Consulting Group (2006, cited in PC 2006) estimated that the transaction costs of allocation trades as a proportion of the value of the trade was 2–3 per cent in New South Wales, Victoria and Queensland, compared with 3.5 per cent for entitlement trades in New South Wales and Queensland. This suggests that the transaction costs of yearly trade in allocations may be lower than the cost of a single transaction to acquire an equivalent volume of water through an entitlement.[3] The cost advantages of trading in seasonal allocations increase where the environmental demands only arise in some years, and yearly trade is not required. Also, when purchasing entitlements there will be periods when the entitlement holding does not match the environmental demand (discussed above). Subsequent trade to account for this would shift the balance further in favour of allocations.

Opportunity costs

The capacity to target environmental benefits more directly than through entitlement purchases could result in substantial savings in the cost of water. In other words, purchasing the water as and when needed would typically have a lower cost than if the water were held in the form of entitlements that were at times underutilised. In addition, acquiring seasonal allocations to address specific identified environmental needs is a more transparent approach than the purchasing of permanent water rights on the basis of predicted future needs. Consequently, it could impose greater discipline on the environmental manager to avoid acquiring surplus water. Finally, as discussed previously, seasonal allocations would not attract the risk premium associated with entitlements.

Several participants were concerned that the Australian Government's involvement in the seasonal allocations market could distort the market and drive up the costs to a greater extent than if the Government only purchased entitlements. For example,

---

3 If the price of an entitlement reflects the expected net present value of the stream of allocations (chapter 3), then the net present value of 3 per cent of the price of allocations incurred every year would be equivalent to 3 per cent of the price of the entitlement. This assumes that equivalent volumes of water per trade are acquired.

the NSWIC argued:

> … the temporary market, particularly in dry periods, is vital to the operation of irrigated agriculture, and the entry of a participant of the size of the Commonwealth will devastate both the market and the businesses that rely on it. (sub. DR72, p. 11)

DEWHA contended:

> Entering the allocation market would immediately inflate the price for everyone in the market, adversely affecting irrigators who are looking to buy water to sustain their crops in the current drought. (sub. DR85, p. 19)

As discussed in chapters 3 and 5, the market for seasonal allocations can not be viewed independently of the market for water entitlements. The price of an allocation depends on the volume of water in the consumptive pool. In this context, acquiring an entitlement for the environment would reduce the supply of allocations available for consumptive use in the same way as if the water was acquired directly in the seasonal allocations market, and the impacts on the price of allocations should be equivalent.

It could be argued that by acquiring entitlements, the Australian Government would provide a clearer signal and longer-term notice to the market of its environmental watering demands, than if it entered the seasonal allocations market every year. For example, if purchases of seasonal allocations by the environmental manager created sudden and unanticipated large spikes in the demand for allocations, irrigators may face high adjustment costs. This could drive up the opportunity cost of water. However, this argument rests on the assumption that in purchasing entitlements, the Government has clearly and accurately communicated the future environmental watering demand to the market. If (as would be likely) significant subsequent trade is required in the future, acquiring entitlements would have a similar impact on the prices of seasonal allocations to direct purchases of allocations.

Comparing entitlements and seasonal allocations

Achieving environmental objectives

As the previous discussion illustrates, acquiring seasonal allocations offers a flexible and relatively low-cost way of responding to identified environmental watering needs. The strategy has some practical limitations (outlined above). However, where it is practical to use seasonal allocations, it would often be a superior alternative to the purchasing of entitlements (table 7.1).

Table 7.1 **Comparing entitlements and seasonal allocations**

Criterion	*Entitlements*	*Allocations*
Effectiveness	**Medium**	**Medium-high**
Targeting	Flexibility in sourcing water throughout the year due to storage rights. Difficult to target variable environmental demands – requires anticipation of timing and size of future environmental demands and of allocations under the entitlement. Unsuitable for adaptive management due to long transaction periods and high individual transaction costs.	Potentially highly accurate – a known volume of water is acquired to address an identified environmental demand. Relatively quick transactions allow adaptive management. Temporary nature of the product facilitates experimentation. Limited carryover rights and difficult to source between irrigation seasons.
Institutional constraints	Caps on net trade out of irrigation areas. Poorly defined property rights in some districts.	No explicit constraints at present.
Efficiency	**Medium**	**High**
Transaction costs	Relatively low if no subsequent adjustment to the holding is required. High, if subsequent adjustment is required to improve targeting.	Relatively low – cost of individual transactions is low and only the transactions necessary for addressing the environmental demand need to be undertaken.
Opportunity costs	Unnecessarily high if the entitlement delivers water that is not needed by the environment. Irrigators use entitlements as a price risk management tool, resulting in a price premium relative to allocations.	Reacting to an identified need reduces the risk of holding unneeded water.

Addressing the transitional objective

The preceding discussion focused on the suitability of water entitlements and seasonal allocations to directly address environmental watering objectives. DEWHA (sub. DR85, p. 19) argued that the primary objective of the RTB program was to achieve a 'permanent rebalancing of the system, to improve the health of the Basin system over the long term'. Consequently, it contended that the buyback should focus exclusively on water entitlements or similar permanent water products.

However, the conclusion that a permanent rebalancing of environmental and consumptive uses of water could only be achieved through the buyback of permanent water products, is not self-evident. For example, as observed earlier, allocating a permanent budget to yearly acquisitions of seasonal allocations could achieve a similar outcome. This strategy would also be more cost effective, given that the price of an entitlement is likely to exceed the (discounted) price of the future stream of allocations due to a risk premium, and that the superior targeting of environmental demands through allocations would lead to lower transaction costs. Further, the rebalancing achieved by the RTB will at any rate not be permanent, because the CEWH in exercising its powers to manage the portfolio of water products (discussed below) will be likely to trade water after the buyback. This will change the balance between consumptive and environmental uses in different regions.

Ultimately, however, even if it were accepted that water entitlements were the most appropriate product for pursuing the transitional objective, it is important that the objective of addressing short term environmental needs is not compromised or forgotten. In addressing those needs, there is a strong case for utilising seasonal allocations in a portfolio of water products.

FINDING 7.1

Purchasing seasonal allocations offers a transparent, flexible and low-cost means of addressing urgent, short-term environmental watering needs. Where practical, this product should be included in the portfolio of water products.

The power of the Commonwealth Environmental Water Holder to purchase allocations

The *Water Act 2007* (Cwlth) allows the CEWH to trade seasonal allocations in some circumstances. The effect of these provisions is not clear, but this power may be limited (box 7.1).

Also, purchasing entitlements and then engaging in subsequent adjustment trade in seasonal allocations under those entitlements will have greater transaction costs than simply acquiring allocations if and when required. It would be appropriate that, in addition to the mix of entitlements acquired under the RTB program, the CEWH is given funding for acquiring seasonal allocations (and other products), at the outset.

Box 7.1 **The provisions for trade in allocations by the Commonwealth Environmental Water Holder**

Section 106 of the *Water Act 2007* (Cwlth) allows the Commonwealth Environmental Water Holder (CEWH) to trade seasonal allocations in some circumstances. The CEWH has interpreted its powers as follows:

> … the CEWH may only dispose of water (seasonal allocations) and holdings (entitlements) if:
>
> - the seasonal allocations are not required to meet environmental objectives in a given water accounting period and cannot be carried over to the next accounting period [s106(1)]; or
> - the proceeds of the disposal (of either seasonal allocations or entitlements) are used to purchase water (either seasonal allocations or entitlements) that improves the capacity of the holdings to meet the environmental objectives [106(2)]. (DEWHA 2009b, pp. 17-18)

While it is not possible to predict how this power will be exercised by the CEWH in the future, there may be circumstances when the above restrictions could lead to inefficient outcomes. For example, there may be periods when, rather than carrying over unneeded water or selling it to acquire water in other locations, it is more efficient simply to sell the water and retain the funds for acquisitions in future seasons. It is not clear that the CEWH will have the power to do that. Tandou Limited observed:

> At the programmes conclusion the Federal and State Governments will collectively own a large parcel of water earmarked for the environment. The question remains: what will the Environmental Water Holder do with this water when all environmental needs are addressed naturally, i.e. in the wet years that will come again? … We are concerned that there appears to be no mechanism for dealing with all this water in high flow or wet years. (sub. 28, p. 7)

7.3 Purchasing of leases on entitlements

An alternative to outright acquisition of water entitlements is the purchase of a lease on an entitlement. Leases on entitlements (also referred to as term transfers in New South Wales and limited term transfers in Victoria) involve the transfer of an exclusive right to an entitlement (or a part of an entitlement) for a fixed term (NWC 2009c).

There was limited trade in leases on entitlements in 2007-08, with 2 leases entered into in New South Wales totalling 1.5 gigalitres (GL), 36 in Victoria totalling 8.3 GL and 69 in Queensland totalling 6.6 GL (NWC 2009b). Leases have not been utilised in environmental water buybacks to date, although there are provisions allowing the purchase of leases in the RiverBank program, while the Living Murray Program allows the acquisition of 99-year leases (appendix B).

The nature of the rights acquired under a lease agreement can vary depending on how the lease is specified. Leases can be long term, short term or periodic with regular renewals on agreed conditions. They can also be for all or part of the allocations accruing to an entitlement, and can also be specified to include or exclude other rights associated with the entitlement, such as storage and delivery rights.

Several participants, for example, Tandou Limited (sub. 28) and Murrumbidgee Irrigation (sub. 39) suggested that leases should be acquired as part of the portfolio. Scoccimarro and Collins (2006), in a survey of irrigator attitudes, discovered that irrigators generally supported the acquisition of leases, because it could reduce the reliance of the environmental manager on seasonal allocation purchases and also make the environmental acquisitions more visible to the market.

Effectiveness

Targeting

The effectiveness of targeting environmental demands through leases would depend largely on the term of the lease. Long-term leases with no provision for renegotiation would operate similarly to outright ownership of entitlements, and would be subject to similar targeting problems. Reducing the duration of the lease or allowing the renegotiation of some terms would improve their flexibility in targeting environmental needs. However, this would increase transaction costs.

If storage rights are included in the lease, the flexibility of the lease in targeting environmental needs would improve (as in the case with outright purchases of entitlements).

Institutional and administrative impediments

Generally, trade in leases on entitlements is subject to fewer institutional and administrative constraints than trade in entitlements. Further, to the extent that leases are a close substitute for full ownership of entitlements, they could offer a way of overcoming some of the constraints applying to entitlement trade. For example, leases could be acquired if the 4 per cent limit on net annual trade of entitlements out of an irrigation area is reached.

Efficiency

Transaction costs

There are little data on the transaction costs associated with entering into entitlement leases. The limited trade in private markets suggests that the costs of setting up a purchase scheme and then identifying potential sellers, and negotiating with them, may be higher than for purchases of entitlements or seasonal allocations. These costs would increase if the leases are diverse in nature. Furthermore, if the leases are of short tenure or allow renegotiation, some of these costs would be ongoing. There may also be increased administrative costs of managing a portfolio of leases of differing characteristics and with different termination dates.

Nevertheless, leases are generally not a complex product and appear to be well understood and supported by irrigators. The Commission has previously observed that the transaction costs associated with similar products, such as leases on farm equipment, are not great (PC 2006). The transaction costs for leases on water entitlements are, therefore, unlikely to be prohibitive.

Opportunity costs

The flexibility in aligning the acquired water with environmental demands, offered by shorter term and renegotiable leases, would manifest in lower costs, compared with the acquisition of entitlements.

The benefits from acquiring short-term flexible leases would need to be balanced against the likely increases in transaction costs. Nevertheless, the ability to trade off transaction and opportunity costs is likely to reduce the aggregate costs of leases, compared to outright purchases of entitlements.

To summarise, the acquisition of leases, rather than outright purchasing of entitlements, could improve the ability of the Australian Government to align the acquired water with environmental demands, and hence reduce the cost of water. There are fewer administrative impediments to trade in leases than to trade in entitlements, and leases appear to be supported by the community. This suggests that entering leases on entitlements is a feasible complement to the outright purchase of entitlements.

7.4 Purchasing of options contracts

An options contract is a derivative product that attaches to a water entitlement and typically involves an agreement for future access to a particular volume of water provided certain conditions are met (a trigger is activated). The contract usually provides for a payment of a 'premium at the time of signing' and an exercise price if the option is exercised. Options contracts could also be utilised in unregulated systems (discussed in section 7.6).

Options contracts are widely utilised in many markets, such as the electricity market and the share market, as a mechanism for managing risk (Scoccimarro and Collins 2006). In the United States, short term options contracts are also utilised in environmental water recovery programs (appendix C). However, their application in the Australian water market has been limited to date.

The Murrumbidgee River Reach pilot project — funded by the Australian Government, Murrumbidgee Irrigation, and the Murrumbidgee Catchment Management Authority — aims to demonstrate the potential benefits of such products. It has operated for several years, but has made limited progress in developing water derivative products. In the private market, there have also been some attempts to establish a market for this product. The National Water Commission reported:

> … the Sydney Futures Exchange has created SFE State Water Indexes with a view for the trading of futures contracts on each regional index to be a mechanism to hedge financial risk associated with water availability. The indexes were established in August 2005. The market, although originally expected to be established during 2006-07, has yet to commence. (NWC 2009b, p. 152)

The Gwydir Valley Irrigators Association also suggested:

> … there has been a small, but informal option market for Gwydir supplementary water for a number of years, and it offers some risk sharing advantages for those wishing to access supplementary water, and this could be of interest to an environmental water manager. (sub. 29, p. 10)

Surveys by Scoccimarro and Collins (2006) and Murrumbidgee Irrigation (sub. 39) indicate that irrigators support the use of options contracts by the Government. Participants in this study (for example, NSW Irrigators Council, sub. 32, National Irrigators' Council, sub. 24) also generally supported the use of options contracts.

Effectiveness

Targeting

An options contract could provide significant flexibility in targeting environmental outcomes. There is flexibility in selecting:

- the duration of the option
- the frequency of the option's exercise over its life — this could reflect the periodic nature of the environmental demand
- the nature and level of the trigger that would activate the option and the volume of water that would become available if the trigger is met, for example:
  - a trigger could be selected to align with the environmental objective and could be based on, for example, storage levels, rainfall, or the volume of allocation under the relevant entitlement (Scoccimarro and Collins 2006)
  - multiple triggers (with different volumes of water associated with them) could be specified on one option, or a trigger could be made contingent on particular events (for example, the contract could specify that the threshold for activating the option is lowered after several seasons of low rain).

Increasing the complexity of the option would increase transaction costs (discussed below). However, in theory, the only constraints on accurate targeting of environmental outcomes are the uncertainty surrounding the future water allocations accruing to the underlying entitlement, and the information requirements of aligning the option trigger with the environmental watering needs. The uncertainty arising from the allocations under the entitlement can be addressed by writing the options contracts on high reliability entitlements. The information requirements of aligning the option trigger with environmental watering could be reduced by shortening the duration of the option.

Institutional and administrative impediments

The absence of an active market for water options makes it difficult to assess whether trade in this product would be subject to significant constraints and, in particular, how the impediments to trade that apply to currently traded water products would apply to options contracts. The lack of legislative or administrative recognition of water options contracts might, however, be construed as a constraint on trade.

Efficiency

Transaction costs

The absence of a market for water options contracts makes it difficult to assess the likely transaction costs associated with this product. However, there are indications that costs could be significant. First, the establishment of an options market would inevitably involve some set-up costs, such as the costs to the parties (including the market intermediaries) of familiarising themselves with the new product, and the costs of developing the institutional support for the product.

At a minimum, developing the institutional support for options contracts would involve the design of the contracts. However, it would also likely require that water options are recognised as a property right and that state water registers are adapted to accommodate them. Scoccimarro and Collins (2006) recommended statutory amendment to support the operation of option contracts.

Murrumbidgee Irrigation (sub. 39, att., p. 26) estimated that the cost of establishing the institutional infrastructure of a RiverReach scheme in the four Basin jurisdictions would be $1 million. It is not clear how this estimate was derived, but current experience with harmonising state water market registers suggests that this may be a significant underestimate.

Second, the economic literature (see for example, Michelsen and Young 1993, Leroux and Crase, sub. 9) suggests that specifying the option and determining its price is a complex task, which is subject to uncertainty over and above that affecting the value of the underlying water product. The uncertainty would increase as the complexity of the option conditions and the duration of the option increase. Consequently, trading in options is likely to involve high negotiation costs, particularly at the outset, when the market for options is thin. Thin markets would also persist if there is significant heterogeneity in the options contracts.

Opportunity costs

By delivering a better alignment between the environmental demand and the water acquisition, options contracts could lead to lower opportunity costs than from purchases of entitlements. This is because the option would reduce the periods when the water is available but not needed for environmental watering. Further, where the environmental water demand is countercyclical to the water demands of irrigators, options contracts could take advantage of the complementary nature of the competing demands, resulting in lower costs.

ABARE modelling of the potential cost of recovering water through options contracts demonstrated that, in the presence of countercyclical demands, there could be significant cost savings relative to the purchasing of entitlements (Heaney and Hafi 2005). For options triggered by high allocations (in other words, where the value of additional water for irrigation may be low) the cost of the water was estimated to be between $12–30 per megalitre. This compared with the cost of $46 per megalitre if the water was sourced through general reliability entitlements. The NSW Government (sub. 51, p. 9) observed that unpublished modelling by Industry and Investment NSW also demonstrated significant potential savings from countercyclical trading in options.

Heaney and Hafi (2005) also observed that options contracts could reduce the cost of a buyback, because they allowed irrigators to retain entitlements and use them as a risk management mechanism (see earlier discussion).

However, the potential benefits of options contracts are likely to depend on particular circumstances. The modelling by ABARE and Industry and Investment, NSW, referred to above, did not demonstrate the existence and extent of environmental demands that could be targeted by countercyclical trade. Scoccimarro and Collins (2006) modelled the potential costs of using options to target environmental watering demands in the Gunbower Koondrook Perricoota Forests. It concluded that, in that particular case, environmental and irrigation watering demands were generally not countercyclical, and the highly variable nature of environmental watering demands made it difficult to design an efficient options contract.

Finally, some of the benefits of options contracts could be captured by using other products. For example, purchasing seasonal allocations and, to a lesser extent, low reliability entitlements would also confer the advantages of countercyclical trade.

In summary, the market for water options trade between irrigators has not developed thus far, despite their theoretical appeal and the absence of any explicit administrative impediments. A survey of irrigators by the BDA Group showed that:

> Irrigators generally held the view that the development of risk management tools would occur as required and that there were no obvious constraints to this should such tools be commercially viable. (Scoccimarro and Collins 2006, p. 56)

This suggests that currently the transaction costs of options contracts may exceed the benefits of switching from trading in existing water products.

Transaction costs may be reduced through addressing the underlying impediments to water trade in general. This should be the priority avenue for government involvement, as it may facilitate the private development of a water derivatives market.

Improved communication by the Australian Government of its environmental watering needs could also facilitate the private development of such products. The NSW Irrigators Council observed that:

> … a centralised exchange servicing a robust market will develop the derivatives – or provide the source entitlement – to any significant buyer that is clear about what they want and/or need. (sub. 32, p. 13)

The absence of a market need not preclude the use of options contracts altogether. There may be some scope for DEWHA to include simple option contracts in a tender process. However, generally, the effectiveness and efficiency advantages of options contracts would be significantly undermined by the current absence of clear environmental targets or requirements, against which the options contracts could be calibrated.

7.5 Purchasing of covenants on entitlements

One way to recover water for the environment is by changing the property rights on existing water products. A covenant could be placed on a water entitlement restricting the use of allocations under that entitlement. The remainder of the allocation would be used on environmental needs.

Covenants on water entitlements are currently not traded privately and have not, to the Commission's knowledge, been utilised in environmental water buybacks to date. However, this approach has been utilised to deliver conservation outcomes on land, for example through various projects under the Natural Heritage Trust. Typically, this involves a revolving trust mechanism, where a property is purchased by the environmental manager, an environmental covenant is placed on it, and the property is resold.

Participants to this study have generally opposed the use of covenants in environmental water recovery. For example, the National Irrigators' Council noted:

> We are unconvinced on the merits of covenants – irrigators would be opposed if the characteristics of entitlements purchased for the environment were to change. (sub. 24, p. 7)

Similarly, the NSW Irrigators Council stated that:

> NSWIC has maintained a policy position over many years that the underlying characteristics of a licence must not be altered based on ownership ... In light of that, NSWIC is wary of covenants … (sub. 32, p. 12)

Effectiveness

Targeting

In theory, a covenant could be specified to align with anticipated environmental watering demands. For example, a covenant prescribing the conditions under which the allocation associated with the entitlement would be shared between the irrigator and the environment, could operate similarly to an options contract.

However, in practice, the effectiveness of covenants is likely to be limited. The covenant conditions would need to be specified for future environmental demands, placing a high information demand on the Government. Further, covenants are typically permanent and are not easily reversed. This, coupled with the prescriptive nature of this product, would result in poor adaptability to uncertainty about environmental demands or changing circumstances. In view of this, covenants are likely to be less effective in targeting environmental demands than their closest substitute — an options contract.

Institutional and administrative impediments

As observed by Scoccimarro and Collins (2006), the acquisition of covenants would create a new class of entitlements. This would require state government involvement. If the Australian Government acquires a diverse set of covenants (as it may need to do to address diverse environmental goals), the administrative complexity at district and state level would rise correspondingly. The Commission has previously observed (PC 2006) that unless a Torrens titling system was developed for water rights,[4] it would be difficult to implement and enforce covenants. Given the challenges in harmonising state approaches to defining and managing water rights, there are likely to be significant difficulties in implementing a universal system of covenants.

Efficiency

Transaction costs

The acquisition of covenants is likely to involve high transaction costs. First, in the absence of a private market for covenants, there would be some set-up costs.

4 Under a Torrens titling system, only the property rights recorded on the title register can affect the title holder. This is in contrast to a register of deeds system, where there may be unrecorded property rights that affect the title holder.

Second, the most practical method of implementing covenants is through a revolving trust system. This involves two transactions, compared with the single transaction necessary for acquiring other water products. And the costs of individual transactions may also be high due to thin markets and the opposition of the irrigators to the use of covenants. Third, the administrative costs of managing a complex portfolio of covenants are likely to be high. Finally, in the absence of an adequate titling system, such as a Torrens system, introducing an additional layer of complexity on the water market, would increase the transaction costs of private trades. Purchasers of entitlements would incur potentially significant additional costs in having to verify that the entitlements are not encumbered in any way.

To summarise, acquiring covenants on entitlements is an inflexible and high cost method of addressing environmental watering demands, and has little merit where markets for other products are well developed. However, a covenant-style arrangement may be a practical option in some unregulated systems, where the nature of the pumping rights attached to water licences and third-party effects mean the water markets are thin or do not exist (discussed below).

7.6 Purchasing water in unregulated systems

The purchasing of water licences or changes to the conditions of licences in unregulated stretches of river systems has been considered by governments as a mechanism to maintain or increase environmental flows. There are, however, limited examples of governments using this option in practice. One example is the streamflow tender in Melbourne catchments in which the Victorian Government purchased water in unregulated parts of the Yarra system to increase environmental flows (appendix B.4). Under the tender, participants submitted bids to surrender their licences altogether or to change conditions of their licences, such as reducing the annual volume extracted or changing the timing of access to water. The Northern Victoria Irrigation Renewal Project (sub. 38) suggested a similar tender could be used by the Australian Government as part of the mechanisms to support recovery of environmental flows.

The NSW Government (sub. 51) and the Queensland Government (sub. 54) suggested that mechanisms for recovering water could be broadened to include use of options or lease contracts, or the use of covenants to target environmental outcomes in unregulated systems. These could be used, for example, to limit pumping from certain events under pre-defined conditions.

As discussed in chapter 3, trade in unregulated systems can be difficult because of physical limitations in transferring water, the potential for conveyance losses, and extraction by downstream users. These factors can limit the effectiveness and efficiency of governments using this option.

Effectiveness

Targeting environmental assets

The effectiveness of purchasing water in unregulated systems depends on the nature of the environmental objectives being targeted. These might include achieving permanent reductions in diversions, maintaining river flows in times of water scarcity, or supplementing beneficial flooding to floodplains and wetlands.

Purchasing individual licences in unregulated systems may provide little flexibility, both temporally and spatially, in targeting environmental objectives because of limited control over environmental flows in the absence of infrastructure or storage facilities. The potential to use the water recovered from purchasing entitlements in unregulated systems to target a particular environmental asset will depend on geographical proximity and the potential for conveyance losses and extraction by downstream users.

That said, purchasing changes in licence conditions, such as cease-to-pump rules or rostering rules, might be an effective means of shepherding water resulting from a high-flow event through a river system for environmental benefit, such as to water a terminal wetland.

The use of options or lease contracts in unregulated systems could provide flexibility in targeting environmental objectives where these can be clearly identified and aligned with the conditions of such contracts (for example, linking cease-to-pump triggers to river height or flow-rate thresholds).

Institutional and administrative impediments

The potential impediments to acquiring water in unregulated systems are largely related to the complexity involved in administering a change in water licences and the shepherding of water downstream, including across trading zones or jurisdictional borders.

In a Memorandum of Understanding signed in September 2009, the Commonwealth and NSW Governments committed to negotiate a bilateral agreement in relation to shepherding of Commonwealth environmental water holdings throughout New South Wales and from the Queensland border. The objective is to provide the capacity to deliver water to environmental assets, or in the case of in-stream environmental watering, to provide protection for environmental flows to pass through the system as far as conveyance losses allow. A joint taskforce will determine what provisions will be contained in the agreement to facilitate this.

The purchase of water upstream will result in an increase in river flows that, in some cases, might increase the reliability of downstream licences or activate sleeper and dozer licences. This can occur where downstream users are not extracting water up to the limits specified by their licence and hence are able to capture water purchased upstream for environmental benefits, thus limiting the effectiveness of the purchase. The Northern Victoria Irrigation Renewal Project commented:

> The major challenge in unregulated systems is to quarantine the environmental flow benefit, so that purchase from one diverter does not merely increase the security of supply for the remaining diverters. (sub. 38, p. 3)

A way around this might be to change access conditions so that extraction limits or cease-to-pump triggers for downstream licences are reduced sufficiently to prevent extraction of the additional environmental flows in the system. This would require negotiation with state and catchment water resource managers and the affected downstream licence holders, as well as monitoring of compliance with changes to extraction limits.

Shepherding of environmental water might be achieved with the voluntary cooperation of downstream licence holders. However, such cooperation may be easier to achieve if it involves only a temporary change to diversions by downstream irrigators. The NSW Government observed:

> In unregulated systems, purchasing 'pumping opportunity' could be achieved through the purchase of extraction rights to reduce pumping from single flow events, if irrigators are contracted and/or agree (collectively) to let the purchased volumetric proportion of each event flow through without pumping. (sub. 51, p. 8)

In the Narran Lakes example in appendix B, water purchased from private on-farm storages upstream was shepherded down the river and across the state border for a single bird breeding event. This was achieved with the cooperation of downstream licence holders who withheld from pumping the water for the time it took for it to pass through each weir, even though commence-to-pump rules had been triggered.

There are possible mechanisms that may avoid or reduce shepherding issues. The Queensland Government (sub. 54) recommended that greater consideration be given to group proposals to adjust access conditions in unregulated systems. A group proposal could maximise environmental outcomes, while minimising impacts on other water licence holders by simplifying shepherding of water to achieve environmental outcomes.

The institutional and administrative impediments will depend on the level of management of unregulated systems. Those with a small number of licence holders may have informal management rules to facilitate trade. In contrast, unregulated systems that involve a large number of users and licences can have complex management rules and enforcement mechanisms.

Efficiency

Transaction costs

Given there are thin markets for trade in unregulated systems, there are limited data available on the magnitude of the transaction costs involved. Notwithstanding this, the transaction costs of the Australian Government purchasing changes to individual licences in unregulated systems is likely to be high, and by necessity, must involve state governments. This includes the costs associated with:

- obtaining information on licence conditions within trading zones (for example, maximum extraction rates, daily pumping rates, cease-to-pump triggers and monitoring of flow variability)
- tendering for bids to surrender or change licence conditions
- negotiating with state and regional water resources managers and downstream licence holders to shepherd the water downstream
- monitoring and enforcement of changes to licence conditions.

Administrative changes to flow rules

There can be substantial administrative and transaction costs associated with the complexity of purchasing changes to individual licences. In some cases, these impediments might be reduced with the voluntary cooperation of downstream licence holders or through the use of group proposals.

If such options are not feasible, as discussed in Chapter 6, an alternative might be to undertake administrative changes to minimum environmental flow rules under state and regional water resource management plans and provide compensation to all licence holders. Rather than accepting offers from individual licence holders to surrender or change the conditions of individual licences, the Australian Government could supplement the provisions for environmental flows that already exist in water resource plans for unregulated catchments. For example, the maximum extraction limits could be lowered or cease-to-pump rules changed, either temporarily or permanently, for all licences within a defined unregulated system.

Compensation could be allocated to all licence holders based on the price per megalitre forgone.

Changing the extraction limits on all licences simultaneously would reduce the impediments to shepherding water through unregulated systems, particularly where there are a large number of licence holders. This option is likely to incur lower transaction costs than those involved in negotiating changes in individual licences and will facilitate more effective targeting of environmental objectives by virtue of the greater control of flows throughout an entire catchment.

However, there may be political, social and institutional impediments to achieving such an outcome. In unregulated systems where water trade is thin or non-existent, establishing a fair market price for the water recovered is likely to be difficult. Further, administrative changes to environmental flow rules may not result in the most efficient outcome if an across-the-board reduction in diversions does not lead to water being recovered from where it is least valued. Nonetheless, such an approach is likely to be a more effective means of recovering water in unregulated systems than purchasing changes to individual licences.

FINDING 7.2

Purchasing water entitlements in unregulated systems can provide environmental managers with different environmental watering possibilities to holding storage-backed entitlements. Although less reliable, holding entitlements in unregulated systems can help managers to restore environmental flows in river systems. However, their effectiveness and efficiency can be compromised by complexities involved in shepherding environmental water downstream. These third-party effects may need to be addressed through negotiating with groups of irrigators, or through administrative changes to environmental flow rules.

7.7 Purchasing of land and water packages

Various past and present environmental water recovery programs have allowed the acquisition of land and water packages (appendix B). The most notable example is the Water for Rivers program that has operated from 2003. Under the Water for the Future initiative, in August 2008, the Australian Government announced the allocation of $50 million to co-fund the purchase of northern Basin irrigation properties and their water entitlements by state governments (Rudd 2008). So far, several properties have been acquired by the NSW Government, the largest purchase being Toorale Station for $23.75 million. Toorale station holds entitlements to extract 14 GL of water from the Warrego and Darling Rivers and the right to harvest water from the floodplain.

There are three grounds for acquiring water and land rights simultaneously:

- the water is needed to address environmental watering needs, while the land is needed to address unrelated objectives
- the water and the land are both inputs into a common environmental objective
- the water right has not been unbundled from the land, and it is not possible to acquire the entire water licence without also acquiring the land — this may be the case in unregulated systems in the northern Basin.

The first justification is outside the scope of this study, while the effectiveness and efficiency of acquiring water and land for the remaining two reasons are analysed below.

Effectiveness

Targeting

If the water and land are acquired simultaneously solely due to the difficulty of unbundling the property rights, the inclusion of the land in the purchase should have no impact on the effectiveness of the targeting of environmental watering needs.

On the other hand, if the land is one of the inputs into the environmental outcome, its inclusion in the acquisition would improve the alignment with the environmental objective. This may occur if the environmental asset is located on the land, or if the land has other features that could contribute to the achievement of the environmental outcome, such as onsite water storage. For example, Tandou Limited observed:

> Ability to carry over large volumes due to on farm storage … adds value to the entitlement. Therefore land and water packages should be considered in the right circumstances. (sub. 28, p. 5)

The Gwydir Valley Irrigators Association argued:

> … it is absolutely critical that the Government funds, either directly or indirectly, the purchase of core wetland sites in the Gwydir, so as to ensure the management of those sites is entirely in keeping with maximising environmental outcomes. If 5% of the funds spent on water purchases had been strategically spent on property purchase, fully integrated environmental management could occur. (sub. 29, p. 10)

But establishing the right circumstances appears to be difficult. For example, the National Irrigators' Council observed:

> NIC does not oppose the purchasing of land and water entitlements in the market place, but submits that it is sub-optimal and has so far been notable for a lack of clear strategy and measurable outcomes. (sub. 24, p. 6)

Ultimately, however, the key consideration with such purchases would be their high cost (discussed below).

Institutional and administrative impediments

The potential to include this option in the buyback would appear to be limited by the *Lands Acquisition Act 1989* (Cwlth), which stipulates that the Australian Government may only acquire land for a 'public purpose'. The effect of this requirement on the buyback is not clear. However, one way of circumventing it is to co-fund the acquisitions of land by state governments, which are not subject to this constraint (as has been done so far).

Efficiency

Transaction costs

There may be significant transaction costs associated with identifying and negotiating with potential sellers of land and water packages. The diverse nature of such acquisitions necessitates significant individual negotiation for each transaction. A streamlined tender process would not be practical, while opportunistic purchasing of properties that come on the market would limit the effectiveness of the environmental targeting. Thin markets would also increase negotiation costs.

After the properties are purchased, the Government would also face administrative costs of managing the acquired land. The Commission has previously argued that private management of land for environmental outcomes is often more cost effective, due to local knowledge (PC 2004).

Opportunity costs

The acquisition of land and water packages would terminate all current private activity on the land and would typically be less cost-effective than mechanisms that allow joint production of private benefits and environmental outcomes. Experience with contracts for environmental services (discussed below) indicates that, in some cases, a small payment to the landholder is sufficient to deliver the outcome, because the landholder also retains most of the productive use of their land and water. The risk of poor outcomes would be particularly great, where the land and water packages are acquired solely because the water could not be unbundled from the land. In those cases, the acquisition of land would have an opportunity cost, but would not contribute to the environmental outcome.

In its earlier report, the Commission concluded:

> Where environmental values of land are high relative to alternative uses, and public management of the land would be more cost-effective than private stewardship, government purchase of entire properties (or part thereof) may be efficient. However, it is likely that, for a majority of agricultural land, it will be more efficient to leave land in private ownership and encourage joint production of environmental services and commercial outputs. (PC 2004, p. 219)

In the context of the buyback, the Commission considers that there are typically lower cost alternatives to the acquisition of land and water packages.

7.8 Contracts for environmental services

Government programs utilising environmental service contracts, have been a popular policy tool for pursuing environmental outcomes in the United States and the European Union for a number of years. More recently, this policy approach has gained prominence in Australia. Several programs have been implemented including, for example, the BushTender (and its several offshoots, such as River Tender) in Victoria, the Liverpool Plains program (run in partnership with the World Wildlife Fund Australia) in New South Wales, and the Onkaparinga Catchment conservation program in South Australia.

Typically, such programs involve a contract between a government and an individual, where the individual is paid to provide a particular environmental service, usually on their land. The environmental services acquired through these programs are not traded privately and there are no existing market platforms, necessitating the use of alternative acquisition methods by the government. Fixed rate payments and individual negotiation are sometimes utilised, but most commonly the contracts are acquired through a tender.

Participants in this study (for example Cotton Australia, sub. 25 and GVIA, sub. 29) have generally supported the use of this policy tool.

Effectiveness

Targeting

Potentially, contracts for environmental services could result in highly accurate targeting of the environmental objectives. In practice, however, much depends on the way the contract is specified, and in particular, whether the obligations imposed on the individual are prescriptive or based on the achievement of particular environmental outcomes. A contract requiring the achievement of particular environmental outcomes, without prescribing the means of achieving them, would result in the greatest alignment with the environmental objective and provide the individual with the greatest flexibility to utilise their local knowledge in achieving the outcome. However, such contracts typically come at high cost and pure performance-based contracts are usually not practical.

The alternative is to specify the contract on the basis of the inputs required to achieve an environmental objective, such as the volume and frequency of water delivery and specific land management practices. Most of the environmental contract programs to date, including the BushTender have been heavily reliant on prescriptive specification of the inputs. The effectiveness of such contracts depends on how well the prescriptive requirements align with the outcome. The contracts would impose similar information requirements on the Australian Government to the purchases of water rights, because the Government would need information about the linkages between the inputs and the outcomes. The information requirements and the potential for misalignment with the environmental outcome would increase as the duration of the contract increases. Typically, longer term contracts are negotiated due partly to the transaction costs. For example, 97 per cent of BushTender contracts are negotiated for 6 years or longer (DSE 2008a). This is likely to limit the capacity of an environmental contract program to engage in adaptive management.

Nevertheless, prescriptive contracts may offer better targeting of environmental outcomes than simple water acquisitions, by virtue of incorporating other inputs necessary for achieving the desired outcome. This would be particularly important for environmental assets located on private land, where the land use may be significantly different from what is required to achieve the environmental outcome.

Cotton Australia argued:

> It is apparent that, despite significant increases in high security entitlement allocation, the Macquarie Marshes in NSW are still largely considered to be a distressed natural asset. It is clear to many that the increased managed environmental water flows are contributing to regular (planned) overgrazing and subsequent degradation of the marsh

system. Therefore the amount of environmental water is not the only determining factor of the condition of this wetland; clearly land use practices will also be a key determinant of the NRM [natural resource management] outcome. (sub. 25, p. 4)

The Gwydir Valley Irrigators Association, similarly, observed:

> … we know much can be achieved through better riparian zone management, enhancing fish passage, reducing cold water pollution, restoring natural hydrological cycles etc. It is highly likely that obtaining additional water will form part of the solution, but should not be seen as the whole solution. (sub. 29, p. 4)

Institutional and administrative impediments

Contracts for environmental services are a widely used policy tool in Australia and there do not appear to be significant constraints specifically applying to this product. However, the impediments to the acquisition of water, such as the 4 per cent limit on net entitlement trade out of a district, may play a role, if additional water needs to be sourced to comply with the contractual obligations.

Efficiency

Transaction costs

The transaction costs of contracts for environmental services are influenced by whether the contract is prescriptive or performance-based. Pure performance-based contracts involve the largest transaction costs. In a review of the international experience, Latacz-Lohmann and Schilizzi (2006) suggested that the difficulties of observing and measuring environmental outcomes, and various random events interfering with the achievement of the outcome, would make complete specification of such contracts virtually impossible. On the other hand, poorly specified contracts create a risk of litigation. Performance-based contracts also place a large risk on the individual and significantly reduce participation for a given program budget. Latacz-Lohmann and Schilizzi concluded that, currently, prescriptive contracts were the only practical option.

However, prescriptive environmental contracts may also generate high transaction costs. Latacz-Lohmann and Schilizzi (2006) observed that the information disadvantage of the government relative to the provider of the environmental service (information asymmetry) could be significant and result in various types of costs.

One such cost arises from an incentive for individuals not to comply with their contractual obligations, because their performance is not easily observable by the government. There is evidence of poor compliance in some European programs. For example, one study found that 24 per cent of the participants in the UK Land Stewardship Scheme were not meeting their obligations, while another reported that over 30 per cent of participants in a German conservation scheme were not complying with their contracts (Land Use Consultants 1995; Latacz-Lohmann 2000). Difficulties in observing compliance would require significant monitoring and enforcement effort by the government and impose a cost on the individual of demonstrating ongoing compliance. In contrast, DSE (2008a) reported that 97 per cent of the landholders were meeting their obligations under the BushTender program.

Another issue is the bias in selecting low cost proposals regardless of the environmental benefit they bring, if the government cannot distinguish between the environmental benefits offered by different providers. The problem can be significant because the individuals would have an incentive to exaggerate the environmental benefits their proposals would generate. This could require the development of more accurate environmental benefit indexes and the investigation of the claims made under the proposals.

A study of administrative costs to governments of environmental contracting schemes in eight European states showed that they ranged between 6–87 per cent of payments to landholders (Falconer and Whitby 1999). In the case of the BushTender trial program, the labour and travel costs of program staff identifying, negotiating and executing contracts (but not including subsequent monitoring and enforcement costs) constituted around 20 per cent of payments to landholders (DSE 2008a, pp. 30, 39).

Opportunity costs

Depending on how they are specified, environmental contracts may have some advantages over the purchase of other products. First, to the extent that the environmental service is provided by a landholder who retains ownership and use of their land, the contracts allow joint production of private and public benefits. The irrigator could maintain some agricultural production on the land and also derive some private benefit from the improved environmental outcomes, and may, therefore, require only a small payment to enter the contract (PC 2004). If the contracts are delivered through a competitive mechanism such as a tender, the irrigator has an incentive to reduce the cost of their bid by maximising those synergies. The BushTender trial program paid landholders an average of $114 per hectare of land on which the conservation services were provided — a substantially lower cost than if the land had been acquired outright and then managed by Government employees (DSE 2008a).

Second, such contracts could reduce the cost of achieving particular outcomes through utilising local knowledge. If landholders are given some flexibility in selecting the mix of inputs they employ to achieve the environmental outcome, they would use their knowledge to select the least-cost method. There would also be a clear incentive to innovate and improve the efficiency over time. These benefits are more likely to arise in the case of pure performance-based contracts, which, as discussed above, are unlikely to be practical. However, even in the case of prescriptive contracts, there would be some flexibility to adopt low-cost methods for achieving the outcome. Allowing the individuals to select the mix of inputs as part of their proposal (as is done in the BushTender, for example) would create an incentive to minimise the cost. Reducing the contract duration or allowing periodic renegotiation could reduce service provision costs over time (however, it may also increase transaction costs).

In summary, environmental service contracts can play a niche role in delivering environmental outcomes on private land, where the community net benefits are positive. Information asymmetries and the challenges in observing and measuring environmental outcomes have largely limited such contracts to a prescriptive specification of inputs into the environmental outcome. This, in turn, limits the potential effectiveness and efficiency advantages of this policy tool. Even so, there is likely to be some scope for the contracted parties to seek out the lowest cost solutions.

7.9 Establishing a portfolio

The previous discussion has shown that there is no ‘one size fits all’ solution in the choice of the water product to address environmental watering needs. Different products would be effective and efficient depending on the circumstances (table 7.2).

Table 7.2 **A portfolio of instruments for environmental watering**

Product	*Effectiveness*	*Efficiency*	*Most appropriate application*
Entitlements	Medium	Medium	Addressing constant known watering needs; using water in storage to address emergency needs and watering demands outside of irrigation seasons. Less efficient than seasonal allocations in addressing short term needs.
Leases on entitlements	Medium	Medium	Addressing less certain environmental demands; replacing entitlements when there are administrative constraints on trade in entitlements.
Seasonal allocations	Medium-High	High	In the short term, addressing current urgent environmental needs, in the longer term addressing variable, uncertain environmental demands during the irrigation season.
Options contracts	Medium-High (long term)	Medium-High (long term)	As water markets develop in the longer term, replacing some of the entitlements and leases in the portfolio.
Covenants	Low	Low	In regulated systems (but rules-based approaches of options contracts might be more appropriate).
Changes to unregulated licences	Low-Medium	Low	To achieve shepherding of water through unregulated systems (might need to be implemented in conjunction with states).
Bundles of land and water rights	Medium	Low	When the same objectives could not be achieved through changes to unregulated entitlements or environmental services contracts (needs to be implemented in conjunction with states).
Environmental services contracts	Medium-High	Medium-High	Environmental assets on private land.

A conclusion that follows from this is that restricting the recovery of water for the environment to water entitlements (or more specifically, storage-based entitlements) is likely to compromise the efficient achievement of specific environmental objectives.

RECOMMENDATION 7.1

In recovering water for the environment, the Australian Government should develop a portfolio of water products, and not focus solely on entitlements. Other products (such as seasonal allocations, leases on entitlements, options contracts and contracts for environmental services) have advantages in specific contexts and should be considered.

8 Mechanics of the buyback

Key points

- A key advantage of the tender mechanism is that it allows the buyer to discover the price of water in the absence of an active market. However, where active water markets exist, this benefit is redundant. In those cases, acquiring water directly on-market is likely to involve lower transaction costs and reduced disruption of existing trading systems.
- The current tender mechanism could be improved by:
  - allowing irrigators to submit bids with several combinations of entitlements and prices
  - modifying the conveyancing process to emulate the process adopted for private transactions
  - improving communication between the Australian Government and the vendors.
- There may be a limited role for the Australian Government in facilitating group proposals to sell water. A group tender mechanism could offer an alternative to administrative acquisition in those cases.
- The buyback should not be targeted at achieving objectives that are unrelated to environmental water recovery, or to helping the transition to lower sustainable diversion limits.
- It is likely that the buyback has proceeded at a faster than optimal pace to date.
- Water market participants would benefit from improved information on how the water purchasing targets under the Restoring the Balance program will accommodate other water recovery programs and the sustainable diversion limits under the Basin Plan.

This chapter discusses the issues relevant to the effectiveness and efficiency of the ‘mechanics’ of the Restoring the Balance (RTB) program. In particular, it considers potential improvements to the design of the purchase mechanism, assesses the case for targeting the buybacks to achieve objectives that are not related to the core objectives of the program, and considers the potential implications of the pace of the program.

8.1 Improving the purchase mechanisms

This section discusses ways to improve the effectiveness and efficiency of the purchase mechanisms adopted under the RTB program (described in chapter 1).

Utilising existing market platforms

In many but not all parts of the Basin, the markets for water entitlements and seasonal allocations are fairly well developed. Annual private trade has grown significantly in recent years, there are many market intermediaries (some of whom are large operators) and several water exchanges (chapter 3).

Consequently, there are several reasons why the Department of the Environment, Water, Heritage and the Arts (DEWHA) could stand in those markets and purchase water entitlements directly, rather than through running a tender.

The principal advantage of a tender mechanism is its price discovery property. If a market already exists, this benefit is redundant, and the use of a tender can introduce some costs. These are due to the conflicting operational requirements of open markets and tenders. An open market operates best when full information about the price of the product is available to buyers and sellers. On the other hand, for a tender to be successful in encouraging competition between bidders, the information about the purchaser's reserve price and the submitted bids needs to be kept confidential (Latasz-Lohmann and Schilizzi 2006). Running a large tender with limited or no price disclosure alongside an existing market is likely to introduce uncertainty into the existing market and lead to potential disruption. Several participants (for example, the NSW Irrigators Council, sub. 32; the National Irrigators' Council, sub. 24; the Gwydir Valley Irrigators Association, sub. 29) have commented on the importance of full price disclosure by DEWHA to the operation of the water market (the general need for transparency in the buyback is discussed later).

A second issue is the coexistence of two purchasing mechanisms, one of which does not reveal prices, which, in turn, could lead to speculative trading. Some sellers may submit opportunistic bids into the tender with the aim of subsequently purchasing entitlements in the open market at a lower price. This behaviour would be encouraged by the expression of interest bidding process used in the RTB program.

Third, purchasing water directly on the market is likely to lead to lower transaction costs for all parties. ABARE (2007) argued that where markets exist, acquiring water in the open market and utilising existing market intermediaries, rather than running a tender, is likely to reduce transaction costs and result in more timely trades. It observed that a tender generally involved several steps for the Australian Government over and above a simple on-market purchase. These include: developing the tender rules; advertising the tender and educating the participants about the tender process; and compiling and comparing the bids. ABARE also suggested that open markets would result in lower information asymmetries between irrigators and the Australian Government, thus limiting opportunities for wasteful strategic behaviour and reducing the risk of paying a premium above the market price of water. Water for Rivers observed that its buying of entitlements directly on the market:

> … has assisted in reducing overhead and transaction costs. It also helps to build a more diverse and robust market 'industry' within the private sector. (sub. DR89, p. 17)

Transaction costs of the Restoring the Balance tenders

Data on the administrative costs incurred by DEWHA in running the tenders are not publicly available. DEWHA has also not released any information about the timeliness of the process in the 2008-09 tender round. For the 2007-08 tender round, DEWHA reported that, on average, it settled its contracts within 102 days of accepting the offer to sell (Hyder Consulting 2008). However, this figure is likely to underestimate the length of the process, because a substantial share of transactions had not been completed at the time the report was prepared. Several study participants expressed frustration about the delays, and the lack of flexibility and transparency of the tender process. For example, the SA Government gave an example of a transaction taking at least six months to finalise:

> … [the SA Government] received reports that the process has been complex and confusing for irrigators. For example, in one case an applicant received approval for the sale of water rights in April 2009 and was promised payment by July 2009. This did not eventuate. Verbal advice subsequently received indicates that settlement will not take place until at least October 2009. (sub. 52, p. 10)

The National Irrigators' Council noted:

> Irrigators have … reported frustration with the unwieldy nature of the tender process and long delays in processing. This has made it difficult for them to plan their business activity. (sub. 24, p. 7)

The National Farmers Federation (NFF) observed:

> NFF understands that currently there is a DEWHA process to determine whether the application is acceptable in terms of the proposition … then there is a DEWHA senior approval prior to progressing to due diligence, exchange of contracts and settlement. This initial process, while necessary has added to an already substantial time frame from offer to acceptance. (sub. 50, p. 13)

The NFF (sub. DR88, p. 14) further argued that one consequence of the delays was that many financially distressed vendors, who needed to settle their debts urgently, had to withdraw their tender bids. In 2007-08, applications to sell 10 gigalitres (GL) of entitlements were withdrawn after the tender concluded.

Timeliness could be improved by modifying the conveyancing processes within the tender (discussed later), and some delays may be attributed to state approval processes. However, open market purchases are still likely to be more expeditious. For example, Water for Rivers indicated that it settles its on-market purchases of entitlements within 10–14 weeks of the verbal agreement with the seller (appendix B).

One manifestation of the greater transaction costs of a tender process would be if DEWHA paid a premium on its entitlement purchases compared with open market trades. This would indicate that sellers demanded a premium over the market price to reflect their greater transaction costs arising from delays and the uncertainty they faced about the tender outcome, compared with a simple sale on the market.

A review of the 2007-08 pilot round of the RTB tender (Hyder Consulting 2008, p. 28) concluded that a 'slightly higher price [was] paid than the prevailing market at the time the … [program] started'. In the case of 2008-09 acquisitions, for locations and entitlement types for which data are available, it appears that DEWHA has paid a small premium above the open market price (table 8.1).

Table 8.1 **Comparison of prices paid for entitlements, 2008-09**

Location of entitlement	*Entitlement type*	*Average price paid in the open market*	*Average price paid under Restoring the Balance*
		$/ML	$/ML
NSW Murray	General security	1 095	1 273[a]
Victorian Murray	High reliability	2 174	2 166[b]–2 369[a]
Victorian Goulburn	High reliability	2 228	2 362
SA Murray	High security	2 380	2 385

[a] Price of entitlements located below the Barmah Choke. For NSW Murray entitlements above the Choke, DEWHA adjusted the prices of some entitlements to reflect changes in Murray Irrigation Limited rules on accounting for delivery losses. DEWHA did not report the proportion of entitlements affected by the changes, but the Commission estimated the price under the old rules to be in the range of $1093–$1317, compared to the open market average price of $1095. [b] Price of entitlements located above the Barmah Choke.

Sources: DEWHA (2009j); Waterfind (2009).

DEWHA's concerns about direct on-market purchasing

DEWHA (sub. DR85) observed that it was considering utilising existing intermediaries, but offered several reasons for its reluctance to follow this path:

- No single intermediary offers complete market coverage. Consequently, engaging a particular exchange or broker would not target all potential sellers.
- The sale contracts offered by existing intermediaries are not standardised across the Basin and sometimes do not leave sufficient time to conduct due diligence checks.
- The financial cost to DEWHA of executing transactions through intermediaries may be greater than through the tender.

However, the fact that no single exchange or broker represents all potential sellers in the market does not appear to be a significant problem. It should not prevent DEWHA from opportunistically accepting sell offers placed on particular exchanges. DEWHA could also post an offer to buy entitlements on several exchanges.

It is also unclear that the absence of a standard contract across the various exchanges, in and of itself, is a problem. And, as discussed below, the Commission considers that DEWHA's purchasing process should be changed to emulate that of private transactions, with the verification of the seller's title and other checks conducted after the signing of a conditional contract of sale.

As stated earlier, DEWHA has not provided the Commission with data on its administrative costs, so a comparison with the financial cost of engaging an existing intermediary is not possible. However, the administrative costs to DEWHA should not be viewed in isolation from the compliance cost to irrigators participating in the tender. Higher transaction costs to irrigators may have resulted in DEWHA having to pay premiums on the market price of entitlements (thus reducing the budgetary cost effectiveness of the buyback).

DEWHA also suggested that if it acquired entitlements through an existing intermediary it would need to establish that the terms and conditions of the intermediary itself met the Australian Government's procurement standards. While there is no specific regulation governing water market intermediaries, general provisions of the *Trade Practices Act 1974* (Cwlth) apply to brokers and exchanges. It appears that the conduct and general performance of existing intermediaries has so far not been a significant problem. The National Water Commission reported:

> ACCC has noted that the number of complaints about intermediaries has been very limited. The ACCC received three complaints concerning water market intermediaries between March 2008 and April 2009. From January 2006 to February 2008, a total of six complaints about water market intermediaries' conduct were received by the ACCC, other state consumer agencies and government departments. (NWC 2009b, p. 151)

To put those numbers into context, in 2008-09, across Australia, there were 5766 trades of entitlements, and 26 285 trades of allocations (NWC 2009a). Nevertheless, to the extent that DEWHA still deems that the conduct of intermediaries is a potential problem, it could allow intermediaries to register to act for DEWHA, subject to passing broad probity checks.

Participants in this study have generally favoured the use of open markets, where such markets are available (box 8.1).

Box 8.1 **Participant views on sourcing water from open markets**

GVIA recommends that DEWHA should stand in the market with a daily posted price, and report immediately on all acceptances. (Gwydir Valley Irrigators Association, sub. 29, p. 8)

NIC would support the government's involvement as a player in the open market for water, noting its involvement would likely help to bring that market toward greater maturity, and foster the development of innovative water market products. (National Irrigators' Council, sub. 24, p. 8)

We note with great interest that the advice ABARE provided in its recommendations for the RTB program before it commenced have been ignored by DEWHA and wonder why, when they recommended the most cost effective way of purchasing water was by using the open market (High Security Irrigators – Murrumbidgee, sub. 8, p. 2).

QRC recommends that any water purchased for the Murray Darling system should be purchased in the open market. (Queensland Resources Council, sub. 27, p. 6)

NSWIC submits that an open market process would have fared far better … (NSW Irrigators Council, sub. 32, p. 13)

… there are problems associated with the Governments tender process and … it would [be] more appropriate for the Government to post specific offers and to respond to specific offers that are made to it. (Coleambally Irrigation Co-operative Limited, sub. DR77, p. 5)

On balance, the Commission considers that where active water markets exist, there is a case for DEWHA to purchase water entitlements directly from those markets, which may include:

- posting an offer to purchase a particular type of entitlement at a specified price on existing exchanges
- opportunistic purchasing of water by accepting the sell offers placed on the exchanges by irrigators
- being open to offers made directly to DEWHA.

In the case of larger acquisitions, the savings in transaction costs (chapter 7) may also justify private negotiation with water sellers.

FINDING 8.1

Where active markets for water entitlements exist, acquiring water entitlements directly from those markets is likely to be more efficient than utilising a tender.

Notwithstanding the above, as argued by ABARE (2007), in the absence of active water markets, a tender will, in many cases, be the most effective and efficient acquisition mechanism. In particular, tenders could be used to acquire water in locations where markets are thin or do not exist, and to acquire water products that are currently not traded in private markets, such as options contracts or contracts for environmental services.

Improving the efficiency of the tender

To date, two tender rounds had been completed, one in 2007-08 and one in 2008-09. For those tenders, DEWHA adopted a rolling tender approach, with each round running for several months and the offers to sell being assessed on a fortnightly basis. However, for its 2009-10 tenders, DEWHA has made substantial changes to the process. The key change is that the latest tender involves short, discrete rounds with the offers to sell assessed at the end of the round (table 8.2).

The Commission considers that the latest tenders are an improvement over the previous rounds and address some of the criticisms that applied to the rolling tender approach. Nevertheless, further improvements could be made, as discussed below.

Allowing bidders to offer several combinations of water volumes and price

Currently, under the RTB, a single bid consists of a proposal to sell a given set of entitlements for a particular price. There may be benefits in introducing some flexibility and allowing the seller to bid several combinations of entitlements and prices as part of a single bid. For example, an irrigator with a 300 ML entitlement holding could offer to sell 100 ML of entitlements at $1000 per ML, 200 ML at $1100 per ML and 300 ML at $1200 per ML (reflecting the increasing cost to the farmer of parting with additional entitlements). This approach could confer several benefits, including:

- The bidding would be less lumpy, and hence, the price would more accurately reflect the true cost of the water (the inefficiencies of lumpy bids were discussed in Tenorio (1993) and Chan et al. (2003)).

- The irrigators can reduce their risk of missing out, which could improve participation in the tender and encourage individual irrigators to offer greater volumes of water for sale as part of their bids.
- There is improved information for the Australian Government on the volumes of water it can obtain before the price of the water begins to rise significantly. This is important in deciding at what pace to proceed with the buyback (discussed later).

Table 8.2 Key features of the Restoring the Balance tenders

	2007-08 and 2008-09 tenders	*2009-10 tenders*
Duration of the round	2007-08 tender — 5 months 2008-09 tender — 9 months	Around three weeks for each of the three rounds
Budget	No explicit budget constraint	Explicit budget constraint ($90m for the first round, $120 million announced for the second round)
Rolling tender or discrete rounds?	Rolling tender — fortnightly assessment of applications received in preceding two weeks	Discrete round — all applications assessed at the conclusion of the round
Types of entitlements accepted	Open to all potential entitlement holders in the southern Basin	Only acquiring entitlements from the New South Wales Murray, Murrumbidgee and Lower-Darling catchments, South Australian Murray, and the Victorian Murray, Kiewa, Goulburn, Campaspe and Loddon catchments A limit of 20 GL of general security entitlements from NSW Generally not accepting low reliability and supplementary entitlements
Status of the application to sell	Non-binding expression of interest	Non-binding expression of interest
Offers combining more than one licence	Accepted	Not accepted
Multiple applications from the same seller	Seller allowed to resubmit a rejected application in the same round	Resubmitting a rejected application is not possible Multiple simultaneous applications not accepted if the sum of sell offers exceeds the total entitlement holding of the seller

Sources: DEWHA (2010; sub. DR85).

There could be an increase in the transaction costs for both the Government and irrigators, due to the increased complexity of the bids. However, it is unlikely that transaction costs would rise significantly. The irrigators would still retain the option of submitting a simple bid if that is less costly to them. And there may be savings for irrigators from not having to repeat bids. The Government's costs are also unlikely to rise significantly. The additional complexity in assessing bids would require a simple price stacking of all of the received combinations of entitlements and prices and then selecting the most cost-effective combination for each successful bid — a task that could be performed electronically.

DEWHA (sub. DR88) suggested that by allowing bidders to submit multiple applications (subject to their total entitlement holding not being exceeded by the sum of their offers), it already provided for bidding of several combinations of prices and entitlements. However, the process could be further expedited to allow such bidding within a single application.

Another issue that arises from incremental bidding through multiple applications is the risk that with non-binding bids, irrigators will engage in strategic bidding. For example, irrigators wishing to sell only a share of their entitlement, could submit several applications with the aim of selecting the highest priced offer accepted by DEWHA.[1] In effect, instead of using the multiple applications to provide information on the opportunity cost of selling different volumes of their water, irrigators would be using them to discover DEWHA's benchmark prices. This would reduce the budgetary cost effectiveness of the RTB program. Thus, the Commission considers that allowing the bidding of several combinations of entitlements and prices as part of a single bid (rather than having several bids for an increment of the entitlement holding) is a superior option.

FINDING 8.2

Allowing irrigators to bid several combinations of entitlements and prices as part of a single bid, could improve the efficiency of the tender.

Replacing the 'expression of interest' process with binding bids

The RTB program has so far adopted a non-binding expression of interest bidding process. Potential sellers submit an application with an offer to sell, which is assessed by DEWHA against other applications. If DEWHA elects to pursue the application, it conducts a 'due diligence' assessment of the offer, and, if satisfied that the offer meets its requirements, proceeds to draft a contract of sale (DEWHA nd). At any stage until the contract is signed, the irrigator is able to withdraw their offer.

1 For example, an irrigator with a 300 ML entitlement holding can submit applications to sell 100 ML for $1000 per ML, a further 100 ML for $1100, and the last 100 ML for $1200 per ML. If all applications are successful, the irrigator can elect to only proceed with the highest priced application. This outcome would not occur if the bids were for aggregate rather than incremental volumes and DEWHA selected a single combination of volume and price.

In the context of the rolling tenders utilised in 2007-08 and 2008-09, the costs of non-binding bidding were likely to be significant. First, the Government faced an administrative cost of pursuing offers that were ultimately withdrawn. Second, there was a greater possibility for wasteful strategic behaviour by irrigators, who could make repeated opportunistic offers until they discovered the Government's price ceiling. Third, there was reduced outcome certainty if bidders withdrew their initial offer after the tender concluded — for example there was a risk of the tender not meeting some critical environmental needs due to late withdrawals by vendors.

Nevertheless, the gains from moving to binding bids are smaller in the case of the 2009-10 tenders. In the latest tenders, the bids are assessed at the end of the round and irrigators can not engage in opportunistic rebidding within each round (although some strategic bidding could still take place across rounds). However, if in the future DEWHA reverts to the rolling tender process of previous rounds there would be strong merit in making the offers to sell binding on irrigators.

Improving the efficiency of the conveyancing process

The RTB conveyancing process involves six steps:

- the Australian Government's acceptance of the offer to sell
- a due diligence process conducted by DEWHA's solicitors to validate the information provided by the seller
- issuing of a contract of sale
- exchange and signing of the contracts (conditional on approval from the relevant state water authority)
- obtaining approval from the relevant state water authority
- settlement and registration of the Australian Government as the new owner of the entitlement (DEWHA nd).

Several participants expressed their frustration about the lengthy conveyancing process adopted by DEWHA. In particular, the due diligence assessment of the offers was criticised. The Deniliquin Lawyers Association stated:

> … the present procedure which involves a non-transparent due diligence process [is] said, in correspondence when it commences, to take between '3 and 4 weeks' but invariably significantly longer, means that the water owners/vendors and, very significantly, their respective lending institutions, are left longer without the certainty of a contract and with no reasonable idea of when the matter may reach completion. This is totally lacking in commercial reality. (sub. 22, p. 2)

The SA Government (sub. 52, p. 12) suggested that some aspects of the due diligence process followed by DEWHA — such as establishing the seller's title to the entitlement and searching for any encumbrances on the title — are already performed at the state level as part of the process of approving entitlement transfers.

The Commission has not received any data from DEWHA on the timeliness of its purchases in 2008-09. For the 2007-08 round of the tenders, DEWHA reported that on average, contracts were signed within 42 days of the offer being accepted (table 8.3). However, it is likely that in many cases this period was longer. The tender concluded on 30 June 2008, and, as observed earlier, contracts for at least 10 GL of the 34.3 GL of entitlements initially offered by irrigators were not signed by 13 August — 44 days after the tender concluded.

Table 8.3 Average time taken to exchange contracts in the 2007-08 round of Restoring the Balance[a]

Stage	*Number of days before next stage*
Due diligence report is prepared	15
Contract issued	9
Exchange of contracts	18

[a] The table excludes data on state agency approval processes, which occur after the exchange of contracts, and which need to be finalised before final settlement occurs.

Source: Hyder Consulting (2008).

The Commission considers that there is a strong case for DEWHA to consider the extent to which its current due diligence processes duplicate those processes at state level, and to remove any overlap.

The Deniliquin Lawyers' Association (sub. 22) argued that the process adopted by DEWHA should be similar to private transactions. In particular, the preparation of the contracts could commence immediately after the acceptance of the offer, rather than on completion of the due diligence process. Contracts could be exchanged before any testing of the seller's title, but be made conditional on verifying the seller's title. The relevant checks could be undertaken after signing the contract. The approach adopted by the SA Government in purchasing water entitlements appears similar and involves:

> Conducting due diligence but with an emphasis on vendor declarations, embedded as vendor warranties in purchase contracts. The key risk mitigation strategy was reliance on the primary obligation of the relevant jurisdiction's statutory authority responsible for approval of transfers to undertake due diligence on vendor bona fides and registered interests, and not bearing an obligation to pay out any funds until such time as the authority had approved and transferred the entitlement. (sub. 52, p. 12)

DEWHA has justified its decision to conduct due diligence prior to the exchange of contracts on two grounds:

> First, complete information on the owners of entitlement is collated as part of the due diligence process so that the contract can be issued to the correct legal entity. Second, the due diligence process encompasses more than a search of the relevant state water register. It also includes other searches which could reveal encumbrances ... In some instances, these additional searches have revealed that the water entitlement was subject to bankruptcy or other legal proceedings. Other due diligence checks include determining if there are any regulatory barriers which could prevent the sale, and confirming that … appropriate power of attorney, trustee or executor arrangements are in place. (sub. DR85, p. 6)

The first of these grounds appears weak, while the second is not directly relevant to the issue of the timing of the due diligence process. It is unclear what the gains to DEWHA are from conducting due diligence checks before issuing the contract of sale, rather than issuing a contract made conditional on the seller satisfying the same checks. And the latter option would improve certainty for the irrigators participating in the tender and has received wide support from participants (for example, National Farmers Federation, sub. DR88; Water for Rivers, sub. DR89; SA Government, sub. DR90). Thus, the Commission considers that there is a strong case for moving the exchange of contracts forward and making the contract conditional on the seller establishing a clear title to the entitlement.

Several participants have also criticised DEWHA for a lack of transparency and poor communication (for example: NIC, sub. 24; SA Government, sub. 52). The Deniliquin Lawyers' Association gave an example of poor communication by DEWHA in relation to its policy on the NSW embargo on sale of entitlements:

> … the tender process … was said to close on 30 June 2009 … Those who tendered in the last seven days appear not to have been considered, regardless of the price. Those participants who have fallen into this category have at least received the certainty of a letter telling them that they have missed out. Decision based on inference continues for those who have not received a letter, but have also not received a contract … at this point, the only comfort participants have is an inference that those who have not received letters will ultimately get a contract if the embargo is lifted … Whatever mechanism is adopted for future use, the communication, particularly when something unexpected arises, must be significantly better than it has been in this phase of the RTB. (sub. 22, pp. 2–3)

There is currently no formal requirement or undertaking by DEWHA to communicate with tender participants other than at the conclusion of each stage of the conveyancing process. The Commission considers that communication with participants could be improved — at a minimum, DEWHA should notify tender participants of any delays in the conveyancing process as well as the reasons for those delays.

FINDING 8.3

The efficiency of the conveyancing process could be improved by:

- *exchanging conditional contracts of sale before the due diligence process commences*
- *assessing the current due diligence process for potential duplication with current state approval processes and removing the sources of duplication*
- *the Department of the Environment, Water, Heritage and the Arts notifying tender participants of any delays in the process and the reasons for the delays.*

The role of group proposals

As discussed in chapter 1, the RTB program allows groups of irrigators to develop a coordinated bid to sell water to DEWHA. This could lead to the decommissioning or reconfiguration of shared off-farm infrastructure that is causing high losses of water.

To the Commission's knowledge, this component of the RTB program has so far not resulted in any purchases of entitlements by the Australian Government. Some participants (for example: NIC, sub. 24; NSWIC, sub. 32) commented that such proposals require cooperation by the infrastructure operator and that the Australian Government has not sufficiently engaged the infrastructure operators. Some (for example, VFF, sub. 31) also suggested that such proposals should attract a price premium for the purchased water.

More generally, there are several potential advantages in dealing with groups of irrigators. However, in most cases irrigators would have sufficient private incentives to organise such proposals without Government involvement.

Group proposals may result in the Australian Government acquiring additional water, due to recovering some of the conveyance losses. These losses can be substantial where delivery is to remote and inefficient parts of the system. However, the irrigators and irrigation infrastructure operators already have a commercial incentive to submit group proposals that include conveyance savings in addition to the sum of the individual entitlement holdings.

Pincus (sub. DR62) observed that even in the presence of such incentives, potentially cost-effective group proposals may still be undermined by the holdout problem. The holdout problem arises when individual irrigators refuse to participate in the group sale or delay their participation, either for non-financial reasons, or with a view to capturing more than their share of the potential profits from assembling in a group. The potential for holdout is a relevant consideration, however, the risk of such outcomes is likely to be reduced by the potential of some offsetting adverse consequences for the irrigators. Being the last irrigator left in a remote part of the delivery system leads to a risk that the irrigation infrastructure operator will recognise the disproportionately high costs of delivery to that location, and will seek to recover them directly.

In some cases, a minimum volume of water may be needed to address a 'lumpy' local environmental demand, necessitating the purchase of entitlements from a group of irrigators in the same delivery system (Pincus, sub. DR62). However, such instances may be rare due to the interconnected nature of much of the southern Basin.

In some cases, dealing with groups of irrigators may be necessary because of third-party effects. For example, shepherding water acquired in unregulated systems is sometimes a significant problem, and requires the cooperation of downstream irrigators (chapter 7).

The Commission considers that the role of the Australian Government in encouraging group proposals is limited. Where such involvement is justified, a market mechanism could have advantages over administrative approaches. Pincus and Shapiro (2008) designed a compulsory group tender to facilitate the purchase of water from groups of irrigators (box 8.2).

Box 8.2 **Compulsory group tender mechanism**

A compulsory group tender is an intermediate option between voluntary sale and compulsory acquisition of water. Under this mechanism, the seller is a group, such as an irrigation district, which is compelled by the government to engage in the tender. Individual irrigators within the district bid the prices they are willing to accept for the sale of their entitlements. The individual irrigators' bids are aggregated at district level and the government compares the group bids, selecting those that are the most cost effective (either subject to its budget or a secret reserve price).

If the bid of the group succeeds, the highest priced individual bid in the group determines the payment per unit of water for the entire group. The proceeds of the sale are distributed to individual irrigators, according to fixed and known fractional shares, typically their share of the nominal volume of entitlements accruing to the district.

To ensure participation in the tender and to discourage holdouts or opportunistic bidding, the mechanism needs to be underpinned by the threat of compulsory acquisition.

Source: Pincus and Shapiro (2008).

Under this approach, irrigator participation and cooperation within groups is encouraged by the threat of compulsory acquisition, should the tender fail to recover a sufficient volume of water. In contrast to administrative acquisition of water, this approach would reveal the value of water to particular groups. The Australian Government would then have the ability to minimise the opportunity cost of acquired water by selecting the lowest price bids.

8.2 Targeting

Some participants in this study (for example, Goulburn Valley Environment Group, sub. 21; NVIRP, sub. 38; VFF, sub. 31) have argued that the RTB program should be targeted at specific locations to address various additional objectives. Potential objectives that could be addressed through a targeted buyback include:

- reducing the social impacts of the buyback
- promoting system rationalisation and addressing the issue of stranded irrigation assets
- reducing the salinity impacts of the buyback.

The case for targeting the buyback to address those issues is analysed below.

Targeting the buyback to reduce adverse social impacts

Some participants have argued that the buyback should be targeted at particular regions to minimise the adverse community impacts caused by a reduction in irrigated agriculture.

The Commission does not support such targeting. First, it would compromise the efficiency of the buyback, because the purchasing would no longer be solely guided by the objective of moving the water to a higher value use.

Second, as discussed in chapter 5 and appendix D, the buyback will result in both positive and negative impacts at the regional level, and it should not be presumed that the negative impacts will be large for all irrigators and in all regions.

Third, the links between the buybacks and the distribution of the impacts are often indirect, with various external factors, including secondary trade, potentially playing a significant role (chapter 5). Consequently, the ability to address social impacts through a targeted buyback will be compromised.

Finally, such targeting may lead to inequitable outcomes. Excluding particular regions from the buyback may confer some benefits on those that would otherwise be adversely affected by the acquisitions. However, it would also impose a cost on those who were willing to sell their water to the Australian Government but have been prevented from doing so.

The Commission, therefore, considers that the buyback should not aim to target social objectives. Other more direct instruments should be employed.

Targeting areas for rationalisation

The Commission received a substantial volume of comment from participants arguing that the buybacks should aim to avoid a 'Swiss cheese' effect (with geographically dispersed properties moving out of irrigated agriculture) and should be targeted at particular locations to achieve system rationalisation.

The arguments for such targeting include that untargeted buybacks could result in:

- an increased cost of servicing fixed infrastructure for irrigators that remain in the system, and, in an extreme scenario, irrigators exiting the system and leaving assets stranded due to not being able to meet the increased cost
- potential dynamic inefficiency in reducing the incentive for future investment in infrastructure — if the buyback increases the costs for the irrigators remaining in the system including the risk of stranded assets, any future investment would be subject to higher risk
- inefficiency because of inaccurately priced water within irrigation systems — postage stamp pricing that does not take account of transmission losses in delivering water to different locations within the system, could mean that the buyback does not take advantage of the potential water savings available from purchasing water in inefficient parts of the system.

The Commission considers that the case for targeting the buyback to prevent a Swiss cheese effect or to pursue system rationalisation is weak.

First, it is not clear that the current 'atomistic' acquisition of entitlements will create a significant risk of stranded assets. Some sellers of entitlements will keep their water delivery right and continue irrigating, while meeting their water needs through acquisitions of seasonal allocations or other entitlements. For example, it appears that, while the Twynam Agricultural Group sold its water entitlements to the Australian Government, it has retained its water access licence and was reportedly purchasing seasonal allocations in the water market (Hunt 2009). And some infrastructure assets can be decommissioned following a reduction in delivery needs.

Second, targeting the buyback to particular areas is an indirect way of addressing the above objectives. Unless, the acquisition of the entitlement is accompanied by a covenant on the land prohibiting irrigation in the targeted areas, or the irrigation infrastructure is entirely decommissioned in the area, such targeting could be undermined by post-buyback trade.

Third, where an atomistic buyback leads to a 'Swiss cheese' of dewatered properties, there may be benefits for remaining irrigators. The National Farmers Federation observed:

> Neighbours are seeing opportunities with their neighbours exiting from irrigation … to expand the area under irrigation using their existing entitlements. The irrigators are seeing an opportunity to acquire an irrigation farm at a much reduced rate – … 10-20% of the price of acquiring the land and water together. (sub. DR88, p. 5)

In any case, other more direct mechanisms already exist to address the above issues. Termination fees are levied to compensate the infrastructure operators and/or irrigators remaining in the system. As argued in chapter 10, termination fees may be too high in some cases. And moving to a system of long-term supply contracts between irrigators — where such fees are negotiated prior to investment in new infrastructure — would further improve the effectiveness and dynamic efficiency of this mechanism.

Third, any strategy of 'picking winners' in irrigated agriculture is likely to suffer from information problems for the Australian Government and may be undermined by absence of community support. The National Irrigators' Council observed:

> In an ideal world, irrigation communities would themselves identify those areas that need rationalisation, upgrading or even closing down. It is better this comes from the ground up than top down. However to achieve community consensus is extremely difficult – some NIC members have tried, but failed to win the level of support necessary for a wholesale re-configuration of certain districts. We are dealing not only with people's businesses that they have worked on for many years and often many generations, but also family homes, lifestyles and communities. (sub. 24, p. 8)

Finally, targeting supposedly 'inefficient' locations for closing down is a blunt approach that disregards the efficiency of individual irrigators in different locations. It is likely to result in inefficient and inequitable outcomes, because there will be irrigators willing to sell their water in locations excluded from the buyback. Equally, there may be efficient irrigators operating in areas targeted for closing down, who should not be pressured to terminate their operations. A buyback relying solely on identifying willing sellers will be more efficient in this regard.

Targeting water that causes environmental externalities

Some participants also argued that the RTB program should acquire water that causes adverse environmental impacts due to the way it is currently used. For example, the buyback could acquire water that currently results in saline return flows. Others (for example, NSWIC, sub. DR72) suggested that while those objectives should not be addressed exclusively by the RTB program, they should still be considered as part of the overall assessment of particular parcels of entitlements.

One example of a targeted approach to addressing additional environmental objectives is the 'traffic light' approach developed by the CSIRO and piloted in the Torrumbarry irrigation area in Victoria (box 8.3).

The Commission considers that the problems identified in the previous section would also apply to targeting of the water that causes salinity (and other environmental externalities), and would undermine the effectiveness and efficiency of this approach. And an atomistic purchasing approach may lead to similar acquisitions to those that would be pursued if those objectives were formally targeted.

Young and McColl (sub. 5, att. 4, p. xiii) observed:

> … in many if not most cases, there will be a strong correlation between willingness to sell and situations that work against river health objectives. That is, the market place may well be such a powerful targetor that there is little advantage in attempting to develop a formal targeting process. The costs may outweigh the benefits.

Ultimately, however, the salinity impacts of water use are a broader issue than could be dealt with under the RTB program, and should be addressed using more direct instruments that apply to all water use and trade (chapter 10).

To summarise, the Commission considers that the buyback should not be targeted at addressing objectives that are unrelated to helping the transition to lower sustainable diversion limits and environmental water recovery.

FINDING 8.4

Using the buyback to address indirect objectives (such as achieving distributional goals, system rationalisation, and reducing the salinity impacts of water use) is likely to compromise the scheme. Other more direct instruments would generally achieve those objectives at lower cost.

Box 8.3 **Pilot study of the 'traffic light' approach to buybacks and investment in irrigation infrastructure**

CSIRO researchers have recently completed a pilot study in the Torrumbarry irrigation area in Victoria on the potential for using a geographically targeted approach in environmental water recovery. The approach is based on modelling the potential environmental flow, salinity, carbon sequestration and recreational benefits of stopping irrigated agriculture in different locations, and the value of irrigated agriculture in particular areas. The targeting involves classifying the area into three planning zones with differing implications for irrigated agriculture:

- green zone — invest in updating irrigation infrastructure in the area
- red zone — purchase water and convert the area to dryland agriculture to reduce river salinity
- amber zone — purchase water and convert the land to carbon sinks.

The authors concluded that a targeted approach would create significant benefits — for example, a reduction in salinity impacts valued at $53 million (compared to $23 million under a non-targeted approach) and an increase in the value of agricultural output of $185 million (compared to a decline of $69 million under a non-targeted approach).

The modelling contains several questionable assumptions. First, the targeting approach is aggregated at a 'pod' level, constituting 10–50 properties. There is no provision for the relative efficiency or inefficiency of particular irrigators within each pod. Second, the study assumes that soil quality is an accurate proxy for agricultural productivity. Soil is just one of the agricultural inputs and its quality is not necessarily an accurate proxy for the overall efficiency of the irrigator. More generally, it is not clear why a top down planning approach to identifying non-productive agricultural areas would lead to more efficient outcomes in agriculture than could be achieved through private markets. The study does not identify any market failures that would justify such government involvement. Third, the study does not assess the merits of this planning approach to environmental water recovery against the merits of direct mechanisms for targeting the same environmental issues in the broader context of all water use and trade.

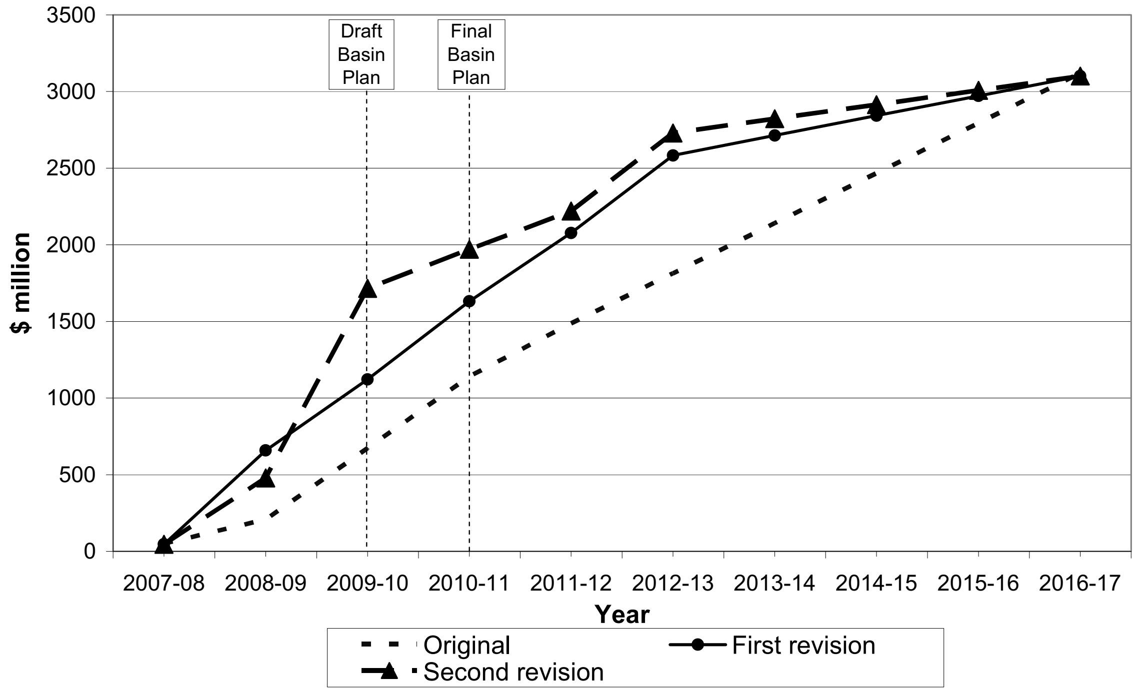
Source: Crossman et al. (2009).

8.3 Pace of the acquisitions

Current pace of the buybacks

The original budgeted expenditure for the RTB program indicates that at the program's commencement, a relatively constant pace of purchasing over 10 years was planned. However, subsequent revisions to the budget, have substantially accelerated the pace of the program. As at 30 September 2009, DEWHA had acquired 612 GL of entitlements of varying reliability at a cost of $947 million (DEWHA, sub. 56), compared to the originally budgeted expenditure of $673 million by the end of 2009-10. In a move to further accelerate the buyback, the *Appropriation (Water Entitlements) Act 2009-10* (Cwlth) has been passed by Parliament. The Act brings forward to 2009-10 expenditure of a further $655 million (figure 8.1).

Figure 8.1 **Cumulative budgeted expenditure for the Restoring the Balance buybacks, 2007-08 to 2016-17[a]**



[a] Where the available budget figures include amounts for multi-year periods, it is assumed that a constant average rate per year was budgeted.

Sources: DEWHA, sub. DR85; DEWHA, pers. comm., 14 August 2009; Hyder Consulting (2008).

At the current budgeted pace of purchasing, around 55 per cent of the program's 10 year budget will be spent within three years of its commencement and before the sustainable diversion limits are scheduled to be published by the MDBA.

Another consequence of the accelerated purchasing is that the Australian Government will have a greater presence in the market in the initial years. Waterfind (2009, p. 15) reported that only around 37 per cent of the announced RTB purchases in 2008-09 have so far been recorded in the registers. Even on those figures, Australian Government acquisitions constituted 35 per cent of the trade. In some cases the Australian Government's share of trades was significantly greater —

in 2008-09, RTB purchases constituted 71 per cent of trades in general security Macquarie entitlements and 62 per cent in general security Gwydir entitlements.

The costs of accelerated purchasing

Accelerating the buyback will increase its cost. Also, acquiring the water earlier than planned will mean that the transaction costs and the opportunity cost of the water are incurred earlier. Due to the fixed nature of some assets in irrigated agriculture, this could increase the cost of shifting the water out of agriculture (box 8.4).

Further, accelerating acquisitions before environmental needs are clearly identified increases the risk of purchasing entitlements in less than ideal locations, or acquiring more water than is ultimately needed, requiring subsequent adjustment of the water holding at additional transaction cost. Acquiring water entitlements before the development of sustainable diversion limits that would determine the future allocations under those entitlements also introduces additional uncertainty into the buyback. Accelerating the buyback before clarifying environmental demands also limits any potential gains from experimentation with the substantial volume of water already held by the Commonwealth Environmental Water Holder and other environmental managers. Such experimentation could improve the environmental targeting of the buyback in the future.

Several participants argued that the pace of the buyback should be slowed. The NSW Irrigators Council observed:

> The major impact [of accelerating the buyback] would likely be on price … Specifically, NSWIC has rejected the 'get in and out fast' theory espoused by noted academics. (sub. 32, p. 9)

Murrumbidgee Irrigation argued:

> Speeding up the program … increases entitlement prices (i.e., costs of acquiring water) and the risks of mismatch between water demands and supply (in terms of timing, location, volume, distribution). MI recommends slowing the pace of water purchase … (sub. 39, p. 7)

Box 8.4 **Asset fixity and its effect on short-term water prices**

Buying water in the short run is likely to be more expensive due to asset fixity in agriculture. Some fixed assets (such as permanent plantings, fences and sheds) have limited salvage value.

Sunk investment costs do not influence the irrigator's production decisions, meaning that once production commences, the ongoing cost is generally small. Hence, the total benefit to the irrigator from production (the difference between revenue and non-water costs that can be avoided by stopping production), will often be substantial.

At some point, fixed assets, such as permanent plantings, may physically deteriorate (with reductions in yield and quality), or the demand for the product may decline permanently due to changing consumer tastes. Also, replacing those assets is likely to be expensive. This reduces the total benefit to irrigators in the long run, and means that buying water will tend to be less expensive if acquisitions are spread over time.

The benefits of accelerated purchasing

An accelerated buyback could deliver some benefits by bringing forward the achievement of some environmental outcomes. As noted in chapter 4, there are many competing uses of environmental water, with some environmental assets requiring more urgent watering than others. In cases where an environmental asset is close to reaching an irreversible environmental threshold, watering may save the asset that would otherwise be lost. DEWHA observed:

> … the Department considers that it is important that it begins to secure water entitlements for the environment ahead of the Basin Plan, so as to commence rebalancing of the system and provide immediate environmental benefits. (sub. DR85, p. 7)

However, two factors may undermine those benefits. First, purchasing to date has focused on entitlements that will deliver only a limited volume of water in the short term. While the Australian Government's predicted long-term yield on the entitlements it purchased is around 63 per cent of their nominal volume, actual yield for 2008-09 was 17 per cent, and over a third of the purchased entitlements (by nominal volume) had no allocations in the past season (DEWHA 2009j; Waterfind 2009). And due to the RTB program's focus on purchasing entitlements and not seasonal allocations, some of the acquisitions appear to have been of entitlements that had no water in their seasonal accounts. The Gwydir Valley Irrigators Association noted:

> … the decision of the Federal Government to buy only entitlements, has meant that in cases where entitlements have included some available allocation in their accounts, this

water has been placed by the original vendor on the market, and sold separately to the entitlement transaction. (sub. 29, p. 7)

Thus, in some cases, the acquired entitlements will only begin accruing water in the following irrigation season. As discussed in chapter 7, purchasing seasonal allocations is likely to be the most effective way of targeting short-term environmental needs.

Second, the environmental effectiveness of accelerated purchasing could be limited by the substantial scientific uncertainty about the ecological responses of particular sites to environmental watering. Coleambally Irrigation Co-operative Limited observed:

CICL … questions the logic for … [the accelerated purchasing] given that there is no environmental watering plan to inform how such water should be used, let alone to justify the need for water to be recovered at a faster pace. (sub. DR77, pp. 5–6)

Chapter 4 has identified the limitations of the environmental targeting that has guided the buyback to date. Although it is unlikely that the Basin Plan will fully resolve this uncertainty, it will improve the ability of the RTB program to target the watering needs of particular environmental assets.

Some participants were also concerned that pre-empting the Basin Plan created a risk that the buyback will bias the Basin Plan to the current pattern of purchasing. The Gwydir Valley Irrigators Association argued:

… purchases completed prior to the Basin Plan, will in fact drive the Basin Plan. That is, if water entitlements have been purchased past a level considered necessary by the Plan, the Plan may simply accept their purchase and adjust the particular valley's new extraction limit to the higher, but unnecessary level. (sub. 29, pp. 4–5)

In sum, the Commission has concerns about the accelerated purchasing of water entitlements on a ‘no regrets’ basis. Acquiring entitlements is unlikely to be the most effective way of targeting short-term environmental watering needs, and there is currently substantial uncertainty about the location, volume and timing of those needs. On the other hand, the costs could be substantial (particularly if significant adjustment to the Australian Government’s water holding is required after the finalisation of the Basin Plan).

The pace of the buyback should reflect the tradeoffs between the increasing costs of shifting water out of agriculture (and in particular, asset fixity in agriculture) and the accelerated achievement of environmental outcomes.

FINDING 8.5

Adopting a fast pace in the buyback of water entitlements before environmental needs are clearly identified could reduce the program's effectiveness and increase its cost to the community. It is likely that the buyback has proceeded at a faster than optimal pace to date.

8.4 The need for transparency

As observed earlier, markets operate best when all participants have access to reliable and timely information. In this context, it is important that the buyback accurately informs the expectations of irrigators and does not unduly disrupt markets by introducing uncertainty about the new level of demand for, and the price of water.

Transparency in reserve prices

Several participants argued that the Government should reveal the prices it is willing to pay for particular entitlements.

For example, the NSW Irrigators Council argued:

> Without question, the single largest problem has been the lack of information on marginal pricing and volumes …. In light of that, improvement could clearly be made by providing marginal pricing information. (sub. 32, p. 13)

The National Irrigators' Council observed:

> The NIC is uncomfortable with the current tender process given its lack of openness and transparency and the lack of timely information provided about sales, volume and prices. (sub. 24, p. 6)

As discussed above, confidentiality of reserve prices is an inherent feature of a tender mechanism and if DEWHA continues to utilise this mechanism, it is appropriate that it keeps its reserve prices secret. (However, as concluded in section 8.1, engaging in direct on-market purchasing, through, for example, placing offers on existing exchanges to purchase a particular entitlement for a particular price, is likely to be more efficient.)

Transparency in purchasing priorities and recovery targets

In conducting the RTB program to date, DEWHA has been using unpublished water recovery targets in each catchment to guide its purchasing. Publicly, DEWHA has provided a list of 'high priority' catchments where environmental water is needed rather than specific environmental goals (chapter 4). The recent tenders reveal the aggregate budget, the information on the catchments where DEWHA will be accepting bids, and the types of entitlements it is seeking. However, this information gives irrigators very little idea about how much is being sought in particular catchments.

The absence of information on DEWHA's purchasing priorities, coupled with the sharp acceleration of the RTB program, can have detrimental impacts on bidder behaviour and distort the participation in the tenders. It can also impact private trade in the water markets and create uncertainty for irrigators making decisions on future business investment.

However, there may also be costs in publishing specific water recovery targets. For example, it might encourage collusion between bidders and other wasteful strategic behaviour where the number of entitlement holders that could meet the target in a particular catchment is small.

Several participants expressed their concern about the lack of transparency in water recovery targets and environmental objectives of the RTB program. The National Irrigators Council noted:

> Irrigators find it hard to understand that the Commonwealth has purchased more than 740 GL of entitlements so far and yet there has not been a list produced of environmental assets and their watering requirements. (sub. DR65, p. 8)

And the Gwydir Valley Irrigators Association observed:

> One of the great frustrations of the environmental water recovery programme is the lack of any real information on water requirements, and therefore recovery targets. While GVIA has some sympathy for the government's 'no-regrets' approach, it does believe that government should be prepared to publish its 'no-regrets' targets and the reasoning behind their establishment. (sub. DR69, p. 10)

DEWHA, on the other hand, argued:

> The Department does not believe it would be appropriate to publicly release the recovery objectives as these are being refined continually. Also, announcement of definitive volumetric targets could be seen as pre-empting the work of the MDBA in establishing the environmental watering plan and sustainable diversion limits under the Basin Plan. (sub. DR85, p. 9)

The Commission considers that while more transparency is desirable, the benefits to potential bidders of DEWHA publishing its targets are likely to be modest. This is because the largest sources of institutional uncertainty in the market are the impact of the Basin Plan on the availability of water (and hence its price) and the application of the risk assignment provisions. Some clarity will be achieved once the proposed Basin Plan is published and draft sustainable diversion limits (SDLs) are released (and the extent of the government's obligations are explained).

However, some uncertainty will still remain even after the Basin Plan is finalised in 2011, because the SDLs may not be expressed as volumetric targets at the catchment level. Therefore, there is a case for DEWHA articulating how it intends to adapt its purchasing strategy to approach the SDLs. This could include whether it intends to approach them proportionately, the types of entitlements it would be seeking, and how it might interpret any formulas the Murray-Darling Basin Authority might apply to setting SDLs. DEWHA could also articulate how the quantities it will be seeking are affected by anticipated water recovery under other programs, including the Sustainable Rural Water Use and Infrastructure program.

9 Institutional and governance issues

Key points

- Governance arrangements for the recovery and management of environmental water in the Murray-Darling Basin are fragmented between government agencies at the local, state and Commonwealth level.
- The referral of state powers to the Murray-Darling Basin Authority should improve coordination in water planning, by setting targets for water recovery, and requiring that all entities manage their Basin water resources in accordance with water plans accredited under the Basin Plan. Environmental water recovery and its management will continue to be conducted by multiple parties.
- In the short term, while the Commonwealth Environmental Water Holder's (the CEWH's) portfolio of water entitlements is being established, the CEWH should have the appropriate budgetary resources to purchase additional water products that allow it to best meet its immediate environmental objectives.
- Transparency and accountability in environmental water recovery under the Restoring the Balance (RTB) program would be improved by providing clear and public information summarising the existing provisions for environmental water in each catchment, and clarifying how RTB purchases take into account environmental water recovered under the Sustainable Rural Water Use and Infrastructure (SRWUI) program, and environmental water provisions in state water sharing plans.
- The CEWH is establishing institutional arrangements to coordinate its actions with state and local environmental water managers. Where an effective and accountable local environmental water manager exists, and there are no significant spillovers from water use, the CEWH should delegate use of an appropriate quantity of its environmental water to that manager, and require the manager to coordinate the use of Commonwealth water with other inputs that best achieve agreed outcomes.
- Recovering water is not always sufficient to achieve desired environmental outcomes. Other inputs, such as capital works to direct environmental flows, and changes to land management practices, are also required. Mechanisms for coordinating these inputs are limited.

Currently, many different government agencies are involved in the recovery and management of environmental water. This is partly a reflection of the distribution of powers between the states and the Commonwealth and the fact that the Basin crosses several state borders. In addition, non-government organisations and private individuals may be involved in environmental water recovery and use. Many of these organisations are interdependent, and hence mechanisms may be needed to ensure the achievement of common environmental objectives, and the reconciliation of competing environmental objectives.

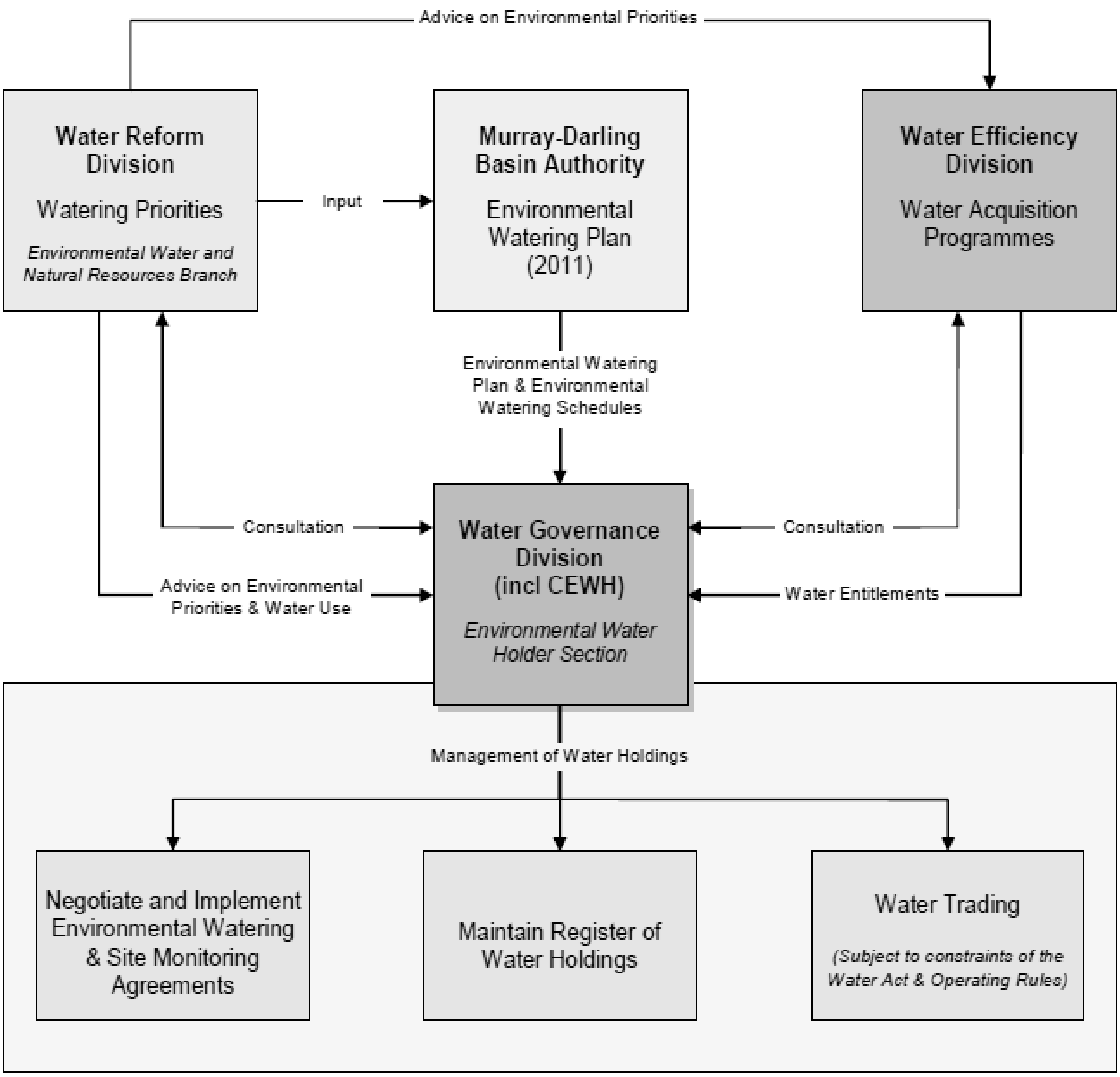
9.1 Who is involved in managing water resources?

Market failures associated with water use can be profound and often warrant government intervention. But the interconnected nature of the Basin and the number of jurisdictions involved, have meant a complex set of institutions, entities and arrangements have developed, which in turn create other problems. In the context of this study, some organisations are involved in recovering water, others are responsible for achieving environmental outcomes, primarily through the use of water, and some undertake both functions.

At the Commonwealth level, the key players relevant to this study all come under the Minister for Climate Change and Water (figure 9.1):

- The Water Efficiency Division (WED) of the Department of the Environment, Water, Heritage and the Arts (DEWHA), which is recovering water through the two programs discussed extensively in this report, Restoring the Balance (RTB) and Sustainable Rural Water Use and Infrastructure (SRWUI).
- The Commonwealth Environmental Water Holder (CEWH), which is a semi-independent statutory entity created under the *Water Act 2007* (Cwlth), tasked with the ongoing management of the Australian Government's environmental water holdings (the CEWH is housed within DEWHA). Water entitlements acquired by the WED are passed to the CEWH for management. The CEWH has powers to buy and sell water products and can enter into contracts with other parties for the cooperative use of its water holdings and the undertaking of infrastructure work that might be needed to use that water (such as a pumping station or earthworks).
- The Murray-Darling Basin Authority (MDBA), a statutory authority created under the *Water Act 2007* (Cwlth) that is responsible for the development, implementation and monitoring of the Basin Plan. While its primary responsibility is in allocating water through the Basin Plan, it has also been involved in water recovery in fulfilling the Commonwealth's part of the Living Murray Initiative (for example, it conducted a tender to purchase water entitlements).

Figure 9.1 **Key Commonwealth water governance arrangements**



Source: DEWHA (2008a).

At a state and local level, relevant organisations or entities include:

- Departments of water and other agencies that oversee the allocation of water within the state and set and enforce property rights. Under the National Water Initiative (NWI), Basin jurisdictions have been implementing water sharing plans that, to varying degrees, specify environmental objectives and set aside statutory environmental water to meet those objectives. Statutory environmental water can be in the form of rules-based water, such as a minimum-flow regime, or held as water entitlements.

- Irrigation infrastructure operators, who in managing the water allocated to them may be required to achieve certain environmental objectives, such as maintaining minimum flow requirements.
- Environmental managers, which can include catchment management authorities, state government wetlands and rivers conservation officers and the like, that are responsible for managing (but rarely acquiring) environmental water at a local catchment level under a water sharing plan.
- Water purchasing entities such as Riverbank in New South Wales and SA Water in South Australia, that then hand the water over to other agencies for management.

And in between, other federal organisations or arrangements include:

- Water for Rivers, a public company established by the Commonwealth, NSW and Victorian Governments to recover water to increase environmental flows into the Snowy River and the River Murray. Recovered entitlements are managed by the NSW Government for jointly agreed objectives (appendix B).
- The Living Murray Initiative. Although this is not strictly an entity, the relevant jurisdictions have entered into an agreement for recovery and management of water that is held by the states but managed to achieve jointly agreed objectives (appendix B).

Last, there are some philanthropic organisations that recover and use water for the environment, and private land owners that may own and manage key environmental assets on their land.

The interdependencies between Commonwealth water recovery and existing organisations and individuals are complex and require coordination in one form or another. For example, water recovery should ideally take into account the amounts of water already held by other environmental managers. Similarly, water allocation to environmental assets may involve use of multiple different parcels of water held by different entities and under different conditions or property rights (for some as statutory water, some as discretionary entitlements), hence requiring coordination in its delivery and use.

The referral of powers to create the MDBA and to give it the power to develop and enforce a Basin-wide plan for the use of water resources should improve coordination in water planning across the Basin. This will principally be achieved by requiring that all entities manage their Basin water resources in accordance with water resource plans accredited under the Basin Plan. Thus, water recovery and allocation actions by local environmental managers will need to be consistent with these plans. But the powers to manage land and enforce property rights remain with the states.

The Basin Plan focuses only on the use of water resources, so cooperative arrangements will still be needed to manage all of the inputs required to achieve environmental outcomes. Even the well coordinated delivery of a sufficient quantity and quality of water will not always be enough to guarantee environmental outcomes.

Establishing the best governance structures for Commonwealth water recovery (under the RTB and SRWUI programs) and environmental water management by the CEWH, within such a fragmented existing system is difficult. This chapter applies governance principles (box 9.1) to the existing Commonwealth arrangements for water recovery and management, and considers what improvements to institutional arrangements could be made to produce a more effective and efficient outcome. While this chapter focuses mostly on Commonwealth arrangements that impact on the buyback, there are implications for the states as well.

9.2 Institutional options for water recovery at the Commonwealth level

The RTB and the SRWUI programs broadly share two common objectives:

- to manage the transition to lower levels of water availability for irrigators under the Basin Plan
- to obtain water for the environment in a cost-effective manner to meet environmental needs, particularly short-term needs (chapter 1).

In addition, the SRWUI program has the objectives of securing a long-term sustainable future for irrigation communities and underpinning food security. Achieving the objectives of the two programs in the most effective and efficient way will depend, in part, on the institutional structures adopted to implement them. This section discusses how governance principles can inform the choice of institutional arrangements that best meet each of these objectives.

Box 9.1 Governance principles for the water sector

The Australian Public Service Commission (APSC) has articulated a general governance framework that includes accountability, transparency, integrity, stewardship, efficiency and leadership (APSC 2008). The National Water Initiative (NWI) 2004 and the Agreement on Murray-Darling Basin Reform 2008 committed Basin jurisdictions to a number of water governance principles including:

- the integrated and complementary management of environmental water between all water holders and managers and different levels of government
- clearly identified environmental objectives
- transparency in water use decisions, and accountability of the environmental manager in managing water and achieving environmental outcomes
- independent management of environmental water from competing uses.

Lockwood et al. (2009) have articulated governance principles, inclusive of the APSC's principles and the NWI and MDB Agreement, specifically for natural resource management in Australia. The eight core principles are:

- Legitimacy — an agency has clear objectives and authority for its responsibilities.
- Transparency — decision making processes are visible, clearly communicated, and information about the performance of a governing body is accessible.
- Accountability — responsibility for decisions and actions is allocated and accepted, and it is possible to demonstrate how these responsibilities have been met.
- Inclusiveness — opportunities to participate in and influence decision making processes and actions are made available to stakeholders.
- Fairness — attention is given to stakeholders' views, personal bias is absent from decision making, and costs and benefits are considered in decision making.
- Integration — there is coordination across different levels of water governance, and there is alignment of priorities, plans and activities across governing bodies.
- Capability — the skills, leadership, experience, resources, knowledge, plans and systems enable organisations to deliver on their responsibilities.
- Adaptability — learning is incorporated into decision making and implementation, threats, opportunities and risks are anticipated and managed, and there is systematic reflection on individual, organisation and system performance.

In addition, the principle of efficiency should be used to assess governance arrangements. Efficiency is of particular importance where transaction costs or the existence of economies of scope result from a given arrangement.

Achieving the transitional objective

To achieve the objective of managing the transition to lower levels of water availability under the Basin Plan, the RTB program is only purchasing water entitlements, and is operated by the WED in DEWHA. Entitlements purchased by the WED are passed to the CEWH for ongoing management. DEWHA has indicated that it is using internal transitional targets to guide entitlement purchases in each catchment based on its own estimates of the sustainable diversion limits to be adopted under the Basin Plan (chapter 8).

The conduct of a major purchasing operation within a government department has its advantages and disadvantages from the point of view of good governance.

Applying the governance principles set out in box 9.1 suggests that the advantages of this arrangement include:

- It allows the potential for a clear focus on achieving the transitional objective.
- It has valid authority, in the sense that the Department can enter into contracts with irrigators.
- There are some integration and efficiency advantages in having the WED and the CEWH in the same organisation. This decreases transaction costs and encourages some synergies between the two sections.
- The WED can readily adapt its purchasing strategy to meet updated transitional targets as better information becomes available.

But there are also some disadvantages:

- The arrangements are not particularly transparent:
  - Many participants have expressed concern over the lack of clear volumetric targets and environmental objectives under the RTB tender, including at the catchment level (chapter 8).
  - Sellers have expressed frustration over a lack of information as to why tender bids are rejected. Transparency can be important in creating trust and a willingness to participate in the buyback. Murrumbidgee Irrigation (sub. 39, p. 7) stated that 'shortcomings [in the tender process do] … little to overcome the fundamental problem of mistrust associated with Government intervention that has the capacity to significantly affect relative economic, social, and environmental welfare across and within regions'.
- There is the issue of the capability of a government department to conduct a buyback efficiently and effectively, though with four rounds now more or less completed, considerable experience and skills would have now built up in the

WED. And there has been some contracting out of key tasks, such as undertaking the due diligence process.

- The RTB tender is operating in an intensely political environment. For example, the Victorian Government has only exempted some areas from the 4 per cent cap on trade of entitlements. This impairs the effectiveness and efficiency of the buyback and its fairness. Establishing a neutral and independent body to undertake water recovery would have helped to ensure the buyback was run solely to achieve its stated objectives.

Alternative approaches

If the purchasing of entitlements is seen as a transitional measure only, there would be some sense in allocating this task to a dedicated group. But it need not be the WED. One alternative would be to transfer the purchasing to the CEWH. This might have some advantages in allowing the water holder to match purchases against environmental priorities, but this may only confer minimal advantages over current arrangements, given that informal feedback occurs between the two groups anyway.

Another approach would be to transfer this function to an independent organisation. For example, the MDBA has recovered water before and has a degree of statutory independence, but transferring the RTB to it would have created a conflict of interest with the setting of the Basin Plan.

A more radical alternative would have been to create a dedicated corporate entity for the purpose. With appropriate powers, accountability arrangements, and a clear transitional objective, this would have advantages over the current system in creating a more neutral environment for the buyback that operates at arms length from the Minister. It would also be able to recruit specialist staff for the purpose. When the transition has been achieved and the RTB terminated, the organisation could be dissolved. In many ways, Water for Rivers is an example of this approach.

However, some participants did not support outsourcing the RTB to a new body. They note that it could result in higher costs to irrigators and slow the pace of water recovery.

> ... we do not relish bearing the additional cost that would inevitably be transferred, in one or form or another, to irrigators were such a body created. (Colleambally Irrigation sub. DR77, p. 6)

> The establishment of a semi-government quango would undoubtedly lead to more costs and subsequently less money available for purchases, probably with little overall

> benefit to irrigators or the government. The time taken for the establishment of such a body would also be an issue. (NIC, sub. DR65, p. 8)

Operating the buyback through a dedicated independent body may cost the same, more or less than the existing arrangements within DEWHA. However, it could well result in changes to the sharing of the cost of running such a body.

The National Irrigators Council offered limited support for purchases to be handed over to the CEWH once the Basin Plan becomes operational:

> ... there might be some advantage in the CEWH taking control of the purchasing plan to ensure that purchases are in line with, but do not exceed, the needs of the environment as set out in the environmental watering plan. (sub. DR65, p. 9)

The Commission notes the example of Water for Rivers as an effective alternative institutional arrangement to recover water entitlements on behalf of the government (appendix B). However, given that more than one third of the RTB budget has been expended already, the transaction costs of changing the purchasing arrangements mid-program, and the lack of support from submissions for alternative arrangements, the Commission sees the WED as the most appropriate institutional arrangement to achieve the transitional objective.

Achieving the environmental watering objective

The RTB tender run by the WED is also being used to purchase water for the environment, particularly to meet short-term needs (chapter 1). Under current institutional arrangements, the WED is purchasing a portfolio of water entitlements that are then given to the CEWH to manage toward meeting its environmental objectives. Purchases of water entitlements by the WED are being guided by DEWHA's own estimates of environmental water needs based on the 'best available information' and advice from the MDBA and the CEWH (chapter 4).

DEWHA has indicated that, in the longer term, once the CEWH has a sufficiently large portfolio of entitlements, it will begin to use its powers to buy and sell a full range of water products (including allocations, leases and options contracts) to balance its water holdings with its environmental watering objectives (DEWHA sub. DR85 p. 20). However, in the short term, the CEWH is relying on the water entitlements recovered by the WED to meet environmental objectives, including immediate ones (chapter 1).

Consideration of the appropriate institutional arrangements to meet the environmental water recovery objective must be divided into the longer term arrangements under a fully operational CEWH, and the current short-term arrangements, where purchases of water entitlements are made by the WED and handed over to the CEWH.

Applying the governance principles set out in box 9.1 to the longer term arrangements for managing (trading and use of) environmental water by the CEWH suggests this arrangement has a number of advantages, including:

- integration of water trading (buying and selling) and use with environmental watering objectives
- capability to adapt water holdings to changing environmental needs through the purchase and sale of a range of water products (although the CEWH's ability to trade is subject to the *Water Act 2007* (Cwlth) and ministerial trading rules)
- independence in water trading decisions (although the CEWH is also a First Assistant Secretary in DEWHA)
- transparency and accountability through reporting requirements (the CEWH is required to report on water holdings, trade, use and outcomes of watering actions)
- adaptability through the CEWH's powers to negotiate on the use of inputs other than water such as infrastructure investments and changes to land practices.

There are some constraints on the ability of the CEWH to trade its water portfolio under the *Water Act* 2007 (Cwlth) and the Ministerial operating rules, and the CEWH is only partially independent. However, the Commission considers the CEWH is an appropriate institutional arrangement to undertake environmental water management in the longer term.

The current short-term arrangements for recovering environmental water, whereby the WED purchases water entitlements for the environment on behalf of the CEWH, has many of the advantages and disadvantages already identified in the previous section on the best institutional arrangements to meet the transitional objective. The advantages of the short term purchasing arrangements include:

- The WED has the authority to enter into contracts with irrigators.
- There are integration and efficiency advantages in having the WED and the CEWH in the same organisation.
- The WED can readily adjust its purchases of entitlements to better match environmental objectives as better information becomes available.

Disadvantages of this approach include:

- Participants have expressed concern over a lack of transparency around identification of environmental assets and objectives for which water entitlements are being recovered (chapter 8).
- There are concerns over the DEWHA's capability to purchase the right mix of water products to meet short-term environmental needs.
- There is no clear mechanism to ensure the independence of water purchases by the WED from political pressures.

Some participants to the study supported the idea of merging of environmental water recovery and management functions in the one body:

> GVIA does not understand why there is, or needs to be a separation, between the Commonwealth Water Purchasing group and the CEWH, and suggests there may be efficiencies in merging these two entities. (GVIA, sub. DR69, p. 10)
>
> MI would suggest that the over-arching environmental water manager should include the environmental water buyer role and the environmental water holder role. (MIL, sub. DR86, p. 11)

As noted earlier, a fully operational CEWH with the powers to trade its environmental water portfolio is an appropriate longer term arrangement to meet the environmental watering objective. The Commission also sees merit in keeping the purchase of entitlements to help meet transitional objectives separate from the management of environmental water holdings.

However, a more important issue for the short-run institutional arrangements for water purchases by the WED, is the potential inefficiency of using one approach (the WED buying water entitlements) to meet the two objectives of aiding transition and recovering water for the environment. Having the WED buy water entitlements may be the most appropriate approach to meet the longer term transitional objective. However, in an ongoing dry period where there are low allocations (even to high reliability entitlements) restricting the WED to buying only water entitlements may mean the CEWH does not have sufficient water to meet immediate environmental needs (chapter 7). And currently, the CEWH is not trading its entitlement portfolio and does not have its own budget to allow it to purchase other water products, such as seasonal allocations, that may better meet current environmental needs.

To address the conundrum of achieving the longer run transitional objective and the short-run environmental water recovery objective, the Commission sees merit in the CEWH being allocated an appropriate budget, commensurate with the benefits of short-term watering options. This would allow it to purchase any complementary water products, such as seasonal allocations, to meet environmental needs that can not be met using its existing portfolio of entitlements. This would improve the ability of the CEWH to achieve the environmental watering objective, while its water portfolio is being established through purchases of water entitlements by RTB (and recovered under SRWUI).

RECOMMENDATION 9.1

In the short term, while the portfolio of water entitlements is being established, the Commonwealth Environmental Water Holder should be allocated an appropriate budget to purchase additional water products that best meet its immediate environmental objectives.

Sustaining rural communities

With regard to the third objective currently addressed through the SRWUI program — helping to secure a long-term sustainable future for irrigation communities — irrigation infrastructure upgrades may not be the best means of achieving this goal (chapter 6).

A range of Commonwealth and state government policies and programs already exist to assist individuals and communities to adjust to changes in economic and social conditions. To the extent that existing government policies and programs are deemed insufficient to achieve the objective of helping to secure a long-term future for irrigation communities, the Australian Government should examine options for a more targeted adjustment program. As this is a matter that lies outside of DEWHA's normal portfolio responsibilities, there would seem to be advantages in conducting this through another agency. There are many potential routes to secure sustainable communities in the Basin beyond water policy, and these should continue to be explored.

9.3 Coordination issues

The governance principle of integration requires the coordination of actions across different levels of water governance and between various governing bodies (box 9.1). Clear institutional arrangements for coordination also improve transparency and accountability, where there are multiple parties involved in achieving the same objective. Coordination in the recovery and management of environmental water is crucial in the Murray-Darling Basin given the involvement of multiple parties and that their activities can often overlap (section 9.1).

Coordination of environmental water recovery

Coordination of the RTB and SRWUI programs with other water recovery activities is particularly important, as these programs are recovering water on top of existing provisions for environmental water in state water sharing plans and other water recovery programs. Good coordination can improve the effectiveness and efficiency of water recovery by avoiding the recovery of too much, too little or the wrong type of water within a given catchment. Coordination is important not only for calibrating the recovery of water for use on particular sites for which water may be held by other parties, but also in setting purchasing priorities across different environmental assets.

To avoid recovering too much or the wrong type of water, DEWHA first estimates the environmental water requirements for each catchment in the Basin (chapter 4). Subsequently, it adjusts these environmental water recovery targets for the volume of water already set aside for the environment through:

- other government water recovery programs such as the Living Murray Initiative and RiverBank
- planned savings from SRWUI projects
- existing state water sharing plans.

Finally, it adjusts the RTB recovery target for delivery constraints that may limit the use of environmental water in a catchment. RTB targets are not published but guide water purchases by DEWHA in each catchment (sub. DR85, p. 9).

Adjustment of the RTB targets for entitlements recovered through other water recovery programs is a relatively transparent process. Information on environmental entitlements recovered under the various government water recovery programs are publicly available through the MDBA Water Recovery Report (MDBA 2010). While the report provides aggregated data on the volumes of environmental water entitlements held by different parties, it does not show the volume or type of environmental entitlement recovered in a given catchment.

DEWHA also states that purchases under RTB are adjusted for the volume of water recovered or expected to be recovered by SRWUI projects. However, it is unclear how this occurs in practice. For example, would the RTB purchase target in a catchment be adjusted for a proposed SRWUI project announced but not yet approved or implemented? The majority of SRWUI projects are yet to pass the due diligence process (chapter 6).

More importantly, it is unclear how DEWHA takes into account the volume of environmental water set aside under state water sharing plans. Where a state plan uses environmental water entitlements, the volume and type of water is generally clear. However, water sharing plans also contain significant rules-based provisions for environmental flows that are not easily translated into volumetric amounts. If DEWHA is taking rules-based flows into account when setting their water recovery targets in a catchment, they could explain how they do this.

Clearer information on how DEWHA coordinates water recovery under the RTB program would improve the transparency of the buyback process and accountability for the volume and type of water recovered in each catchment. It would also better inform market participants in deciding whether to sell into the tender or apply for irrigation infrastructure subsidies.

As mentioned earlier, some public information on existing provisions for environmental water are available in the Murray-Darling Basin Water Recovery Report (MDBA 2010). However, the report does not show the volume or type of entitlement recovered in a given catchment. Nor does it list environmental water set aside in state water sharing plans through rules-based flows, or as entitlements.

FINDING 9.1

Transparency and accountability in environmental water recovery under the Restoring the Balance (RTB) program would be improved by:

- *the Murray-Darling Basin Environmental Water Recovery Report including a summary of all existing provisions for environmental water by catchment. The summary should include environmental water set aside under state water sharing plans as rules-based flows and water entitlements, as well as environmental water entitlements recovered through government-funded water recovery programs.*
- *the Department of the Environment, Water, Heritage and the Arts clarifying how RTB water recovery targets in a catchment take into account environmental water to be recovered under the Sustainable Rural Water Use and Infrastructure program, and rules-based environmental water provisions in state water sharing plans.*

Coordination of environmental water management

Environmental water is being held and managed by multiple parties across the Basin. Their activities can often overlap, and responsibilities for environmental outcomes are dispersed across different agencies and managers at all levels. Hence, mechanisms for coordinating the management and release of environmental water are important. The role of the CEWH as the largest holder of discretionary environmental water in the Basin, and the only holder of environmental water with a Basin-wide focus, is especially important.

Coordination of water delivery is required where different holdings of water may be used to support the same environmental asset or assets. Coordination can allow water under the control of different managers to be combined to maximise an environmental outcome, for example by extending a flood event further into a wetland. Alternatively, coordination can prevent too much water from being delivered to a jointly targeted asset, or an environmental flow from causing damage to third parties (for example, through flooding or bank erosion).

States have, to varying degrees, established environmental water managers to distribute discretionary environmental flows in accordance with objectives set out in catchment level water use plans. For example, in New South Wales, the Department of Environment, Climate Change and Water decides how to distribute seasonal allocations from environmental entitlements established under state water sharing plans and other entitlements purchased through RiverBank. Water use decisions are based on the recommendations of regional DECCW wetlands and rivers officers, under advice from local consultative committees.

Government-funded water recovery programs also have their own arrangements for prioritising environmental flows between targeted assets. For example, the Living Murray uses the Environmental Watering Group (EWG) to decide how to distribute seasonal allocations across the six icon sites based on environmental objectives laid out in site management plans, and under advice from a consultative committee (appendix B).

The CEWH is now operating alongside these state and local environmental water managers in deciding how to use water accruing to Commonwealth environmental entitlements. Under the *Water Act 2007* (Cwlth), the CEWH will be required to manage its water in accordance with the EWP when this is finalised, and receives advice on this from the Environmental Water Scientific Advisory Committee (DEWHA 2009b).

In the context of these fragmented institutional arrangements for environmental water management in the Basin, the Agreement on Murray-Darling Basin Reform 2008 committed governments to the complementary management of all environmental water. Overall, the Basin Agreement requires that:

> … the use of environmental water should be coordinated across all types of environmental water and between all holders of environmental water entitlements to achieve agreed environmental objectives in the most cost efficient and effective way possible (p. 36).

Under the Basin Plan and EWP, there will be a convergence between state and Commonwealth watering priorities. However, in the interim, there may be divergent views about environmental watering goals. Even once the Basin Plan comes into effect, environmental water will still be managed by different parties (the CEWH, various state agencies and the Living Murray EWG) and held in different forms (both non-discretionary rules-based flows and discretionary water entitlements) across the Basin. Mechanisms to coordinate the complementary use of all environmental water holdings are needed.

Some of these mechanisms are already in place. The CEWH has a representative on the Living Murray EWG and some state environmental water advisory committees, and has participated in joint environmental watering actions resulting in 76 giglitres (GL) of Commonwealth water being used with 140 GL provided by water delivery partners. (DEWHA, sub. DR85)

In deciding whether to make Commonwealth water available, the CEWH considers watering proposals from state and local environmental managers and determines the best use of Commonwealth environmental water against its own priorities. To do this, the CEWH receives information from jurisdictions and local environmental managers on environmental asset characteristics, state ecological objectives, water requirements, monitoring approaches, and costs and management regimes associated with watering actions (DEWHA 2009b). DEWHA observed:

> For each 'round' of Commonwealth watering, input for environmental watering decisions is sought from Basin jurisdictions who in turn consult with Catchment Management Authorities and other local stakeholders, such as environmental watering groups. This input informs the CEWH's consideration and includes delivery arrangements and costs for proposed uses. Jurisdictions provide this input in the context of their own planned use of environmental water and that of the TLM. (DEWHA, sub. DR85, p. 22)

The CEWH notifies jurisdictions or local managers of its decisions and approved watering action proceeds. In most cases, the jurisdiction or local manager delivers the water and undertakes monitoring and evaluation (DEWHA, sub. DR85, p. 23).

Other mechanisms to coordinate Commonwealth watering are under development or yet to be implemented. For example, the CEWH is working with jurisdictions and river operators to put in place appropriate institutional arrangements to integrate environmental flows with river operations and to facilitate shepherding of environmental water. The CEWH can also enter into agreements with recipients of Commonwealth water regarding how the water is used, including changes to land management practices and for the undertaking of capital works (DEWHA, 2009b).

Finally, it is unclear how the CEWH will coordinate the use of Commonwealth water with unplanned releases by local managers that typically piggy back on natural flow events. The use of discretionary environmental water, to some degree, can be planned in advance and coordinated through Commonwealth watering 'rounds' run by the CEWH. However, local managers who wish to access Commonwealth water rapidly (within 48 to 72 hours of a local rain event) to augment a natural increase in river flow may not have time to submit a proposal. It is unclear how the CEWH intends to coordinate timely Commonwealth water releases in these cases. So far, informal networks seem to have sufficed. However, as the volume of water available for release rises this will become increasingly difficult and costly to maintain.

FINDING 9.2

Holdings of environmental water and the management of those holdings in the Murray-Darling Basin are fragmented between various state and local environmental water managers and the Commonwealth Environmental Water Holder (CEWH). Some institutional arrangements for coordinating the CEWH's environmental watering activities with other environmental water managers have been implemented. However, mechanisms for the full coordination of environmental water management are still evolving.

Achieving the effective and efficient use of all types of environmental water under existing fragmented institutional arrangements requires the CEWH to undertake an ongoing and complex central coordination role including:

- acquiring sufficient knowledge of each catchment it operates in (water infrastructure delivery systems, channel constraints, local water markets)
- facilitating the transfer of accurate and timely local information (on the condition of environmental assets, weather conditions) from local managers
- accessing the required water management and scientific expertise to process information
- undertaking timely consultations, decision making and water deliveries
- maintaining clear lines of responsibility and accountability with water delivery partners.

The Gwydir Valley Irrigators Association raised concerns about the ability of the CEWH to incorporate local information in its decision making process and manage centrally environmental water:

> It is clear from the Gwydir experience that effective (environmental water) management requires local management, backed by local knowledge and experience. It will be impossible to effectively manage environmental water for the Gwydir, from

Canberra. … The Gwydir has a long established ECA Advisory Committee, that makes recommendations on the management of the ECA and DECC&W water, while the Commonwealth is developing a parallel system. The Commonwealth does have observer status on the ECA committee, and has indicated a willingness to work with the committee, but at the same time is maintaining its independence … (sub. DR69, p.10)

The Goulburn Broken Catchment Management Authority also noted the importance of local information in making sound environmental management decisions:

… catchment management authorities … are the bodies with local knowledge to ensure appropriate design and implementation, identify and raise unintended impacts and to coordinate the many existing activities at both state and regional levels … (sub. DR70, p. 2)

Local environmental managers can have better knowledge of local environmental conditions, channel capacity constraints, and the potential to achieve desired outcomes in more efficient ways by trading off inputs such as more water against changes to land management practices or investments in water infrastructure. In addition, where the manager is closer to the environmental asset, he or she may be able to act in a more timely manner in undertaking opportunistic watering. Better accountability for the achievement of environmental objectives may result from closer contact with the local community and clearer lines of responsibility. Local management can also generate gains from innovation and experimentation, and reduce the potential for duplication, and the transaction costs of coordination mechanisms needed when different organisations are involved in environmental watering.

The Commission recognises that local environmental management may not produce an optimal Basin-wide outcome where there are significant spillovers from water use between catchments. In addition, the states have a mixed track record of setting aside environmental flows and managing those flows to meet environmental targets (NWC 2007), and hence the Australian Government may be reluctant to hand over control of its entitlements. To address these issues, broader institutional arrangements, such as the CEWH, are needed to coordinate Basin-wide water use to maximise overall environmental outcomes.

However, some submissions support the delegation of some of the CEWH's decision making responsibilities for the release of Commonwealth water to local environmental water managers where they exist and are appropriately governed:

[The CEWH] … should be able to devolve service provision to catchment based environmental service providers if devolution to specific catchments is appropriate. (MIL, sub. DR86, p.11)

… where there are mature and efficient environmental water managers in place (such as the Gwydir ECA Advisory Committee), then the CEWH should delegate the

> management of its water resources to that committee, rather than trying to replicate a management system. … The ECA committee would have to produce an annual plan (which it does) and the CEWH could then assess that plan, and if consistent with the aims of the CEWH, then the sensible and efficient thing to do, would be to hand over the management of the Commonwealth water to the ECA committee. The committee could then report back the outcomes to the CEWH … (GVIA, sub. DR69, p. 10)

The Commission supports a more decentralised approach to managing environmental water, wherever this is practical. While retaining ownership of its entitlements, the CEWH could enter into agreements with partner environmental water managers that delegate some of the CEWH's role in deciding releases of Commonwealth environmental water. Appropriately structured agreements could access some of the gains from local management and ease the complexity of the CEWH's central coordination role. This might work best where:

- environmental objectives are agreed between the CEWH and the local environmental water manager
- local managers have clear accountability for the achievement of environmental outcomes, and the necessary authority and skills to act
- there are no significant spillovers from the use of the environmental water that cannot be managed locally, for example, where there may be additional benefits from coordinating water use between more than one catchment.

The agreements could specify mechanisms to annul the arrangement if water was poorly used, and could include appropriate requirements for monitoring and reporting on outcomes.

Another important area where coordination mechanisms in environmental management are needed is in the combining of water other environmental inputs.

Coordination between water and other inputs in achieving environmental outcomes

Current and emerging institutional structures governing water use in the Basin focus almost exclusively on recovering and allocating water, and give little or no consideration to the need to use water in conjunction with other inputs to achieve desirable environmental outcomes. Yet this is a crucial issue.

The *Water Act 2007* (Cwlth) is concerned only with planning of water resources. (This narrow scope reflects the powers that were referred to the Commonwealth to develop a Basin Plan). In setting SDLs and environmental objectives, no explicit consideration need be given to the mix of inputs that might be required to achieve environmental outcomes. For example, diversion works may help achieve a flooding event with less water than might be needed to achieve an overbank flow. And land management practices can be crucial to protect or restore an environmental asset.

As noted in chapter 6, there is only limited ability to coordinate the use of water acquired by the Commonwealth with the provision of other inputs by the states. As discussed in an earlier section, the CEWH can enter into contracts and arrangements directly related to use of Commonwealth water holdings, and can consider land management practices in prioritising environmental watering actions (DEWHA, sub. DR85).

Many participants to the study have emphasised the need to coordinate management of environmental water with other inputs to improve the productivity of water use and environmental outcomes.

Horticulture Australia and the GVIA noted the importance of coordinating increased flows with better land management to maximise environmental outcomes:

> Implementation of environmental flows must be accompanied with the necessary supporting works (eg. weed control, grazing management, fish passage) to ensure the maximum environmental benefit is achieved from the flow. (Horticulture Australia, sub. 36, p. 8)
>
> GVIA … is very frustrated by the almost total focus on water volumes. For example, it is well known, that if a desired environmental outcome is increased fish numbers, increased flow in the absence of habitat restoration eg re-snagging, or effective management of cold-water pollution risks, will achieve little or nothing. (GVIA, sub. 69 p. 10)

Murrumbidgee Irrigation argued that environmental managers should have the resources and powers to buy (and trade water for) other inputs, including environmental services:

> The environmental manager could also benefit from resources to enable purchase of water, infrastructure and environmental services from other environmental management agencies as well as exchange water for the delivery of specified environmental outcomes. (MIL, sub. DR86, p. 10)

The Victorian Farmers Federation highlighted the need for environmental managers to act like commercial irrigators and invest in improving the efficiency of their water use:

> Investing in infrastructure to deliver environmental water, just as in the case of water for other uses, minimises losses thereby reducing the volume of water needed to achieve any particular outcome. This could involve upgrading channels and piping water to supply wet lands. (sub. DR78, p. 13)

The Australian Conservation Foundation argued:

> … over-extraction of water is acknowledged as by far the most significant (threat) and if it is not adequately dealt with, any investment to address other threats, for example, pests, weeds, logging, grazing, etc will be redundant. … but as … programs address over-extraction, other land and water management issues will become increasingly important. (sub. DR79, p. 2)

The Commission agrees with these submissions and supports the powers given to the CEWH to enter into agreements to match the use of Commonwealth water with complementary infrastructure investments and other activities, such as changes to land management practices. However, the Commission notes that overall, Basin jurisdictions have committed to a predominately planned and water-centric approach to improving environmental outcomes in the Basin. All jurisdictions need to work together to ensure that water is used efficiently in conjunction with other inputs to achieve desired outcomes.

FINDING 9.3

Recovering water is not always sufficient to achieve desired environmental outcomes in the Basin. Other inputs, such as capital works to manage and direct environmental flows, and changes to land management practices, may also be required. Yet the Basin Plan, and the Australian Government's buyback and infrastructure programs, focus solely on recovering water. Better systems are needed to coordinate the mix of water purchases with other actions and inputs to achieve the desired environmental outcomes.

Alternative approaches to environmental management

An alternative approach might have been to decide on what environmental outcomes were needed and then to provide appropriate financial assistance to local environmental managers, private and public, to achieve these goals. This approach might have improved outcomes through capturing the gains from local environmental management discussed earlier, as well as the productivity gains that could flow from being able to combine the best mix of inputs, rather than just water, to achieve the desired environmental goals.

Young (2010) has provided an example of a decentralised approach to environmental management that would allow the local environmental manager or trustee to apply a mix of inputs, including water, toward meeting environmental objectives (box 9.2).

Box 9.2 **Flexible environmental water management by 'regional trusts'**

Young proposes a decentralised approach to environmental water management, where the local manager or trustee has powers to apply a full range of inputs to best achieve targeted environmental objectives.

Young argues that all environmental water could be specified as entitlements. Only those environmental entitlements that can not be managed locally would be managed centrally by 'a system trustee', who would also be responsible for improving knowledge, developing broad-scale strategies, and researching environmental watering technologies.

The majority of environmental entitlements would be held by regional environmental trusts. Trustees would be independent from government, required to use their holdings of environmental water to meet explicit environmental objectives, and be made accountable for achievement of those outcomes. Each trust would be allocated a portfolio of environmental water entitlements sufficient to meet its environmental objectives. Trusts could also receive funding from state governments, the sale of seasonal allocations from their entitlement portfolio, and private donations.

Trustees would be free to engage in a range of environmental management activities that they believe would best achieve their environmental goals, including buying other water products and environmental services, and entering into agreements relating to environmental water use, such as changes to land management practices.

Young argues the advantages of this approach could include:

- greater certainty for managers on the amount of environmental water available to them, allowing longer term planning and independence from political influence
- better use of local knowledge, improving decision making
- improved accountability for outcomes
- lower transaction costs as coordination with the central manger is reduced
- flexibility to experiment and innovate using a range of inputs other than just water.

Source: Young (2010 unpublished).

Young's example modifies the current institutional structure by allocating the majority of environmental entitlements to a local trustee who could use the entitlement portfolio, and possible additional funding sources, to develop the most appropriate approach to environmental management for the catchment. This approach would include the power to sell seasonal allocations to finance the purchase of other inputs, if this was the most effective strategy.

The Commission sees merit in Young's proposal in the sense that it builds on the existing water recovery arrangements that aim to recover a portfolio of environmental entitlements for use in catchments across the Basin. In addition, it offers an alternative approach to the centralised role of the CEWH, in that it combines local knowledge with a full mix of inputs to achieve improved environmental outcomes.

However, there are problems with Young's approach. Local environmental managers have already been established in states (to varying degrees of success), and how these regional trusts could be established within existing state environmental management systems is unclear. Young's proposal notes the importance of accountability of the trusts but provides limited details on how this would be achieved. In particular, it is unclear how the ability of trustees to sell allocations into consumptive use to fund the purchase of other inputs could be reconciled with the approach under the Basin Plan.

The Commission prefers to build on existing arrangements, where possible, and sees merit in combining the gains from a more localised approach to environmental management with improvements from using water as one of a number of inputs toward achieving desired environmental outcomes. That said, there may still be cases where direct funding of a local manager to produce a desired outcome may be an effective and efficient approach (chapter 7), particularly where environmental assets are on private land.

RECOMMENDATION 9.2

Where an effective and accountable local environmental water manager exists, and there are no significant spillovers from water use, the Commonwealth Environmental Water Holder should enter into an agreement that:

- ***delegates use of an appropriate quantity of its environmental water to that manager***
- ***requires the manager to coordinate the use of Commonwealth water with other actions and inputs that best achieve agreed outcomes.***

10 Overcoming impediments

Key points

- The 4 per cent limit on out-of-area trade of water entitlements should be eliminated as soon as possible. Limits on the amount of entitlements that can be sold to the Commonwealth through the buyback should also be eliminated.
- New rules for termination fees present less of an impediment to the buyback than the previous rules. It is likely, however, that termination fees are still excessive in some areas.
- Irrigation infrastructure operators that are concerned about the potential for 'Swiss cheese' buybacks to reduce the competitiveness of their irrigation area can help manage this issue themselves by introducing more cost-reflective pricing of water delivery.
- Ways to expand choices about intertemporal water use should be investigated. This might involve changes to carryover provisions, or wider adoption of capacity sharing.
- The buyback will not achieve the intended environmental outcomes unless land management practices are coordinated with environmental watering.

Rural water markets are relatively well developed in Australia. Progress with water reform is helping to create an environment that is more conducive to conducting an effective and efficient water buyback. Reform continues to be pursued, guided by the National Water Initiative (NWI). In addition, the *Water Act 2007* (Cwlth) gives the Australian Competition and Consumer Commission (ACCC) an enhanced role with respect to water market rules and charges.

Notwithstanding these positive developments there remain significant impediments to the efficient operation of water markets, as documented in the National Water Commission report: *Australian Water Reform 2009*. These often undermine water buybacks.

This chapter identifies impediments to the recovery of water for the environment in the Murray-Darling Basin (the Basin) and how they might be overcome. As required by the terms of reference, the focus is on impediments to water buybacks. Both direct impediments (which impede the effectiveness and efficiency of purchasing water for the environment) and indirect impediments (which can compromise the achievement of the desired environmental outcomes) are covered.

10.1 Reducing volumetric restrictions on trade

Volumetric restrictions on trade within the Basin can prevent the transfer of water from low to high value uses. These restrictions can impede government buybacks of water for the environment as well as irrigator-to-irrigator trade.

Reforming the 4 per cent limit on trade in entitlements

Under the NWI an annual limit (or cap) of 4 per cent on the level of permanent trade out of all water irrigation areas is permitted. While jurisdictions can not set a more restrictive limit, there is discretion to set a less restrictive one, or have no limit at all. Trade in seasonal allocations has no such limit.

Water entitlements bought by governments for the environment are generally treated as trade out of an area, and so count towards the limit. An exception is where land and entitlements are purchased together.

The current situation

The application of the limit in Victoria is most often cited as a barrier to trade. This is because, in this state:

- the limit is applied to relatively small areas, meaning that a relatively high proportion of trades are inter-area trades (this situation changed to a modest extent in January 2010, when the Victorian Government merged the district of Robinvale, Red Cliffs and Merbein with the First Mildura district (Holding 2010))
- disassociating an entitlement from land is counted as trade out of an area, even though the owner and location of use of the water may not change as a result of disassociation
- the limit is generally enforced, whereas in some other states, such as South Australia, the limit has not been enforced and/or less restrictive limits have been set.

The limit was binding in Victoria even before government purchases of entitlements became a significant component of trade. As government purchases have increased, the limit has been binding in more areas and the limit has been reached earlier in the irrigation season. In 2008-09, 8 out of the 10 irrigation districts reached the limit and 94.5 per cent of Victorian high-reliability entitlements held in irrigation districts were within a district that had reached the limit (Frontier Economics 2009). The limit was also binding in the Murrumbidgee Irrigation area of New South Wales in 2008-09 (NWC 2009b).

With regard to 2009-10, the Department of the Environment, Water, Heritage and the Arts (DEWHA) reported:

> Already in the current water year (2009-10), the limit has been reached in five districts for high reliability water (Central Goulburn, Murray Valley, Pyramid-Boort, Torrumbarry and Robinvale, Red Cliffs, Merbein) and one district for low reliability (Murray Valley). So far in 2009-10, trade approval for Australian Government purchases worth in excess of $80 million has been denied due to the operation of the Victorian four per cent rule. (DEWHA, sub. 56, p. 11)

In 2008, the Council of Australian Governments (COAG) stated an ambition to raise the limit to 6 per cent by the end of 2009 (COAG 2008a). More recently, attention has moved to specifying exemptions to the limit to facilitate water recovery for the environment. Most significantly, the Australian and Victorian Governments have agreed to exemptions that reportedly will enable the Australian Government to purchase 300 gigalitres (GL) more in water entitlements over five years than it would be able to under strict application of the 4 per cent limit (that is, allowing purchases of 460 GL in Victoria instead of 160 GL). The extra water will come from:

- targeted buybacks in 'less productive' areas (to be identified by the Victorian Government in conjunction with the Northern Victoria Irrigation Renewal Project), which will be exempt from the limit
- Small Block Irrigator Exit Package related purchases being approved even where this means the limit will be exceeded.

Under the agreement, the 4 per cent limit will be maintained until 2011. From that year, the limit will be phased out, with a view to removing it by 2014 (Rudd and Brumby 2009).

Why is the limit an impediment?

When the limit is reached, any further sales of entitlements out of an area are not permitted. This means that willing sellers in these areas are prevented from selling to willing buyers outside their area. The pool of potential out-of-area sellers becomes constrained to those in areas that have not reached the limit and so entitlement prices in these areas can become higher than they would otherwise be.

In this constrained environment, the gains from trade tend to be lower and some potential buyers may withdraw from the market as prices increase. Those prevented from selling their entitlements are left worse off, although they may have the option of selling their seasonal allocation or selling their entitlement for a lower price within the area. Irrigators that are in financial difficulty, due to drought or other cause, can be disadvantaged by the limit. The Australian Bankers' Association says that the 4 per cent limit has stopped farmers from settling debts, leaving the land and investing more money (Fyffe 2009).

The 4 per cent limit impedes both the buyback and irrigator-to-irrigator trade. For the buyback, it is likely to increase the price that needs to be paid for entitlements, thereby decreasing budgetary cost effectiveness. The exemptions agreed by Victoria relax the constraints on the buyback but are selective. This means that while more entitlements can be purchased from each irrigation area than without the exemptions, these extra purchases can only occur from specified sources.

What should be done?

Some study participants have argued that the 4 per cent limit is justified because it reduces the pace of rural adjustment resulting from water trading and lessens problems associated with stranded irrigation assets. For example, the Victorian Farmers Federation (VFF) stated:

> The VFF strongly supports mechanisms like the 4 per cent limit on permanent trade out of an irrigation district and termination fees, not only to ensure that rural adjustment resulting from movements of water occurs at a manageable pace, but to also guarantee that farmers not selling their water and wanting to continue farming are not faced with stranded assets and increased costs. (sub. 31, p. 3)

More recently, the VFF has argued for some exemptions to the limit to address hardship and equity issues (VFF, sub. DR78).

Others opposed the 4 per cent limit due to its impacts on those wishing to sell entitlements:

> The 4 per cent rule has deprived numerous landowners the right to sell their water entitlement for the best price and to make an investment decision of their choice. (The Jackson Group, sub. 10, p. 4)

> [The 4 percent limit] is an unreasonable restriction on an irrigators' property right and is causing hardship for many irrigators who wish to sell part or all of their water but can't. Supporters might argue it maintains productive capacity in a particular region, but only if the irrigator doesn't go broke in the meantime. (National Irrigators' Council, sub. 65, p.10)

The NSW Irrigators' Council (sub. 32) suggested that the limitation on Victorian purchases had lead to the buyback sourcing a high proportion of entitlements from New South Wales.

The ACCC has undertaken a thorough review of the 4 per cent limit and came to the conclusion that it should be removed, arguing:

> Overall, the ACCC considers that the 4 per cent limit is a poorly targeted mechanism for dealing with concerns about the rate of structural adjustment on communities, and the risk of stranded assets. The ACCC considers that approaches that do not prevent efficient water market function and water moving to its most highly valued use should be used to manage community adjustment. (ACCC 2009c, p. 82)

The National Water Commission has also considered the arguments for and against the 4 per cent limit and has recommended its removal:

> The Commission recommends the coordinated removal of all artificial barriers to trade, including the 4 per cent limit. (NWC 2009b, p. 137)

The Productivity Commission agrees that the 4 per cent limit is a poorly targeted means of addressing rural adjustment concerns and stranded assets issues and that it should be removed as soon as possible. While the limit might result in some reduction in the rate of decline of some regional economies, it does so at the expense of other regions and the broader community. The Commission's preferred approach for facilitating rural adjustment is outlined in chapter 6. The issue of stranded assets is addressed later in this chapter, as part of the discussion of termination fees.

The exemptions agreed by Victoria mean that the limit will be less of an impediment to the buyback than it would be otherwise. Among other things, they appear to enable the quantity of entitlements purchased in Victoria under the buyback to be in proportion to the share of Basin entitlements held in that state. However, the exemptions place annual restrictions on purchases from Victoria and require that a geographically targeted buyback be conducted in this state. As discussed in chapter 8, this form of targeting is likely to reduce efficiency.

The current arrangement of having a limit and exemptions can also make adjustment problems for particular regions more acute than the alternative of unrestricted trade. This is because the buyback becomes more geographically concentrated as a result of the exemptions.

New South Wales limits on sales into the buyback

The NSW Government placed an embargo on the sale of water entitlements from New South Wales for the environment (mainly affecting sales to the Commonwealth) in May 2009. This was in response to a high proportion of early purchases under the Restoring the Balance program being from New South Wales and a view that this imposed an unfair burden on the state. The embargo caused uncertainty and delay for a large number of irrigators in New South Wales whose bids to sell into the 2008-09 tenders had been accepted by the Commonwealth.

In September 2009, the embargo was lifted after an agreement was reached with the Australian Government on various matters relating to the program. This included setting a cap on Commonwealth water purchases in New South Wales of 890 GL of general security entitlement (or equivalent) over five years from the start of 2008-09, with sub-caps applying to individual years. The agreement also allows the substantial backlog of intended trades that were held up by the embargo to be approved (NSW Government and Commonwealth of Australia 2009).

This agreement constrains the potential pace of the buyback in New South Wales. It would be far preferable for decisions about the pace of the buyback to be made from a Basin-wide perspective, as originally intended.

Several study participants argued that it would be acceptable, or even preferable to remove the cap on Commonwealth water purchases in New South Wales, but only if restrictions in other jurisdictions were removed (National Irrigators' Council, sub. DR65; NSW Irrigators' Council, sub. DR72). For example, Coleambally Irrigation Co-operative Limited (CICL) stated:

> CICL supports the recommendation [recommendation 10.1 below] but notes that it is Victoria that stands in the way of the 4% cap being lifted. CICL would strongly object to NSW being prevailed upon in this regard until such time as Victoria agrees to a level playing field. (sub. DR77, p. 6)

FINDING 10.1

Restrictions on water trade in Victoria and New South Wales have the potential to impair the effectiveness and efficiency of the buyback:

- *Victoria's agreement to allow some exemptions to a 4 per cent limit on out-of-area trade of water entitlements is an improvement. But because the extra purchases can only occur from specified areas, the constraints decrease the cost effectiveness of the buyback, and increase adjustment problems for some regions.*

- *New South Wales' agreement to lift a blanket embargo on sales to the Commonwealth and replace this with annual volumetric caps is less distortionary than the Victorian restrictions, but it does limit options for conducting a faster buyback, should this be deemed necessary.*

RECOMMENDATION 10.1

The 4 per cent limit on out-of-area trade of water entitlements should be eliminated as soon as possible, rather than phased out by 2014 as currently scheduled. Limits on the amount of entitlements that can be sold to the Commonwealth through the buyback should also be eliminated.

10.2 Improving pricing

Avoiding excessive termination fees

Termination fees and exit fees are both payments from water users to irrigation infrastructure operators. They differ in that termination fees are paid when a water delivery right is surrendered, while exit fees are paid when a water entitlement is sold.

Exit fees were introduced after constraints on trade in water entitlements began to be relaxed. These fees were adopted as a means of managing the risk that irrigation assets would be stranded (left significantly underutilised) by trade, with consequent cost or viability implications for remaining irrigators. In recent years there has been a move toward using termination fees rather than exit fees. Exit fees are now no longer permitted (this was originally stipulated in schedule E of the Murray-Darling Basin Agreement).

The current situation

Termination fees are regulated and set as a multiple of the annual access fee charged by the irrigation infrastructure operator. The purpose of annual access fees is to recover fixed costs of delivering water (including fixed operating and capital costs). Some operators have argued that access fees are set low, meaning that part of the fixed costs is recovered through volumetric charges, and that maximum permissible termination fees should be set with this in mind. This has given rise to the notion of a 'shadow access fee' — the fee that would need to be charged to recover all fixed costs. Until August 2009, termination fees were permitted to be up to 15 times either the actual or the shadow annual access fee.

From 1 September 2009, termination fees have had to comply with new rules recommended by the ACCC and adopted by the Minister for Climate Change and Water (Wong 2009c). The rules cap termination fees at 10 times the annual infrastructure access fee. The rules also prohibit calculating termination fees using shadow access fees and automatically triggering termination when an irrigator sells their entitlement.

Termination fees vary considerably across the Basin, both in absolute terms and as a proportion of the market prices for the entitlements typically held by irrigators in each area (table 10.1). Data on termination fees as a percentage of entitlement price give an indication of the proportion of the revenue gained from selling entitlements that would be consumed in termination fees, in cases where the seller chooses to surrender their delivery right. In most instances this is between 8 and 15 per cent, although it is sometimes considerably higher in areas that have pumped irrigation systems (as opposed to gravity systems).

Are current termination fees excessive?

Farmers who are considering selling their entitlement and exiting irrigated agriculture will take into account the net proceeds from the sale. Where termination fees apply, net proceeds are lower than they would otherwise be. For this reason, termination fees (at any level) can prevent a trade that would have benefited the buyer and seller. The higher the fee the greater the potential for this to occur.

Termination fees generally leave both buyers and sellers (who plan to exit) worse off (that is, buyers pay more and net proceeds for sellers are lower). For government purchases for the environment this results in a reduction in budgetary cost effectiveness. Less water, and (other things being equal) less environmental benefits, can be purchased for a given level of expenditure. Differences in termination fees can also result in distortions, as explained by Murrumbidgee Irrigation:

> Termination fees have not stopped trade but they have distorted purchases away from high to low termination fee areas … (sub. 39, p. 11)

The question is whether these negative consequences of termination fees are outweighed by benefits. And, if so, what constitutes an optimal, as opposed to an excessive, termination fee?

The immediate benefits of termination fees accrue to the irrigation infrastructure operators to whom they are paid. Remaining irrigators in the area may subsequently benefit, either because this revenue enables the operator to charge lower fees, or because the irrigators are shareholders for the operator (as is generally the case in

New South Wales). Termination fees may also discourage some irrigators from terminating their delivery right. Irrigators who retain their delivery right must continue to contribute towards meeting the fixed costs of water delivery, and this can benefit irrigation infrastructure operators and remaining irrigators.

Table 10.1 **Termination fees in the Murray-Darling Basin, 2009-10**

	Termination fee	*Termination fee converted*[a]	*Entitlement price*[b]	*Termination fee as a percentage of entitlement price*
	$/ML DE	$/ML AE	$/ML	%
Murray Irrigation (NSW)	140	140	1 297	10.8
Murrumbidgee Irrigation (NSW)[c]				
Wah Wah district	75	75	na	na
Other districts	106	106	na	na
Integrated horticultural supply	283	283	na	na
Goulburn-Murray Water (Vic)				
Shepparton	36 114	361	2 382	15.2
Central Goulburn	29 637	296	2 382	12.4
Rochester	23 458	235	2 382	9.9
Pyramid–Boort	17 973	180	2 382	7.6
Murray Valley	23 850	239	2 276	10.5
Torrumbarry	25 719	257	2 276	11.3
Lower Murray Water (Vic)				
Merbein	2 643	317	2 276	13.9
Red Cliffs	3 643	437	2 276	19.2
Robinvale	8 276	993	2 276	43.6
First Mildura: South	5 160	619	2 276	27.2
First Mildura: Other	4 300	516	2 276	22.7
Central Irrigation Trust (SA)	248	248	2 381	10.4

[a] Termination fee converted to dollars per megalitre of water access entitlement held by a typical irrigator (based on the allocation of delivery entitlement that occurred when delivery rights were unbundled from access entitlements). Some irrigators will have entitlement holdings that are different to this, and so would be subject to a different termination fee (when expressed in terms of $/ML access entitlements). [b] Based on the average price paid under the Restoring the Balance program during 2008-09. [c] Excludes small area supplies. DE: delivery entitlement. AE: access entitlement. **na** Not available.

Sources: CIT (2009); Coburn, G., Goulburn-Murray Water, pers. comm., 30 November 2009, Frontier Economics (2008); Goulburn-Murray Water (2009a); Lower Murray Water (2009); Murray Irrigation (2009); Murrumbidgee Irrigation (2009b).

Some study participants suggested that termination fees should be set to be equivalent to the negative effects on remaining irrigators that result from exits (such as higher fixed costs for maintaining infrastructure being spread over fewer farmers). For example, the VFF contended:

> … appropriate and consistent termination fees across state boundaries are vital for fair trade in water and to ensure irrigators do not suffer from rising prices when water is traded out of an area. (sub. 31, p. 13)

In the Commission's view, this is not an appropriate way to set termination fees. For one thing, operators should play their part in finding ways to reduce the need for price rises, whether this be through identifying cost savings that may become possible following exits, or attracting new irrigators to the area. More importantly, such an approach prioritises the interests of remaining irrigators ahead of those of exiting irrigators, irrigators in water importing areas and (in the case of buybacks) taxpayers, without sound justification.

The ACCC has cautioned against 'insulating remaining irrigators from price increases to an inappropriate degree' (ACCC 2008, p. xvi). It argued:

> Setting the maximum termination fee multiple requires balancing the need to provide certainty for operators and irrigators to undertake efficient investments against providing price signals for operators to achieve allocative efficiency in the provision of access services (e.g. incentives for rationalisation). (ACCC 2008, p. xv)

This suggests that termination fees should be set not at a level that ensures remaining irrigators are not left worse off by exits, but at the level necessary for economic efficiency.

Termination fees may be justified on efficiency grounds in some circumstances, for example, where capital costs associated with past investment in infrastructure are being recovered through the annual access fee (and there is at least an implied contract between the operator and the irrigator). Without a termination fee an irrigator considering exiting would factor into their decision not only the price they could get for their entitlement, but also the fact that exiting would free them of their obligation to contribute towards these capital costs. This could result in an inefficient trade if the entitlement was sold to someone who valued it more than the asking price but less than the price plus the capital costs not paid.[1]

It should, however, be appreciated that regulated termination fees are not the only way (or necessarily the best way) of creating an environment that is conducive to

[1] Efficient incentives could be achieved in another way without the need for termination fees. That is, by removing the requirement for irrigators to contribute toward capital costs associated with past (sunk) infrastructure investment. This is the approach advocated by Pincus (sub. DR62). The point being made is simply that if irrigators are contributing towards these costs through the access fee, a termination fee is justified on efficiency grounds.

efficient trade and investment. In a previous report, the Commission argued for the introduction of a system of supply contracts between operators and water users that specify financial and service obligations (PC 2006). Other analysts have also concluded that this approach would improve transparency and the likely efficiency of investment decisions. For example, Goesch stated:

> The advantage of using long term contracts over exit fees for new investments is that irrigators will know their capital liability in advance of the investment taking place. … the use of long term contracts effectively imposes a market test on new investments and, in doing so, increases the likelihood that these investments are only undertaken where they are economically viable. (Goesch 2001, p. 633)

Supply contracts might include termination fees; however, these could be tailored to the circumstances applying in each irrigation area and could be set in advance of new investment occurring. The existing regulatory rules for termination fees do not provide for this level of flexibility. Irrigation infrastructure operators are able to apply a termination fee of 10 times the annual access fee, even where this is above what is required on efficiency grounds. For example, a much smaller termination fee (or no termination fee at all) might be appropriate where there is no debt associated with past investment in infrastructure being recovered through the annual access fee, and no existing plans for investment in the delivery system for which current irrigators would have an implicit if not explicit obligation for.

Accordingly, the current arrangements are likely to result in termination fees being excessive in some areas. The potential for this to occur increased when the ACCC moved away from its initial position that an annual access fee multiple of eight provided a reasonable balance, to ultimately recommend a multiple of 10.

What should be done?

The new termination fee rules seem likely to go further than is warranted from an efficiency perspective in some instances. In the Commission's view, moving away from the current system of termination fees, in favour of long-term supply contracts, is an option that is worth further consideration.

That said, the new rules are a clear improvement on the previous rules. In particular, they:

- reduce barriers to water entitlement trade
- improve signals for the rationalisation of irrigation infrastructure
- ensure those selling entitlements have the option of retaining their water delivery rights.

The new rules also benefited from an extensive consultation process conducted by the ACCC. The reservations raised here do not warrant an immediate reconsideration of the rules. Rather they are matters that, in the Commission's view, should be examined when they next come up for review.

More cost-reflective water delivery pricing

Current situation

In some irrigation areas, irrigators face the same set of water delivery charges (sometimes known as 'postage stamp' pricing), despite the fact that the costs of delivery can vary considerably from irrigator to irrigator. For example, it is often much more costly to deliver water to an irrigator at the fringes of an irrigation network than to one who is next to a main channel. In this context, the costs of delivery include costs for constructing, maintaining and operating infrastructure as well as costs associated with losing water during conveyance (that is, through evaporation and leakage).

Some irrigation infrastructure operators have taken limited steps towards more cost-reflective pricing. In some cases, this is confined to increasing charges for stock and domestic customers so as to reduce or remove their cross subsidisation by irrigators. In other cases, 'postage stamp' pricing has been replaced by 'zonal' pricing. Under this system, irrigators in more costly to service zones face higher delivery charges than those in other zones, but any differences in delivery costs within the zone are not reflected in prices.

Changes underway in the Goulburn-Murray Irrigation District will achieve a more cost-reflective outcome via a different route. One aspect of the Northern Victorian Irrigation Renewal Project underway in this district is that incentives are being provided to irrigators to create new private connections to the channel system operated by Goulburn-Murray Water (Northern Victoria Irrigation Renewal Project, sub. 38). This will allow old spur channels to be decommissioned. Once built (or refurbished), the costs of maintaining the new infrastructure will be borne by the irrigators concerned and so those with longer connections will generally face higher costs.[2]

[2] Note that the incentives provided may compensate for these higher costs. The important point is that the irrigators' future decisions regarding the use and maintenance of the connection will be appropriately influenced by the associated costs.

Why is lack of cost-reflective pricing an impediment?

Postage stamp or zonal pricing can be efficient when cost differences are small or difficult to quantify. However, when this is not the case, it can lead to inefficient water use and trading decisions. Trading is affected because the incentives for irrigators to sell their water allocations or entitlements are not appropriately influenced by the true costs of delivering water to them.

The absence of cost-reflective pricing potentially makes buybacks that operate at the level of individual irrigators inefficient. For example, the relatively high system-wide cost savings that may result from the exit of irrigators at the fringes of a network will not be appropriately reflected in the prices that these irrigators would be willing to accept for their water entitlements. Similarly, irrigators who are relatively inexpensive to service, but who are paying an averaged price, will have a greater incentive to sell entitlements than is appropriate from a system-wide perspective.

The costs of this inefficiency are mainly borne by the irrigation infrastructure operator and/or the irrigators remaining in the area. The physical manifestation of the inefficiency is that the irrigators selling into the buyback are more dispersed across the area than is ideal (the ‘Swiss cheese’ problem discussed in chapter 8).

What should be done?

Postage stamp and zonal pricing can result in inefficient outcomes from water trade, whether that trade is irrigator-to-irrigator or irrigator-to-government. But the burden of this inefficiency falls mainly within the irrigation area and it is at this level that the solution of moving to more cost-reflective delivery pricing is available. There are, however, costs associated with doing this, as argued by some study participants:

> … the benefits [of moving to more cost-reflective pricing] are likely to be quite small relative to the costs involved with changing pricing systems and related definition of delivery rights. Murrumbidgee Irrigation has already gone through such changes and is still wrestling with consequences and costs. The benefits would need to be very clear and very large before we would entertain such changes again. (Murrumbidgee Irrigation, sub. DR86, p. 12)

> National Farmers Federation notes that cost-reflective pricing has been largely implemented (for most gravity irrigators) at an area level but not at individual irrigator level. To do so, would be extremely expensive. Therefore, the transaction costs are too high and it would be inappropriate to implement at a farm level as the gains would be lost due to its cost. (NFF, sub. DR88, pp. 22–3)

The costs and benefits of moving to more cost-reflective pricing are likely to vary across irrigation areas. Pricing at a broad zonal level may be appropriate in some areas, and a greater degree of price differentiation appropriate in others.

Some study participants argued that more cost-reflective pricing was at best only part of the solution to the 'Swiss cheese' issue and did not obviate the need for the buyback to be targeted (Murrumbidgee Irrigation, sub. 39; National Irrigators' Council, sub. 24; NSW Irrigators' Council, sub. 32).

For example, Murrumbidgee Irrigation contended:

> … cost-reflective delivery prices would likely provide an incentive for particular entitlement holders to sell [but] they would likely be too small relative to the value of entitlements to overcome 'hold out' problems.
>
> On balance more cost-reflective delivery prices are just part of an over-all suite of incentives and mechanisms that would be required to improve the efficiency and effectiveness of buyback and water saving projects. (sub. 39, p. 10)

The difference that cost-reflective pricing would be likely to make to the incentives for irrigators to sell entitlements is examined in box 10.1. This suggests that where differences in delivery costs across irrigators are no more than about 20 per cent, the change in incentives is likely to be reasonably small.

Box 10.1 How changes in the price of water delivery affect irrigators

Frontier Economics (2008) examined the gross margin (gross income less variable costs) of a typical long grain rice farm in the Murray region of New South Wales. While income and costs are different for different irrigated crops (and vary across irrigators growing the same crop), these data can be used to illustrate the effect that moving to more cost-reflective water delivery prices can have on irrigators.

In this case study, the delivery fees and charges account for around 19 per cent of total variable farm costs. Accordingly, where moving to cost-reflective pricing resulted in a 10 per cent increase in water delivery charges for the irrigator, this would raise total variable costs by around 2 per cent and decrease gross margin by about 8 per cent. A 40 per cent rise would increase total variable costs by around 8 per cent and decrease gross margin by about 32 per cent.

These figures tend to suggest that moderate changes in delivery charges, of the order of say 10 to 20 per cent would be likely to have only a small change in the incentives for the irrigator to sell entitlements. More substantial changes in delivery charges would, however, cause greater changes in incentives. Data from other sources indicates that this is likely to also apply for at least some other crop types (Industry and Investment NSW nd).

A given reduction in water use can be achieved through discontinuing water delivery to parts of an area, or in a geographically dispersed manner, or some combination of the two. The pattern that is most economically efficient is likely to vary across irrigation areas. Where delivery costs do not vary strongly across an area, it may be that a 'Swiss cheese' outcome is efficient. From the remaining irrigators' perspective, a 'system rationalisation' approach will nearly always be preferred because it makes increases in delivery costs less likely. However, rationalisation may only be able to be achieved by closing down efficient irrigation businesses, and this may not be desirable from a community-wide perspective.

Moving to more cost-reflective pricing will, therefore, not necessarily prevent a geographically dispersed pattern of sales into the buyback. What it will do is create the right incentives for individual irrigators and groups of irrigators to participate, thereby making an efficient mix of 'Swiss cheese' and system rationalisation more likely.

It is also important to understand the influence of cost-reflective pricing in a dynamic sense. Where a group proposal to sell into the buyback is being negotiated, the prospect of changes in *future* delivery prices may have a strong influence on the individual's incentives to participate. Consider an irrigator who can foresee that if they do not participate, they are likely to be left as the only irrigator on a spur channel. If they appreciate that a policy to implement cost-reflective pricing is in place this may substantially increase their incentive to participate. The irrigation infrastructure operator could add to these incentives by waiving termination fees and sharing some of the revenue from conveyance water savings across the group of irrigators.

As discussed in chapter 8, the Commission is not in favour of using the mechanism of targeting the buyback to avoid geographically dispersed purchases, as this would create efficiency and equity problems of its own.

Whether or not to move to more cost-reflective water delivery pricing is essentially a matter for individual operators to decide. The advantages of taking this step include that it reduces the potential for 'Swiss cheese' buybacks to reduce the competitiveness of irrigation areas.

FINDING 10.2

Irrigation infrastructure operators can reduce the risk that geographically-dispersed sales into the buyback will harm the competitiveness of their irrigation area by moving to more cost-reflective pricing for water delivery.

Putting a price on salinity

There are various types of salinity that occur in the Basin, including dryland and river salinity. Collectively these impose significant financial and environmental costs and pose risks for the future. These costs and risks are addressed by the Basin Salinity Management Strategy. Under this strategy, jurisdictions are responsible for managing salt discharges to the River Murray. BDA Group reported:

> The Strategy is supported by a system of salinity credits and debits measured in terms of EC [electrical conductivity: a measure of salinity level] impacts at Morgan. Actions by jurisdictions that serve to reduce salinity impacts at Morgan earn credits, which can be used to offset other actions and reduce costs associated with managing the State's River Murray salinity impacts. (BDA Group 2006, p. 20)

There are various types of actions that can be taken to reduce river salinity. Some of these focus on land management, while others involve engineering works that prevent saline water entering rivers. Dilution flows can also be provided to address local concentrations in salt levels.

While some existing measures are used to manage the contribution of irrigation to river salinity (including water use approvals), irrigators do not generally face efficient incentives to manage their individual impacts on salinity. That is, irrigators who, due to their location, are responsible for adding to river salinity do not generally bear the costs associated with this.

This means that these irrigators will not generally take these costs into account in their decisions, including decisions about whether to participate in the buyback. If this situation is allowed to persist the benefits from the buyback, and from water trade generally, are likely to be lower than they could potentially be.

As discussed in chapter 8, the Commission's view is that to achieve enduring benefits this issue should be addressed not through the buyback (or through the Sustainable Rural Water Use and Infrastructure program), but through separate policy instruments designed for this purpose. This might involve:

- delineating irrigation areas into zones according to the impact that they have on salinity (as is currently done in the Sunraysia region of Victoria)
- providing financial incentives, or using water use regulations, to reduce irrigation in high-impact zones.

10.3 Addressing other direct impediments

Speeding up and simplifying the processing of trades

Chapter 8 discusses the time taken from irrigators submitting a bid to a Restoring the Balance tender through to entitlement trades being finalised. Most of the steps in this process are under the control of DEWHA and unnecessary delays with these should be addressed by the department (chapter 8). Approval and registration of trades, however, are the responsibility of state government agencies. These agencies perform these functions for all entitlement trades, whether they be irrigator-to-irrigator or irrigator-to-government.

Delays in approving trades can impose significant costs on buyers and sellers. In the case of the buyback, they can delay the watering of stressed environmental assets and seriously inconvenience sellers. The National Irrigators' Council stated:

> … [our] members have consistently reported frustration with delays in processing trades and this is a matter that needs to be taken up with state governments. (sub. 24, p. 11)

While there have been some improvements in the time taken to approve entitlement trades in recent years, excessively long approval times, sometimes over 100 days, still occur (NWC 2009b). The National Water Commission reported:

> … processing delays, especially for trade in water access entitlements (compared with allocation trade), continue to undermine the efficiency and effectiveness of water markets. Public reporting of performance against recently agreed COAG service standards is expected to drive significant future improvements in trade processing times, both within and between jurisdictions. (NWC 2009b, p. x)

The buyback has also suffered delays associated with trade restrictions in Victoria and New South Wales. DEWHA stated:

> There have been delays in the processing of some applications, primarily as a result of state government restrictions on water trading. For instance, applications in NSW were delayed by the four month embargo on environmental water purchases. As in other years, processing of applications was delayed in Victoria as the Department had to wait for the 2009-10 ballot to see if the accumulated trade approvals would be approved within the allowable net trade under the Victorian four per cent rule. (sub. 56, p. 7)

In some cases, improvements can be achieved through agencies employing better systems or providing adequate resources. In other cases, complementary reforms such as separating (or unbundling) water delivery rights and water use approvals from water access rights are necessary to reduce the number and complexity of issues that need to be considered for approval. Also, the compatibility of the various water registers used across the Basin needs to be improved to make interstate trade quicker and easier. As discussed in chapter 3, COAG is developing a National Water Market System that may assist with this.

Transforming commonly-held entitlements

In New South Wales and South Australia, statutory rights to water are generally held by irrigation infrastructure operators, with individual irrigators holding a right to a share of the operator's bulk entitlement. Irrigators wishing to sell their right may need to transform it into a water entitlement that can be held by someone other than the operator. The cooperation of the operator is needed to achieve transformation. This is unlike the situation in Victoria, where statutory rights are held by individual entitlement holders.

The National Water Commission reported that some operators have obstructed transformation and that this has been a significant constraint to trade (NWC 2009b). Such actions have the potential to impede the purchase of water entitlements by governments as well as irrigator-to-irrigator trade.

The ACCC has developed water market rules that aim to ensure that the policies and administrative requirements of irrigation infrastructure operators do not prevent or unreasonably delay transformation, or trade of a transformed irrigation right. These rules have been adopted by the Commonwealth Minister for Climate Change and Water and came into full effect on 1 January 2010.

In the majority of cases, the monitoring and enforcement of the new rules by the ACCC should largely remove what has been a significant restriction to water trade. There are, however, some irrigators in joint water supply schemes in New South Wales who may not be able to take advantage of transformation. The ACCC's preliminary position is that the NSW Government should review the existing arrangements for trade for these irrigators (ACCC 2009b).

Unbundling

Australia has been moving progressively from bundled to unbundled water-related rights. The first reform commenced was unbundling (separating) water entitlements from land titles. More recently, some states have begun separating water delivery rights and water use approvals from water access rights (box 10.2).

Unbundling water entitlements from land is largely complete in most jurisdictions, with Queensland being the main exception. Of most significance for the buyback, Resource Operation Plan provisions relating to the Lower Balonne region have been deferred due to a legal challenge by Munya Lake Pty Ltd and others. Due to this deferral, there is no legal basis for the sale of water entitlements separate to land. This helps explain why no water entitlements for this area have been purchased under the Restoring the Balance program, despite the Lower Condamine–Balonne being identified as a high priority catchment for water recovery. DEWHA commented:

> Purchases have not been made in … the Lower Condamine–Balonne, because entitlements are not yet tradeable from land and in any case no value for money sell offers were received. (sub. 56, p. 8)

Box 10.2 **Definition of terms**

Water access right: A right to hold or take water from a water resource. Water access entitlements (referred to in this report simply as 'water entitlements') are one type of water access right.

Water delivery right: A right to have water delivered by an irrigation infrastructure operator.

Water use approval: Approval (or licence) to use water on a particular area of land. The environmental impact of the proposed use is the main factor taken into account in deciding whether to grant approval.

Source: NWC (2009c).

On 3 March 2010, a judgment was handed down in favour of the Department of Natural Resources and Water (Munya Lake Pty Ltd & Ors v The Chief executive, The Department of Natural Resources and Water [2010] QSC 58). This would appear to allow the Resource Operation Plan provisions to be implemented, thereby removing the legal impediment to sales into the buyback from the Lower Condamine–Balonne region.

Considerable progress has also been made with other types of unbundling in the Basin, but the process is incomplete. For example, water delivery rights have not been separated from water access rights for unregulated rivers in Victoria and New South Wales (NWC 2009b).

The main purpose of unbundling is to make the unbundled elements separately tradeable. The advantages of unbundling water delivery rights and water use approvals from water access rights include:

- simplified and more timely processing of water entitlement trades, as issues related to delivery and use do not need to be considered

- allowing irrigators to sell their water entitlement while retaining the option of opportunistically irrigating using purchased seasonal allocations
- better management of congestion in water systems (congestion is where channel capacity is not sufficient to meet unconstrained demand)
- allowing water users to purchase only those rights that they need.

The last of these advantages is of particular relevance to government purchase of water for the environment. Unbundling allows environmental water managers to purchase water access entitlements, without having also to pay for delivery capacity that they may not need. Bundled rights, therefore, can impede water buybacks by increasing costs (PC 2006).

The main disadvantage of unbundling is the cost associated with setting up the necessary legal and institutional framework and ongoing costs associated with trading multiple types of entitlements rather than one (PC 2006). It is possible that these costs outweigh the benefits in some irrigation districts, and so unbundling of all water-related rights may not be worthwhile in all locations.

10.4 Overcoming indirect impediments

As stressed throughout this report, the benefits of the buyback and other water recovery efforts relate to the environmental improvements achieved (relative to what would have occurred otherwise) and not simply the quantity of water acquired. For this reason, it is important to consider impediments that do not directly impede the purchase of water, but which can reduce the environmental benefits obtained from the water acquired.

One of the most important indirect impediments is the lack of effective arrangements for coordination of environmental watering with other inputs, such as land management. Due to the importance of appropriate governance arrangements to overcoming this impediment, this issue is discussed in chapter 9. The other main indirect impediments are discussed below.

Improving arrangements for carrying over water

Prior to the late 1990s, holders of water entitlements backed by storage generally lost any of their allocation that they had not used or traded by the end of the irrigation year. Since then, new arrangements have been introduced in most regions to allow entitlement holders the flexibility to hold over some of their water (appropriately reduced to allow for evaporation) to the following year. Most commonly, carryover provisions have been used, but in Queensland, capacity sharing has been preferred in some systems.

Carryover provisions allow entitlement holders to hold over a proportion of their water allocation to the next year, subject to limits that are set at the system level. These limits are used to manage third-party impacts that can arise because water that is carried over by individuals takes up storage capacity that might otherwise have been used to increase allocations for all entitlement holders. Under conventional carryover arrangements, when a storage spills (overflows) those who have carried over water have caused others to lose some water that they would otherwise have been allocated.

The National Water Commission reported:

> Carryover was first introduced in the southern MDB in New South Wales in 1998-99. Carryover has been available since 2006-07 in Victoria and is now permanently available. South Australia allows carryover as an emergency drought measure, but those arrangements are not permanent.[3] Currently observed rules for carryover arrangements include limits, such as for carryover volumes to be a maximum of 50 per cent of entitlement in New South Wales and Victoria. (NWC 2009b, p. 153)

The National Water Commission (2009b) also concluded that the limits on carryover may be overly conservative. That is, that they go beyond what is needed to manage third-party impacts.

In Victoria, more flexible carryover rules are to be introduced from the end of the 2009-10 irrigation season (DSE 2009). Flexibility is to be provided through the introduction of 'spillable water accounts', that allow water users to carryover water in excess of previous limits. Those who make use of these accounts will bear the risks themselves, with the water in these accounts being the first to spill when the storages overflow.

Introducing capacity sharing is a more far-reaching reform that changes the nature of water rights. As explained by Hughes:

> Rather than allocating users a share of total releases, each user is allocated a share of total storage capacity, as well as a share of inflows into and losses from the storage. (Hughes 2009, p. 2)

Under this system, capacity share holders are credited with a share of inflows. Those that have carried over water may find (in a wet year) that their share fills

[3] The SA Government advise that carryover was available in certain circumstances even before an administrative arrangement for carryover was introduced as an emergency drought measure (sub. DR90).

quickly and once full, they are no longer credited any inflows. Accordingly, while they have greater flexibility in carrying over water, they also bear the risks associated with this. Capacity sharing has been successfully introduced in the St George and MacIntyre regions of Queensland (Hughes 2009).[4]

Preventing water users from carrying over water, or having arrangements for this that are unnecessarily conservative, is an indirect impediment to the buyback because it reduces how flexibly environmental entitlements can be used to meet temporal variations in environmental watering needs. More flexible arrangements also offer advantages to irrigators and this has been the main motivation for the reforms undertaken to date.

The ACCC has examined the issue of carryover and recommended:

> … the use of continuous accounting, capacity sharing and spillable water account[s] with no limits on carryover volumes to increase water holder's access to water across seasons. Where these are not feasible, other methods to extend access to carryover water should be pursued. (ACCC 2009b, p. 88)

The Productivity Commission endorses this recommendation. The ACCC's analysis focuses primarily on the benefits of carryover to irrigators. Given that a large quantity of entitlements are being acquired for the CEWH, the benefits of carryover to environmental water managers is also an important consideration. These are likely to be considerable, given that many sites have highly variable environmental water demands (chapter 4).

There are important issues, including third-party impacts, to be considered in developing carryover arrangements that allow individual water users greater flexibility and the opportunity to manage risks themselves. Factors such as the size and number of storages, types of water products, the mix of irrigation activities and the nature of environmental water demands may influence the approach that is most suited to each region. Accordingly, there would be value in a study that improved the understanding of these issues. Such a study has the potential to promote the wider adoption of capacity sharing and/or spillable water accounts, where appropriate. The National Water Commission, with its remit to promote sustainable management and use of Australia's water resources, would be best placed to conduct this study.

[4] Continuous sharing is a variation on capacity sharing that also makes use of continuous accounting (a mechanism for continually assessing and reporting accounts). It has been introduced in some catchments in New South Wales (ACCC 2009b).

RECOMMENDATION 10.2

The National Water Commission should conduct a study into ways of expanding the ability of water users to carry over water, while adequately managing third-party impacts. This study should examine the suitability of capacity sharing, 'spillable water accounts' and other arrangements across different regions.

It should not be assumed, however, that entitlement holders will have greatly expanded rights for carrying over water in the future, as managing third-party impacts and the risk of spills will always be an issue. Limits on carrying over water are one reason why governments should consider purchasing other water products for the environment, such as seasonal allocations (chapter 7).

Enabling 'shepherding' in unregulated systems

In some unregulated systems, there is a risk that water purchased for the environment may be diverted by water users downstream, thus contributing little or no additional water for the environment. Where shepherding is a problem, there is some potential to adjust water recovery mechanisms through group purchases and across-the-board administrative changes to licence conditions. The government could also negotiate voluntary shepherding agreements (chapter 7).

Alternatively, governments could address the source of the problem — water property rights that make trade difficult. The aim would be to alter property rights so that downstream trade does not increase the volume of water that third parties are entitled to divert.

One change that could be implemented would be to alter pumping rules by setting the 'cease to pump' limits based on streamflow upstream of irrigators. Since any reduction in diversions by sellers would not have an impact on these upstream flows, trade in water would not have an impact on pumping opportunities for third parties. Accordingly, diversions between the seller and buyer would be unlikely to increase as a result of trade. Similarly, water purchased for the environment would not be able to be extracted by others. Another option is to allow pumping opportunities to increase, but change volumetric limits to ensure that additional water is not diverted by downstream irrigators (SKM 2009b).

There are likely to be limits to the improvements that can be made, however, especially in complex systems where irrigators can source water from multiple unregulated rivers. For example, trade might become possible within a particular zone, but third-party extraction might remain a problem where the potential buyer (or environmental site) was further downstream. While governments should continue to investigate property right changes in unregulated systems to facilitate water trade (including environmental water buybacks) changes should only be introduced where the benefits exceed the costs. This needs to be assessed on a case-by-case basis.

Dealing with the connectivity of water systems

Due to the connectivity of water systems, the inflows to streams, rivers and dams that determine the availability of surface water depend on more than just rainfall patterns. For example, surface water availability can be reduced by:

- higher temperatures that result in more evaporation (climate change projections suggest that increased evaporation, combined with changes in rainfall patterns, is likely to be a major cause of reduced inflows in coming decades (CSIRO 2008))
- bushfires that result in mature forest being replaced by young, actively growing, forest that have higher evapotranspiration rates
- extraction of groundwater (Evans (2004) estimated that, on average in the Basin, surface water will be reduced by 60 megalitres for every 100 megalitres of groundwater extracted)
- irrigation infrastructure upgrades (on-farm and off-farm) that result in a smaller proportion of irrigation water ending up as return flows into rivers and streams
- capture of water in farm dams that reduces inflows to shared water resources
- changing land use to one that intercepts more water (for example, replacing pasture with a forest plantation) (van Dijk et al. 2006).

Apart from the first two (which are the province of other policy domains), these matters should be addressed through water policy. The aim should not be to prevent these activities from occurring, but rather to introduce property right arrangements and other policy responses that result in them being undertaken only to the extent that they produce net benefits for the community. Failure to do this tends to result in excessive levels of these activities, with consequences for both consumptive and environmental water uses. An example of this was given by the National Water Commission:

> The lack of recognition of connectivity between surface water and groundwater resources is now a significant factor undermining confidence in the security of water access entitlements and water provided for the environment. An area of particular concern is the Murray-Darling Basin, where groundwater extractions have increased dramatically following the 1995 cap on surface water diversions. (NWC 2009b, p. 37)

The need to address connectivity is acknowledged in the NWI and action has been (and continues to be) taken to address this. The National Water Commission reports that all jurisdictions have made some progress in assessing the connectivity between surface water and groundwater and in developing integrated management arrangements for integrated systems, but that implementation is slow (NWC 2009b). In the longer term, it is envisaged that the Basin Plan will set sustainable diversion limits for groundwater, as well as surface water, and allow the two to be managed in conjunction with one another (MDBA 2009c).

Some policy deficiencies also remain with regard to water interception activities. For example, the National Water Commission reports that South Australia is the only jurisdiction that regulates the interception impacts of commercial forests. Horticulture Australia also argued that regulation of dams is inadequate:

> … the proliferation of extra domestic and stock catchment dams should be controlled where they are outside of the controls of farm dams legislation and yet may still have an impact on water availability downstream. (sub. 36, p. 3)

In general, these deficiencies do not directly impede the conduct of the water buybacks, but they do have the potential to reduce the quantity of water that the buybacks will deliver for the environment. While not being in a position to assess the specific timeframes mentioned, the Commission endorses the substance of the following National Water Commission recommendation:

> To reduce the potential for further erosion of security of existing water access entitlements, the [National Water] Commission recommends that significant and potentially significant water interception activities be immediately identified and quantified, and a process for addressing them clarified within the next six months. This will enable jurisdictions to meet their commitment to include any proposals for additional water interception activities above an agreed threshold size into existing water access entitlement regimes by no later than 2011. (NWC 2009b, p. 28)

Failure to account for connectivity is also evident in some proposals to ‘save’ water by upgrading irrigation infrastructure. That is, water is sometimes counted as saved when in reality it is simply prevented from re-entering rivers as return flows (chapter 6).

11 Concluding comments

Key points

- Although built on the sound foundations of the National Water Initiative, water policy in the Murray-Darling Basin has been poorly designed and, therefore, difficult to implement. Ideally the Basin Plan should have been finalised before the buyback began, and infrastructure upgrades made only after the buyback had started to indicate those irrigation areas that have a long-term future.
- The short-term and long-term goals of recovering water for the environment need to be clarified and addressed separately. Short-term urgent environmental watering needs can be best met through a portfolio approach, and longer-term needs addressed though the buyback.
- The amount of water that has been recovered already and is likely to be recovered through existing programs is substantial. It will likely exceed the lower bounds of what some commentators have called for in terms of minimum flows necessary for a moderate probability of achieving a healthy river system.
- Depending on how the Murray-Darling Basin Authority defines the Basin-wide SDL level, there is some likelihood that current water recovery programs will recover more water than is necessary to meet the obligations of Basin jurisdictions.
- Some of the funds allocated to the Sustainable Rural Water Use and Infrastructure program should be recovered and used for other purposes. To the extent necessary, some of these funds might be used to top up the funds committed to the buyback. Some might also be directed to a structural adjustment program to assist irrigation communities, which is not wholly dependent on subsidising irrigation infrastructure.

The problems associated with the Murray-Darling Basin (Basin) have vexed the Commonwealth and State Governments for many years. Various initiatives undertaken at various times have been met with only limited success in terms of improving the environmental sustainability of the Basin, in general, and increasing environmental water flows, in particular. There were reasons for optimism with the release of the National Water Initiative (NWI) and the subsequent agreement between all Basin jurisdictions, leading to the creation of the Murray-Darling Basin Authority.

Aspects of the Australian Government's recent initiatives in water policy are well founded. For example, a water buyback can quickly address the overallocation of water entitlements using a willing seller model. Similarly, the case for a Basin Plan based on revised Sustainable Diversion Limits (SDLs) is sound. By contrast, there was always a weakness in the proposition that large-scale, taxpayer funded infrastructure works could effectively and efficiently contribute to solving the problems in the Basin.

11.1 Diversifying the Australian Government's water purchase program

The Australian Government asked the Productivity Commission to report on market mechanisms for recovering water in the Basin for the environment, and ways in which it could diversify its current approach. A general conclusion is that purchasing water from willing sellers is a sound approach to meeting the Australian Government's commitment to obtain additional water for the environment. Indeed, it should be the preferred method for recovering water, taking precedence over subsidising investment in water saving infrastructure.

The Commission has also been at pains to distinguish between the short-term and long-term objectives that are inherent in the Government's buyback and affiliated programs. The Department of Environment Heritage and the Arts (DEWHA) has made much of the buyback being a means to 'restore the balance', which is parlance for easing the transition to the lower SDLs that are seemingly inevitable under the forthcoming Basin Plan. But the Government's statements and actions suggest that it is also concerned about meeting the short-term objective of providing water to meet urgent environmental watering needs. The Minister has mentioned the importance of the buyback to restoring '… the rivers and water resources of the basin …' (Wong 2009c), and the Government has greatly accelerated the buyback, seemingly to achieve more environmental watering in the short to medium term than it originally envisaged. So short-term priorities also seem to be important.

This distinction provides a framework for considering ways the Australian Government should 'diversify' its programs.

Regarding the 'transitional' objective, the Commission's main observations include that the Government could make much more use of purchasing entitlements on the market and that it could improve its tender process (where it is necessary to use this mechanism), largely through expediting the settlement of contracts. Where markets are well developed, the Australian Government should purchase water on-market and leave the tender mechanism to those parts of the Basin where markets are underdeveloped or non existent. The transparency of how DEWHA conducts the buyback should also be improved.

Regarding the short-term environmental watering objective, the Commission sees merit in the Commonwealth Environmental Water Holder (CEWH) being given a budget to purchase a portfolio of products (additional to the entitlements it receives from the buyback) that might help to address short-term urgent watering needs. It is somewhat ironic that much concern is expressed about the urgent plight of environmental assets, but the focus on entitlements has meant that little water has actually been delivered to date — 76 gigalitres to the end of January 2010. An alternative approach that focused on greater use of seasonal allocations and other similar products might have achieved far more in the short term. There seems to be little point in amassing future supplies of water if ecosystems are seriously or irreparably damaged in the meantime.

The Commission has also recommended further attention be given to removing impediments to trade in water markets.

But while the gains from these recommendations are non trivial, far greater gains can be achieved by radically rethinking how the different ways of recovering water are integrated. This requires that the buyback be seen in the larger context of water reform policy.

11.2 The implementation of water policy

Water reform policy in Australia is based on many sound principles, many of which were articulated in the NWI of 2004. But governments have been slow to implement these reforms, and subsequent initiatives including the *Water Act 2007* (Cwlth) (with its Basin Plan), and the commitment to the buyback and infrastructure upgrades now raise questions about the integration and sequencing of water reform initiatives.

The National Water Initiative

The NWI pushed strongly for the further development of markets in water including through: clarifying property rights; unbundling water from land; the development of compatible water registers; and the efficient pricing of water (incorporating full cost recovery). The parties also agreed to make a more explicit allowance for the needs of the environment, and to address 'overallocation' and 'overuse' in the context of developing statutory water plans.

Addressing overallocation and overuse

The process that the parties agreed to take in addressing overallocation and overuse was methodical, in the sense that water plans were first meant to establish the extent of overallocation or overuse before corrective measures were to be applied. The risk assignment provisions would reveal who was to bear the risk of reductions in allocations or reliability, and to the extent that governments bore the responsibility, various water recovery measures were to be used, including the purchase of water. The selection of water recovery measures chosen was to be primarily on the basis of cost effectiveness, but with a view to 'managing socio-economic impacts'. While the NWI process does not clearly articulate the objective of water planning, other than to say that it will provide for 'secure ecological outcomes' and 'resource security outcomes', it contains some recognition of the need to make tradeoffs between competing outcomes (see ss. 36-37).

This process was given further substance in a report to the Department of Prime Minister and Cabinet on the NWI and water trading by Price Waterhouse Coopers (PWC). PWC recommended that state governments contemplating recovering water through market mechanisms should first develop an appropriate framework before embarking on any large scale purchases of environmental water. The framework would require, among other things, that the government: '…clearly define the objective/s for each water purchase and the parameters around them (for example, the community's valuation of environmental outcomes and the resulting price that should be paid in the market)' (PWC 2006, p. xviii).

The point in raising this is that a sound process for recovering water had been agreed, but by and large is not being used. Few water plans have addressed overallocation to date, and events have largely been overtaken by the Water Act and the commitment to develop a binding Basin Plan.

The buyback should have come after the Basin Plan

The Australian Government's buyback and infrastructure programs are now being implemented. More than $1.3 billion dollars of the $3.1 billion set aside for the buyback has been spent and more than half of it will have been committed by the time the Basin Plan is finalised in mid 2011. Slower progress has been made delivering funding through the $5.8 billion Sustainable Rural Water Use and Infrastructure (SRWUI) program, but DEWHA claims that $4.4 billion of this is committed, subject to due diligence assessment.

In the Commission's view the ideal sequencing of initiatives would have been for the Basin Plan to have been finalised before committing taxpayer funds to compensate irrigators for policy induced reductions in the availability or reliability of water for consumptive use. (The obligations of the states should have also been clarified before the buyback.) This would have allowed sufficient time between the announcement of the SDLs and their subsequent implementation in 2014 and beyond, to implement a buyback and ease the transition to the new limits. By and large the Commission considers that any worthwhile infrastructure expenditure should have been deferred until the buyback had largely worked its course, thus reducing the risk of gold plating assets that might subsequently become stranded. It would also have allowed a clearer perspective on developing any additional programs for assisting irrigation communities to adjust to the lower levels of water availability.

Instead, the two water recovery programs are proceeding rapidly — the buyback very rapidly — and uncertainty in the market place is rife.

Cost–benefit analysis and cost effectiveness

As far as the Commission is aware, little prior consideration was given to the costs and benefits of the Water Act and the intention to restore the basin to environmental sustainability through the imposition of a Basin Plan. Neither, it seems, were the buyback or SRWUI programs subject to close scrutiny before they were introduced. There is therefore little information in the public arena to assess the public interest in these programs, and in respect of the Restoring the Balance (RTB) and SRWUI programs, whether the funds allocated were appropriate, either in absolute terms or relative to one another.

Of central importance is the Basin Plan itself, and whether it will lead to the best use of the Basin's water resources (as the objects of the Act would suggest it should). Assessing this would require considering the tradeoffs between environmental and consumptive uses and a careful weighing up of all of the costs and benefits — whether environmental, social or economic. If the RTB and SRWUI programs are seen only as a means of transitioning to the lower SDLs under the Basin Plan, it would be sufficient to assess them only in terms of cost-effectiveness. However, to the extent that they are argued to provide other benefits (for example recovering water in the form of entitlements can give different options to rules based water), or impose other costs (for example, decreased return flows from 'saving water' through infrastructure programs), they too should have been subject to cost–benefit analysis.

While the SRWUI program does not appear to have been subjected to ex ante cost–benefit analysis, it does require that particular projects meet due diligence tests, which include a cost-benefit test. Again, little public information is available on the rigour of these analyses. For example, the Northern Victoria Irrigation Renewal Project have cited a benefit to cost ratio of 1.54 for stage two of the Food Bowl project (which will be part funded through the SRWUI program), but the analysis is not publicly available. While greater than one, this figure does little to inspire confidence that these sorts of projects are unambiguously in the public interest.

In the Commission's assessment, subsidising infrastructure is generally a poor use of taxpayer funds. The benefits are predominantly private in nature, and the likelihood is that most of the 'low hanging fruit' has already been picked. Furthermore, subsidising irrigation infrastructure is inconsistent with the cost recovery principles in the NWI. There may be some intangible benefits to local communities but it is not clear that the 'sustaining irrigation communities' objective that the Australian Government has set itself, is best addressed through subsidising infrastructure, nor is it obvious that DEWHA is the best agency for delivering programs for this purpose.

As a rule, therefore, the guiding principles should be a sound Basin Plan, and the use of cost effectiveness as the main criterion for choosing water recovery options. This suggests that purchasing entitlements is the best way of meeting the transitional objective the government has set. However, the end point is still unknown and the way the Basin Plan is being developed gives cause for concern.

11.3 How much additional water is needed for the environment in the long term?

The Basin Plan requires that SDLs be set for each sub catchment and the Basin as a whole. There must also be an environmental watering plan. According to the Water Act, SDLs must be set using the best available scientific knowledge and they must reflect an environmentally sustainable level of take. As discussed in chapters 4 and 6, the Commission has concerns about this approach. But before returning to this theme, it is worth recapping on just how much water may be necessary to achieve a level of health considered acceptable from an ecological or scientific perspective.

Achieving ecological health in the longer term

There are various claims about how much water needs to be recovered on average for the environment. Clearly, the amount required will vary from year to year and from catchment to catchment, depending on seasonal conditions, the availability of water and the varying needs of the environmental assets concerned. The most authoritative claims at the Basin-wide level include:

- In a report for the then Murray-Darling Basin Commission in 2002, Jones et al (2002, p. 17) concluded that, with operational improvements, 1950 GL of new environmental flow allocations would lead to a moderate likelihood of achieving a healthy system, and 4000 GL would provide a high probability of achieving this outcome.
- The Research Centre for Freshwater Ecology Scientific Reference Panel reported to COAG on the ecological outcomes of returning flows of 350, 750 and 1500 GL per annum. It concluded that 1500 GL — combined with improvements in structural, operational and water quality management (for example use of regulators and weir pool raising) — would provide considerable 'whole-of-river and local ecological habitat benefits' (SRP 2003).
- The Wentworth Group have argued for additional flows of between 2116 GL and 4350 GL to have a moderate to high probability of having a healthy connected river system (Wentworth Group 2008, p. 11). The Group asserts that these are the best estimates that science can provide at this time (table 11.1).

The basis for calculating these additional quantities varies, so it is difficult to compare them. But as a rule, these quantities are additional to the rules-based water set out in state water plans and their equivalent.

The range of volumes is roughly 1500 GL to over 4350 depending on the level of health that is targeted, and the estimated probability of achieving that level of health. Where the MDBA will set the Basin-wide SDL is unknown, but given its science based approach to setting SDLs, and the limited additional evidence it has to work with, the MDBA will presumably settle on something in this range.

How much additional water is required?

The additional water that needs to be recovered to achieve the scientific based targets discussed above depends on how much water has already been recovered and is expected to be recovered under existing programs. Considerable progress has already been achieved through several programs with approximately 1210 GL of expected average flows almost recovered (table 11.1). These include the Living Murray Imitative (485 GL by mid 2010), Water for Rivers (70 GL for the Murray by 2012), NSW Riverbank (47 GL by mid 2011), and what has already been purchased through the RTB (532 GL). This water already represents approximately half the Wentworth Group's minimum additional flow, and is about 77 per cent of the 1500 GL benchmark used by COAG.

Table 11.1 **Likely environmental water recovery under major existing programs**

Program	*Estimated average annual flow*
	GL
The Living Murray (end 2009-10 expected)[a]	485
Water for Rivers (Murray River share expected by 2012)[b]	70
NSW RERP (end of 2010-11 imputed)[c]	47
NVIRP stage one[d]	75
Restoring the Balance (end Jan 2010)	532
Restoring the Balance (imputed balance of program)[e]	736
SRWUI to date	**na**
SRWUI (imputed total on completion)[f]	595
Total	2540

[a] Long Term Cap Equivalent. [b] Water for Rivers target of average annual flows. [c] Based on average price paid to date of $1250 per ML of entitlement, and average expected reliability of entitlements purchased to date of 44 per cent approximately. [d] NVIRP estimate of long term average annual water savings. [e] Based on average price paid to date of $1633 per ML of entitlement, and average expected reliability of entitlements purchased to date of 67 per cent approximately. [f] Based on the assumptions that all of the $5.8 billion SRWUI budget will be spent on water recovery projects, that infrastructure is half as cost effective as purchasing entitlements, and that 50 per cent of water saved is earmarked for the environment. **na** Not available.

Sources: DECCW (pers. comm. 10 March 2010), DEWHA (sub. DR85), MDBA (sub. DR87), NVIRP nd, Water for Rivers 2009a.

The additional water that stands to be recovered through the balance of the RTB and through the SRWUI program could easily take the total to above the Wentworth minimum target. So far, the RTB program has purchased entitlements for an average cost of approximately $1633 per ML, but these are of varying reliability. Using DEWHA's average reliability estimate, the cost is approximately $2440 per ML of average annual flow. If these prices prevailed during the balance of the buyback, DEWHA could expect to recover approximately 736 GL of additional average annual flows with the remaining funds.

Little information is available on the net water savings that can be achieved through infrastructure, so it is hard to estimate how effective the Government's SRWUI program will be.[1] The Commission has serious doubts about the net gains to be made, once the loss of return flows are considered, not to mention the illusory savings resulting from more accurate metering. But for the sake of argument if infrastructure investment was half as cost effective as buybacks, and 50 per cent of

[1] In the National Plan for Water Security, the Howard Government estimated that infrastructure investment could achieve a 25 per cent saving of total irrigation water use or approximately 2500 GL per annum (Howard 2007).

the water savings were allocated to the environment, the $5.8 billion budget[2] could yield savings of another approximately 595 GL of annual flow. If this conservative estimate of savings came to pass, total water recovered would be 2540 GL.

While this is a very rough projection, it does suggest that, even in the absence of the Basin Plan, the existing water recovery programs could recover substantially more than the Wentworth Group's minimum target.

FINDING 11.1

Without even implementing the Basin Plan, the amount of water that is likely to be recovered for the environment through existing programs is substantial. It will likely exceed the lower bounds of what some commentators — such as the Wentworth Group — have called for in terms of minimum flows necessary to achieve a moderate probability of achieving a healthy river system..

Maximising net benefits to the community

As noted in chapter 6, the Commission is concerned about the way that the MDBA is interpreting the Water Act's definition of a SDL. That concern is that the MDBA is setting SDLs using a science-based approach that does not give adequate regard to the opportunity cost of water or the value that the community attaches to watering environmental assets. Further, the Basin Plan is attempting to achieve desired environmental, economic and social outcomes solely through allocating water, when a mix of inputs might achieve the same or similar outcome with less water. For all of these reasons, the Commission is concerned that the MDBA may set more stringent SDLs than is in the best interests of the Australian community.

The Commission is not rejecting the case for allocating more water for the environment. This is patently necessary to restore some semblance of health to the Basin's environment. But potential now exists for one misallocation of resources (too little water for the environment) to be replaced by another (higher than necessary social and economic cost). To the extent that there is scope to do so, the MDBA is encouraged to define SDLs in a way that has more explicit regard for the objects of the Water Act, which include that the Basin resources be managed in the public interest, and to optimise economic, social and environmental outcomes (ss. 3(a) and 3(c)). If a strict legal interpretation of the SDL definition precludes this, the Act should be amended.

2 The total budget for the SRWUI program is $5.8 billion, but some of this has been allocated for grants to local government (for example $200 million for the Strengthening Basin Communities program), and hence is not being directed to investment in water saving infrastructure.

If this approach is taken, the optimal basin-wide SDL — that is, the one that maximises returns to the community when all of the costs and benefits are considered (whether environmental, social or economic in nature) — will be higher (and conversely the amount reserved for the environment lower) than if a science only approach was taken. From this perspective, it is conceivable that the amount of water that existing programs are expected to recover, could exceed what a revised Basin Plan would require.

11.4 Where to from here

The Commission has outlined a suite of water policy recommendations in this report that would promote the public interest in water policy in the Basin. Some are targeted at making the existing buyback work better, others at sharpening the Australian Government's ability to address short-term environmental watering needs. But the most substantial are directed at improving the institutional framework.

In the Commission's view, the institutional framework for recovering water should have been clarified before deciding on how and where water would be recovered. Under this approach, the buyback of entitlements — as a means of transitioning to the lower levels of water availability under the Basin Plan — should have commenced only after the Plan had been ratified (and the assignment of risk between irrigators and governments decided). Urgent short-term needs could have been addressed through the purchase of seasonal allocations. And to the extent that they provide net benefits to the community, investment in new irrigation infrastructure should have come after the buyback had given some indication of where the more viable areas were likely to be. Above all, sound cost-benefit analysis should have preceded intervention.

It is not possible to wind back the clock, but there is still much that Basin jurisdictions could do to provide greater institutional certainty for the recovery and management of water for the environment in the Basin. The most urgent is to commit to the setting of SDLs that will provide a high level of protection for the environment that is consistent with what is best for Australians — present and future — as described above.

Having set more appropriate targets it would then be appropriate to rely much more on buybacks to close the remaining gap, commensurate with the extent of the Government's obligations. In the Commission's view, as much as possible of the funds currently ear-marked to the infrastructure program should be recovered and used for other purposes. This might not be popular with irrigators and some jurisdictions. But if some of the funds are redirected to the buyback, this opposition might be more muted than before the buyback commenced. Some regions do not stand to gain very much from the infrastructure program, and diverting funds into the buyback might provide more uniform compensation to irrigators across the Basin.

In the collective enthusiasm of Basin jurisdictions to address the real environmental problems that exist in the Basin, good policy processes and principles have been overlooked. Short-term needs could have been addressed more effectively while a more coherent long-term strategy was being developed. Greater care is needed to ensure that the very substantial resources committed to the Basin produce the highest net returns to the community for the taxpayer funds expended. As the measures are currently conceived and sequenced, the Commission fears that the benefits will not justify the substantial public expenditure and the socioeconomic dislocations imposed.

A Consultation

Table A.1 **List of submissions**

Individual or organisation	*Submission number*
John Ashworth	DR59
Australian Conservation Foundation	41, DR79
Australian Dairy Farmers Limited	48
Australian Floodplain Association	30
Barossa Infrastructure	14
Prof Henning Bjornlund	19
Prof Jeff Bennett	7
Border Rivers Gwydir Catchment Management Authority	53
Bourke Shire Council	34
T Bowring & Associates	DR84
David Boyd	DR58
Ian Brimblecombe	12
P.C. & C.J. Brophy	3
Coleambally Irrigation Co-operative Limited	DR77
Cotton Australia	25
Crane Group	4, DR61
Dr Lin Crase and Sue O’Keefe	1
Dr Lin Crase, Sue O’Keefe and Brian Dollery	2
Deniliquin Lawyers' Association	22
Department of the Environment, Water, Heritage and the Arts	56, DR85
Eastern Australia Agriculture	45
Environment Victoria	23, DR83
Gannawarra Shire Council	43
Goulburn Broken Catchment Management Authority	26, DR70
Goulburn Valley Environment Group	21
Quentin Grafton	DR81
Quentin Grafton and Qiang Jiang	18, DR82
Gwydir Valley Irrigators Association	29, DR69
Robert Halse	DR63
Healthy Soils Australia	DR64
High Security Irrigators-Murrumbidgee	8
Horticulture Australia Ltd	36
Iplex Water	DR60
The Jackson Group	10

(Continued on next page)

Table A.1 (continued)

Individual or organisation	Submission number
Anke Leroux and Lin Crase	9
Tim Lloyd	6
Tom Loffler	DR67
Lowbidgee League Inc	17
Paul McGowan	13
Moira Shire Council	15
Murray Dairy	49
Murray-Darling Basin Authority	40, DR87
Murray River Group of Councils	DR74
Murrumbidgee Irrigation	39, DR86
Murrumbidgee Private Irrigators Inc	DR73
National Farmers Federation	50, DR88
National Irrigators' Council	24, DR65
National Water Commission	DR71
North Central Catchment Management Authority	44
Northern Victoria Irrigation Renewal Project	38, DR68
NSW Government	51
NSW Irrigators' Council	32, DR72
Carol O'Donnell	54, 57
Professor Jonathan Pincus	DR62
Queensland Farmers' Federation	35, DR91
Queensland Government	54, DR75
Queensland Resources Council	27
Risk and Sustainable Management Group	33
Riverina and Murray Regional Organisation of Councils (RAMROC)	16
SA Government	52, DR90
Shire of Wakool	42
Southern Riverina Irrigators	47
Judith Stubbs and Associates	DR66
Swan Hill Rural City Council	DR80
Tandou Ltd	28
Victorian Farmers Federation	31, DR78
Water for Rivers	DR89
Watermove Pty Ltd	20
Alistair Watson	11
Wentworth Group of Concerned Scientists	46
Western Murray Irrigation Ltd	37, DR76
Mike Young & Jim McColl	5

Table A.2 **List of visits**

Location/Interested parties
Canberra
ABARE
Basin Community Committee
CSIRO Land & Water
Professor Quentin Grafton
Department of the Environment, Water, Heritage and the Arts
Murray-Darling Basin Authority
National Farmers Federation
National Irrigators' Council
National Water Commission
The Treasury
NSW
Border Rivers-Gwydir Catchment Management Authority
Coleambally Irrigation Co-operative Limited
Cotton Australia
Department of Environment, Climate Change and Water
Department of Premier and Cabinet
Department of Primary Industries
Department of Water and Energy
Gwydir Valley Irrigators Association
High Security Irrigators – Murrumbidgee
Mr Sam Kirkby
Moree Chamber of Commerce
Murray irrigation Ltd
Murrumbidgee Irrigation
NSW Farmers Association
NSW Irrigators' Council
NSW Treasury
Ricegrowers' Association of Australia
Riverina and Murray Regional Organisation of Councils (RAMROC)
Mr Bruce Southeron
Southern Riverina Irrigators
Water for Rivers
Wentworth Group of Concerned Scientists
Mr Adam Wettenhall
QLD
AgForce Queensland
Balonne Shire Council
Border Rivers Food and Fibre Irrigators Association
Ms Leith Boully
Central Downs Irrigators Ltd
Department of Environment and Resource Management

(Continued on next page)

Table A.2 (continued)

Location/Interested parties
Department of Premier and Cabinet
Goondiwindi Regional Council
Macintyre Brook Irrigator's Association Inc
Ms Sarah Moles
Queensland Cotton
Queensland Farmers' Federation
Smartrivers Irrigation Association
Stanthorpe Landcare
SunWater
SA
CSIRO Sustainable Ecosystems
Department of Trade and Economic Development
Department of Transport, Energy and Infrastructure
Department of Treasury and Finance
Department of Water, Land and Biodiversity Conservation
Lower Murray Irrigators
Meningie Infrastructure Committee
Murraylands Development Board
Primary Industries and Resources SA
SA Government
SA Water
Waterfind Pty Ltd
Professor Mike Young
VIC
Australian Competition & Consumer Commission
Australian Conservation Foundation
Department of Primary Industries
Department of Sustainability and Environment
Goulburn Broken Catchment Management Authority
Goulburn Murray Water
Murray River Group of Councils
Northern Victoria Irrigation Renewal Project
Victorian Farmers Federation

Table A.3 **Public meetings**

Public Meeting
Victoria — 1 February 2010
Shepparton
New South Wales — 2 February 2010
Griffith
South Australia — 5 February 2010
Renmark

B Buybacks in Australia

Key points

- Clearly identifying environmental assets and ecological objectives, and setting water recovery targets to meet those objectives, improves the transparency and accountability of water recovery programs.
- Assessing water recovery projects (market based measures and infrastructure investments) against common criteria, including least cost per gigalitre (GL), can improve the cost effectiveness and efficiency of these programs.
- Environmental water recovery has been outsourced to an incorporated body with water recovery objectives, powers and required resources. This institutional arrangement can improve the independence of water recovery, lower administrative costs, and improve flexibility and innovation in the water recovery task.
- Water recovery programs have considered inputs, other than just water, in achieving their environmental aims, including research into better use of environmental water, investments in infrastructure to better deliver water, and agreements with land owners on land management practices.
- Tenders and on-market purchases have recovered water entitlements:
  - at a lower average cost per GL long term cap equivalent (LTCE) compared with infrastructure investments
  - in greater quantities compared with infrastructure investments
  - in a more timely manner compared with infrastructure investments.
- On-market purchases have recovered entitlements cost-effectively, in a timely manner, and with low transaction costs compared with tenders.
- The assessment and notification of bids in tenders has occurred quickly, compared with seeking approval for an entitlement sale from irrigation companies, water authorities, and mortgagees. Seeking approvals can delay settlement significantly.
- Water recovery programs have recognised that a portfolio of water products best meets environmental watering needs. Programs have purchased predominantly water entitlements, but seasonal allocations and water from on-farm storages have also been used. Water options contracts are also available.
- Environmental water has been recovered in rules-based systems through the purchase of water from on-farm storage and changes to licence conditions. Shepherding arrangements are needed to direct the water to environmental asset.

Prior to the Restoring the Balance water recovery program that is the focus of this study, a number of other programs have been involved in the recovery of water in the Murray-Darling Basin to meet environmental needs. This appendix summarises the aims and operations of these programs, their progress to date in recovering water and delivering it to environmental assets, and where possible, draws lessons from the programs to inform the approach to water recovery under the Restoring the Balance buyback.

Water recovery programs and actions addressed in this appendix include:

- the Living Murray Initiative
- Water for Rivers
- the New South Wales Rivers Environmental Restoration Program (including the RiverBank tender)
- the use of water instruments other than water entitlements, including:
  - SA Water purchases of seasonal allocations
  - the Murrumbidgee River Reach project for water options contracts
- purchases in flows-based river systems, including:
  - the Narran Lakes Environmental Water Purchase in New South Wales
  - the Victorian Stream Flow Tender in Yarra basin catchments.

B.1 The Living Murray Initiative

Prior to the Restoring the Balance buyback, the Living Murray Initiative (the Living Murray) was the largest water recovery program in Australia. The Living Murray has received $700 million in funding over 2004 to 2009 from the Commonwealth, NSW, Victorian, SA and ACT Governments to fund the recovery of a portfolio of water entitlements capable of delivering average annual flows of 500 gigalitres (GL) Long Term Cap Equivalent (LTCE)[1] to six icon sites[2] along the River Murray system by mid 2009. To complement the water recovery program, the Murray-Darling Basin Ministerial Council (MDBMC) has allocated $250 million over 2003 to 2011 to the Environmental Works and Measures Program to fund

1 The LTCE is a unit of measure used to create a common currency for volumes of water recovered under the Living Murray. It is the estimated average allocation that would have accrued to a given water entitlement based on climate and inflow data from 1891 to 2003.

2 The six icon sites are the Barmah-Millewa Forest; Gunbower and Koondrook-Perricoota Forests; Hattah Lakes; Chowilla Floodplain; the Murray Mouth, Coorong and Lower Lakes; and the River Murray Channel (COAG 2004).

infrastructure works at the six sites to improve delivery of recovered environmental water (COAG 2004).

Two intergovernmental agreements (IGAs), signed by the Living Murray partner governments, set out the funding contributions and water recovery targets for each jurisdiction (table B.1):

- The 2004 IGA on Addressing Water Over-allocation and Achieving Environmental Objectives in the Murray-Darling Basin (IGA 2004) allocated $500 million from partner governments to water recovery and $100 million to the Environmental Works and Measures Program (COAG 2004).
- The 2006 Supplementary IGA on Addressing Water Over-allocation and Achieving Environmental Objectives in the Murray-Darling allocated an additional $200 million from the Commonwealth to water recovery projects and $100 million to the Environmental Works and Measures Program (COAG 2006).

Table B.1 **Government contributions[a] and water recovery targets under the Living Murray Initiative**

State/territory	*State/territory contribution 2004[b]*	*Commonwealth contribution 2004[b]*	*Commonwealth contribution 2006[c]*	*Total*	*Water recovery target*
	$m	$m	$m	$m	GL(LTCE)[d]
NSW	115	100	100	315	249
Victoria	115	86	86	287	214
SA	65	14	14	93	35
ACT	5	-	-	5	2
Total	300	200	200	700	500

[a] Indicative targets. [b] The Intergovernmental Agreement (IGA) 2004 on Addressing Over-allocation and Achieving Environmental Objectives in the MDB. [c] The Supplementary IGA 2006 on Addressing Over-allocation and Achieving Environmental Objectives in the MDB. [d] The Long Term Cap Equivalent is the estimated average allocation that would have accrued to a given water entitlement based on historical climate and inflow data from 1891 to 2003.

Source: COAG (2004; 2006).

This section gives an overview of water recovery under the Living Murray as a whole. It then examines three market-based approaches to buying water entitlements under the Living Murray: the MDBA Pilot Environmental Water tender; the MDBA Water Entitlement tender; and on-market purchases by SA Water.

Governance

The 2004 IGA and the Living Murray Business Plan (the Business Plan) outline the governance and operational framework for the Living Murray. The MDBMC oversees implementation of the program through its approval of the Business Plan and proposed water recovery projects. Jurisdictions, and other parties, implement projects and manage water delivery to the icon sites. The MDBA administers the Living Murray in accordance with the Business Plan. The Business Plan outlines:

- the ecological objectives at each of the six icon sites
- the approval and funding processes for water recovery projects, including the criteria used to assess projects for implementation
- how recovered water is delivered and can be traded to meet environmental watering needs (MDBC 2007b).

The 2004 IGA and the Business Plan also require the development of:

- Environmental Management Plans for each of the six icon sites which identify the specific watering regimes (flow, volume, timing, duration and security) needed to meet the Living Murray ecological objectives
- an overarching annual Living Murray Environmental Watering Plan, based on the icon site Environmental Management Plans, to guide overall use of recovered water across the icon sites (MDBC 2007b).

Water recovery and delivery

The 2004 IGA requires the permanent recovery of water through the acquisition of water entitlements (COAG 2004). The 2006 IGA expanded the scope of the program to include 99-year leases on entitlements (COAG 2006). Water can be recovered through market-based purchases, on-farm and off-farm infrastructure investments, regulatory measures and urban water projects. Water savings from infrastructure investments and regulatory changes are converted into legally secure and tradeable water entitlements, and may be transferred to the Living Murray partner or shared between irrigators and the Living Murray.

Anyone may propose a water recovery project to the MDBMC which assesses all projects against a common set of criteria set out in the IGA 2004. The criteria include:

> … the degree to which the characteristics of the recovered water will fulfil the requirements of the [Living Murray] Basin Environmental Watering Plan … or any other environmental objectives which may be agreed

the cost effectiveness of the proposed measure, including initial cost per unit of water, and ongoing costs arising from the management, storage or delivery of the water to achieve the agreed environmental objectives …

other matters … [that] include social and economic impacts, salinity and water quality outcomes, … and third-party impacts. (ss. 32-3)

Projects approved by the MDBMC are listed on the Eligible Measures Register (EMR) and can receive implementation funding. The 'pending' column in table B.2 lists projects on the EMR and the volume of water (GL LTCE) expected to be recovered. Water entitlements recovered from completed projects are listed on the Environmental Water Register (EWR). The 'recovered' column in table B.2 lists the expected annual volume of water available (GL LTCE) from these recovered water entitlements. Living Murray entitlements are usually held by the party which recovered them, including the states, the MDBA, DEWHA or others (MDBC 2007b).

The Living Murray Environmental Watering Group[3] (EWG) develops an annual Environmental Watering Plan (annual EWP) based on: the six icon site management plans; scientific data on the condition of the icon sites; and consultations with stakeholders. The annual EWP outlines how seasonal allocations from Living Murray entitlements can be used to meet the watering needs at each icon site. Jurisdictions are responsible for delivering allocations accruing to Living Murray entitlements in their ministerial accounts. The annual EWP also manages allocations accruing to River Murray water entitlements recovered by Water for Rivers (see section B.2) (MDBC 2007b).

In 2007-08, due to on-going dry conditions, the Living Murray EWG developed a critical refuge strategy to prioritise delivery of available water to high value refuge areas within the six icon sites (MDBC 2008a). The Commonwealth Environmental Water Holder (the CEWH) is also using the critical refuge strategy to guide the use of available Commonwealth water (DEWHA 2009a). Joint Living Murray and Commonwealth environmental watering actions are being targeted at the critical refuge sites through the Living Murray EWG.

Living Murray entitlements may be traded on the permanent market when this is consistent with the objectives of the annual EWP. However, revenue from trading must be used to acquire other water entitlements that better match the requirements of the annual EWP. The MDBMC approves all trading of Living Murray water entitlements (COAG 2004). No trading has occurred to date.

3 The Living Murray Environmental Watering Group includes partner government agencies, a representative of the Commonwealth Environmental Water Holder, and MDBC staff.

Progress to date — water recovery

The Living Murray did not meet its water recovery target of 500 GL LTCE by June 2009. However, the MDBA expects 485 GL LTCE will have been recovered by 30 June 2010 (MDBA, sub. 87, p. 6). As at December 2009, the EWR held 465.4 GL LTCE of water entitlements (table B.2). The MDBA estimates a further 19.8 GL LTCE will be recovered from projects currently underway (table B.2).

Of the Living Murray water entitlements recovered as at November 2009, approximately 30 per cent were recovered through infrastructure investments, 25 per cent through regulatory changes and 45 per cent through market-based measures. Only permanent water entitlements have been purchased. No allocations, leases or other water products have been acquired (MDBA, pers. comm., 25 November 2009).

The security profile of Living Murray entitlements is heavily weighted toward medium and low security and supplementary licences. As at 30 June 2009, approximately 5 per cent of the entitlements held were high security, 54 per cent were medium and low security, and 41 per cent were supplementary and unregulated licences (MDBA 2009i).

Progress to date — water delivery

In recent years, due to continued dry conditions and the low level of seasonal allocations accruing to entitlements, the Living Murray has had difficulty in meeting the environmental objectives set out in the six icon site Environmental Management Plans. In 2007-08, Living Murray entitlements delivered 16.5 GL of physical water to the refuges (4.2 GL was allocated from the 133 GL LTCE of entitlements on the Environmental Water Register at that time, and 12.8 GL was sourced from Water for Rivers entitlements (MDBC 2008a)). In 2008-09, the Living Murray delivered 6.5 GL of physical water to the six icon sites from the 342 GL LTCE of entitlements recovered as at 30 June 2009. Around 7 GL was carried over for use in 2009-10 (MDBA 2009f). A number of the Living Murray watering actions were supplemented with Commonwealth water managed by the CEWH (DEWHA 2009e).

Table B.2 **Living Murray Initiative water recovery as at December 2009**

Jurisdiction	*Type of project*	*Recovery source*	*Recovered*[a]	*Pending*[b]
			GL (LTCE)[c]	*GL (LTCE)*[c]
NSW	Market based	NSW tender to purchase up to 125 GL of entitlements (through RiverBank)	113.7	
NSW	Market / Infra.	Package B	56.0	6.0
NSW	Market based	Murray Irrigation Limited supplementary water access license	17.8	
NSW	Market based	Tandou supplementary access licence	9.3	
NSW	Infrastructure	Ricegrowers Assoc. — On-farm Water Efficiency A1	1.2	
NSW	Infrastructure	Wetlands water savings stage 1		0.6
NSW	Infrastructure	Ricegrower's Assoc. — On Farm Water Efficiency Round 2	2.6	3.6
NSW	Infrastructure	Pipe It	0.2	
Total NSW			**200.8**	**10.2**
VIC	Regulatory / Infrastructure	Goulburn-Murray Water Package	144.9	
VIC	Infrastructure	Lake Mokoan Recovery Package	28.1	
VIC	Infrastructure	Shepparton Modernisation Project	29.3	
Total Vic			**202.3**	
SA	Market based	Securing government held water for environment	13.0	
SA	Market based	Purchase from willing sellers Stage 1	5.0	
SA	Market-based	Securing government held water for environment	17.0	
Total SA			**35.0**	
MDBA	Market based	Pilot environmental water purchase	13.2	
MDBA	Market based	Environmental water purchase project	13.9	6.6
MDBA	Market based	On-farm reconfiguration demonstration		3.0
Total MDBA			**27.1**	**9.6**
Total[d]			**465.4**	**19.8**

[a] Environmental Water Register listings have been completed and seasonal allocations to these entitlements are available for environmental use. [b] Eligible Measures Register listings are being implemented, water is not yet available. [c] The Long Term Cap Equivalent (LTCE) is the estimated average allocation that would have accrued to a given water entitlement based on historical climate and inflow data from 1891 to 2003. [d] Total includes 0.176 GL recovered through infrastructure projects under the Water Through Efficiency Tender.

Source: MDBA (2009q).

Comparing water recovery mechanisms under the Living Murray

A number of reviews of water recovery under the Living Murray have been undertaken to date:

- A 2006 MDBMC issues paper noted that, from 2004 to 2006, when water recovery projects focused on off-farm infrastructure investments, no water entitlements were recovered. It found that the cost of recovering water through infrastructure projects was considerably higher and would take longer than purchasing water from the market (MDBMC 2006).
- An audit of the Living Murray in 2005-06 concluded that it would be difficult to achieve the 500 GL target by mid-2009 if water recovery continued to focus on small-scale infrastructure measures. The report recommended a greater emphasis on market-based recovery to meet investment and volumetric targets (MDBMC 2007). In 2006, in recognition of these findings, the MDBMC expanded water recovery to include on-farm efficiency projects and market-based measures, such as tenders (MDBMC 2007).
- A 2009 MDBA progress report found that the Living Murray would not achieve its recovery target of 500 GL LTCE by mid-2009, although it noted that accelerated implementation of existing projects could see the target met by the end of 2009. The report also found that drought had severely limited the amount of physical water delivered to the icon sites. The report also noted that:
  - the initial focus on infrastructure projects at the expense of market mechanisms had slowed the rate of water recovery
  - across a range of water recovery projects, infrastructure investments had a higher cost per GL of water recovered compared with market mechanisms
  - the Business Plan does not adequately address coordination of watering activities under the annual EWP and noted the importance of cooperation with other environmental water holders, including the Commonwealth Environmental Water Holder (MDBA 2009i).

Data from the MDBA 2009 progress report on the cost per GL LTCE of various Living Murray water recovery projects supports previous findings that market-based mechanisms can recover larger quantities of water entitlements at a lower cost compared with infrastructure measures (table B.3). The seven listed market-based measures recovered 194.2 GL LTCE of water entitlements through a mix of tenders and on-market purchases at an estimated cost of between \$1.1 million and \$2.6 million per GL LTCE. The average cost of water recovered through these market measures was \$1.7 million per GL LTCE. In contrast, the five listed infrastructure projects recovered 74 GL LTCE at an estimated cost of between

$1.5 million and $3.1 million per GL. The average cost of water recovered through infrastructure measures was $2.2 million per GL LTCE (MDBA 2009i).

Table B.3 **Cost effectiveness of some water recovery projects under the Living Murray Initiative[a,b]**

	Estimated cost/GL	*Quantity recovered*	*Estimated total cost*
	$m/GL (LTCE)	GL (LTCE)	$m
Market based measures			
Murray Irrigation Ltd. purchase	1.1	17.8	19.6
Tandou purchase	1.5	15.5	23.3
SA Govt. held water[c]	1.5	13.0	19.5
MDBA pilot water purchase	1.6	13.2	21.6
NSW tender (RiverBank)	1.7	112.7	192.0
SA willing sellers stage 1[c]	2.2	5.0	11.1
SA Govt./willing sellers[c]	2.6	17.0	43.5
Total		**194.2**	**330.6**
Average	**1.7**		
Infrastructure measures[d]			
Lake Mokoan Package	1.5	36.0	54.0
Rice Growers efficiency 1	2.5	2.5	6.3
Rice Growers efficiency 2	2.5	3.0	7.5
Shepparton modernisation	2.8	30.0	84.0
Sustainable dairy farms	3.1	2.5	7.8
Total		**74.0**	**159.6**
Average	**2.2**		

[a] Estimated cost per GL LTCE and estimated total cost were derived from figure 22 in the MDBA Living Murray Progress Report 2009 (MDBA 2009c). Water recovery projects from figure 22 were not included in this table if: they recovered 1 GL or less; recovered water through a mix of infrastructure and market-based mechanisms; or had not been implemented. [b] All amounts have been rounded to one decimal place. [c] GL amounts are nominal entitlement volumes, not LTCE. LTCE is between 0.9 and 1.0 the nominal values. [d] The Goulburn-Murray Water Recovery Package was not included as an infrastructure measures as the cost data provided in figure 22 of the MDBA Living Murray Progress Report 2009 was not consistent with other sources.

Source: MDBA (2009i); SA Government (sub. 90, p. 11).

Project 1 — the MDBA pilot environmental water tender

The MDBA, under the Living Murray, ran a pilot expression of interest tender in 2007 to purchase up to 20 GL of high and medium security entitlements within the southern Murray-Darling Basin at prevailing market prices (table B.4). The pilot round was to run from 16 July 2007 until 28 September 2007. Due to oversubscription, the pilot period closed on 13 August 2007 (MDBC 2007a).

The MDBA advertised the opening of the round in regional media and invited willing sellers to lodge non-binding expressions of interest (EOIs) to sell their water entitlements. EOIs were assessed against price information in a weekly market report prepared by external consultants. EOIs were reviewed on a 'first come, first served' basis within a week of being received. Sellers were notified of the outcome within 10 days of the assessment. No negotiation was entered into. Successful sellers received the price they bid. Unsuccessful sellers were able to resubmit bids within the round (MDBA 2009p). The MDBA used external solicitors for all water conveyancing work. Due diligence times varied between six weeks to four months depending on the type of water entitlement, the location and the business arrangements of the seller (MDBA, pers. comm., 25 November 2009).

Outcomes

The pilot tender recovered 13.2 GL LTCE (14.2 GL NSW Murray general security, 1.8 GL Victorian high reliability) at a cost per GL LTCE of $1.6 million[4] (MDBA 2009i) (table B.3).

Project 2 — the MDBA water entitlement tender

The MDBA, through the Living Murray, ran a single round expression of interest tender to purchase entitlements from willing sellers in the southern Murray-Darling Basin (table B.4). The tender opened on 6 May 2009 and closed 30 June 2009, when the allocated budget of $50 million was spent. The MDBA did not set a quantitative purchase target for the tender (MDBA 2009m).

The MDBA advertised the opening of the tender round stating that it would purchase high and medium security water entitlements of more than five megalitres (ML) in the southern Murray-Darling Basin at prevailing market prices. Individual sellers and their agents lodged applications to sell to the MDBA. Sellers specified the volume of water entitlements they were willing to sell and the price per ML they would accept. Applications also required additional information about the type of entitlement and any conditions attached to it. All applications were treated as confidential (MDBA 2009m).

4 Cost per GL LTCE was estimated from data in the MDBA Living Murray Progress Report 2009 (MDBA 2009i).

Table B.4 Summary of design features of tenders and on-market purchases of water products

Program	*Budget target*	*Volumetric target*	*Water products*	*Duration of round*	*Assessment*	*Price stacking*	*Negotiation*	*Market price benchmark*	*Non-binding bids*	*Time to settlement*
Tenders										
TLM MDBA pilot tender	no	20 GL	water entitlements	4 weeks	in round	no	no	yes	yes	na
TLM MDBA tender	yes ($50 m)	no	water entitlements	7 weeks	in round	no	no	yes	yes	18 weeks
RiverBank (yearly tender)	yes (yearly)	no	water entitlements	until budget spent	in round	no	yes	yes	yes	8-12 weeks
Vic. stream flow tender	no	target flow rate	changes to water licence	6 weeks	end of round	yes	no	na	yes	na
On-market purchases										
Water for Rivers	yes (yearly)	no	water entitlements	2007-2008	..	..	yes	yes	yes	10-14 weeks
RiverBank	yes (yearly)	no	water entitlements	on-going	..	..	yes	yes	yes	na
TLM SA Water	no	up to 35GL	water entitlements	2006-2009	..	..	yes	yes	yes	12-16 weeks
SA Water 2008-09	no	50 GL	water allocations	2008-09	..	..	yes	yes	yes	na

na Not available .. Not applicable

Sources: DECCW (2008; 2009c; pers. comm., 23 November 2009); Melbourne Water (2007); MDBA (2009i, 2009l; 2009m; pers. comm., 25 November 2009); MDBC (2007a); SA Department of Premier and Cabinet (pers. comm., 16 November 2009); SA Government (sub. 52); SA Water (pers. comm., 10 March 2010); Water for Rivers (pers. comm., 5 November 2009).

The MDBA assessed EOIs on a fortnightly cycle during the tender round against common assessment criteria, including:

- the price per ML — the MDBA assessed bids against prevailing market prices based on independent market advice updated fortnightly during the tender round
- the entitlement type (location and security) — the MDBA purchased water entitlements that were able to deliver water to the icon sites (MDBA 2009m).

Expressions of interest classified as large were considered within one working day of their receipt by the MDBA. EOIs classed as small were considered at the end of each fortnight. No information was provided on what a large or small EOI constituted. The MDBA advised vendors if their bids were to be pursued within five working days of assessment. Bids were either rejected or accepted — the MDBA did not enter into negotiations. Successful sellers received the price they bid, unsuccessful sellers were able to resubmit bids immediately (MDBA 2009m).

On notifying a seller of an interest in purchasing a water entitlement, the MDBA engaged external conveyancing solicitors to commence the transfer process. At this time, sellers were required to provide additional information, such as a copy of the water entitlement certificate. The tender documents estimated the average conyeyancing time at 16 weeks, with the MDBA assessment and notification process taking no longer than 14 working days. The length of time for final approval depended on how complicated the ownership of the water entitlement was, and the length of time for approval from irrigation companies, water authorities and mortgagees. Purchases only became binding on the exchange of contracts (MDBA 2009m).

The NSW embargo on water sales to the Commonwealth for environmental purposes, which came into effect on 29 May 2009, meant that no NSW entitlements were purchased in this tender. The 4 per cent cap on water trade out of Victorian districts restricted purchases in Victoria (MDBA 2009m).

Outcomes

An MDBA progress report indicates the MDBA will recover approximately 20.5 GL LTCE of SA and Victorian high security water entitlements within the budgeted $50 million at an estimated cost of $2.4 million per GL LTCE (MDBA 2009i).

Project 3 — SA Water on-market entitlement purchases

Between 2006 and 2009, SA Water, acting as an agent for the SA Government, purchased on-market 19.5 GL of high security SA River Murray water entitlements (table B.4). Additional entitlements were also purchased from SA Government departments. SA Water purchased the water entitlements through negotiations with willing sellers. The SA Government reimbursed SA Water for the costs, and entitlements were transferred to the Minister for the River Murray for use under the Living Murray (sub. 52, p. 11).

A single officer at SA Water undertook the entitlement purchases. Contact with the market and prospective vendors was primarily over the phone. Purchases were negotiated directly between the SA Water officer and individual vendors on a transaction-by-transaction basis. Due diligence was based on vendor declarations included in purchase contracts, and checks conducted by the relevant statutory water authority responsible for approval of entitlement transfers. Payment was not made until the water authority had approved and transferred the entitlement (sub. 52, p. 12).

A market price for entitlements was established by reference to other recently concluded transactions and standing offers. The SA Government engaged independent consultants to monitor and report on current and anticipated prices. Once verbal negotiations were complete, SA Water would confirm an offer to buy a water entitlement in writing within one to two business days. Typically, the time from a verbal agreement to final settlement was 12 to 16 weeks (SA Department of Premier and Cabinet, pers. comm., 16 November 2009).

Outcomes

Results from the SA Water purchases[5] to date include:

- the Securing Government-held Water for Environmental Use project purchased 13 GL at a cost of $1.5 million per GL
- the Purchase from Willing Sellers Stage 1 project purchased 5 GL at a cost of $2.2 million per GL
- the Securing Government-held Water and Purchases from Willing Sellers project purchased 17 GL at a cost of $2.6 million per GL (table B.3) (sub. 52, p. 11).

---

5 All GL amounts are nominal entitlement volumes, not LTCE. LTCE is between 0.9 and 1.0 of the nominal values.

Lessons from the Living Murray Initiative

Identifying targeted environmental assets and ecological objectives at each icon site, and establishing the water recovery targets to meet those objectives, improves the transparency and accountability of water recovery through the Living Murray Initiative.

Development of the Icon Site Management Plans and investment in water delivery infrastructure through the Environmental Works and Measures program, highlights the importance of inputs other than water in achieving the Living Murray environmental objectives.

Assessing all proposed water recovery projects (market based measures, infrastructure investments, and regulatory changes) against a common set of criteria, including least cost per GL LTCE, improves the cost effectiveness and efficiency of water recovery through the Living Murray.

In order to achieve its target of recovering 500 GL LTCE with a budget of $700 million, the Living Murray needs to recover water at an average cost of $1.4 million per GL LTCE. If the largest water recovery measure achieved through a regulatory change is deducted from the 500 GL target — the Goulburn-Murray Water Recovery package sales deal[6] — the Living Murray would need to recover the remaining 380 GL (through market based measures and infrastructure investments) at an average cost of $ 1.73 million per GL LTCE.[7]

Available data for the Living Murray indicate:

- Market-based mechanisms (tenders and on-market purchases) can recover water entitlements:
  - at a lower average cost per GL LTCE ($1.7 million) compared with infrastructure investments ($2.2 million) (table B.3)
  - in greater quantities (185 GL LTCE) compared with infrastructure investments (124 GL LTCE) (table B.2)
  - in a more timely manner compared with infrastructure investments (MDBMC 2006; 2007).

6 The Goulburn-Murray Water Recovery Package recovered 120 GL LTCE at a cost of $43 million through a regulatory change to the administration of sales water in Victoria.

7 The $1.73 million per GL LTCE number is calculated by dividing the remaining Living Murray budget of $657 million by the remaining 380 GL LTCE recovered through other projects.

- On-market purchases can recover significant quantities of water entitlements cost effectively, in a timely manner and with low transaction costs compared with tenders.
- The assessment and notification of bids in a tender can occur relatively quickly compared with seeking approval for an entitlement sale from irrigation companies, water authorities, and mortgagees. These approval processes can significantly delay settlement.
- The New South Wales trade embargo and the Victorian 4 per cent trading cap have restricted entitlement sales.

B.2 Water for Rivers

The Joint Government Enterprise Limited (registered under the business name Water for Rivers) is a public company established in 2003 by the Commonwealth, NSW and Victorian Governments. Water for Rivers aims to recover a portfolio of water entitlements capable of delivering average annual environmental flows[8] of 282 GL by June 2012 — 212 GL to return the Snowy River to 21 per cent of its natural flows and 70 GL for increased flows down the River Murray. To achieve this aim, the three shareholder governments have invested $425 million in the company to fund water recovery (Water for Rivers 2009a). *The Snowy River Inquiry Outcomes Implementation Deed 2002* (the Deed) is a legally binding agreement between the partner governments that sets out funding arrangements (table B.5), river flow targets and ecological objectives for the Snowy and Murray rivers.

Table B.5 **Government funding for Water for Rivers, $m**

	Commonwealth[a]	*NSW*	*Victorian*	***Total***
2003-2012	125	150	150	**425**

[a] Includes a 2003 Commonwealth contribution of $75 million and an additional $50 million allocated in 2008-09 in recognition that the cost of recovering water through infrastructure and market purchases had increased.

Source: Water for Rivers (2009a).

This section gives an overview of water recovery by Water for Rivers as a whole. It then examines two methods used by Water for Rivers to recover water entitlements: on-market purchases; and on-farm reconfiguration projects.

[8] The Water for Rivers unit of ‘average annual flows’ is not directly comparable to the Living Murray Initiative’s Long Term Cap Equivalent (LTCE). However, both terms are used to approximate the expected long term average volume of water available for use.

Governance

The Deed established the corporate governance structure and operational guidelines for the recovery of water entitlements by Water for Rivers. Under the Deed, Water for Rivers is owned by the three partner governments, each with equal shareholdings. A board of three directors — unanimously appointed by the shareholders — develops an annual Business Plan that outlines planned expenditure on water recovery projects during the year. Under direction from the Board, the Water for Rivers Chief Executive Officer and staff implement approved water recovery projects, or may outsource implementation to third parties (Water for Rivers 2002).

Water recovery and delivery

Water for Rivers recovers water entitlements through a range of projects, including:

- investing in on-farm and off-farm water efficiency projects, including the reconfiguration and, in some cases, resale of irrigation properties. Water savings from these investments are converted into legally secure water entitlements. The Deed establishes investment in water efficiency projects as Water for Rivers' primary method of water recovery
- on-market purchases of water entitlements from willing sellers. Tenders have not been used by Water for Rivers. Rather, purchases have been negotiated with individual sellers, or through brokers at prevailing market prices. The Deed allows entitlement purchases as a secondary method of water recovery if deemed necessary to meet water recovery targets (Water for Rivers 2002).

The Board or shareholder governments may propose a water recovery measure. The Board analyses the proposed measure against a common set of criteria set out in the Deed, including:

- that water be recovered from diversions of the River Murray above the Darling River, in the Murrumbidgee River and the Goulburn River systems
- that entitlements must be able to deliver seasonal allocations that contribute to the increased flows in the Snowy and Murray Rivers as set out in the Deed
- that water recovery be through the least cost per unit of water having regard to the level of reliability (Water for Rivers 2002).

In assessing the least cost recovery method, the Board compares the cost of a proposed water recovery project with the prevailing market price for water entitlements in that area. In addition, in 2004, the Board imposed a hurdle price of \$1.25 million per GL based on the requirement to recover average flows of 282 GL per year within the given budget. As the cost of water recovery increased, the hurdle price was increased to $1.5-$1.8 million per GL (Water for Rivers. pers. comm., 5 November 2009).

Under the Deed (p. 20), the Board is also required to assess a proposed water recovery project against third-party impacts, including the extent of any adverse impact on:

- the level of reliability of water entitlements in diversions from the River Murray System, the Murrumbidgee River System and the Goulburn River System …
- water flows currently providing environmental benefits in the River Murray System, the Murrumbidgee River System and the Goulburn River System …
- the seasonal availability of the entitlement to be received by South Australia under the MDB Agreement …
- the quality of the water supplied to South Australia …
- the relevant market for Water Entitlements …
- stakeholders including rural communities.

Ownership of water entitlements recovered by Water for Rivers is transferred to the NSW and Victorian Governments. However, under the Deed, all entitlements are managed by the NSW Government (Water for Rivers 2002). The NSW environmental water holder develops an annual environmental watering plan based on seasonal allocations accruing to Water for Rivers entitlements and the environmental objectives set out in the Deed. The NSW water holder takes advice from an expert scientific committee and shareholder governments in developing the annual watering plan. The Snowy Hydro Corporation releases environmental flows into the Snowy and Murray Rivers under a licence agreement with the NSW Government (Water for Rivers 2002). Allocations accruing to Water for Rivers River Murray entitlements are available for use downstream under the annual Living Murray Environmental Watering Plan (Water for Rivers 2009d).

Progress to date — water recovery

Water for Rivers appears likely to meet its target of 282 GL of average annual flows by 2012. As of November 2009, 197 GL of water entitlements of various security levels had been recovered (table B.5). Water for Rivers estimates a further 110 GL of entitlements of various security will be recovered from water efficiency projects underway or under development (table B.6) (Water for Rivers, pers. comm., 5 November 2009).

Table B.6 **Water for Rivers water recovery as at November 2009**

Source and project type	*Entitlements*	*GL*[a]	*Cost*[b]	*Cost/GL*[c]
Projects already completed			$m	$m
NSW and Vic., On-market purchases	NSW Gen. Sec., Vic. High/Low Reliability	81.5 (39)[d]	(35.3)[d]	(0.9)
NSW and Vic., On-farm reconfigurations	General Security	31.5 (21)[e]	(24.2)[e]	(1.2)
NSW, Forrest Creek 1, Alternate water supply	Murrumbidgee High Sec.	11.3	4.6	0.4
NSW, Forrest Creek 2, Alternate water supply	Murrumbidgee High Sec.	23.4	16.8	0.7
NSW, Coleambally Irrig., Channel automation	Conveyance	3.5	4.9	1.4
NSW, Barren Box Swamp, Storage deepening	Conveyance	20.0	29.2	1.5
Vic., Woorinen, Pipeline	High Reliability	1.5	2.0	1.3
Vic., Normanville, Pipeline	High Reliability	3.9	4.3	1.1
Vic., Goulburn-Murray, Improved measurement	High Reliability	16.4	11.0	0.7
Vic., Goulburn River Irrig., Flow measurement	High Reliability	2.0	6.4	3.2
Lake Mokoan Stage 1	High Reliability	1.0	1.4	1.4
Total recovered[f]		**197.0**		
Projects under way and under development				
NSW and Vic., On-farm reconfiguration	NSW Gen. Sec., Vic. High/Low Reliability	20.0		
NSW, Murrumbidgee River efficiency	Gen. Sec.	30.0		
Old Man Creek	Conveyance	5.0	5.0	1.0
Bundidgerry Creek	Conveyance	2.0	6.0	3.0
NSW, Yanco Creek efficiency	Gen. Sec	10.0		
Vic., Lake Mokoan Stage 2 storage decommissioning	High Reliability	21.0		
Vic., Central Goulburn channel automation	High/Low Reliability	21.0		
Total under recovery and under development[f]		**110.0**		

[a] GL amounts are from projects listed as 'Complete' and 'Current' on the Water for Rivers web site. [b] Cost is calculated as the proportion of the total cost of a project multiplied by the proportion of environmental water entitlements recovered from total water savings. [c] Cost/GL is calculated by dividing the reported cost by the reported quantity of environmental water recovered. [d] Cost data were only available for 39 GL NSW General Security of the total 84 GL recovered. [e] Cost data were only available for 21 GL General Security of the total 30 GL recovered. [f] Projects of less than 1 GL have not been listed.

Sources: Water for Rivers (2009b; 2009c; 2009f; pers. comm., 5 November 2009).

For Water for Rivers, as at November 2009:

- around 40 per cent of entitlements (82 GL of various security) have been recovered through on-market purchases, 15 per cent (32 GL NSW general security) through on-farm reconfigurations, and 45 per cent (84 GL of various security) through other infrastructure investments (table B.6)
- over 80 per cent of the water entitlement portfolio is weighted toward higher security entitlements. Of the 197 GL recovered to date, 34.7 GL were Murrumbidgee high security, 24.8 GL were Victorian high reliability, 23.5 were NSW conveyancing licences and 79 GL were NSW general security (table B.6).

Progress to date — water delivery

No data on water deliveries from the Water for Rivers' water entitlement portfolio were provided to this study.

On-market water entitlement purchases

Water for Rivers ran an ongoing program to purchase water entitlements through existing markets and water brokers at prevailing market prices in the Murrumbidgee, Goulburn and Murray River systems in 2007 and 2008 (table B.4). Regionally-based Water for Rivers project officers publicised the water purchases through visits to target areas, using word of mouth and water brokers. Individual sellers and brokers contacted Water for Rivers and directly negotiated the sale of water entitlements. Offers to sell were assessed against common criteria, including:

- prevailing market prices in the area and the Water for Rivers hurdle price (initially $1.25 million per GL, later increased to $1.5 to $1.8 million per GL)
- the ability of the water entitlement to meet environmental objectives in the Snowy and Murray Rivers as set out in the Deed (Water for Rivers, pers. comm., 5 November 2009).

Water for Rivers ran its own internal assessment and transaction process in parallel with outsourced due diligence checks on water entitlements offered for sale. On average, the time from verbal agreement to final settlement took 10 to 14 weeks (Water for Rivers, pers. comm., 5 November 2009).

Outcomes

Water for Rivers purchased 81.5 GL of NSW general security and Victorian high and low reliability entitlements in the NSW Murray and Murrumbidgee Rivers and

Victorian Goulburn and Murray systems (Water for Rivers 2009b). Available data for on-market purchases show 39 GL of NSW general security entitlements were purchased for $35.3 million at a cost of $0.91 million per GL (table B.6).

Lessons from Water for Rivers

Identifying stream flow rates and ecological objectives in specific rivers, and establishing the water recovery targets to meet those objectives, improves the transparency and accountability of water recovery by Water for Rivers.

Assessing all proposed water recovery projects (on-market recovery, infrastructure investments and farm reconfigurations) against a common set of criteria, including least cost per GL, improves the cost effectiveness and efficiency of Water for Rivers.

Environmental water recovery can be outsourced to an incorporated body with water recovery objectives, powers and resources. This institutional arrangement can improve the independence of water recovery, lower its administrative costs, and allows flexibility and innovation in the approach to the water recovery task.

In order to achieve its target of recovering 282 GL of average annual flows with a budget of $425 million, Water for Rivers needs to recover water at an average cost of $1.5 million per GL of average annual flows. Compared with the estimated average cost of water recovered under the Living Murray of $1.73 million per GL LTCE (section B.1), Water for Rivers appears to be a more a more cost effective water recovery program.[9]

Evidence from Water for Rivers indicates the cost of water recovery through:

- on-market purchases appears to be lower ($0.91 million per GL NSW general security), compared with on-farm reconfigurations ($1.15 million per GL NSW general security)
- infrastructure investments varied between $0.41 million per GL Murrumbidgee high security and $3.2 million per GL Victorian high reliability entitlements (table B.6).

The use of on-market purchases and water brokers can recover significant quantities of water entitlements cost effectively, in a timely manner and with low transaction costs compared with tenders and infrastructure investments.

---

[9] Direct comparisons between the cost per GL of water recovered by different programs is difficult as GL amounts are not directly comparable, prices differ over catchments and time.

B.3 Rivers Environmental Restoration Program (using the RiverBank tender)

The NSW Rivers Environmental Restoration Program (RERP) is a joint NSW and Australian Government program — $173.3 million[10] over 2005-06 to 2010-11 — to improve the condition of specific NSW rivers and wetlands primarily through market-based purchases of water entitlements for environmental use. RERP aims to maximise the benefits from the recovered water by also funding research into environmental water use, investing in infrastructure to better deliver the recovered water, and by developing partnerships with private land owners at target sites (DECCW 2009a). NSW DECCW purchases water for RERP using a tender process that operates under the name RiverBank. The RiverBank Business Plan sets out the ongoing funding arrangements for purchases by RiverBank on behalf of the RERP (table B.7) and target environmental assets and objectives.

Table B.7 **Rivers Environmental Restoration Program expenditure targets 2006-07 to 2010-11[a]**

Financial year	*Investment target* [b]	*Actual investment*
	$ m	$ m
2006-07	15.0	16.6
2007-08 [c]	46.0	44.4
2008-09 [c]	37.0	47.4
2009-10 [c]	23.0	15.4[d]
2010-11	23.0	
Total[e]	**144.0**	**123.8**

[a] Includes $101.5 million from the NSW Government and $45.9 million from the Australian Government. [b] To the nearest million. [c] The Australian Government funding is budgeted over 2007-08 to 2009-10. [d] Committed to date. [e] Total includes program costs but not $3.5 million allocated to the Pipeline NSW Recovery Project.

Source: DECCW (pers. comm., 8 March 2010).

To date, RiverBank has primarily purchased water entitlements for the RERP through an annual expression of interest tender. RiverBank also undertakes on-market purchases as opportunities arise. In establishing RiverBank as a market-based water recovery mechanism, the NSW Government noted that other water recovery programs operating in the state (the Living Murray Initiative and Water for Rivers) were recovering water through infrastructure investments and that

[10] The NSW Government contributed $101.5 million through its RiverBank Fund from 2005-06 to 2010-11. The Australian Government contributed $71.8 million over 2007-08 to 2009-10. Of the total program funding of $173.3 million, $147.3 million is to purchase water licences with the remaining $25.9 million used to conduct research, invest in infrastructure and develop partnerships with private land owners at target sites.

this approach could be costlier, take longer and be riskier in terms of final cost and volume of water recovered compared with market-based recovery (DECCW 2008).

The branch of DECCW that conducts RiverBank purchases also acts as a 'single desk' buyer of water entitlements for the NSW Wetland Recovery Program and the Basin-wide Living Murray Initiative (section B.1) (DECCW 2008).

Governance

The RiverBank Business Plan (the Business Plan) sets out the ongoing governance and operational framework for RiverBank purchases. The NSW Environmental Trust[11] allocates yearly funding and oversees implementation of RiverBank through its approval of the Business Plan. In undertaking this role, the Trust receives advice from a group of experts in river and wetland ecology, environmental water management and water markets. The Water for the Environment Branch of the NSW DECCW conducts the RiverBank purchases in accordance with the Business Plan (DECCW 2008). The annual Business Plan outlines:

- planned water entitlement purchasing and trading targets in each target valley for the year
- water delivery targets for the year
- funding sources and budget allocations
- any coordination with other water recovery programs operating in New South Wales
- strategic partnerships with Catchment Management Authorities, landholders and other bodies to maximise benefits from water delivery
- monitoring and evaluation of trading and environmental outcomes (DECCW 2008).

Water recovery and delivery

The Business Plan requires that RiverBank purchases acquire a portfolio of water access licences in each target valley. Currently, RiverBank is purchasing high security, general security and supplementary water entitlements. RiverBank is investigating the potential for investing in new water products such as leases,

[11] The NSW Environment Trust consists of five representatives; the Minister for Climate Change and the Environment (Chair); the Secretary of the Treasury; the Director General of DECCW; a nominee of the NSW Nature Conservation Council; and a nominee of the Local Government and Shires Association (DECCW 2008).

options and forward contracts. However, none has been used to date. Seasonal allocations can not be purchased with government funding but may be bought using profits from water trading (DECCW 2008).

The 2008-09 Business Plan prioritised the purchase of general security water entitlements in each valley, arguing that:

> General security is the most commonly available product and strikes an appropriate balance between water availability and management flexibility to form the base of a portfolio for each valley/asset. (DECCW 2009c, p. 30)

RiverBank purchases water entitlements in river valleys that are connected to targeted environmental assets listed in the Business Plan. These include the Narran Lakes, the Gwydir wetlands, the Macquarie Marshes, wetlands along the Lachlan River, and areas on the lower Murrumbidgee River floodplain[12]. RiverBank does not have a set volumetric target for water recovery. The Business Plan allocates funding over the five years of the program and between target river valleys. The quantity of water entitlements recovered depends on the availability of entitlements and the prices paid. The water entitlements acquired by RiverBank for the RERP are held by the NSW Minister for Climate Change and the Environment (DECCW 2008).

NSW DECCW decides how to use seasonal allocations accruing to RiverBank entitlements through Annual Watering Plans in each catchment. In New South Wales, Water Sharing Plans (WSP) legally set aside a proportion of water in a catchment for environmental needs. RiverBank purchases of water entitlements provide additional environmental flows. DECCW develops an Annual Watering Plan that sets out how environmental flows from the WSP can be combined with these additional flows best to meet environmental needs in a given catchment. A regional DECCW Wetlands and Rivers Conservation Officer develops the Annual Watering Plan, guided by Water Sharing Plan rules, a catchment level Adaptive Environmental Water Use Plan[13], data on local conditions and advice from stakeholders[14] (DECCW 2009f).

---

[12] The RiverBank tender is also used to purchase water entitlements for the Wetland Recovery Project for the Gwydir wetlands and the Macquarie Marshes, and for the Living Murray Initiative in the NSW Murray, Lower Darling and Murrumbidgee regulated river systems to deliver water to downstream icon sites along the Murray River (DECCW 2009a).

[13] A RiverBank Adaptive Environmental Water Use Plan provides statutory authority for the use of water licence account water for the environment, and lists the environmental assets in a catchment to be watered and broad ecological objectives to be achieved with RiverBank water.

[14] Stakeholders include CMAs, environmental advisory groups established under water sharing plans, the State Water Corporation and community groups (DECCW 2009f).

Seasonal allocations accruing to recovered entitlements can be traded where the water is unlikely to achieve more than marginal environmental improvements at targeted assets, can not be carried forward, or where current prices represent a market opportunity and there is a net environmental benefit from the trade. Revenue generated from the sale of allocations may be used to meet the costs of holding water licences, purchase additional water entitlements, allocations or other water products, and to fund capital works (DECCW 2008).

Design of the RiverBank tender

The RiverBank tender has run yearly tender rounds since 2005-06 to purchase water entitlements for the RERP (table B.4). RiverBank advertises the opening date for a round through rural media and contacts in the target river valleys. Individual sellers and water brokers must lodge a written expression of interest specifying the type and volume of water entitlements they are willing to sell and the price per ML they would accept. All bids are confidential (DECCW 2008).

RiverBank regularly assesses these expressions of interest on a 'first-come, first-served' basis against a common set of assessment criteria including:

- the ability to deliver water to targeted environmental assets in the Business Plan
- the price per ML — RiverBank compares the bid price with recent market activity and internal price benchmarks derived from an independent assessment of water markets. DECCW may contact sellers if a bid is slightly above the benchmark price to renegotiate the sale price. Where an acquisition is proposed at a price more than 15 per cent above the price benchmark, RiverBank must seek the approval of the Chair of the Environmental Trust and justify why the entitlement is valuable in meeting RiverBank's ecological objectives (DECCW 2009c)
- the security type of entitlement — the Business Plan currently prioritises general security entitlements in its target water sources, although high security and supplementary water access entitlements may be considered
- the size of entitlement offered — RiverBank will seek to minimise the number of individual transactions it undertakes for each water source
- any restrictions on the entitlement — these may be on the entitlement itself (for example, a high-flow condition on a supplementary entitlement), or may arise out of the water sharing plan that applies to an entitlement (for example restrictions on the transfer of entitlements downstream of certain points) (DECCW 2008).

RiverBank usually contacts successful bidders within a month of the bid being received. Purchases continue until RiverBank spends the allocated budget for the financial year. Contracting and conveyancing are undertaken by external providers in accordance with the *Water Management Act 2000* (NSW) (DECCW 2008), and this may typically occur over a two to three month time-frame, depending on the clarity of title, removal of encumbrances and any factors affecting registration of the transfer (DECCW, pers. comm., 23 November 2009).

RiverBank has also been purchasing water entitlements outside of tender rounds from willing sellers through direct negotiations (table B.4). Individual sellers or brokers can contact RiverBank and offer to sell entitlements using an expression of interest. RiverBank uses the tender assessment criteria in assessing out of tender bids. RiverBank may also contract with water agents or brokers to facilitate the purchase of water entitlements and allocations on their behalf, and is considering the use of online water trading platforms to purchase licences (DECCW 2008). To date, RiverBank has not purchased seasonal allocations and has not entered into leases over entitlements. The development of derivative water products has been curtailed by continuing drought in most parts of the NSW Murray-Darling Basin (DECCW, pers. comm., 23 November 2009).

Progress to date — water recovery

As of 28 February 2010, RiverBank had recovered around 92.3 GL of NSW general security entitlements and 6.3 GL of supplementary entitlements for the RERP (table B.8) in the four catchments targeted by the Business Plan (DECCW, pers. comm., March 2010).

Table B.8 **RiverBank entitlement purchases for Rivers Environment Restoration Program, as at 28 February 2010**

Regulated water source	*Water entitlements*	
	General security	*Supplementary access*
	GL[a]	GL[a]
Gwydir	14.9	0.44
Macquarie and Cudgegong	39.2	0.14
Lachlan	24.6	–
Murrumbidgee	13.5	5.70
Total	**92.3**	**6.28**

[a] These quantities have been estimated from unit share data provided by NSW DECCW. Units of measure for entitlements purchased under RiverBank for the Rivers Environmental Restoration Program are in unit shares. Currently one unit share at full allocation is equivalent to one ML in all valleys except the Lachlan, which has a maximum 0.7ML/ unit share at full allocation. – Nil or rounded to zero.

Source: DECCW (2009d; pers. comm. 8 March 2010).

The RiverBank section of DECCW, acting as a 'single desk' buyer, has also recovered water entitlements for:

- the NSW Wetland Recovery Program — 6.1 GL of NSW general security entitlements and 1.3 GL of supplementary entitlements (DECCW 2009d)
- the Living Murray NSW Water Purchase — 112.7 GL LTCE of water entitlements of various security (section 9.1).

Progress to date — water delivery

Allocations accruing to RERP water entitlements have been very low in recent years due to the on-going dry period. DECCW has used the available water to target specific environmental assets or in coordination with releases of planned environmental water delivered under Water Sharing Plan rules (table B.9) (DECCW, pers. comm., 8 March 2010).

Table B.9 **Water deliveries from RiverBank entitlements**[a]

	2007-08	*2008-09*	*2009-10*[b]
Water source	GL	GL	GL
Gwydir	0	0.1	0.1
Macquarie	0.7	0	2.7
Lachlan	0	0	0
Murrumbidgee	0	0.8	2.0

[a] All quantities are rounded to 1 decimal place. [b] As at 30 January 2010.

Source: DECCW (pers. comm., 23 November 2009).

Lessons from RiverBank purchases

While the RERP does not have volumetric targets for its water recovery, purchases in a catchment are guided by Water Use Plans that list targeted environmental assets and environmental outcomes in each catchment. This improves the transparency and accountability of water recovery under RERP.

In addition to recovering water for the environmental, the RERP funds research into environmental water use, investments in water infrastructure at targeted sites, and enters into agreements with CMAs and private land owners to better coordinate water use with other inputs. Using environmental flows with a mix of other inputs improves the productivity of available environmental water and should better achieve the environmental objectives under the RERP.

While the RERP has only purchased water entitlements to date, it explicitly recognises that a diverse portfolio of products can better meet environmental watering needs, and it has the power to purchase these products.

The RERP has used a combination of tenders and on-market purchases to recover large volumes of water entitlements in a timely and cost-effective manner compared with other tenders and infrastructure investments. RiverBank has recovered:

- 90 GL of general security entitlements and 6.1 GL of supplementary licences for the RERP at an average cost of $1.25 million per GL (DECCW, pers. comm., 23 November 2009).
- 112.7 GL LTCE of water entitlements on behalf of the Living Murray Initiative at an average cost of $1.7 million per GL LTCE (table B.3).

B.4 Use of water products other than water entitlements

SA Water on-market purchases of seasonal allocations

During 2008-09 the SA Government acquired 50 GL of seasonal allocations on-market as a contingency measure to ensure the government could meet future environmental needs. A significant portion of the water will be used in conjunction with the Clayton regulator. The water has been be carried over into 2009-10. (SA Department of Premier and Cabinet, pers. comm., 16 November 2009).

SA Water purchased the seasonal allocations, acting as an agent for the SA Government (table B.4). SA Water used its network of contacts with individuals, brokers and corporate entities and irrigation bodies in the water market to make it known that they were purchasing allocations. Purchases were negotiated through direct contact with a range of vendors and their brokers throughout the Southern Connected Murray Darling Basin.

The price paid was negotiated for each transaction, and was based on various sources of information, including contact with market participants and sellers, on-line sources of price and offer information, and by testing the market with prices. SA Water's standard terms of contract require that full payment is made within 14 days of receiving notification of a trade approval. In most cases, payment was made within 5 to 7 days of approval (SA Water, pers. comm., 10 March 2010).

Murrumbidgee River Reach Project for options contracts

The aim of the Murrumbidgee River Reach Project (River Reach) is developing and trialing a water options exchange for the Murrumbidgee Valley to trade new water products (such as options contracts). Through the River Reach exchange, an environmental water manager would be able to purchase options contracts on water entitlements made available by entitlement holders. Murrumbidgee Irrigation Limited (MIL), as an entitlement holder, is able to directly supply River Reach products and has indicated that it can make up to 40 GL available per annum. In addition, there is expected to be opportunities to broker exchanges through packaging River Reach products (with specific triggers) from various entitlements (MIL, pers. comm., 10 March 2010).

The contracts would be triggered in wetter years allowing water to be diverted to supplement environmental flows and induce flooding of targeted environmental assets in the Murrumbidgee Valley. In drier years, when the options contract is not triggered, any seasonal allocations accruing to the water entitlements would be retained by the entitlement owner for consumptive use. The outcome of the trial will inform the possible establishment of similar markets in other parts of the Basin (DEWHA 2009h).

How would River Reach work?

Environmental demands for water are, in part, counter-cyclical to irrigation demands. Permanent plantings demand regular and reliable water to maintain agricultural output. To meet this demand, irrigators tend to hold high security and general security water entitlements that, on average, supply more secure and reliable water flows in drier years than low security or supplementary licences. In wetter years, seasonal allocations surplus to irrigators' needs can be sold on allocations markets. Many environmental assets tend to require intermittent, high-volume flow events followed by a number of years of less water. To provide for environmental flows in wetter years under the current system of water licences, an environmental manager may hold supplementary licences and purchase seasonal allocations.

Using River Reach options contracts, water entitlement holders, with higher security than supplementary entitlement, will be able to sell a given volume of the water allocated to their entitlement under agreed terms and conditions, such as when allocations exceed a trigger level. The options contract enables the buyer to purchase an option over the water, at agreed terms and conditions, that can be exercised at the discretion of the buyer. The buyer would only pay for the option, and payment for the water would only occur if the buyer chose to exercise the option.

The entitlement would remain the property of the irrigator, and in drier years all allocations up to the trigger level would be retained by the irrigator. In wetter years, once the irrigator has received the specified level of allocations and the trigger has been reached, the environmental water manager would have the right to further allocations. For a given high security or general security entitlement, this type of options contract gives individual irrigators the ability to identify water of least value to them in terms of their production, and sell it, while maintaining a secure supply below the trigger (sub. 39, p. 15).

Murrumbidgee Irrigation Limited argues that the primary benefits of River Reach are that options contracts allow the permanent acquisition of more supplementary-type water that best matches environmental demands, and that this water can be acquired at a lower cost per ML (compared with acquiring water for the environment through purchasing permanent high, medium and low security entitlements). MIL argues that options contracts could:

- make additional supplementary water (of around 250 GL) available by enabling environmental water managers to access to allocations accruing to high and general security entitlements without having to buy those entitlements
- deliver environmental water at a lower cost per ML compared to water entitlements in two ways. First, River Reach would enable environmental buyers to avoid the cost of buying unneeded security when purchasing existing high and general security entitlements. Second, risk-averse irrigators may prefer to hold their entitlements and sell unwanted allocations to an environmental water holder through an options contract, rather than sell their entitlement and buy seasonal allocations as needed. River Reach buyers may be able to acquire a given quantity of environmental water at a lower cost by entering into an options contract with an entitlement holder, rather than by acquiring the whole entitlement (MIL, sub. 39, p. 23).

Outcomes

To date, there has not been an exchange of a River Reach options contract with an environmental buyer, although River Reach has received in-principle support from potential sellers and buyers. A trial with commercial buyers did occur during the 2009-10 water season.

MIL has identified a number of impediments for environmental buyers of options contracts, including:

- a lack of legislative and regulatory backing to support the rights of buyers and sellers under a River Reach contract

- the modelling of environmental demands in a form that enables a match with River Reach products has yet to be completed to the satisfaction of some potential buyers
- the pricing of potential River Reach products is untested. The risks of being 'first in' may be quite large, especially for environmental buyers (MIL, pers. comm., 10 March 2010).

Lessons from River Reach

Options contracts may allow:

- an increase in the supply of supplementary-type water by accessing lower valued allocations accruing to high and general security entitlements held by irrigators
- acquisition of environmental water at a lower cost per ML by allowing an environmental water holder to purchase an option on an entitlement instead of purchasing the entitlement.

B.5 Water recovery in flow-based river systems

This section summarizes two programs used to purchase water for the environment in flow-based river systems — the Narran Lakes Environmental Water Purchase and the Victorian Stream Flow Tender.

The Narran Lakes environmental water purchase

In April 2008, the MDBC paid $2 million for 10.4 GL of water from a private on-farm storage in Queensland. The water was released in accordance with an agreed program and shepherded downstream to the Narran Lakes in northern NSW to maintain water levels to extend and enhance a waterbird breeding event. The Narran River is one of a network of river channels in the Lower Balonne system. Unlike the other major streams in this network which flow through to the Barwon River, it feeds into a terminal wetland system. The extent of wetland flooding has decreased in recent years due to lower annual rainfalls, reductions in stream flow and flooding events, and increased upstream extraction for irrigation. The Narran Lakes Nature Reserve is a Ramsar Wetland in recognition of its significance for waterbirds (MDBA 2009h).

As a result of the good summer rainfall in early 2008 and extended flow in the Narran River, large bird colonies — predominantly ibis — established breeding sites at the Narran Lakes. In early March 2008, monitoring by officers from the

NSW DECCW showed that falling water levels in the lake were putting the breeding event at risk. DECCW decided to give the breeding event a high priority as it was one of the largest waterbird breeding events recorded in the Narran Lakes and the most significant in the Murray-Darling Basin since 1998. In addition, there was a high risk the ibis population would collapse if the breeding event failed as the birds had not bred for the last nine years of their ten-year breeding life (MDBA 2009h).

Officers from NSW DECCW, working with officers from the Queensland Department of Environment and Resource Management (DERM), purchased water from a Queensland water entitlement holders' storage to maintain lake levels at a sufficient depth and for sufficient time to allow the ibis chicks to fledge. The steps undertaken were as follows:

- Determining how much water was needed in the Narran Lakes and for what length of time to allow a successful breeding event. DECCW officials used available data and hydrological modelling to set a goal of delivering enough water to maintain the water level at the Back Lake (where the breeding colony was concentrated) at 300 mm for 30 days.
- Determining how much, and at what rate, water needed to be released from the contracted Queensland storage to achieve the watering goal in the Narran Lakes, 140 kilometres downstream. DECCW used available data and hydrological modelling to establish a release schedule for a total of 11 GL.
- Establishing a price for the water in the absence of a market. Under flow-based regimes in Queensland and northern NSW river systems, water is primarily stored in private on-farm storages with little market trade. NSW and Queensland officers estimated a market value for physical water of around $180 per ML by using the marginal returns to water from irrigating a hectare of wheat (assuming a wheat price of $350 per tonne, a yield in tonnes per hectare and a water application rate).
- Locating and buying the water. It was determined that seasonally assigning water from water allocation holders out of Beardmore Dam to enhance minor releases downstream to the Narran would not provide the size of inflows within the timeframe required. DECCW officers then approached the MDBC to secure funding for a water purchase from on-farm storages in Queensland. The MDBC's Natural Resource Management Committee authorised $2.5 million for the purchase. DECCW officers telephoned irrigators in Queensland looking for willing sellers from private on-farm storages. An irrigator with 30 GL of stored water agreed to sell 11 GL earmarked for wheat production for the $180 per ML price. Importantly, the irrigator was able to start releasing the water the next day in good faith while purchase contracts were drawn up.

- Shepherding the water down river and across the state border. The Queensland water entitlement holders along the intervening section of the Narran River are metered and can only pump from flow events under announcement by DERM. At the time of the Narran Lakes purchase, river flow had diminished to below access trigger levels thereby providing clear passage for any released water. In addition, the NSW Department of Energy and Water (DEW) contacted the NSW down-river licence holders to notify them that an environmental flow was passing. Gauging stations on the Queensland side of the border and in New South Wales enabled DECCW to accurately monitor flows and account for losses on route. To ensure the correct amount of water passed through each weir, Queensland officers marked the river level at the weirs before the environmental water arrived and ensured the water was drawn down to that level as the water passed through (MDBA 2009h).

Outcomes

A total of 10.4 GL of water was purchased in Queensland and shepherded to the Narran Lakes at an approximate cost of $1.88 million dollars. The price of $180 per ML is difficult to compare with any established market price at the time as no trade of this type of water occurs in the area. Upstream at St George, where a government-owned and run irrigation scheme exists, it has been known for supplemented water to trade in the range of $100 to $250 per ML on a seasonal basis.

The primary outcomes observed during and after the water delivery were:

- Water levels at the Back Lake were maintained at (a minimum of) 300 mm for 30 days thereby achieving the water delivery goal.
- Close to 50 000 ibis chicks fledged from two colonies. However, mortality in the second colony appears to have been very high – of 120 000 eggs, 24 600 chicks fledged with losses likely due to nest abandonment (due to falling water levels).
- Other bird species, vegetation, fish and other biota, and the ecosystem generally would also have benefited (MDBA 2009h).

A Murray-Darling Basin Authority (MDBA) evaluation of the Narran Lakes purchase found that it was reasonable to assume that the water purchase had extended the breeding event and allowed more chicks successfully to hatch (MDBA 2009h).

Lessons from the Narran Lakes purchase

Physical water can be purchased and shepherded downstream in flow-based river systems to meet urgent environmental needs. However, this requires:

- monitoring of environmental assets and hydrological modelling
- willing sellers with on-farm storage
- fast and effective coordination between relevant parties
- available funding
- appropriate regulation and metering of licence holders
- gauges to measure river flows and calculate losses.

The MDBA evaluation argues that temporary purchases of physical water could form part of a portfolio of measures to provide water for the environment in unregulated river systems. The evaluation suggests that the portfolio could also include:

- the purchase or lease of strategically located on-farm storages
- the contracting of put-options and sell-options on on-farm water
- purchasing changes to water licence conditions (MDBA 2009h).

Victorian stream flow tender

In 2007, the Victorian Government held a tender, asking water licence holders in three Yarra Basin catchments to offer to vary permanently their licence conditions in ways that would contribute to increased environmental stream flows in exchange for a one-off payment (table B.4). Under section 51 of the *Water Act 1989* (Vic), the take and use of surface water in unregulated catchments is governed by water licences issued by the relevant water corporation. In the Yarra Basin, this is Melbourne Water. Stream Flow Management Plans (SFMPs) may be developed to place conditions on these licences. SFMPs are approved by the Victorian Minister for Water, specify the total amount of water available in a catchment for extraction, and describe how the water will be shared between the environment and consumptive users. For a given catchment, a SFMP may establish:

- an environmental flow regime, including minimum stream flow rates in ML per day. The stream flow rate must be exceeded at gauging stations/compliance points along the river to allow pumping to occur
- a cap on the total volume of water that can be taken from a catchment in a year

- trading rules that apply to transfers of water entitlements into, out of, and within, the catchment
- conditions on take and use licences. These conditions may include variations in the minimum stream flow rate or bans and restrictions on pumping (Melbourne Water 2009).

Stream Flow Management Plans are developed by a community-based consultative committee[15] and are reviewed every five years. The stream flow regimes recommended by the consultative committee are based on scientific studies that determine minimum flows required to achieve the ecological objectives of the rivers (DSE 2007).

Under the *Water Act 1989* (Vic), the water corporation (Melbourne Water in the Yarra Basin), must ensure water licences issued in a catchment comply with the minimum flow rules, the diversion cap and other requirements as set out in the SFMP. Melbourne Water issues various types of water licences to regulate water use in a catchment, including licences for:

- pumping water for irrigation, domestic and stock use, or commercial irrigation. When the minimum stream flow rate is exceeded and extraction permitted, a licence sets a maximum daily extraction rate and a cap on the annual volume of water extracted
- off-stream dam filling and on-stream dam harvesting. These licences specify limits on how much water can be taken and used
- use of irrigation or commercial dams
- water trading into or within a catchment (Melbourne Water 2009).

The stream flow tender process

In 2006, draft SFMPs prepared for the three catchments of Olinda Creek, Stringybark Creek, and Pauls, Steels and Dixons Creeks recommended increased minimum environmental stream flow rates. Under the *Water Act 1989*, all water licences needed to be amended to reflect the higher minimum flow rates within five years (by 1 July 2012). The Victorian Government held the pilot stream flow tender in 2007 to:

- help increase environmental flows before the July 2012 change

[15] Membership includes licence holders, representatives from local and state governments, Environment Victoria and the relevant water corporation.

- allow licence holders to assist in achieving the higher stream flow rates through voluntary changes to their licence conditions (DSE 2007).

Through the tender, all licence holders in the three catchments were invited to submit a bid to make voluntary and permanent changes to their licence conditions that would contribute toward achieving the stream flow rates in the draft SFMP in exchange for a one-off payment. A bid had to specify the proposed change to licence conditions, the price of making the change and when the change would happen. The tender permitted three methods for changing licence conditions, including:

- changing the timing of access to water. For example, for a licence permitting pumping all year round the holder could offer to restrict pumping to winter only, thereby increasing summer flows
- reducing the annual licence volume by a specified amount. The minimum stream flow rate and daily extraction rate would remain unchanged but the total volume of water pumped would be lower, thereby increasing stream flows overall
- surrendering their entire licence (Melbourne Water 2007).

The tender was conducted in a single round over two months from May to July 2007. The total budget of the tender was not disclosed to bidders and bid details were treated in confidence. Licence holders were allowed one bid per licence. All bids were assessed against standard criteria after the close of the round. The overarching criterion for assessing bids was 'value for money' determined by sub-criterion, including:

- how the proposed licence change or surrender would contribute toward meeting the new environmental stream flow rates. Bids to change the timing of access to water and bids to reduce licence volume competed directly in the tender although they were assessed separately
- timing of licence condition change. Bids to change licence conditions sooner were preferred over bids to change later
- least cost
- length of river receiving the benefit. Bids from licence holders in the upper catchment were preferred over bids from the lower catchment (Melbourne Water 2007).

Bids were rejected or accepted without negotiation and no rebidding was allowed. The tender used discriminatory pricing where sellers received the price they bid. All bidders were notified of the outcome on 3 August 2007 (Melbourne Water 2007).

Outcomes

The water recovered through the changes to licence conditions in the Olinda Creek and Stringybark Creek catchments will achieve 56 per cent and 65 per cent of the required increase in stream flow rates, respectively, once the draft SFMPs are adopted (table B.10). Changes to licence conditions in Steel Creek and Dixon Creek will achieve only limited progress toward the new stream flow rate, 2 per cent and 5 per cent respectively (table B.10).

Table B.10 **Stream flow tender outcomes, 2007[a]**

Catchment	*Bids*	*Outcomes*
Olinda Creek	21 received 9 accepted	43 ML of licence volume surrendered 48 ML of licence volume managed in line with draft stream flow management plans (SFMP) flow rates Annual cap reduced from 728.7 ML to 685.7 ML Changes (would) achieve 56 per cent of increased stream flow required under the draft SFMP Licence conditions altered 1 July 2008
Stringybark Creek	19 received 15 accepted	12 ML of licence volume surrendered (2 ML all-year licence and 10 ML on-stream dam-filling licence) 566 ML of licence volume managed in line with draft SFMP rates Annual cap reduced from 2676 ML to 2664 ML Changes (would) achieve 65 per cent of increased stream flow required under the draft SFMP Licence conditions altered 1 July 2008
Steels, Pauls and Dixon Creeks	2 received 2 accepted	50 ML of licence volume managed in line with draft SFMP rate Annual cap remains 1884 ML Changes (would) achieve 2 per cent (Steels Creek) and 5 per cent (Dixons Creek) of increased flows required under the draft SFMP Licence conditions altered 1 July 2008

[a] Estimated percentage increases in stream flow resulting from changes to licence conditions are dependent on the adoption in 2012 of the higher minimum stream flow rates proposed in the draft SFMPs.

Source: Melbourne Water (2007).

In an unregulated river, the water recovered through changes to licence conditions can often increase the reliability of supply for users downstream. However, the recovered water can be protected by raising minimum stream flow rates to maintain reliability of supply at the pre-tender level.

Under the Victorian tender, increased stream flow from changes to water licences purchased upstream will be protected by an increase in the stream flow rate for all licence holders when the SFMPs are adopted in 2012. In the interim, the changes to licence conditions may increase the reliability of downstream licences in the catchment.

In future tenders, DSE proposes to model the increase in reliability of downstream licences as a result of changes to upstream licences, and increase the minimum stream flow rates on all licence holders to ensure recovered water remains in the river (Department of Sustainability and Environment, pers. comm., 16 November 2009).

Lessons from the stream flow tender

Tenders can be used to purchase changes to licence conditions in flow-based river systems to increase stream flows. However, this requires shepherding arrangements to ensure water recovered through variations to licences is retained in the river system.

C Overseas buybacks

Key points

- Water rights and institutions in the western United States are substantially different from Australia. Most users have 'appropriative' rights to source water, and strong protection of third party interests makes trading water difficult and expensive.
- In many states, the development of irrigation has reduced the amount of water in rivers and lakes, which has damaged fish populations.
- In response, water has been administratively reallocated to the environment through legislation and voluntarily reallocated through numerous water buybacks.
- Some water buybacks are run by government agencies, while others are run by non-government organisations, like conservation trusts.
- Purchase mechanisms vary, with negotiation being commonly used. Temporary trades (leases) are more common than permanent trades (transfers).

The terms of reference ask the Commission to review mechanisms used internationally to purchase water entitlements. While there are many examples of water buybacks in the western United States, there do not appear to have been major water buybacks in other countries (except Australia). This is not surprising as there are only a small number of countries with developed water property rights and a high level of environmental concern (PC 2003).

This appendix covers buybacks from California, Oregon and Colorado (table C.1). These states were selected because their water institutions are relatively advanced, making the lessons from environmental water buybacks in these states broadly applicable to the Murray-Darling Basin. The case studies also highlight a range of approaches to buying environmental water.

Table C.1 **Summary of water buyback organisations and programs covered in this appendix**

Organisation/Buyback	*Water acquired (total holding)*	*Purchase mechanism*	*Organisation type*
Deschutes River Conservancy (Oregon)	360 ML per day	Mainly fixed rate payments, has experimented with tenders	Private
Freshwater Trust (Oregon)	390 ML per day	Mainly negotiation, including with individuals and groups	Private
Water Acquisition Program (California)	300 GL	Mainly negotiation	Public
Environmental Water Account (California)	340 GL	Mainly negotiation	Public
Instream Flow Program (Colorado)	970 ML per day	Most water acquired through donations (tax breaks)	Public
Colorado Water Trust (Colorado)	1 GL and 20 ML per day	Negotiation	Private

C.1 Water rights and institutions

The water buyback programs discussed in this appendix were designed with specific water rights and institutions in mind. In many cases, differences in the design and implementation of water buyback programs can be explained by differences in state water law, or other institutional characteristics. These institutional characteristics are also relevant in assessing whether some of the buyback mechanisms used in the western United States could be used in Australia.

Appropriative rights (defined below) are the most common type of water right in the western United States. Colorado and Oregon use appropriative rights almost exclusively, while California uses a mix of appropriative and riparian rights (PC 2003). Riparian rights in the western United States permit the owners of land adjacent to natural watercourses to divert water for 'reasonable and beneficial' use. Riparian users share water equally according to the area of land irrigated. Riparian rights are generally 'senior to' appropriative rights, meaning that riparian claims must be satisfied before other users are assigned water (DWR 2005). Water buybacks usually focus on appropriative rights since riparian rights cannot be traded separately to land. Hence, the institutions discussed subsequently in this section relate only to appropriative rights.

Appropriative rights allow water right holders to divert a specified flow or volume of water, subject to conditions. For example, appropriative rights must be used 'reasonably and beneficially' (that is, not wasted) (PC 2003). Moreover, the diversion and use of water must not cause unlawful injury to other water right holders (Rice and MacDonnell 1993). The 'no injury' rule is used by state agencies and water courts to assess water transfers and leases, and to ration available water among competing right holders (box C.1).

While the owners of appropriative rights have a perpetual right to use water, the water resource remains in the public domain (Water Colorado 2009). Individual irrigators sometimes own appropriative rights, but these rights are more commonly owned by water wholesalers and retailers, with irrigators sourcing water through shares or other contractual rights (box C.2) (PC 2003).

Box C.1 **Rationing water with appropriative rights**

Suppose there are two appropriative rights over a river. Person S (senior) has a right that was established in 1880, with a nominal entitlement of 10 ML per day. Person J (junior) has a right that was established after 1880, with a nominal entitlement of five ML per day. To keep the example simple, irrigators are assumed to use all of the water they are entitled to. The complication of return flow is also ignored.

If streamflow exceeds 15 ML per day, both appropriative rights can be satisfied. If streamflow is between 10 and 15 ML per day, and person J was to continue to extract five ML per day, their behaviour would injure person S (who, having the older water right, would have first claim to any available water). Under these circumstances, person S would be entitled to initiate a 'river call', and the relevant state agency would order person J to reduce irrigation until sufficient water was available for person S (DWR 2009). Over this range, rationing would be borne entirely by person J. If streamflow is less than 10 ML per day, person J would cease diversions, and person S would have to reduce water use (being limited by streamflow).

This example can be generalised to the case of many appropriative rights, with people holding 1880 rights being allocated their full entitlement before people holding 1881 rights receive any water, and people holding 1881 rights being allocated their full entitlement before people holding 1882 rights receive any water, and so on.

In some states rationing is even more complex. In Colorado, for example, 'priority' is jointly determined by the date of appropriation and water use. Under this system, water for human consumption is given highest priority, followed by agricultural water, and then water for other uses (PC 2003).

Box C.2 Irrigation water supply chain

In Colorado, there are approximately 50 water wholesalers. Water wholesalers are responsible for operating water infrastructure, and source water through appropriations or leasing arrangements with government infrastructure agencies.

Water retailers are responsible for distributing water to end users, and are usually structured as public water districts (also known as irrigation districts) and mutual companies (also known as ditch companies). Unlike mutual companies, public water districts can raise taxes on property (Anderson and Snyder 1997). Water retailers sometimes own water rights, or alternatively, contract with wholesalers to access water.

Water users supplied by water retailers generally have rights to a share of (district or company) water by virtue of land ownership, contractual arrangement, or stock ownership (PC 2003).

What are the barriers to trade in appropriative rights?

In principle, appropriative rights can be transferred among users within connected river systems. However, in most states there are numerous institutional barriers that substantially limit the extent of permanent trade. These barriers also constrain environmental water buybacks, which are generally subject to similar institutional barriers as transfers among consumptive users.

As discussed in box C.2, irrigators may own water shares rather than appropriative rights. Since transfers of water shares within an irrigation district do not require appropriative rights (underlying the water shares) to be transferred, trade in water shares is a matter for irrigation districts and is not subject to state water law. While irrigators may require permission from their irrigation districts (or mutual companies), irrigators are generally able to trade water shares within their district relatively freely.

The transfer of appropriative rights, on the other hand, is subject to numerous (and sometimes prohibitive) rules. Proposed transfers are usually assessed on the basis of injury to third parties. Oregon and Colorado only consider 'unlawful injury to water rights' (box C.3), while California also considers injury to wildlife and rural communities.

Transfers may also need to be approved by government infrastructure operators. In California, the majority of water infrastructure is managed by the United States Bureau of Reclamation and the Californian Department of Water Resources.

Transfers that require the use of government infrastructure must be approved by the relevant operator, in addition to the standard assessment process outlined above.

Box C.3 **The approval process for transfers of appropriative rights in Colorado**

The transfer approval process in Colorado is long and complex. Buyers must first demonstrate their intention to divert water for beneficial use. A water right application is then submitted to the water courts. At the same time, buyers must publish a legal notice to announce their intention to buy appropriative rights. Interested parties then have two months to file a 'statement of opposition' on the grounds of injury.

The case is reviewed by the diversion engineer, who makes a recommendation to the water court. If there are no statements of opposition, the water referee will review the division engineers' recommendations and ask for clarifying information before making a ruling. In the absence of protests, the judge will sign the ruling. If there is opposition to the proposed transfer at any stage, and the parties cannot settle their differences privately, the case will be presented to the water judge at trial. The parties can appeal to the Colorado Supreme Court if necessary.

Sources: PC (2003); Water Colorado (2009).

In response to these legal impediments, water users have developed alternatives to the transfer of appropriative rights, such as leases. In Colorado, leasing water is relatively straightforward. Approval from the water court is usually not required, although written notice is needed and transfers may be challenged by other water users (PC 2003; Rice and MacDonnell 1993).

How common is water trade?

The limited extent of water trade in the western United States shows that there may be substantial transaction costs (and administrative barriers) associated with many leases and transfers of appropriative rights. Transaction costs can have a large influence on the net benefits of environmental water buybacks, and are a major consideration in their design and implementation.

There were around 2165 appropriative right transfers in the western United States between 1987 and 2005, with Colorado accounting for around three quarters of these transfers. By contrast, California had around 71 transfers over that period, while Oregon had around 12. California had around 365 leases, the largest number of any state. Colorado and Oregon had around 90 and 60 leases, respectively (Brewer et al. 2007)[1].

The large number of transfers in Colorado relative to other states is mainly due to rules that partially exclude water users in the Northern Colorado Water Conservancy District (NCWCD) from some of the water transfer rules discussed above. The exemption is because the NCWCD sources water from another river basin (Rice and MacDonnell 1993). Moreover, appropriative rights in the NCWCD have equal priority — unlike in most other regions, where every right has a different (and sometimes uncertain) priority. In the NCWCD, the volume of water allocated to the consumptive pool is administratively determined, and then assigned to individual users based on the number of rights held. These features are similar to Australian water rights and tend to reduce the costs of trading appropriative rights, leading to substantial trading activity (Howe and Goemans 2003, p. 1056).

The institutional barriers to trade can be substantial outside the NCWCD. Some potential transfers do not satisfy legal requirements and are rejected or never attempted. The legal requirements also increase transaction costs and may cause long delays. In California, the broad interpretation of the 'no injury' rule can introduce substantial uncertainty over 'who has standing to [contest a water transfer] and uncertainty over when interveners are entitled to block a transfer and when compensation should be paid' (CWWM 1992, p. 223). In Colorado, the use of water courts means that water transfers generally require a water attorney and a water resource engineer (DWR 2009). Transfers usually take between four and 24 months. However, these delays compare favourably with Oregon, where it can take up to three years (Water Colorado 2009; WRD 2009a).

What are instream rights?

Most appropriative rights have diversion requirements. Without diversion, the water assigned to conventional appropriative right may be reallocated to other users, while the underlying water rights could eventually be cancelled. Environmental water is sometimes kept instream rather than being diverted, and hence, appropriative rights that have diversion requirements are unsuitable for many environmental uses. Instream rights are exempt from diversion requirements and often guarantee minimum streamflow over a river reach, or at a specific point, conditional on 'senior' appropriative right holders receiving a full allocation of water. Like appropriative rights, the priority of instream rights is determined by the date written

1 These figures were collected by Brewer et al. (2007) from public sources and may not include all transfers and leases.

on the right. If an instream right has been established by converting an appropriative right, the instream right will retain the date of the initial right. If, on the other hand, an instream right has been created without cancelling an appropriative right, the priority of the instream right will be determined by the date that it was established.

In Colorado and Oregon, the ownership of instream rights is restricted to government agencies. However, Oregon in particular relies on private individuals and groups to buy environmental water. To comply with state water law, water rights are then donated to the State Government. In California, private individuals and groups can own instream rights (SWRCB 1999).

Are there administrative options for reallocating water to the environment?

The ability of governments to source appropriative rights is limited by state constitutions. For example, the Californian Constitution states that the Government must not deprive 'any appropriator of water to which the appropriator is lawfully entitled' (DWR 2005, p. 4.38). This protection has been lessened in California by an expansion in the public trust doctrine, which allows the Government to acquire compulsorily water for the environment. The Californian public trust doctrine requires the Government to allocate sufficient water resources for public uses, which were once limited to commerce, fishing and navigation, but now also include environmental protection. The new interpretation was established in 1983 by the California Supreme Court. In the Mono Lake case, the Supreme Court found that diversions by Los Angeles were harming wildlife and damaging recreational and aesthetic values, and therefore breached the public trust doctrine. The courts restricted Los Angeles' appropriative rights by temporarily capping its diversions from Mono Lake at 15 GL per year and imposing other conditions (Anderson and Snyder 1997).

Federal Government regulation has also been used to reallocate water to the environment. For example, the *Endangered Species Act 1973* bans government and non-government actions that harm listed species, such as the wild summer steelhead and bull trout. During the 2001 drought, the Bureau of Reclamation allocated most of the water in Klamath Lake (a freshwater lake in south central Oregon) to support fish populations. This was challenged by local irrigators, who had existing water supply contracts with the Bureau of Reclamation. However, the federal district court ruled against the irrigators, saying that the Act took precedence over existing contracts (Pagel 2002).

Hence, some environmental needs take precedence over irrigator rights. This means that administrative reallocation can occur without agreement from irrigators, and voluntary mechanisms, such as water buybacks, may not be necessary to achieve environmental objectives. However, like the National Water Initiative's 'risk sharing principles', the conditions under which the coercive reallocation of water is legally possible are not always clear and are subject to dispute.

C.2 Water buybacks in Oregon

In 1995, total water use in Oregon was around 10 900 GL. Surface water use was around 9500 GL. The agricultural sector accounted for approximately 78 per cent of water use, with around two million acres of land being irrigated (Solley 1998).

Oregon has two main mountain ranges, the Coast mountains and the Cascades. There is substantial rainfall and snowfall in western Oregon, but eastern Oregon is typically dry (Schiller 1998). In the Deschutes Basin, rainfall varies from around 250 millimetres per year in the lower central region, to around 2500 millimetres per year in the eastern Cascades (CBWTP 2009). The main rivers in Oregon are the Klamath River (in southern Oregon), the Deschutes and Willamette rivers (in central and western Oregon) and the Columbia River (which marks the northern border with Washington). The Columbia River is the largest river in the Pacific Northwest region of North America.

Over the last century, the number of salmon in the Columbia Basin has fallen from around 16 million to around one million, and some species of salmon and steelhead have become endangered. This has been attributed to habitat loss and growth in consumptive water use, particularly in the agricultural sector (Garrick et al. 2009). The damage to salmon populations has caused widespread concern, with a poll conducted by an Oregon newspaper in the 1990s revealing that 60 per cent of respondents considered falling salmon numbers to be the largest environmental problem in the state (Schiller 1998).

The plight of salmon was a major consideration behind the development of basin plans in 1955. Basin level assessments were used to estimate diversion limits, and develop streamflow rules (Achterman 2008)[2]. Water rights created before 1955 were exempt from the rules, and the rules were sometimes suspended to allow the owners of water rights created after 1955 to use additional water (Golden and

2 In Oregon and other states the emphasis on saving habitat for fish tends to make environmental planning less complex than in Australia where there are a larger number of water-related environmental objectives.

Aylward 2006). The perceived ineffectiveness of streamflow rules in protecting the natural environment led to the introduction of instream rights in 1987.

In Oregon, there are currently over 1000 environmental instream leases and water rights, with a combined flow of 2200 ML per day. In 2007, the Water Resources Department received around 50 water rights through transfers and donations, with a combined flow of 600 ML per day. The Oregon Government does not buy or lease water directly. Instead, it relies on donations from conservation groups such as the Klamath Basin Rangeland Trust, the Deschutes River Conservancy, and the Freshwater Trust (WRD 2009b). But these groups are typically subsidised by state and federal governments (box C.4).

Box C.4 **Government subsidies to private conservation in Oregon**

Environmental water acquisition in Oregon is decentralised relative to other states. The Oregon Government does not buy water. The Oregon Watershed Enhancement Board (2001, p. 8) argues that 'local citizens and groups have the greatest understanding of watershed priorities in their local areas' and planning is decentralised to use this knowledge. The Board provides capacity building grants to conservation groups and funds environmental restoration projects, such as water buybacks. The commitment of private funds to any project must be at least 25 per cent. The total value of grants was around $20 million in 1999, with the Board funding around 360 projects (Golden and Aylward 2006).

Private conservation groups can also receive grants through the Columbia Basin Water Transactions Program. The program was established by the Bonneville Power Administration, a federal government power company that operates throughout the Columbia Basin. Under the program, local groups submit proposals that are assessed within a competitive process and according to published criteria. The Columbia Basin Water Transactions Program operates at the basin level, and also buys water in Idaho, Montana and Washington.

There are a number of examples of water buyback programs in Oregon. This appendix will focus on the Deschutes River Conservancy's Instream Leasing Tenders and the Freshwater Trust's Water Acquisition Programs.

Deschutes River Conservancy

The Deschutes Basin is located in central Oregon, and supports one of the last remaining wild spring chinook salmon populations in the Columbia basin, as well as endangered bull trout and steelhead. Irrigation diversions in the Deschutes Basin have resulted in low winter streamflow along the upper Deschutes River, and low summer streamflow along the middle Deschutes River. During the summer irrigation season around 90 per cent of streamflow is typically diverted from the middle Deschutes River (DRC 2009).

The Deschutes River Conservancy (DRC) was established in 1996 by environmental groups, a Native American group and local irrigation districts. The DRC receives around 45 per cent of its revenue from individuals, foundations and businesses. It receives a similar amount from state and federal governments. In 2003, several projects were funded under the Columbia Basin Water Transactions Program (CBWTP 2009).

The DRC has acquired and leased around 390 ML per day of instream rights and leases along the Deschutes River and its tributaries. This is a substantial increase from less than 100 ML per day in 2002. The DRC is around half way towards meeting its main water acquisition goal, which is to restore around 600 ML per day of streamflow to the Deschutes River.

In 2008, most water was sourced through a leasing program, which obtained 220 ML per day from around 230 landowners. Many landowners lease water to the DRC every year. A further 125 ML per day was sourced from water conservation programs (such as upgrading delivery infrastructure), while 15 ML per day was sourced from permanent transfers. The DRC also has a substantial habitat restoration program and has undertaken physical restoration work on around 160 km of streams, created a number of wetlands, and planted around 150 000 native riparian plants (DRC 2009).

The DRC uses a number of leasing arrangements, including:

- standard one year leases; split season leases (which allow irrigators to use water rights at critical times during the irrigation season)
- five year leases (which allow irrigators to withdraw before the start of each irrigation season).

Around 60 per cent of water in the leasing program is donated by landholders who are unable to profitably use water, but are nevertheless keen to retain their water rights for use or sale in the future (DRC 2009)[3]. The DRC leasing program has used a range of purchase mechanisms, such as tenders and fixed rate payments.

Instream leasing tenders

Before the introduction of instream leasing tenders in the Ochoco Irrigation district, the DRC used fixed payments to lease water from landholders. In 2002, irrigators

[3] Under Oregon law, water rights must be used at least once every five years.

were offered a fixed payment of $9 per ML, but this proved insufficient, with just one irrigator agreeing to lease water. The DRC realised that higher payments would be required to source additional water, but the 'best' payment was uncertain. Tenders were advocated as an alternative that would reveal information on irrigators' willingness to accept (Hartwell and Aylward 2007).

The DRC used tenders in 2003 and 2004. In designing the tender mechanism a key motivation was to keep things simple. Discriminatory pricing was considered to be more intuitive than uniform pricing, while single round tenders were considered to be less complex than multiple round tenders. Single round tenders were also seen as a way of reducing transaction costs, compared with multiple round tenders (Hartwell and Aylward 2007).

The DRC used reserve prices to limit the costs of unexpectedly high bidding. The reserve prices were determined in advance and were not revealed to irrigators. The budget was $50 000 in both years. Bids were ranked from lowest to highest (in terms of dollars per share)[4], and successively higher bids were accepted until the reserve price was exceeded or the budget exhausted.

A similar process was used in both auctions. Initially, the DRC sent letters and applications to around 150 landowners in the Ochoco Irrigation District. Applications were only sent to landholders with more than 10 acres of water shares. Participants were given around three weeks to submit applications, while the assessment period was around two weeks.

In the 2003 tender, the reserve price was based on an analysis of fixed payment schemes in neighbouring irrigation districts, where the DRC had previously leased water, and 'back of the envelope' studies that valued water shares in the Ochoco Irrigation District. The studies suggested that the annual cost of leasing water could be around $75 per share. The environmental benefits were the other main consideration in setting the reserve price, with the DRC concluding that the environmental benefits from an additional share were likely to exceed $75 for most plausible levels of water purchases.

Seven landholders in the Ochoco Irrigation District submitted bids, ranging from $29 to $109 per share. In total, landholders offered 616 shares for sale and the total value of offers was just under $50 000. Only three bids were below the reserve price

4 Landholders in the Ochoco Irrigation District source water through shares that are based on the area irrigated. For example, the volume of water available per (acre) share was 3.7 ML in 2003 and 4.9 ML in 2004. The allocation of water is still uncertain in February when the DRC tenders were conducted. Hence, the tenders were based on water shares that were specified in terms of acres (rather than volumetric allocations, which would have been specified in acre feet or ML).

of $75 per share. These bids were accepted, securing 196 shares at a total cost of around $10 500.

The DRC increased the reserve price the following season to $91 per share. This was partly based on an assessment of the 2003 auction which revealed that increasing the reserve price to $91 per share would have doubled the volume of water acquired. In 2004, nine landholders submitted bids, ranging from $29 to $85 per share, which were all under the reserve price. The total value of water shares offered was less than the budget constraint, so all bids were accepted, with the DRC leasing 642 shares at a total cost of around $43 100. The average bid was $67 per share (in volume weighted terms) — a 16 per cent decrease from the previous season. Irrigators who had participated in 2003 tended to cluster their bids in 2004 around $60 per share (the highest price paid in the previous round) and $75 per share (the reserve price in the previous round). Some irrigators who had submitted bids in 2003 above the reserve price revised their bids downwards, contributing to the convergence at $60 and $75 per share, while others did not participate in the 2004 tender.

In 2005, the DRC reverted to fixed payment water buybacks in the Ochoco Irrigation District. Under the tenders, the 'cut off' payment was around $31 per ML in 2002 and $22 per ML in 2003. (This is expressed in megalitres rather than shares so that the tenders can be compared with fixed rate payments using a common metric.) When fixed rate payments were reintroduced the offer was reduced to $9 per ML. Despite a reduction in payments, the volume of water leased increased when fixed payments were reintroduced. While this could be attributed to the change in purchase mechanisms (although this is unclear), the additional leases could have also resulted from other factors, such as improved relationships with potential sellers.

Tenders versus fixed rate payments

The DRC has experimented with a number of different purchase mechanisms, including fixed payments and tenders, thus providing some evidence of the benefits and costs of these mechanisms in practice. Hartwell and Aylward (2007, p. 28) argue that the tenders were an improvement, and conclude that 'compared with previous [fixed payment] methods, the auction was successful at increasing the amount of water leased and ensuring low restoration costs'.

However, while the volume of water leased increased under the tenders, some (or perhaps all) of this increase can be attributed to an increase in DRC payments from $9 (under fixed payments) to $31 (the cut off under the first tender) per ML (again, this is expressed in megalitres rather than shares).

As discussed above, fixed payments were replaced because the DRC was unable to determine in advance the number of water shares that would be supplied at different prices. While the instream leasing tenders did reveal information on landholder's willingness to accept, it was impossible to use this information to run a more effective tender since the reserve price was determined in advance. In this regard, the tenders did not contribute any additional flexibility.

The tenders could have been modified to introduce more flexibility. For example, instead of using a reserve price, the maximum payment could have been determined after examining landholder's bids. This would have allowed the DRC to respond to higher than expected bidding in 2003 by increasing its maximum payments. However, a potential drawback is that not using a reserve price could exacerbate overbidding in tenders with small numbers of participants.

Freshwater Trust Water Acquisition Program

The Oregon Water Trust was the first water trust in the United States. It was established in 1993 to address concerns that summer irrigation diversions were reducing habitat for anadromous[5] and resident fish, limiting access to spawning grounds, and adversely affecting water temperature and water quality (Freshwater Trust 2009).

In 2009, Oregon Water Trust and Oregon Trout merged to become the Freshwater Trust with the aim of better coordinating water buybacks and watershed restoration. Oregon Trout was formerly a conservation group that undertook various watershed restoration programs, such as planting trees, restoring estuaries, resloping banks, and returning rivers to their historic channels.

In the late 1990s, the Oregon Water Trust received around two thirds of its water acquisition funding from private individuals and groups, and around one third from public agencies (Schiller 1998). Currently, the water acquisition program receives substantial funding from the Columbia Basin Water Transactions Program, which is run by the Bonneville Power Administration (a federal government power company that operates dams in the Columbia Basin).

In 2006, the Oregon Water Trust had around 390 ML per day of instream water, of which around 145 ML per day was sourced from water rights, with the remainder

5 Anadromous fish — such as Chinook salmon, steelhead, striped bass, American shad, white sturgeon, and green sturgeon — spend most of their lives in the ocean before returning to freshwater rivers to spawn.

being sourced through leases (Walker Foundation 2009). This water is acquired through donations and payments to landholders.

The Freshwater Trust is generally constrained when it uses money from foundations or government grants. For example, Columbia Basin Water Transactions Program money can only be used in the Columbia Basin. The Freshwater Trust must source alternative funding to buy water elsewhere. Within river basins, however, the Freshwater Trust has substantial discretion over which projects it undertakes.

The Freshwater Trust sources water mainly in basins that once supported substantial fish populations. Within these basins, it identifies streams where:

- additional water will increase the number of fish
- existing consumptive water rights can be transformed into secure environmental rights.

The Freshwater Trust specialises in buying water on small to medium size tributaries that provide spawning and rearing habitat for fish, and where the ecological benefits from small volumes of water can be substantial (Freshwater Trust 2009).

Purchase mechanism

The Freshwater Trust usually buys water from individual landholders. However, it has also leased water from irrigation districts. In 2005, for example, it struck an agreement with six ditch companies and 115 landholders, whereby landholders would be compensated for maintaining minimum streamflow in the Lostine River at 35 ML per day. This allowed adult Chinook salmon to migrate upstream to their spawning grounds. The Lostine River deal required majority approval within the six ditch companies, and passed with strong, but not universal, support from landholders.

When buying from individual landholders, the Freshwater Trust initially approached potential sellers through unsolicited letters and door knocking, which attracted only limited interest. An alternative, more successful method, has been working with local conservation groups who introduce the Freshwater Trust to landholders interested in selling water. The introductions build trust between buyers and sellers, which is valuable given the complexity of Oregon's water trading system.

Most acquisitions are negotiated and the Freshwater Trust will generally visit the landholder to learn about the business. They also discuss the landholders' objectives, since many landholders are motivated by non-financial considerations.

When developing an initial offer, the Freshwater Trust assesses the landholder's individual circumstances and the streamflow demands of the river. This introduces substantial flexibility, for example, a split season agreement was negotiated with Austin Ranch, which committed it to cease irrigating during July each year. The agreement contributes additional streamflow in the second half of the irrigation season, when water is more valuable to the environment than to Austin Ranch. The Freshwater Trust also uses payments to encourage:

- changes in land use, such as moving towards crops that use less water
- water conservation projects, such as installing new irrigation systems
- source switching from surface water to another source, such as groundwater
- point of diversion change (withdrawing water further downstream, meaning that additional environmental water is available between the initial and new points of diversion)
- rotational pooling agreements which involve neighbours sharing water rights on a rotational basis (Freshwater Trust 2009).

Landholders also have the flexibility to (temporarily) lease or (permanently) transfer water to Freshwater Trust. Leases are seen as having three main advantages. First, leases give landholders a chance to evaluate the costs of using less water, while retaining the ability to resume full water use in the future. Second, leases allow the Freshwater Trust to buy water on short notice in response to drought and other unexpected events. This has advantages because in Oregon permanent transfers can take a number of years. Third, there is generally less opposition to leases in rural communities. As mentioned above, the transaction costs of permanent transfers in Oregon are substantial, and may exceed the transaction costs of perpetually renewing leases.

As well as cash payments, the Freshwater Trust has used 'in kind' payments. For example, a landholder near Buck Hollow Creek agreed to sell water in exchange for hay as compensation for reduced pasture production.

Personal negotiation tends to have higher transaction costs than alternative purchase mechanisms for mass acquisitions, but in circumstances where only a small number of potential sellers are involved, negotiation may be more appropriate, thus reducing transaction costs and increasing flexibility.

Monitoring

The Freshwater Trust has an extensive monitoring program to ensure that environmental water is not diverted illegally. The Freshwater Trust monitors around three quarters of the environmental water sourced under its programs (mainly through irregular streamflow measurements and fixed gauges). The Freshwater Trust also monitors changes in the ecological condition of streams where water has been acquired or restoration activity undertaken. In the Lostine River example, ecological monitoring is conducted by the Fisheries Research Division of the local Native American Tribe, who run annual Spring Chinook Salmon surveys.

C.3 Water buybacks in California

In 1995, total water use in California was around 63 400 GL, with surface water use at around 43 200 GL. The agricultural sector accounted for approximately 80 per cent of fresh water use, with around nine million acres of land being irrigated (Solley 1998).

The buybacks discussed in this section occur in California's Central Valley, which extends around 650 km from north to south, and produces around 8 per cent of agricultural output (by value) in the United States. The northern half, also known as the Sacramento Valley, receives around 500 millimetres of rain annually. The southern half, known as the San Joaquin Valley, is substantially drier. The Sacramento and San Joaquin Rivers meet at the Sacramento-San Joaquin River Delta, which is the largest estuary on the west coast of the United States. The Delta also supplies water to the Central Valley Project, the State Valley Project (major infrastructure developments) and the San Francisco Bay Area.

Around 60 per cent of anadromous fish species in California are in danger of extinction. According to Lauer (2009), the pink and chum salmon, southern steelhead and coho salmon face the greatest immediate threat. The Californian Government conducts regular fish surveys in the Sacramento-San Joaquin River Delta. The most recent survey results, released in 2009, suggest that the populations of many fish species, including Delta smelt, were the lowest since records began. Lauer (2009) attributes this to increased long-term diversions for consumptive use, as well as the impacts of drought and climate change.

This appendix examines two Californian water buybacks — the Water Acquisition Program and the Environmental Water Account. Expressed in terms of value, these are among the largest environmental water buybacks in the world, yet are still very modest by comparison to *Restoring the Balance*.

Water Acquisition Program

The Water Acquisition Program (WAP) is administered by the US Department of Interior. The program was established to address commitments under the *Central Valley Improvement Act 1992* (US) to increase waterfowl habitat and fish numbers. Some WAP water is allocated to wildlife refuges to restore wetlands that provide habitat for waterfowl (USBR 2003a). WAP water is also used to implement the Anadromous Fish Restoration Program, which was introduced to double the natural production of anadromous fish.

Since 2000, the amount of water purchased annually under the WAP has varied from around 265 to 345 GL. Around one third is typically allocated to wildlife refuges, with the remainder being used to increase streamflow. Average annual expenditure on water acquisitions is typically around $US15 million (USBR 2009).

Purchase mechanism

The WAP buys water mainly from major water users such as public irrigation districts through direct negotiation. The Department of Interior has expressed an interest in buying water from individual irrigators, but nevertheless recommends that people work with their irrigation districts to 'develop coordinated water transfer proposals capable of providing substantial quantities of water' (DWR and USBR 2008, p. 6).

Until 2000, the volume of water acquired under the WAP was highly variable, in part, because most purchases were conducted on an annual basis. This changed as a result of the San Joaquin River Agreement, which committed members of the San Joaquin River Group Authority (an alliance of major water users on the San Joaquin River and tributaries) to make water available for the River. There are complex rules governing the supply of water by the San Joaquin River Group Authority, with environmental releases varying throughout the year and depending on seasonal conditions (EAEST 1999). Water that is not sourced under this Agreement continues to be acquired on an annual basis.

Environmental Water Account

The Environmental Water Account (EWA) was established in 2000 by CALFED, a joint initiative of 25 government agencies that have responsibility for the Sacramento-San Joaquin River Delta. CALFED implements environmental pumping regulations that limit diversions from the Sacramento-San Joaquin River Delta at certain times. These regulations also reduce the overall volume of water that can be diverted by Central Valley and State Water Project pumping plants in any season. The EWA was established to reduce the impact of pumping regulations on overall diversions by acquiring water from willing sellers, and delivering this water to the Central Valley and State Water Projects as compensation. The process was explained by Begley et al. (2006, p. 32):

> When [fish deaths] are approaching limits set by the EWA regulatory agencies, a EWA panel can ask for pumps to be shut down. For example, Department of Fish and Game biologists monitoring the salmon populations on the Sacramento River could advise the Department of Water Resources to decrease pumping for a designated amount of time, allowing migrating fish to swim safely through. The Water Projects are then reimbursed for the loss of water associated with the periods of decreased pumping.

EWA acquisitions were around 340 GL in 2007 (CALFED 2008).

Purchase mechanism

The EWA trades with major sellers only, including water districts and groundwater banks — it does not buy water from individuals (Hollinshead and Lund 2006). EWA water is generally purchased north of the Sacramento-San Joaquin River Delta, where water tends to be less expensive. Moreover, this generates additional environmental benefits as water must pass through the Delta to be delivered to Central Valley Project and State Water Project pumping plants.

While the EWA could use a mix of long-term and short-term arrangements, it tends to use leases and single-year options contracts to source water. Options contracts are usually signed early in the year, before uncertainty surrounding water availability has been resolved. DWR (2002, p. 7) noted:

> The price of the option paid to the seller will be negotiated and is typically small, paid early and non-refundable except in limited circumstances. The total price of the water if 'called' will include the option price as a downpayment. ‘Call dates’ for options are negotiable but should balance the needs of prospective buyers and sellers.

Water leases and options are generally purchased through negotiation. The EWA contacts water districts, inviting them and other interested parties to submit proposals. The EWA will then meet with potential sellers to negotiate (DWR 2002). Potential acquisitions are evaluated with reference to ‘need, availability, and cost’ (CALFED 2000).

The administrative complexity associated with water sales under the EWA can be considerable. For example, sellers may need to evaluate the socioeconomic impacts of the sale, and are encouraged to ‘complete their own environmental documentation of the water [sale] in compliance with the *California Environmental*

Quality Act [1970]' (DWR 2002, p. 7). These costs may explain why large sales are more common than small sales.

Recent changes

The EWA has not reversed the decline in endangered fish numbers. CALFED conducted a review of the program in 2007, which concluded that 'it is uncertain whether EWA actions are having any favourable impact on [fish that reside exclusively in the delta]' and while 'actions taken to protect anadromous species have had a positive influence … actions outside the Delta have been far more effective in improving populations than the EWA actions in the Delta' (CALFED 2007, p. 3). In response to the review, the federal court ruled that the existing biological opinion regarding the use of pumping facilities was inadequate. The federal court has since introduced new 'operational actions' on the Central Valley Project and State Water Project, and has relaxed the requirement on CALFED agencies to provide compensation. Because the EWA was established mainly to deliver compensation, the future of the program is uncertain. A limited version of the EWA is planned for 2009, while the program may be discontinued in 2010.

In 2003, a plan was developed to coordinate the WAP and EWA, with the intention of avoiding competition between the programs and increasing efficiency (USBR 2003c). The extent of coordination is not clear, but where possible water is acquired to meet the objectives of both programs (USBR 2003b).

C.4 Water buybacks in Colorado

In 1995, total water use in Colorado was around 19 100 GL, with surface water use at around 16 000 GL. The agricultural sector accounted for approximately 92 per cent of water use, with around four million acres of land being irrigated (Solley 1998).

Colorado has experienced many of the same environmental problems as California and Oregon. Colorado Trout Unlimited (2009, p. 1) noted that 'many rivers and streams in Colorado are heavily depleted and lack the flows necessary to sustain healthy coldwater fisheries'. Moreover, the number and size of wetlands has decreased, with Colorado losing approximately 50 per cent of wetlands between 1790 and 1990. The construction of dams and other barriers to fish movements, and the proliferation of introduced species have also contributed to environmental damage. In the Colorado River, 25 per cent of native fish are endangered (Upper Colorado Endangered Fish Recovery Program 2009).

To address these concerns, a number of water buyback programs have arisen. Some of these are run by conservation trusts, such as the Colorado Water Trust, while the Colorado Government also has a buyback program.

Instream Flow Program

The Instream Flow Program (ISFP) was established in 1973. The program is run by the Colorado Water Conservation Board (CWCB) (Charney 2005). The ISFP was intended to 'correlate the activities of mankind with some reasonable preservation of the natural environment' by sourcing water through appropriations, and hence creating new water rights (Merriman and Janicki 2009, p. 1). The program has been expanded to include acquisitions (permanent transfers and leases), with the CWCB being allowed to 'buy or accept donations of water reasonably necessary to improve the environment' (Malloch 2005, p. 52). There were four leases and 17 transfers under the ISFP between 1973 and 2005. The combined flow associated with these leases and transfers is almost one GL per day (Charney 2005).

Any person can apply to have a stream or lake considered for the ISFP, including state and federal government agencies. The CWCB then invites public comment, and assesses proposals within an annual review cycle. Once a stream or lake has been included in the program, there is another approval process for each appropriation or acquisition. Under existing rules, instream rights are held in public trust and cannot be sold.

Acquisition programs

Before 2008, CWCB did not have a budget to buy water, and instead acquired water through donations, which received a tax break (Landry 1998). In 2009, the CWCB was assigned $1.5 million to buy water (CWT 2009a). The rules and guidelines governing the buyback were finalised in March and by September 2009, the CWCB was working on a number of proposals. The CWCB is collaborating with voluntary organisations, such as the Colorado Water Trust and Trout Unlimited. For example, the Colorado Water Trust is locating and negotiating with potential sellers, and may share the costs of some acquisitions.

In 2009, the Colorado Government also established a tax credit program. Under the program, the CWCB will allocate income tax credits to landholders who donate water rights to the ISFP. The tax credits will be up to 50 per cent of the value of the donated water right, as determined by the CWCB. These are more generous than the tax breaks that previously applied. Around $2 million a year has been allocated to the program (CWT 2009).

Colorado Water Trust

The Colorado Water Trust (CWT) was established in 2001. It is a private, non-profit organisation 'that engages in and supports voluntary efforts to restore and protect streamflows in the state of Colorado' (CWT 2009b, p. 1). The primary mechanism for acquiring water has been (permanent) transfers, but with recent legal changes that reduce the costs of (temporary) leases, leases are now an option that they are considering. The CWT has completed transfers on Blue River and Hat Creek, and is currently working on two further deals.

Prioritisation

When it was established, the CWT surveyed a number of government agencies and conservation groups to develop a list of priority watersheds (Malloch 2005). The CWT is currently undertaking a more comprehensive state-wide assessment process. Within priority watersheds, water rights are assessed against the following criteria:

- **Conservation Benefits** — The water right must benefit a 'water-short', ecologically significant, water-dependent natural environment. Are there significant conservation benefits, such as providing an instream flow that will benefit a water short existing CWCB instream flow? Is it a stream reach that lacks a CWCB appropriation because of insufficient water? Will a trout or native fish stream reach benefit from the acquisition? Are there water-dependent natural areas, such as wetlands and riparian areas, or environmentally beneficial agriculture and wildlife habitat?
- **Credible Records** — There must be credible records of actual consumptive use of the water right. Except under extremely limited circumstances, the Colorado Water Trust will not accept conditional rights.
- **Public versus Private Benefits** — Will the acquisition provide greater public than private benefits?
- **Secondary benefits** — Is there public access to the protected stream reach that will benefit? Is there urban proximity? Are there recreation benefits? Aesthetic?
- **Support** — The Colorado Water Trust will also work to avoid the purchase of water rights whose change of water rights application will be hotly contested. Is there support from the local community and other stakeholders and water users?
- **Collaboration** — Does the acquisition provide the opportunity to collaborate with other conservation programs and organizations and local groups?
- **Duplication of Conservation Efforts** — The water right should complement rather than duplicate or compete with other established conservation programs.
- **Colorado Water Law** — If the water right is acceptable, the change of water rights application must comply with every aspect of Colorado water law, including the

law governing water development under interstate compacts and equitable apportionments (CWT 2009b, p. 1).

Acquisitions

In 2004, the CWT acquired a water right to 21 ML per day on Blue River for around $130 000. As required under Colorado law, the water right was donated to the CWCB and an instream right was created over 12 miles of Boulder Creek (a tributary of Blue River). As mentioned above, the transaction costs associated with permanent transfers in Colorado are substantial. In the Blue River example, the transaction required around $70 000 of donated legal and engineering assistance (Malloch 2005). However, this figure is somewhat misleading, because it was the first private environmental transfer in Colorado — subsequent transfers may not be as costly.

D Regional impacts of water buybacks

Key points

- There have been a number of studies that estimate the impacts of water buybacks (or other reductions in water availability) on regional communities in the Murray-Darling Basin.
- The studies suggest that the impacts are unlikely to be large at the Basin level. The most robust modelling available estimates that the buyback will result in a small increase in real consumption in most southern Basin regions — that is, a net gain to the communities modelled. The model assumes that buyback participants will keep farming, which tends to bias the results.
- An increase in real consumption as a result of the buyback is possible because irrigators are paid for the water they sell. Without the payments, the impact of the buyback on real consumption in most southern Basin regions (excluding any benefits from reallocating water to the environment) would be unambiguously negative. However, with the payments, the impact could be positive or negative.
- While the impacts should be moderate at the southern Basin level, and could even be positive, some towns might experience large reductions in gross regional product.

This appendix reviews a number of studies that estimate the impacts of water buybacks and other reductions in water availability on regional communities. The main studies reviewed are:

- Dixon et al. (2009)
- Peterson et al. (2004)
- Qureshi et al. (2007)
- RMCG (2009)
- Judith Stubbs and Associates (2010).

These studies use a variety of modelling approaches to estimate the impacts of a reduction in water availability on the southern Murray-Darling Basin economy. The models and their limitations are discussed below.

D.1 Dixon et al. (Centre of Policy Studies)

The Centre of Policy Studies at Monash University modelled the regional impacts of the buyback using its computable general equilibrium model, TERM-H2O. The model has 17 southern Basin regions. The agricultural sector was modelled in detail, with 10 irrigated agricultural industries and seven dryland agricultural industries.

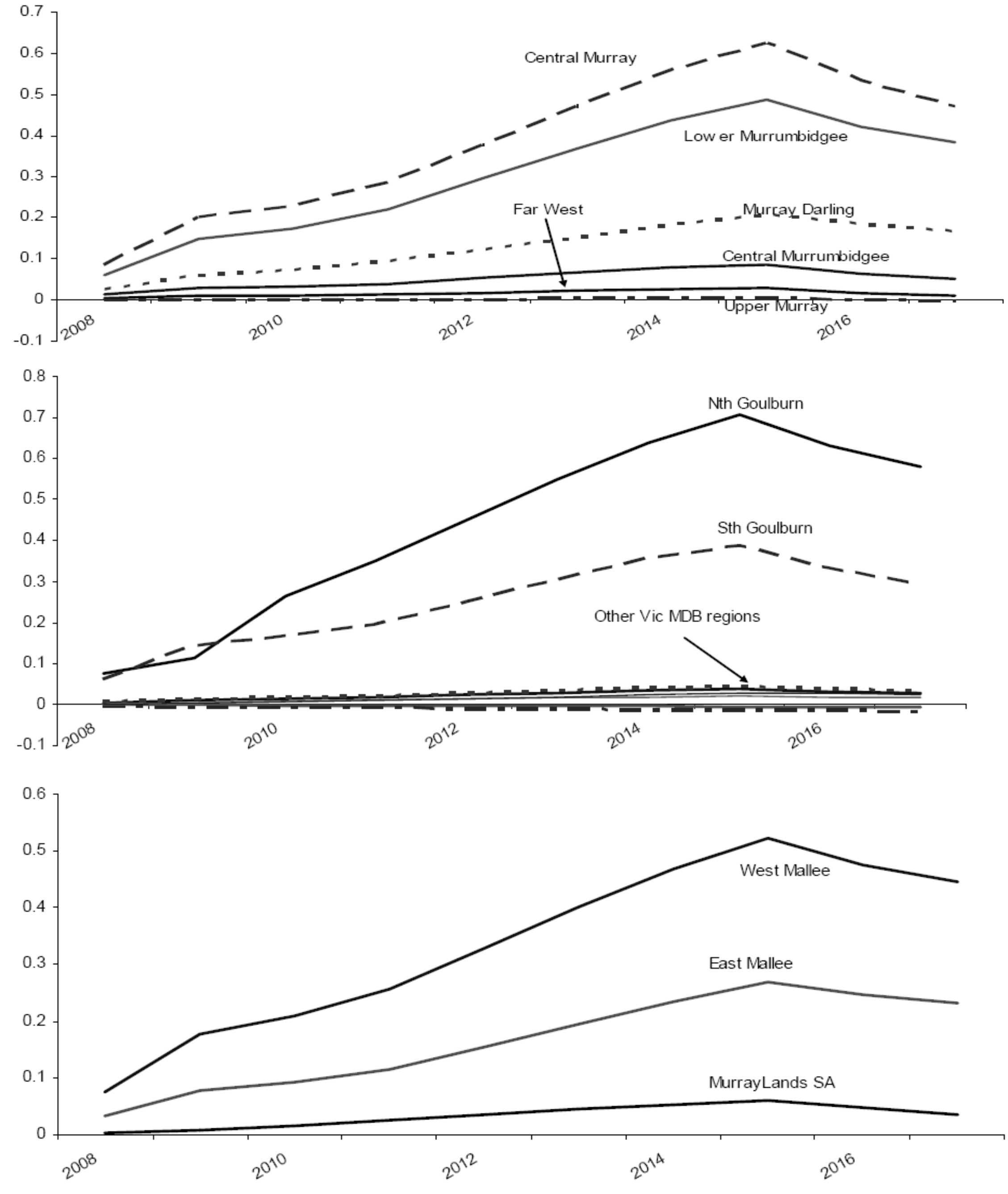
TERM-H2O compares the values of key variables, like real consumption, with and without the buyback. The main buyback scenario was a 1500 gigalitres (GL) acquisition over eight years in the southern Basin. This may understate or overstate the volume of water acquired in the southern Basin under Restoring the Balance. The buyback was modelled as an across the board reduction in water availability. Subsequent water trade was allowed across the southern Basin to reallocate water to the highest value uses. The payment to irrigators for buyback water was added to regional income.

In general, the estimated impacts of the buyback on real consumption were positive. The gains were largest in North Goulburn, Central Murray and West Mallee, with real consumption being around 0.5 per cent higher in 2017 relative to the no buyback baseline (figure D.1). In most regions the impact of the buyback on real consumption in 2017 was estimated to be an increase of less than 0.1 per cent. Dixon et al. (2009) attributes the positive impact on real consumption to an increase in disposable income as a result of buyback payments. In TERM-H2O, this more than compensates for the effects of reduced water availability.

These estimates are at the regional level and outcomes will vary for towns and individuals. At the industry level, the quantity of irrigated cereals was estimated to decline by around 33 per cent, and irrigated rice by around 22 per cent. The irrigated cotton and dairy industries were less affected, with output falling by around two per cent. The output of irrigated horticulture was essentially unchanged, even increasing slightly for fruits and vegetables.

TERM-H2O places the buyback within a conceptually robust economic framework. However, the results are a consequence of many assumptions, and different assumptions could generate substantially different results. Dixon et al. (2009) do not include any sensitivity analysis — showing how results change as key parameters are altered — so it is difficult to know how robust the conclusions are.

Figure D.1 **Change in real consumption as a result of the acquisition of around one third of irrigation water, by catchment**



Source: Dixon et al. (2009).

A number of important assumptions relating to the Dixon et al. (2009) analysis are outlined below:

- The volume of water applied per hectare irrigated was assumed to be fixed. In practice, irrigators may reduce their water application rates as the buyback increases the relative price of water compared with land. To take a related example, the substitution parameters (relevant in determining responses to the water buyback) do not appear to have a strong empirical basis. These limitations regarding the structure and parameterisation of the model mean that it may not adequately represent agricultural production systems in the southern Basin. This could result in unreliable estimates.

- The baseline and buyback scenarios include an increase in 'irrigation water efficiency'. However, the rate of growth in irrigation water efficiency is assumed to be the same in both scenarios. In general, the estimated 31 per cent increase in water prices under the buyback scenario would be expected to spur the development and adoption of new technology, leading to larger increases in irrigation water efficiency. These advances could offset some of the negative impacts of the buyback on agricultural output.
- TERM-H2O is a deterministic model. It does not account for random variation in climatic and market conditions. Introducing variation in rainfall tends to increase the attractiveness of opportunistic cropping activities, such as irrigated cereals and rice, compared with perennial activities. This could also influence the responsiveness of different activities to changes in water prices.
- Buyback participants are assumed to keep farming. This is implied by the assumptions that agricultural capital and operator labour are fixed, while buyback payments are added to regional income. This assumption is unlikely to strictly hold, and could cause the model to overstate the benefits of the buyback to regional communities. However, Dixon et al. (2009) argue that relaxing the assumption is unlikely to make a substantive difference to the results, since buyback payments are generally small relative to the size of regional economies.
- Like most other computable general equilibrium models, TERM-H2O assumes full employment and does not model adjustment costs. Thus, the model can not estimate the change in 'real consumption' that might happen if some people become unemployed as a result of the buyback.
- The benefits from increasing the allocation of water to the environment were not modelled. These benefits could include agricultural productivity gains from reduced salinity, which could be substantial, and increased tourism. Hence, the modelling could underestimate the benefits from the buyback.

D.2 Peterson et al. (Productivity Commission)

In 2004, the Productivity Commission modelled the impacts of reduced water availability on regional communities using an earlier version of the TERM model.

This work was undertaken with the Centre of Policy Studies. Instead of 17 southern Basin regions, the model had just seven. The agricultural sector included 15 irrigated agricultural industries. There were a similar number of inputs compared with TERM-H2O. However, the production functions which describe the relationships between inputs and outputs were substantially different.

Peterson et al. (2004) did not model the water buyback. Instead, the scenarios represent 'across-the-board' reductions in the availability of irrigation water of 10, 20 and 30 per cent. The reason for the reduction in water availability is not specified and there is no compensation. To place these reductions in perspective, the Dixon et al. (2009) simulations discussed above, assume a 33 per cent reduction in water availability from 2005-06 levels (which is equivalent to 1500 GL). The scenarios reported below assume costless water trade between regions and activities in the southern Basin. The model uses long run closure assumptions (allowing capital to move between industries and regions).

The reductions in water availability are estimated to reduce gross regional product in the southern Basin by 0.5 per cent in the 10 per cent scenario, and 2 per cent in the 30 per cent scenario. The results show that the negative impact of reductions in water availability on gross regional product in the southern Basin are likely to be nonlinear (and increasing at an increasing rate). Peterson et al. (2004) decomposed the results, demonstrating that around 70 per cent of the estimated reduction in gross regional product came from the primary industry sector. There was also a reduction in gross regional product contributed by the services sector. The reductions in gross regional product under the 30 per cent scenario are largest in the NSW Murray (4.4 per cent) and Murrumbidgee (3.2 per cent) regions (table D.1).

Table D.1 **Gross Regional Product effects of a 30 per cent reduction in water availability**

Relative to the baseline

Region	*Estimated impact*
	%
Murrumbidgee	-3.2
NSW Murray	-4.4
Mallee	-1.8
Goulburn	-1.7
Loddon Campaspe	-0.6
Ovens Murray	-0.2
Murray Lands South Australia	-1.3

Source: Peterson et al. (2004).

The industry level breakdown is only reported for the 10 per cent scenario. Rice output falls most, by 20 per cent. Dairy output declines by four per cent, while the output of irrigated horticultural industries generally declines by less than one per cent (table D.2). Given these estimates are for a 10 per cent reduction in irrigation water availability — compared with a 33 per cent reduction in the more recent Dixon et al. (2009) simulations — it seems reasonable to conclude that the agricultural impacts in this version of the TERM model are many times larger, for the same reduction in irrigation water availability.

Table D.2 **Change in industry output associated with a 10 per cent reduction in water availability**

Relative to the baseline

Industry	*Estimated impact*
	%
Sheep	-1.5
Other broadacre	-2.4
Beef cattle	-2.1
Dairy cattle	-3.8
Rice	-20.3
Citrus	-0.5
Apples and pears	-0.4
Stone fruits	-0.4
Other fruits and nuts	-0.5
Premium irrigated grapes	-0.6
Irrigated pasture	-3.2
Vegetables	-1.0

Source: Peterson et al. (2004).

This modelling shares many of the same assumptions as Dixon et al. (2009), but the irrigation module is substantially different. In particular, Peterson et al. (2004) assumes that irrigation industries have very little capacity to profitably substitute towards other inputs as water becomes more expensive. Sensitivity analysis shows that the more limited the substitution possibilities, the larger the agricultural, and hence regional, impacts. This could explain many of the differences in the results. The other substantive difference is that in this modelling, water is withdrawn without compensation, unlike Dixon et al. (2009) where water is implicitly sold to the government on a voluntary basis. Ignoring the benefits from buyback payments is likely to cause bias in the application of this modelling to a water buyback scenario.

D.3 Qureshi et al. (CSIRO)

The CSIRO has also modelled the impacts of reallocating water to the environment. Qureshi et al. (2007) estimated the impact on agriculture in the southern Basin of a reduction in water availability. Unlike the other models, Qureshi et al. (2007) does not estimate the impacts on regional communities. However, understanding whether the agricultural impacts are substantial is a first step towards understanding the regional impacts. It also enables a comparison of the agricultural results generated by a 'purpose-built' agricultural model, with the agricultural results reported from the computable general equilibrium models above.

The model used in Qureshi et al. (2007) covers 13 regions in the southern Basin. There are 12 agricultural activities. The model allows substitution between water and other inputs. These other inputs, 'land' and 'other costs', must be used in fixed proportions. The model is a short-run model. The area of land used for 'permanent plantings' like horticulture is assumed to be fixed. The model includes five different states of nature, representing different annual climatic conditions. The area of land used for 'annual cropping' activities is allowed to expand and contract, within limits, depending on seasonal conditions.

The main scenarios investigate a 500 GL reduction in expected water availability in the southern Basin (notionally due to a water buyback). The reduction varies across states of nature, with more water being reallocated to the environment in wet years. The model was run with and without water trade between regions. Two buyback scenarios were run for each trade scenario. The first scenario represents an 'across-the-board' reduction in water availability from all regions. The second scenario reduces water availability more in 'lower-value' regions, referred to by the authors as a 'targeted buyback'.

In the simulations without trade between regions, the buyback is estimated to reduce irrigated agricultural income in the southern Basin by 1.4 per cent under the 'targeted buyback' scenario, and 2.4 per cent under the 'across-the-board buyback' scenario. The difference arises because the marginal value of water varies substantially across regions in the baseline (no buyback) scenario. For example, the value of an additional ML of water was estimated to be $6 per ML in the Goulburn region (the least expensive region) and $156 per ML in the Mallee (the most expensive region). Given these differences, the cost of buying water can be reduced by acquiring more water from the Goulburn and less water from the Mallee than in the 'across the board buyback' scenario.

According to Qureshi et al. (2007, p. 301), their conclusion that 'spatially targeted water acquisition for environmental flows from low opportunity cost regions can substantially reduce costs of acquiring environmental flows' does not apply when trade is introduced. In the simulations with trade between regions, the differences in marginal values across connected regions are almost eliminated (the model limits the volume of water that can be traded, so some differences persist). The gains from buying water mainly in cheaper regions are therefore largely eliminated, and hence there are no appreciable benefits from running a 'targeted buyback'.

Qureshi et al. (2007) also models the impact of a 1000 GL buyback. This is estimated to reduce irrigated agricultural income in the southern Basin by 5.4 per cent under the 'targeted buyback' scenario and without trade between regions. Like Peterson et al. (2004), this shows the cost of reduced water availability increasing at an increasing rate.

As mentioned above, the scenarios assume that the volume of water allocated to the environment increases in wet seasons. Qureshi et al. (2007) also modelled the implications of allocating the same volume every year (equal to the long-term average under the variable scenario). This increased the agricultural cost of water acquisition, but not substantially. This could be because, in the model, water prices are relatively insensitive to weather conditions.[1]

There are reasons to doubt the model's ability to accurately estimate the impact of reduced water availability on irrigated agriculture. The model was calibrated so that the baseline scenario roughly corresponds to 2001 land and water use. Since there was considerable trade in water allocations in that year, it is unlikely that substantial differences in the marginal value of water could have persisted across connected regions. By contrast, the calibrated baseline simulation shows substantial variability in expected marginal values across regions (table D.3), raising questions about the implied regional water demand functions in the model. As these implied regional water demand functions more or less determine the cost of reduced water availability, this brings into question the robustness of the estimates. It should also be noted that some of the differences in shadow prices could be because the model uses a number of different states of nature.

A related concern is that minimum area constraints in the model were used to prevent unprofitable annual activities from disappearing. A consequence of this assumption is that, beyond a point, increasing water prices will not influence the area of land used for some irrigated activities.

1 Average water prices in the baseline scenario range from \$21 per ML in the wettest years to \$42 per ML in the driest years.

D.4 RMCG

RMCG was commissioned to analyse the economic impacts of reduced water availability associated with the Restoring the Balance water buyback in the Wakool Shire (southern New South Wales). The Wakool Shire has an agricultural–based economy, with around 40 per cent of the workforce being employed in agriculture (RMCG 2009).

Table D.3 **Expected marginal values of water in different regions**
Baseline simulation

Region	*Marginal value*
	$/ML
Upper Murray	10
Kiewa	14
Ovens	20
Broken	9
Goulburn	6
Campaspe	12
Loddon	12
Avoca	22
Murray River	33
Murrumbidgee	12
Mallee	156
Wimmera	120
Lower Murray	117

Source: Qureshi et al. (2007).

There is no modelling in RMCG (2009). Instead it assumes that that each additional ML contributes $300 in additional agricultural output. The reasoning behind this assumption is not explained. To estimate the regional economic impacts, RMCG (2009) assume that every dollar of reduced agricultural output results in three dollars less regional output. Given these assumptions, every 1000 ML reduction in water through the buyback is estimated to result in a $900 000 contraction in the size of the regional economy.

In estimating the agricultural impacts, one limitation of the analysis is the assumption that every one per cent reduction in water availability reduces agricultural output by one per cent. In practice, agricultural output is likely to fall by less than one per cent. Another key assumption is that every dollar of reduced agricultural output results in three dollars less regional output. To have confidence in the results, the 'regional multiplier' would need to be based on robust empirical analysis.[2] While there is nothing inherently wrong with using multipliers to examine distributional issues, large multipliers, such as those derived from input-output models, often do not capture the potential for displaced labour and other resources to move into alternative productive uses. For example, when a factory closes, some workers will find employment elsewhere. This reduces the impact on regional output, and should be taken into account. Finally, RMCG (2009) does not seem to account for buyback payments, which should moderate the impacts of changes in the agricultural sector on the regional community.

D.5 Judith Stubbs and Associates

A similar approach was used by Judith Stubbs and Associates to estimate the employment impacts of the buyback. The study used ABS data to estimate the number of people employed per GL for a number of agricultural industries in the Basin. The vegetable and grape industries had the highest labour to water ratio, employing around 20 people per GL. By contrast, the rice and cotton industries employed around one person per GL on average.

Based on linear regression analysis, Judith Stubbs and Associates estimate that for each agricultural job, there are another 0.9 jobs within the local community. There are no details on the regression equations that were estimated, so the Commission is unable to assess whether this number is reliable or how it should be interpreted.

Judith Stubbs and Associates then estimated the employment impacts of a 790 GL reduction in the volume of agricultural water, assuming the labour to water ratio remains unchanged. At the Basin level, the estimated employment losses range from 1 800 to 26 500, depending on the type of agriculture affected. Another limitation of this analysis is the assumption that no displaced workers will find work elsewhere. This is likely to bias the results in the direction of higher employment losses, especially when viewed from a long-run or national perspective (Judith Stubbs and Associates, sub. 66).

2 RMCG (2009) includes a footnote explaining that the Riverina Regional Development Board uses a multiplier of three. However, the Board does not justify the decision. Having reported a direct impact of $2 million per year, the Board asserts that ‘the [Leeton] Shire considers that the application of a multiplier of three will result in an annual economic loss of $6 million from the Leeton and Yanco community’ (RRDB 2004, p. 3). There is no further discussion of the multiplier.

D.6 Discussion

Overall, the models suggest that the impacts of the buyback on gross regional product and real consumption in the southern Basin are unlikely to be large (table D.4). Dixon et al. (2009) estimates a small increase in real consumption at the Basin level in the southern Basin. By contrast, estimates based on RMCG (2009) analysis suggest a three per cent reduction in gross regional product as a result of the buyback. The quite small impacts reported are consistent with the relatively modest contribution irrigated agriculture and related activities make to the southern Basin economy (expressed as a share of gross regional product).

Table D.4 **Impact of 30 per cent reduction in the availability of irrigation water in the southern Basin**

Relative to the baseline

Source	*Estimated impact*	*Buyback payments*
Dixon et al. (2009)[a]	Small increase in real consumption (less than 0.6 per cent in 2017)	Yes (assumed to stay in the region)
Peterson et al. (2004)	2 per cent reduction in gross regional product	No
Extrapolation based on Qureshi et al. (2007)[b]	12 per cent reduction in irrigated agricultural income	No
Extrapolation based on RMCG (2009)[c]	3 per cent reduction in gross regional product	No
Extrapolation based on Judith Stubbs and Associates (2010) [d]	Reduction in Basin employment of between 3 400 and 50 000	No

[a] Dixon et al. (2009) estimated the impact of a 33 per cent reduction in water availability. Furthermore, there were no estimates of the impact for the entire southern Basin. Since the largest regional impact was a 0.6 per cent increase in real consumption, the aggregate impact will be less than this. [b] The estimate is based on the 'targeted buyback' scenario without water trade between regions. Qureshi et al. (2009) estimates the impacts of 500 and 1000 GL reductions in water availability on irrigated agricultural income in the southern Basin. Using a quadratic function, the Productivity Commission ran a simple regression to estimate the impact of a 1500 GL reduction in water availability. [c] RMCG (2009) estimates the impacts of reduced water availability in the Wakool Shire (southern NSW). In an attempt to make the results comparable with other modelling, the Commission has extrapolated results to the remainder of the southern Basin. RMCG (2009) uses regional multiplier analysis to estimate that every GL of reduced water availability will reduce gross regional product in the Wakool region by $900 000. If other regions experienced similar impacts on average, the estimated impact of a 1500 GL reduction in water availability on gross regional product in the southern Basin would be $1.35 billion per year. The database used for Peterson et al. (2004) values gross regional product in the southern Basin at $23.3 billion and (national) gross domestic product at $528 billion. These are outdated numbers, and gross regional product in the southern Basin is now probably substantially higher. ABS (2008b) estimates that gross domestic product was around $1133 billion in 2007-08. Under the assumption that the relative size of the southern Basin economy has remained unchanged since then, scaling the initial southern Basin gross regional product estimate by (1133/528) generates a value of $50 billion. Hence, the estimated gross regional product impact is (1.35/50) or 2.7 per cent, which is rounded to the nearest integer. [d] The Commission has assumed a linear relationship between the volume of water acquired and impact on employment.

The models are substantially different conceptually and in application, and these differences are reflected in the results. At a broad level, the divergent results can be attributed to three key areas:

- The sensitivity of agricultural output to reduced water availability — for example, Dixon et al. (2009) estimates that a 33 per cent reduction in water availability will reduce irrigated agricultural output in the southern Basin by 7 per cent, while RMCG (2009) assumes an equi-proportional (or 33 per cent) reduction in irrigated agricultural output. In this regard, the estimates by Dixon et al. (2009) are more plausible in the sense that a less than proportional reduction in output would be expected. In general, larger agricultural impacts will tend to result in larger regional impacts.
- Whether buyback payments are modelled — only Dixon et al. (2009) explicitly models a buyback scenario, where irrigators are compensated for selling water. The other models estimate the impacts of reductions in water availability without compensation. Buyback payments will tend to benefit regional communities, so not taking them into account results in the benefits of the buyback for those communities being underestimated.
- The transmission of agricultural impacts to the regional economy — for example, RMCG (2009) assumes that regional output falls by three dollars for every dollar reduction in agricultural output. This is substantially higher than Peterson et al. (2004), who estimated a $1.40 reduction in regional output for every dollar reduction in agricultural output (on average, under a 10 per cent reduction in water availability). Thus, the same reduction in agricultural output would generate more than two times the regional impact under the RMCG approach, compared with Peterson et al. (2004). The lack of empirical or theoretical basis for the RMCG (2009) multiplier assumptions means that the end results should be treated with some caution.

While the impacts of the buyback should be moderate at the southern Basin level, some towns and regional centres could experience large reductions in gross product. As mentioned above, the Basin-level impacts are moderated by the small share of irrigated agriculture in the Basin economy. By contrast, some towns are heavily reliant on irrigated agriculture (for example, Coleambally), and moreover, could experience substantially larger reductions in water availability than the southern Basin average. The impacts of the buyback could be substantial in these communities.

The impacts of the buyback in the northern Basin have not been modelled. However, the overall impacts are unlikely to be substantially different from those in the southern Basin. The percentage of workers employed in agriculture is a key determinant of the impact of a contraction in agricultural activity on the regional economy. In 2006, this was around 6 per cent in the Victorian MDB and 8 per cent in South Australian MDB. This is similar to the Queensland MDB, where around 7 per cent of the labour force was employed in agriculture (ABS 2008b).

References

ABARE (Australian Bureau of Agricultural and Resource Economics) 2007, *Purchasing water in the Murray-Darling Basin*, ABARE report for the Department of Environment and Water Resources, October.

—— 2008, *Australian Commodities*, vol. 15, no. 1, March.

ABS (Australian Bureau of Statistics) 2008a, *Australian National Accounts: National Income, Expenditure and Product*, Cat. no. 5206.0, ABS, Canberra.

—— 2008b, *Water and the Murray-Darling Basin: A Statistical Profile 2001–01 to 2005–06*, Canberra.

ACCC (Australian Competition and Consumer Commission) 2008, *Water Charge (Termination Fees) Rules: Final advice*, December.

—— 2009a, *Water infrastructure charge rules: Advice to the Minister for Climate Change and Water*, Canberra.

—— 2009b, *Water Trading Rules: Draft Advice*, December, Canberra.

—— 2009c, *Water trading rules position paper*, Canberra.

Achterman, G. 2008, *Overview of Oregon's Current Water Situation*, http://water.oregonstate.edu/roundtables/download/AchtermanOregonWater.pdf (accessed 18 August 2009).

ACIL Tasman 2008, *Australia's Working Rivers: The Role of Infrastructure and Water Buybacks in Recovering Environmental Flows*, Prepared for the Crane Group, May.

—— 2009, *Regional Economic Effects of Irrigation Efficiency Projects: Report of Case Studies*, Prepared for the Crane Group, September.

Adamson, D., Mallawaarachchi, T. and Quiggin, J. 2007, 'Water use and salinity in the Murray-Darling Basin: a state-contingent model', *Australian Journal of Agricultural and Resource Economics*, vol. 51, no. 3, pp. 263-81.

Anderson, T. and Snyder, P. 1997, *Water Markets: Priming the Invisible Pump*, Cato Institute, Washington DC.

Appels, D., Douglas, R. and Dwyer, G. 2004, *Responsiveness of demand for irrigation water: a focus on the Southern Murray-Darling Basin*, Productivity Commission Staff Working Paper, Melbourne.

Australian Public Service Commission 2008, *Building Better Governance*, www.apsc.gov.au/publications07/bettergovernance1.htm (accessed 20 November 2009).

BDA Group 2006, *Issues and Options in applying market based measures in the Living Murray First Step*, report to the Murray-Darling Basin Commission, March.

Begley, L., Edwards, K., Heard, S. and Walling, L. 2006, *Managed Water Use Efficiency: Evidence and Practice*, report for the Department of Water Resources, California.

Bennett, J. 2008, 'Defining and managing environmental flows: inputs from society', *Economic Papers*, vol. 27, no.2, pp. 167-82.

Bjornlund, H. and Rossini, P. 2007, 'Fundamentals Determining Prices in the Market for Water Entitlements: An Australian Case Study', *International Journal of Water Resources Development*, vol. 23, no. 3, pp. 537-53.

BLM (Bureau of Land Management) 2001, *California Water Rights Fact Sheet*, www.blm.gov/nstc/WaterLaws/california.html (accessed 17 August 2009).

BMT WBM, 2007, *Ramsar Snapshot Study*, Final Report, www.environment.gov.au/water/publications/environmental/wetlands/pubs/ramsar-snapshot-study.pdf (accessed 16 March 2009).

Boardman, A., Greenberg, D., Vining, A. and Weimer, D. 2001, *Cost-Benefit Analysis: Concepts and Practice*, Prentice Hall, New Jersey.

Brewer, J., Glennon, R., Ker, A. and Libecap, G. 2007, *Water Markets in the West: Prices, Trading, and Contractual Forms*, Working Paper no. 30/2007, International Centre for Economic Research, Torino, Italy.

Brookes, J.D., Lamontagne, S., Aldridge, K.T., Benger. S., Bissett, A., Bucater, L., Cheshire, A.C., Cook, P.L.M., Deegan, B.M., Dittmann, S., Fairweather, P.G., Fernandes, M.B., Ford, P.W., Geddes, M.C., Gillanders, B.M., Grigg, N.J., Haese, R.R., Krull, E., Langley, R.A., Lester, R.E., Loo, M.,Munro, A.R., Noell, C.J., Nayar, S., Paton, D.C., Revill, A.T., Rogers, D.J., Rolston, A., Sharma, S.K., Short, D.A., Tanner, J.E., Webster, I.T., Wellman, N.R. and Ye, Q. 2009, *An Ecosystem Assessment Framework to Guide Management of the Coorong*, Final Report of the CLLAMM Ecology Research Cluster, CSIRO: Water for a Healthy Country National Research Flagship, Canberra.

CAF (Charities Aid Foundation) 2006, *International Comparisons of Charitable Giving*, www.cafonline.org/pdf/International%20Comparisons%20of%20 Charitable%20Giving.pdf (accessed 21 September 2009).

CALFED 2000, *Environmental Water Account Update*, http://wwwoco.water.ca.gov/calfedops/notes/2000/oct/ewaupdate.pdf (accessed 28 April 2009).

—— 2007, *CALFED Bay-Delta Program*, http://deltavision.ca.gov/ BlueRibbonTaskForce/August2007/Item_4_Attachment_2.pdf (accessed 18 August 2009).

—— 2008, *Program Plan (Year 2009): Environmental Water Account*, http://calwater.ca.gov/content/Documentslibrary/ProgramPlans/2008/ Draft_EWA_Program_Plan_Year_9.pdf (accessed 18 August 2009).

CBWTP (Columbia Basin Water Transactions Program) 2009, *Columbia Basin Water Transactions Program*, http://cbwtp.org/jsp/cbwtp/index.jsp (accessed 17 August 2009).

Chan, C., Laplagne, P. and Appels, D. 2003, *The Role of Auctions in Allocating Public Resources*, Productivity Commission Staff Research Paper, Melbourne.

Charney, S. 2005, *Decades Down the Road: An Analysis of Instream Flow Programs in Colorado and the Western United States*, Colorado Water Conservation Board, Denver.

CIT (Central Irrigation Trust) 2009, Berri, Cadell, Chaffey, Cobdogla, Kingston, Loxton, Moorook, Mypolonga and Waikerie Irrigation Trusts Incorporated and Lyrup Village Settlement Trust Incorporated: *Proposed Fees and Charges for the 2009/2010 year*, www.cit.org.au/ (accessed 7 November 2009).

COAG 1994, *The Council of Australian Governments' Water Reform Framework*, www.environment.gov.au/water/publications/action/pubs/policyframework.pdf (accessed 31 July 2009).

—— 2004, *The Intergovernmental Agreement 2004 on Addressing Water Over-allocation and Achieving Environmental Objectives in the Murray-Darling Basin*, www.coag.gov.au/coag_meeting_outcomes/2004-0625/docs/iga_water_ overallocation_murray_darling.pdf (accessed 20 October 2009).

—— 2006, *The Supplementary Agreement on Addressing Water Over-allocation and Achieving Environmental Objectives in the Murray-Darling*, www.cmd.act.gov.au/__data/assets/pdf_file/0016/2581/supplementary_ agreement_mdbasin.pdf (accessed 20 October 2009).

—— 2008a, *Communique*, 3 July, www.coag.gov.au/coag_meeting_ outcomes/2008-07-03/docs/communique 20080703.pdf (accessed 30 September 2009).

—— 2008b, *Murray-Darling Basin Environmental Water Recovery,* www.coag.gov.au/coag_meeting_outcomes/2008-1129/docs/20081129_water_ recovery_mdb.pdf, (accessed 20 October 2009).

Colorado Trout Unlimited 2009, *Colorado Water Project*, www.cotrout.org/Conservation/ColoradoWaterProject/tabid/89/Default.aspx (accessed 18 August 2009).

Commonwealth of Australia 2006, *Handbook of Cost Benefit Analysis*, January.

Crase, L. 2009, 'Water policy in Australia: the impact of change and uncertainty', in Dinar, A. and Albiac, J. (eds), *Policy and Strategic Behaviour in Water Resource Management*, Earthscan, London, pp. 91-107.

—— and O'Keefe, S. 2009, 'The paradox of national water savings: a critique of 'Water for the Future'', *Agenda*, vol. 16, no. 1, pp. 45-60.

Crossman, N.D., Connor, J. D., Bryan, B. A., Summers, D.M. and Ginnivan J. 2009, *Reconfiguring an Irrigation Landscape to Improve Provision of Ecosystem Services*, CSIRO Working Paper Series, no. 2009-07, Canberra.

CSIRO 2008a, *Water availability in the Murray-Darling Basin*, A report to the Australian Government from the CSIRO Murray-Darling Sustainable Yields Project, Canberra.

—— 2008b, *Water availability in the Murray*, A report to the Australian Government from the CSIRO Murray-Darling Basin, Sustainable Yields Project, Canberra.

CWT (Colorado Water Trust) 2009a, *Colorado Instream Flow Tax Credit*, www.coloradowatertrust.org/images/uploads/ISF_Tax_Credit_-_White_Paper_ Final_Draft.doc (accessed 18 August 2009).

—— 2009b, *Colorado Water Trust*, www.coloradowatertrust.org/ (accessed 18 August 2009).

CWWM (Committee on Western Water Management) 1992, *Water Transfers in the West: Efficiency, Equity, and the Environment*, National Academy Press, Washington DC.

DECCW (Department of Environment, Climate Change and Water) 2008, *RiverBank Business Plan 2008-09*, www.environment.nsw.gov.au/ resources/ water/environmentalwater/08474BusPlanPartA0611.pdf (accessed 6 October 2009).

—— 2009a, *City and Country Environment Restoration Program*, www.environment.nsw.gov.au/resources/candc/ccerp05634.pdf (accessed 25 November 2009).

—— 2009b, *Environmental Water Management Planning,* www.environment.nsw.gov.au/environmentalwater/watermanagement planning.htm (accessed 25 November 2009).

—— 2009c, *New South Wales RiverBank Business Plan Part B: Annual Plan 2009–10*, www.environment.nsw.gov.au/resources/environmentalwater/09547 riverbpptb.pdf (accessed 30 November 2009).

—— 2009d, *Rivers Environmental Restoration Program*, www.environment.nsw.gov.au/environmentalwater/rerp.htm (accessed 10 November 2009).

—— 2009a, *The NSW Rivers Environmental Restoration Program*, www.environment.nsw.gov.au/environmentalwater/rerp.htm (accessed 20 November 2009).

—— 2009b, *The NSW Rivers Environmental Restoration Program*, www.wetlandrecovery.nsw.gov.au/ (accessed 20 November 2009).

—— 2009e, *Water for the Environment's Achievements* www.environment.nsw.gov.au/environmentalwater/achievements.htm (accessed 25 November 2009).

DEH (South Australian Department of Environment and Heritage) 2009, *The Coorong, Lower Lakes and Murray Mouth, Directions for a Healthy Future*, Murray Futures project.

DEWHA 2008a, *Commonwealth Environmental Water Holder Business Plan 2008-09*, Canberra.

—— 2008b, *Restoring the Balance in the Murray-Darling Basin (water Entitlement Purchasing) Program Information and Guidelines 2008-09 for the Southern Murray-Darling Basin*, Canberra.

—— 2009a, *A Framework for Determining Commonwealth Environmental Watering Actions, A discussion paper*, www.environment.gov.au/water/policy-programs/cewh/pubs/cehw-framework-discussion-paper.pdf (accessed 30 September 2009).

—— 2009b, *Commonwealth Environmental Water Holder 2009-10 Business Plan*, www.environment.gov.au/water/publications/action/pubs/cewh-business-plan-2009-10.pdf (accessed 20 November 2009).

—— 2009c, *Commonwealth Environmental Water Holder Business Plan 2008-09*, www.environment.gov.au/water/publications/action/pubs/cewh-business-plan-2009-10.pdf (accessed 20 November 2009).

—— 2009d, *Criteria for Identifying Wetlands of International Importance*, www.environment.gov.au/water/topics/wetlands/ramsar-convention/ identification-criteria.html (access 19 October 2009).

—— 2009e, *Environmental Watering Locations*, www.environment.gov.au/ water/policyprograms/cewh/watering/index.html#catchments (accessed 10 November 2009).

—— 2009f, *Fact Sheet: Environmental Water Recovery*, www.environment.gov.au/water/policy-programs/entitlement-purchasing/ pubs/irrigator-recovery.pdf (accessed 19 October 2009).

—— 2009g, *Murray-Darling Basin Small Block Irrigators Exit Grant Package*, www.environment.gov.au/water/programs/entitlement-purchasing/small-block-irrigators.html (accessed 15 September 2009).

—— 2009h, *Murrumbidgee River Reach Pro*ject, www.environment.gov.au/water/policy-programs/water-smart/projects/ nsw16.html (accessed 2 October 2009).

—— 2009i, *Planned Approach for Restoring the Balance in the Murray-Darling Basin - Water Purchase Program: 2008-09 and Beyond*, www.environment.gov.au/water/publications/mdb/planned-approach-for-restoring-the-balance.html (accessed 13 September 2009).

—— 2009j, *Progress of 2008-09 Restoring the Balance in the Murray-Darling Basin Water Purchasing*, www.environment.gov.au/water/policy-programs/ entitlement-purchasing/2008-09.html (accessed 15 February 2010).

—— 2009k, *Restoring the Balance in the Murray-Darling Basin*, www.mdba.gov.au/files/restoring-balance.pdf (accessed 15 September 2009).

—— 2009l, *Sustainable Rural Water Use and Infrastructure*, www.environment.gov.au/water/policy-programs/srwui/index.html (accessed 23 November 2009).

—— 2009m, *Water for the Future Priorities*, www.environment.gov.au/water/ australia/priorities.html (accessed 20 November 2009).

—— 2009n, *Water Policy and Programs*, www.environment.gov.au/water/policy-programs/index.html (accessed 8 February 2010).

—— 2010, *Commonwealth Environmental Water Holder*, www.environment.gov.au/water/policy-programs/cewh/index.html (accessed 15 February 2010).

——2010, *First Southern Basin Tender 2009-10 Tender Guidelines*, Canberra.

—— nd, *Restoring the Balance in the Murray Darling Basin (Water Entitlement Purchasing): Program Information and Guidelines 2008-09 for the Northern Murray Darling Basin*, Canberra.

—— 2010, *Restoring the Balance in the Murray-Darling Basin Water for the Future - Fact Sheet*, www.environment.gov.au/water/publications/mdb/restoring-balance.html (accessed 10 March 2010).

DIPNR (NSW Department of Infrastructure Planning and Natural Resources) 2004, *A guide to the Water Sharing Plan for the Murrumbidgee Regulated River Water Source*, NSW Government, Sydney.

Dixon, P.B., Rimmer, M.T. and Wittwer, G. 2009, *Modelling the Australian Government's buyback scheme with a dynamic multi-regional CGE model*, General Paper, Melbourne, April.

DRC (Deschutes River Conservancy) 2009, *Deschutes River Conservancy*, www.deschutesriver.org (accessed 17 August 2009).

DSE (Victorian Department of Sustainability and Environment) 2007, *Stream Flow Tender in Melbourne Water Catchments*, www.melbournewater.com.au/content/library/rivers_and_creeks/stream_flow_management/Frequently_asked_questions.pdf (accessed 23 October 2009).

—— 2008a, *BushTender: Rethinking Investment for Native Vegetation Outcomes. The application of auctions for securing private land management agreements*, Department of Sustainability and Environment, East Melbourne.

—— 2008b, *Fact Sheet 2: What are we planning for?*, Draft Northern Regions Sustainable Water Strategy, www.ourwater.vic.gov.au/__data/assets/pdf_file/0016/22228/DSE_2_FactSheet_web.pdf (accessed 12 October 2009).

—— 2009, *Northern Region Sustainable Water Strategy*, November.

DWE (NSW Department of Water and Energy) 2009, *Proposal to enable environmental water entitlements acquired in the Darling River at Toorale Station, to be diverted downstream of the Menindee Lakes*, www.dwe.nsw.gov.au/water/pdf/recovery_darling_shepherding_report_water_accounting.pdf (accessed 12 October 2009).

DWR (Department of Water Resources) 2002, *Information to Parties Interested in Making Water Available to the Environmental Water Account or the State's 2002 Dry Year Water Purchase Program*, www.watertransfers.water.ca.gov/docs/Information_to_Parties_Interested5_13_02.pdf (accessed 28 April 2009).

—— 2005, *California Water Plan Update 2005: A Framework for Action*, www.waterplan.water.ca.gov/ (accessed 28 April 2009).

—— 2009, *California State Water Project Overview*, www.water.ca.gov/swp/ (accessed 28 April 2009).

—— and USBR (Californian Department of Water Resources and Bureau of Reclamation) 2008, *Water Transfers in 2009 Involving the California Department of Water Resources and Bureau of Reclamation, Mid-Pacific Region*, Draft Report, www.watertransfers.water.ca.gov/docs/sacvalley intro09.doc (accessed 28 April 2009).

Dyack, B., Rolfe, J., Harvey, J., O'Connell, D. and Abel, N. 2007, *Valuing recreation in the Murray: an assessment of the non-market recreational values at Barmah Forest and the Coorong*, CSIRO: Water for a Healthy Country National Research Flagship.

EAEST (EA Engineering, Science, and Technology) 1999, *Meeting Flow Objectives for the San Joaquin River Agreement 1999-2010: Environmental Impact Statement and Environmental Impact Report*, Lafayette and Sacramento, California.

Evans, R. 2004, River-groundwater interaction in the Murray–Darling Basin: technical status and management options, paper presented at the 9th Murray-Darling Basin Groundwater Workshop, Bendigo, 12–19 February.

Falconer, K. and Whitby, M. 1999, The Hidden Costs of Countryside Stewardship Policies: Investigating Policy Administration and Transaction Costs in Eight European Member States, Contributed paper, Agricultural Economics Society Annual Conference, Belfast, 26–29 March.

Freebairn, J. 2009, Allocation of and investment in the environment, contribution to the Productivity Commission Roundtable Proceedings, *Promoting Better Environmental Outcomes*, Melbourne.

—— and Quiggin, J. 2006, 'Water rights for variable supplies', *Australian Journal of Agricultural Economics*, vol. 50, no. 3, pp. 295-312.

Freshwater Trust 2009, *The Freshwater Trust: Changing the Course of Conservation*, www.thefreshwatertrust.org/ (accessed 18 August 2009).

Frontier Economics 2007, *The Economic and Social Impacts of Water Trading: Case Studies in the Victorian Murray Valley*, report for the Rural Industries Research and Development Corporation, National Water Commission and Murray–Darling Basin Commission, Canberra.

—— 2008, *Termination Fees and Landholder Considerations*, final report prepared for the ACCC, October.

—— 2009, *Volumetric Restrictions on Water Entitlement Trade*, a report prepared for the ACCC, August.

Fyfe, M. 2009, ‘Banks say ditching cap could help farmers’, *Sunday Age*, 3 May.

Garrett, P 2009, *New Southern Basin Water Purchasing for 2009-10*, Media release no PW 395/09, 14 December, www.environment.gov.au/minister/garrett/2009/pubs/mr20091214a.pdf (accessed 15 January 2010).

Garrick, D., Siebentritt, M.A., Aylward, B., Bauer, C.J. and Purkey, A. 2009, Water Markets and Freshwater Ecosystem Services: Policy Reform and Implementation in the Columbia and Murray Darling Basins, presentation to the International Conference on Implementing Environmental Water Allocations, Port Elizabeth, South Africa, 23–26 February.

Gippel, C.J. 2003, *Review of Achievements and Outcomes of Environmental Flow Initiatives Undertaken on the extended River Murray System to August 2002*, Report by Fluvial Systems Pty Ltd, Stockton, to Murray-Darling Basin Commission, Canberra, March.

Goesch, T. 2001, ‘Delivery charges for water: their impact on interregional trade in water rights’, *Australian Commodities*, vol. 8, no. 4, pp. 626-34.

Golden, D. and Aylward, B. 2006, *Instream Flow in the Deschutes Basin: Monitoring, Status and Restoration Needs*, Deschutes Water Alliance, Bend, Oregon.

Gorddard, R., Connor, J., and Ranjan, R., 2009, Environmental triage decisions during a drought, paper presented at the 53rd Annual Conference of the Australian Agricultural and Resource Economics Society, Cairns, 11–13 February.

Goulburn-Murray Water 2009a, *Goulburn-Murray Rural Water Corporation Fees and Charges 2009-10*, www.g-mwater.com.au/customer-services/feesandcharges (accessed 26 November 2009).

—— 2009b, *Terms and Conditions for Carryover of Seasonal Allocation*, www.g-mwater.com.au/downloads/Terms_and_conditions_for_permanent_carryover_2009.pdf (accessed 20 November 2009).

Hailu, A. and Thoyer, S. 2005, *Auction Design for Water Buybacks*, University of Western Australia Research Paper.

Hamstead, M. 2009, *Improving Environmental Sustainability in Water Planning*, National Water Commission Waterlines Report Series no. 20, September.

Hansen, K., Howitt, R. and Williams, J. 2006, Implementing options markets in California to manage water supply uncertainty, presentation at the American Agricultural Economics Association Annual Meeting, Long Beach, California, 23–26 July.

Hartwell, R. and Aylward, B. 2007, *Auctions and the Reallocation of Water Rights in Central Oregon*, River Paper Series no. 1, Deschutes River Conservancy, Bend, Oregon.

Heaney, A. and Hafi, A. 2005, Using water options to meet environmental demands, ABARE conference paper no. 05.3, presented at the 49th Annual Australian Agricultural and Resource Economics Society Conference, Coffs Harbour, 8–11 February.

—— Dwyer, G., Beare, S., Peterson, D. and Pechey, L. 2005, 'Third-party effects of water trading and potential policy responses', *Australian Journal of Agriculture and Resource Economics*, vol 50, no. 3, pp. 277-93.

Hodge, I. 2000, 'Agri-environmental policy: a UK perspective', in Helm, D. (ed), *Environmental Policy: Objectives, Instruments and Implementation*, Oxford University Press, pp. 216-40.

Hollinshead, S. and Lund, J. 2006, 'Optimization of Environmental Water Account purchases with uncertainty', *Water Resources Research*, vol. 42, no. 8, W08403.

Holding, T. (Victorian Minister for Water) 2010, *Changes to trading rules give Sunraysia irrigators greater choice*, 29 January, www.premier.vic.gov.au/component/content/article/9253.html (accessed 26 February 2010).

Horne, A., Stewardson, M., Freebairn, J., and McMahon, A. 2009, *Using an economic framework to inform management of environmental entitlements*, River Research and Applications, John Wiley & Sons Ltd.

Howe, C.W. and Goemans, C. 2003, 'Water Transfers and their Impacts: Lessons from Three Colorado Water Markets', *Journal of the American Water Resources Association*, October, pp. 1055-65.

Hughes, N. 2009, Management of irrigation water storages: carryover rights and capacity sharing, ABARE conference paper 09.2 presented at the Australian Agricultural and Resource Economics Society Conference, Cairns, 12 February.

Hunt, P. 2009, 'Sellers tap back into water well', *Weekly Times*, 28 October.

Hyder Consulting 2008*, Review of the 2007-08 Water Entitlement Purchases*, report to the Department of the Environment, Water, Heritage and the Arts, Canberra, 24 September.

Industry and Investment NSW nd, *Farm Budgets and Costs*, www.dpi.nsw.gov.au/agriculture/farm-business/budgets (accessed 10 March 2010).

Jerich, S. 1997, 'California's 1995 Water Bank Program: purchasing water supply options', *Journal of Water Resources Planning and Management*, vol. 123, no. 1, pp. 59-65.

Jones, G., Hillman, T., Kingsford, R., McMahon, T., Walker, K., Arthington, A., Whittington, J. and Cartwright, S. 2002, *Independent Report of the Expert Reference Panel on Environmental Flows and Water Quality Requirements for the River Murray System*, prepared for the Environmental Flows and Water Quality Requirements for the River Murray Project Board.

Keneally, K. and Wong, P. 2010, *Lower Lakes to receive at least 148 gigalitres from NSW Floods*, Media release, 19 January, www.ministers.sa.gov.au/images/stories/mediareleasesJAN10/joint%20release%20floodwaters.pdf (accessed 11 March 2010).

Kirby, M., Evans, R., Walker G., Cresswell, R., Coram, J., Khan, S., Paydar, Z., Mainuddin, M., McKenzie, N. and Ryan, S. 2006, *The Shared Water Resources of the Murray Darling Basin*, Murray-Darling Basin Commission, Canberra.

Land Use Consultants 1995, *Countryside Stewardship Monitoring and Evaluation*, Third Interim Report to the Countryside Commission, London.

Landry, C. 1998, *Saving our Streams Through Water Markets: A Practical Guide*, Political Economy Research Centre, Bozeman.

Latacz-Lohmann, U. 2000, European Agri-Environmental Policy Facing the 21st century, paper presented at the 44th Annual Australian Agricultural and Resource Economics Society Conference, Sydney, 23–25 January.

—— and Schilizzi, S. 2006, *Auctions for Conservation Contracts: a Review of the Theoretical and Empirical Literature*, report to the Scottish Executive Environment and Rural Affairs Department, no. UKL/001/05.

Lauer, S. 2009, *A Briefing on Californian Water Issues*, www.watereducation.org/userfiles/CA%20Briefing%20Feb%2009.pdf (accessed 18 August 2009).

Lockwood, M., Davidson, J., Curtis, A., Stratford, E,. Griffith, R. 2009, *Governance Principles for Regional Natural Resource Management,* Report No 1, University of Tasmania, Hobart.

Lower Murray Water 2009, *Lower Murray Urban and Rural Water Corporation Tariffs Notice of Tariffs: new tariffs from 1 July 2009*, www.lmw.vic.gov.au/html/customer_centre/documents/RuralTariffs200910.pdf (accessed 6 November 2009).

Mallawaarachchi, T. and Foster, A. 2009, *Dealing with irrigation drought: the role of water trading in adapting to water shortages in 2007-08 in the southern Murray-Darling Basin*, ABARE research report 09.6 to the Department of the Environment, Water, Heritage and the Arts, Canberra.

Malloch, S. 2005, *Liquid Assets: Protecting and Restoring the West's Rivers and Wetlands through Environmental Water Transactions*, Trout Unlimited, Arlington, Virginia.

MDBA (Murray-Darling Basin Authority) 2008, *The Living Murray Fact Sheet: Environmental watering Update*, www.mdba.gov.au/system/files/TLM-2008-environmental-watering_0.pdf (accessed 12 November 2009).

—— 2009a, *About the Basin Plan,* www.mdba.gov.au/basin_plan/concept-statement/about-the-basin-plan (accessed 28 October 2009).

—— 2009b, *Basin Plan Fact Sheet 3: Sustainable Diversion Limits and the Impacts of Environmental Water Purchases*, www.mdba.gov.au/files/ publications/Basin-Plan-SDL-fact-sheet.pdf, (accessed 20 November 2009).

—— 2009c, *Development of Sustainable Diversion Limits for the Murray-Darling Basin*, Issues Paper, November.

—— 2009d, *Environmental Watering Locations*, www.environment.gov.au/water/ policy-programs/cewh/watering/index.html (accessed 27 November 2009).

—— 2009e, *How the Basin Plan Will Affect Us All,* www.mdba.gov.au/basin_plan/concept-statement/effects (accessed 15 March 2010).

—— 2009f, *Murray–Darling Basin Authority Annual Report 2008–09,* www.mdba.gov.au/MDBA-Annual-Report/index.html (accessed 12 January, 2010).

—— 2009g, *Murray Darling Basin government irrigation storages — 30th September 2009*, www.mdba.gov.au/files/waterstorages/weeklybasinreports/ WB090930-Basin-Water-Storages-30September-2009.pdf (accessed 12 October 2009).

—— 2009h, *Northern Basin Program Options for Environmental Water: An Evaluation of the 2008 Narran Lakes Environmental Water Purchase*, www.mdba.gov.au/files/publications/Options-for-environmental-water.pdf (accessed 27 November 2009).

—— 2009i, *Progress Report on the Living Murray Initiative – the First Step*, www.mdba.gov.au/system/files/TLM-Progress-Report.pdf (accessed 20 November 2009).

—— 2009j, *River Murray System Drought Update 19: June*, www.mdba.gov.au/system/files/drought-update-June-2009.pdf (accessed 12 October 2009).

—— 2009k, *The Basin Plan: a Concept Statement*, www.mdba.gov.au/basin_plan/ concept-statement (accessed 20 November 2009).

—— 2009l, *The Living Murray Environmental Water Recovery Progress Report,* www.mdba.gov.au/system/files/Water-Recovery-progress-report.pdf (accessed 25 November 2009).

—— 2009m, *The Living Murray Water Purchasing Project FAQs*, www.mdba.gov.au/system/files/FAQs-TLM-Water-Purchase.pdf (accessed 10 November 2009).

—— 2009n, *Water Audit Monitoring Report 2007/08: Report of the Murray-Darling Basin Commission on the Cap on Diversions*, Canberra.

—— 2009o, *Water Recovery Measures*, www.mdba.gov.au/programs/tlm/water-recovery measures, (accessed 23 November 2009).

—— 2009p, *Water Recovery Measures*, www.mdba.gov.au/programs/tlm/water-recoverymeasures#Pilot_Environmental_Water_Purchase (accessed 18 October 2009).

—— 2009q, *Water Recovery Progress Report* http://www.mdba.gov.au/files/tlm/Water_Recovery_Progress_Report-22_Dec_2009_(2).pdf (accessed 30 December 2009).

—— 2010, *Murray-Darling Basin Water Recovery Report*, www.coag.gov.au/coag_meeting_outcomes/2009-12-07/docs/murray-darling_basin_report.pdf (accessed 10 March 2010).

MDBC (Murray-Darling Basin Commission) 2000, *Review of the Operation of the Cap*, Canberra.

—— 2001, *Water Audit Monitoring Report 1999/00*, Canberra.

—— 2002, *Water Audit Monitoring Report 2000/01*, Canberra.

—— 2003, *Water Audit Monitoring Report 2001/02: Report of the Murray-Darling Basin Commission on the Cap on Diversions*, Canberra.

—— 2004, *Water Audit Monitoring Report 2002/03: Report of the Murray-Darling Basin Commission on the Cap on Diversions*, Canberra.

—— 2005, *Water Audit Monitoring Report 2003/04: Report of the Murray-Darling Basin Commission on the Cap on Diversions*, Canberra.

—— 2006a, *Market Based Water Recovery Fact Sheet,* www.thelivingmurray.mdbc.gov.au/__data/page/195/TLMfactsheet-WaterRecoveryMarketMeasures.pdf (accessed 6 July 2009).

—— 2006b, *Water Audit Monitoring Report 2004/05: Report of the Murray-Darling Basin Commission on the Cap on Diversions*, Canberra.

—— 2007a, *Pilot Environmental Water Purchase Project*, http://thelivingmurray.mdbc.gov.au/programs/water_recovery/environmental_water_purchase/, (accessed 30 November 2009).

—— 2007b, *The Living Murray Business Plan 2007,* http://thelivingmurray.mdbc.gov.au/__data/page/1327/TLM_Business_Plan_2007_Revision.pdf (accessed 6 August 2009).

—— 2007c, *Water Audit Monitoring Report 2005/06: Report of the Murray-Darling Basin Commission on the Cap on Diversions*, Canberra.

—— 2008a, *Annual Report 2007-08*, www.mdbc.gov.au/subs/annual_reports/AR_2007-08/index.htm (accessed 3 August 2009).

—— 2008b *Barmah Choke Study, Fact Sheet 1: Project Background*, www.thelivingmurray.mdbc.gov.au/__data/page/1908/Barmah_Choke_FS1.pdf (accessed 12 October 2009).

—— 2008c, *Murray-Darling Basin Rivers: Ecosystem Health Check, 2004-07*, A summary report based on the Independent Sustainable Rivers Audit Group's SRA Report 1: A Report on the Ecological Health of Rivers in the Murray–Darling Basin, 2004–2007, submitted to the Murray–Darling Basin Ministerial Council in May.

—— 2008d, *Water Audit Monitoring Report 2006/07: Report of the Murray-Darling Basin Commission on the Cap on Diversions*, Canberra.

—— 2009, *The Murray-Darling Basin Agreement*, www2.mdbc.gov.au/about/the_mdbc_agreement.html (accessed 15 September 2009).

—— nd, *Projects being Implemented (Eligible Measures Register)*, www.thelivingmurray.mdbc.gov.au/programs/water_recovery/water_recovery_register/implemented (accessed 24 September 2009).

MDBMC (Murray Darling Basin Ministerial Council) 1995, *An Audit of Water Use in the Murray-Darling Basin - June 1995,* www.mdbc.gov.au/__data/page/86/95_Audit_report.pdf (accessed 31 July 2009).

—— 2003a, *Council of Australian Governments' Meeting Communiqué 14 November*, www.mdbc.gov.au/__data/page/1589/MC34_communique_Nov-03.pdf (accessed 30 June 2009).

—— 2003b, *Ecological Assessment of Environmental Flow Reference Points for the River Murray,* System Interim Report prepared by the Scientific Reference Panel for the Murray-Darling Basin Commission, Living Murray Initiative*, October 2003,* www.thelivingmurray.mdbc.gov.au/reports/srp_reports (accessed 20 August 2009).

—— 2006, *Issues and Options in applying market based measures in the Living Murray First Step March 2006,* www.thelivingmurray.mdbc.gov.au/__data/page/1327/Issues_and_options_ report.pdf (accessed 23 July 2009).

—— 2007, *Review of the Living Murray Implementation 2005/06, Report of the Independent Audit Group, May,* www.thelivingmurray.mdbc.gov.au/__data/page/1327/2006TLM_IAG_Report_- _Publish.pdf, (accessed 10 July 2009).

Melbourne Water 2007, www.melbournewater.com.au/content/library/rivers_and_creeks/stream_flow_management/stream_flow_reports/Olinda_Creek_Stream_Flow_Management_Plan_Low_Res.pdf (accessed 15 November 2009).

—— 2009, *Stream Flow Management,* www.melbournewater.com.au/content/rivers_and_creeks/waterway_diverters/stream_flow_management.asp (accessed 15 November 2009).

Merriman, D. and Janicki, A., 2009, *Colorado's Instream Flow Program - How it Works and Why it's Good for Colorado*, www.cde.state.co.us/artemis/nr3/nr32in72005internet.pdf (accessed 18 August 2009).

Michelsen, A.M. and Young, R.A. 1993, 'Optioning agricultural water rights for urban water supplies during drought', *American Journal of Agricultural Economics*, no. 75, pp. 1010-20.

Molle, F. and Turral, H. 2004, Demand management in a basin perspective: is the potential for water saving overestimated?, paper prepared for the International Water Demand Management Conference, Jordan, 30 May–3 June.

Murray Irrigation 2009, *2009/10 Pricing Schedule: Annexure A to the Charges Policy*, July, www.murrayirrigation.com.au/files/3291000.pdf (accessed 6 November 2009).

Murrumbidgee Irrigation 2009a, *Annual Report*.

—— 2009b, *Schedule of Charges 2009-10*, www.mirrigation.com.au/Customers/charges0910.htm (accessed 7 November 2009).

—— nd, *Barren Box Storage and Wetland — Overview*, www.mirrigation.com.au/BBS/Overview.htm (accessed 6 November 2009).

NFF (National Farmers Federation) 2009, *Submission to the Issues Paper: Development of Sustainable Diversion Limits for the Murray-Darling Basin*, www.nff.org.au/get/2478946153.pdf (accessed 15 March 2010).

NWC 2007, National Water Initiative Biennial Assessment of Progress, First Assessment, Canberra, July 2007.

—— 2008, *Australian Water Markets Report 2007–2008*, Canberra.

—— 2009a, *Australian Water Markets Report 2008–2009*, Canberra.

—— 2009b, *Australian Water Reform 2009: Second biennial assessment of progress in implementation of the National Water Initiative*, Canberra.

—— 2009c, *Water Dictionary*, Canberra.

NSW Government and Commonwealth of Australia 2009, *Memorandum of Understanding in Relation to Water for the Environment*, September, www.water.nsw.gov.au/About-us/News/2009/default.aspx (accessed 29 October 2009).

NVIRP (Northern Victorian Irrigation Project) nd, *Stage 1 and 2*, www.nvirp.com.au/the_project/stage_1_and_2.aspx (accessed 2 October 2009).

Oregon Watershed Enhancement Board 2001, *A Strategy for Achieving Healthy Watersheds in Oregon*, Oregon Watershed Enhancement Board, Salem.

Pagel, M.O. 2002, *The Intersection of Federal ESA Regulations and State Water Law*, www.schwabe.com/showarticle.aspx?Show=9070 (accessed 17 August 2009).

Pannell D. 2008a, 'Environmental policy for environmental outcomes', in Productivity Commission Roundtable Proceedings, *Promoting Better Environmental Outcomes*, Canberra 19–20 August.

—— 2008b, 'Public benefits, private benefits, and policy intervention for land-use change for environmental benefits', *Land Economics*, vol. 84 no. 2, pp. 225–40.

—— 2008c, *Triage in environmental management*, http://cyllene.uwa.edu.au/~dpannell/pd/pd0131.htm (accessed 29 July 2009).

PC (Productivity Commission) 2003, *Water Rights Arrangements in Australia and Overseas*, Commission Research Paper, Melbourne.

—— 2004, *Impacts of Native Vegetation and Biodiversity Regulations*, Inquiry Report no. 29, Melbourne.

—— 2006, Rural *Water Use and the Environment: The Role of Market Mechanisms*, Research Report, Melbourne, August.

—— 2009, *Government Drought Support*, Inquiry Report no. 46, Melbourne.

Perry, C. 2007, 'Efficient Irrigation; Inefficient Communication; Flawed Recommendations', *Irrigation and Drainage*, vol. 56, pp. 367-78.

Peterson, D., Dwyer, G., Appels, D. and Fry, J. 2004, *Modelling water trade in the southern Murray-Darling Basin*, Productivity Commission Staff Working Paper, Melbourne.

Pincus, J. and Shapiro, P. 2008, 'Between forced resumption and voluntary sale: a mechanism for the collective sale or transfer of irrigation water', *Economic Papers*, vol. 27, no. 4, pp. 303-14.

Price Waterhouse Coopers 2006, *National Water Initiative water trading study*, Report to the Department of the Prime Minister and Cabinet, June.

Qureshi, M.E., Connor, J., Kirby, M. and Mainuddin, M. 2007, 'Economic assessment of acquiring water for environmental flows in the Murray Basin', *Australian Journal of Agricultural and Resource Economics*, vol. 51, no. 3, pp. 283-303.

——, Schwabe, K., Connor, J. and Kirby, M. 2010, 'Environmental Water Incentive Policy and Return Flows', *Water Resources Research*, in press.

Rice, T.A. and MacDonnell, L.J. 1993, *Agricultural to Urban Water Transfers in Colorado: An Assessment of the Issues and Options*, Colorado Water Resources Research Institute, Fort Collins.

RMCG 2009, *Socio-economic impacts: closure of Wakool Irrigation District (or parts thereof)*, http://wakool.local-e.nsw.gov.au/files/353401/File/SocioEconomicmpactsWakoolShire09.pdf (accessed 13 October 2009).

Robson, B.J., Mitchell, B.D. and Chester, E.T. 2009, *Recovery pathways after flow restoration in rivers,* Waterlines Report Series, No. 15, February, National Water Commission, Canberra.

RRDB (Riverina Regional Development Board) 2004, Submission to Inquiry into the Murrumbidgee College of Agriculture, RRDB, Wagga Wagga.

Rudd, K. (Prime Minister) 2008, *New measures to deal with the critical situation in the Murray-Darling Basin*, Media release, 14 August.

—— and Brumby, J. (Premier of Victoria) 2009, *New Commonwealth – Victorian water agreement*, Media release, 4 June.

Sawyers, G. 2005, A primer on California water rights, paper presented at the University of California Agricultural Issues Centre 2005 Spring Outlook Forum.

Schiller, E. 1998, *The Oregon Water Trust*, Competitive Enterprise Institute, Washington DC.

Scoccimarro, M. and Collins, D. 2006, *Natural Resource Buybacks' and their Use to Secure Environmental Flows*, Land & Water Australia, Canberra.

SCRRAT (Standing Committee of Rural and Regional Affairs and Transport) 2008, *Water management in the Coorong and Lower Lakes (including consideration of the Emergency Water (Murray-Darling Basin Rescue) Bill 2008)*, Canberra.

SKM (Sinclair Knight Merz) 2002, *The FLOWS method, A method for determining environmental watering requirements in Victoria*, report prepared for the Victorian Department of Natural Resources and Environment, February.

—— 2009a *Water Trade and the Hydrological Connectivity of Surface Water Systems*, Melbourne.

—— 2009b *Water Trade Between Water Sources: Trade involving farm dams and unregulated catchments*, Melbourne.

Social and Economic Reference Panel for the MDBC 2008*, Brief Assessment of the Merits of Purchasing Water Entitlements During a Time of Low Water Availability*, April.

Solley, W. B. 1997, *Estimates of Water Use in the Western United States in 1990, and Water Use Trends, 1960 to 1990*, US Geological Survey, Reston, Virginia.

Spencer, C. 2004, Evolution of strategies and practices for acquisition, storage, and conveyance, presentation at Calwater Workshop, 8 September.

SRP (Scientific Reference Panel) 2003, *Ecological Assessment of Environmental Flow Reference Points for the River Murray System*, Interim Report prepared for the Murray Darling Basin Commission, Living Murray Initiative.

SWRCB (State Water Resources Control Board) 1999, *A Guide to Water Transfers*, www.waterboards.ca.gov/waterrights/water_issues/programs/water_transfers/ docs/watertransferguide.pdf (accessed 28 April 2009).

Tanner, L. 2009, (Minister for Finance and Deregulation), Second Reading, Appropriation (Water Entitlements) Bill 2009-2010, House of Representatives, *Proof Hansard*, 18 November, p. 5.

Tenorio, R. 1993, 'Revenue equivalence and bidding behaviour in a multi-unit auction market: an empirical analysis', *Review of Economics and Statistics*, vol. 75, no. 2, pp. 302-14.

The Allen Consulting Group 2006, *Transaction costs of water markets and environmental policy instruments*, report to the Productivity Commission.

—— 2007, *Improving market confidence in water intermediaries*, Waterlines Occasional Paper No. 3, National Water Commission, Canberra.

Upper Colorado Endangered Fish Recovery Program 2009, *The Upper Colorado River Basin and Endangered Fish*, www.fws.gov/coloradoriverrecovery/ Crovervu.htm (accessed 18 August 2009).

USBR (United States Bureau of Reclamation) 2003a, *Frequently Asked Questions*, www.usbr.gov/ mp/cvpia/3406b3_wap/faq.html (accessed 28 April 2009).

—— 2003b, *U.S. Department of Interior Water Acquisition Program: Anadromous Fish Restoration Program Fact Sheet*, www.usbr.gov/mp/cvpia/3406b3_wap/ info/fact_sheet_afrp_11-2003.pdf (accessed 28 April 2009).

—— 2003c, *U.S. Department of Interior Water Acquisition Program: Background Information Sheet*, www.usbr.gov/mp/cvpia/3406b3_wap/info/background_info_sheet_11-2003.pdf (accessed 28 April 2009).

—— 2009, *Water Acquisition Summary*, www.usbr.gov/mp/cvpia/3406b3_wap/docs/latest_water_acq_sum.pdf (accessed 28 April 2009).

van Dijk, A., Evans, R., Hairsine, P., Khan, S., Nathan, R., Paydar, Z., Viney, N. and Zhang. L. 2006, *Risks to the Shared Water Resources of the Murray-Darling Basin*, prepared by the CSIRO for the MDBC, Canberra.

VEAC (Victorian Environmental Assessment Council) 2008, River Red Gums Forest Investigation, Final Report, www.veac.vic.gov.au/riverredgumfinal/VEAC_RRGF_final_report-all.pdf (accessed 30 September 2009).

Walker Foundation 2009, *2005-06 Water Rights Acquisition Program*, http://walker-foundation.org/net/org/project.aspx?projectid=43127&s=24518.0.69.5316 (accessed 18 August 2009).

Water Colorado 2009, *Buying Water Rights: How is it Done?*, www.watercolorado.com/water_rights-buying_water.shtml (accessed 17 August 2009).

Waterfind 2009, *2008-09 Annual Murray-Darling Basin Water Market Report*, Adelaide.

WFR (Water for Rivers) 2009a, *Completed Projects,* www.waterforrivers.org.au/projects/completed/ (accessed 16 November 2009).

—— 2009b, *Current Projects*, www.waterforrivers.org.au/projects/current/ (accessed 16 November 2009).

——2009c, *On-Farm Recongiguration*, www.waterforrivers.org.au/projects/current/reconfiguration.asp (accessed 16 November 2009).

—— 2009d, *The Murray River*, www.waterforrivers.org.au/murray/ (accessed 16 November 2009).

—— 2009e, *Water for Rivers*, www.waterforrivers.org.au/ (accessed 20 November 2009).

—— 2009f, *Water Recovery Progress Report – May 2009*, www.waterforrivers.org.au/about/update/ (accessed 16 November 2009).

—— 2009g, *Water Recovery Program*, www.waterforrivers.org.au/about/program/ (accessed 16 November 2009).

Watermart 2009, *Water Mart On Market Trading Platform*, www.colyirr.com.au/waterMart/ (accessed 12 October 2009).

Waterwatch Australia 2002, *National Technical Manual, Module 4, Physical and Chemical parameters*, www.waterwatch.org.au/publications/module4/ turbidity.html (accessed 6 November 2009).

Wentworth Group of Concerned Scientists 2008, Submission to Senate Inquiry into the urgent provision of water to the Coorong and Lower Lakes, September.

Wong, P. (Commonwealth Minister for Climate Change and Water) 2008, *Rudd Government to invest $12.9 billion in water*, Media release no. PW 56/08, 29 April, www.environment.gov.au/minister/wong/2008/pubs/mr20080429.pdf (accessed 14 August 2009).

—— 2009a, *$56 million for development of a national water market system,* Media release no. PW 324/09, 9 November.

—— 2009b, *Address to the Murray Darling Association 65th National Conference and AGM*, www.climatechange.gov.au/minister/wong/2009/major-speeches/September/sp20090904.aspx (accessed 15 February 2010).

—— 2009c, *New Murray-Darling water market and termination fee rules*, Media release no PW 25/09, 11 February, www.climatechange.gov.au/ minister/wong/2009/media-releases/ February/mr20090211.aspx (accessed 23 November 2009).

—— 2009d, Speech given at the Victorian Farmers Federation Annual General Meeting, 11 June, Melbourne, www.climatechange.gov.au/minister/wong/ 2009/major-speeches/June/sp20090611.aspx (accessed 9 November 2009).

—— and MacDonald, I. (NSW Minister for Primary Industries) 2009, *$21.7 million for irrigation efficiency in the Gwydir Valley*, Media release no. PW 289/09, 7 October.

WRD (Oregon Water Resources Department) 2009a, *Flow Restoration in Oregon*, www.oregon.gov/OWRD/ mgmt_instream.shtml (accessed 17 August 2009).

—— 2009b, Water Right Transfers, www.wrd.state.or.us/OWRD/ mgmt_transfers.shtml (accessed 17 August 2009).

Young, M. D., *Managing Environmental Water*, Paper prepared for an Australian Farm Institute environmental water project to be published in June 2010. Australian Farm Institute, Sydney.