

Lessons from the Australian Millennium Drought

Stuart White
Institute for Sustainable Futures
University of Technology Sydney

In the period 1995 to 2009 Australia experienced the millennium drought. In many parts of Australia, this was the worst drought since records began. Water storages for many Australian cities and towns reached the lowest levels recorded. Irrigated agriculture was also severely affected.

Some of the strategies that were adopted by the urban water industry, supported or advised by the Institute for Sustainable Futures at the University of Technology Sydney included:

- implementation of water use restrictions regimes, some standard and some more innovative
- innovative drought planning and contingency methods using 'real options' analysis for supply-side (desalination, groundwater and inter-catchment transfer) and demand-side (accelerated demand management, wastewater reuse) options
- design, assessment, implementation, monitoring and evaluation of water efficiency programs
- drought pricing options
- large scale customer engagement options including web-based self assessment

There are several key lessons that were learnt, and principles that were applied. Some of these are described below.

1. The linkages between long term supply demand planning strategy and drought response strategy are important. Although the severity of the millennium drought surprised many in the Australian water industry, some cities had already invested heavily in water efficiency before the drought, and some would have come close to dead storage without this investment. Water

efficiency investment has been the quiet achiever over the last 20 years, saving more water than has been used from new supplies, at a fraction of the cost.

2. In terms of drought response, the most effective strategies combined supply-side options and demand-side options. *There was a need to buy time, to slow the rate of decline in storages by reducing demand.* This was achieved through a combination of restrictions, target campaigns e.g. “Target 140”, accelerated demand management – based on rapid and large scale investment in water efficiency. Supply options included desalination, inter-catchment transfers, groundwater, large scale reuse schemes and storage augmentation.
3. This drought saw the emergence of the idea of applying ‘real options’ analysis to water supply planning for the first time in Australia. For example, in Sydney, we provided advice to the state government to apply these principles through a strategy of desalination readiness with the potential to save AUD\$1 billion. This advice was accepted and stood for 12 months, before being overturned, at considerable on-going cost.
4. The water industry is changing rapidly. Just as we are in the middle of big changes in the energy industry, we are seeing the beginning of similar shifts in urban water management. Per capita demand has hardly increased since the drought despite the removal of restrictions. There is increasing interest and investment by the development industry in integrated water solutions including precinct and building wastewater and stormwater reuse. The water-energy nexus is now well understood, which will mean increased questioning of energy intensive solutions. Finally global awareness of the importance of recovering scarce nutrients, particularly phosphorus is increasing. Smart meters, feedback and customer empowerment are increasingly expected. All of this means that drought responses will need to be ‘future proof’ for this changing backdrop.

The accompanying table provides a summary of the options that were applied in various locations and in varying degrees during the Australian millennium drought.

Stuart White
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Range of options applied during Australian millennium drought

Option	Type	Description	Indicative marginal cost (BRL/m ³)	Timescale (Short: 3 to 6 months; Medium 6 – 24 months; Long: 2 – 5 years)	Being applied or considered in Sao Paulo?	Examples/ notes
Access dead storage	Emergency supply	Construction of pumps and infrastructure to access water below gravity off-take points	30+	M	Y	Applied in Sydney in 2006. Marginal cost is high as this option only provides additional water during severe (say 1:100) drought periods.
Emergency groundwater supplies	Emergency supply	Construction of groundwater extraction infrastructure for emergency replenishment of water supplies.	30+	M - L		Applied in Sydney in 2006. In this case, it was designed to operate only during drought, allowing the aquifer to recharge at other times.

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Inter-catchment transfers	Supply	Construction of pipelines and channels to transfer water from other catchments.	3-10	M - L	Y	Applied in Melbourne and south-east Queensland. Can be undertaken in a contingency or real options manner. The marginal cost depends on whether the water source is only used during drought.
Desalination	Supply	Construction of seawater desalination plants for supply of water to coastal cities.	6-10	L	Not suitable	Applied widely in Australia, with mixed results. In Sydney, the first application of real options planning ('readiness to construct') desalination capacity was applied February 2006 - February 2007.
Advanced wastewater treatment for indirect potable reuse	Supply	Construction of additional treatment systems on existing wastewater treatment plants to provide high quality treated effluent to supplement potable water supply reservoirs or groundwater sources.	3-10	L	Y	Constructed as a contingency option for south-east Queensland, and subsequently as a main water supply in Perth.

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Advanced wastewater treatment for non-potable reuse	Source substitution	Construction of additional treatment on existing wastewater treatment plants to provide high quality treated effluent for non-potable uses to industry, businesses, larger users.	3-10	M-L	Y	Constructed in South-East Queensland, and Sydney.
Decentralised (building or precinct) wastewater reuse	Source substitution	Construction of small scale modular wastewater treatment plants in buildings or precincts, such as in basement or neighbouring car parks, to provide water for non-potable purposes (cooling towers, toilets, irrigation, wash down).	3-10	S-M		Several examples in Sydney and Melbourne, driven by green building rating, and also enabled by new legislation in New South Wales (Water Industry Competition Act).
Pressure and leakage management	Demand reduction	Management of pressure in the network to reduce bursts and losses, and active management of leakage through routine testing of the distribution network on a rolling basis.	1-4	S-M	Y	This option was in place in many cities, but was significantly accelerated in Sydney and south-east Queensland. It can be ramped up quickly with the right equipment and skilled workforce.

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Apartment metering	Demand reduction	Retrofitting of water meters to each individual unit of occupancy, with, for example, remote reading of smart meters.	1-4	S-M		A program of retrofitting water meters was rolled out in New York City and resulted in a 20% reduction of water use. It also reduces conflict and allows drought management responses to be better targeted and equitable.
Water use restrictions	Drought management	Rules for acceptable water use imposed, with fines for breaches. This includes a ban on hosing down hard surfaces or vehicles, structured times and days for outdoor irrigation, management of the use of pools, car washes and playing field irrigation.	<1	S	Y	The rules vary by city, and also the severity of the requirements varies depending on dam levels. In Australia, there has been a long history of water use restrictions during drought.
Water rationing	Drought management	Limiting water use to industries or geographical zones.	<1	S	Y	This can be imposed more easily where break tanks are in place, but has practical (backflow) and equity implications.

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Drought pricing	Drought management	Increasing the price of water during drought periods, depending on the level of reservoirs, and for water use over pre-determined and advertised levels.	<1	S		This option has had limited application in Australia except for fines for exceeding water use limits. It has significant advantages in terms of a price signal and also to maintain utility revenues when they are most needed. Issues of equity, low-income support and shared metering need to be considered in the design.
Campaign with per capita water use targets and other benchmarks	Drought management	A mass campaign associated with a per person demand target	<1	S		This option was very successful in south-east Queensland, and also in Melbourne. In south-east Queensland 'Target 140' exceeded its goal (127 litres per person per day was achieved). This was assisted by other water efficiency programs (see below).

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High water users engagement	Drought management	A major program of contacting the top (say) 10% of water using households and requiring their participation in a household survey, and requesting their engagement with water efficiency programs.	<1	S		This program was implemented in south-east Queensland, and was very successful. An online and hard copy survey was used, and achieved over 90% compliance.
Water efficiency performance standards	Demand reduction	This involves national regulation of the efficiency of water using appliances, fixtures and equipment. This includes cooling towers, toilets, urinals, washing machines, dishwashers, taps, shower heads, irrigation equipment.	1-4	M-L		This option has been in place in Australia for some appliances, and is being considered for others. The US Energy Act (1992) is a model, as is the Brazilian standards for e.g. electric motors.

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Building regulations	Demand reduction	This involves specifying the water using performance of new houses, apartments and other buildings.	1-4	M		This has been implemented in various forms in various Australian states. The New South Wales regulation (www.basix.nsw.gov.au) is performance-based and specifies a 40% reduction in demand for new houses based on 2004 average demand.
Business water efficiency programs	Demand reduction	This involves providing incentives to encourage the retrofitting of water efficient equipment and the use of water efficient processes in shops, offices, factories, restaurants and other businesses. This includes cooling towers, toilets, urinals, irrigation systems, taps, showers, wash down, laundries, leakage reduction on premises.	1-4	S		This has been implemented in various forms in various Australian cities. In some cases free or reduced cost water audits are offered, in others support for implementation. In other cases loans have been used, and business consumers are required to take advantage of water efficiency incentive schemes.

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Residential water efficiency programs	Demand reduction	This can take several forms, including a low cost service offered to visit households, assess water use efficiency, offer the installation of replacement reduced cost efficient appliances and fixtures. It can also involve rebates offered on appliances and fixtures including washing machines, toilets or showerheads. The aim is to increase the proportion of water using equipment that is best practice in terms of efficiency.	1-4	S		This option had been in place before the drought in Sydney, and in minor ways in other cities. During the drought it was accelerated and expanded in a significant way in Sydney, south-east Queensland.
Government buildings water efficiency programs	Demand reduction	A requirement that all government agencies implement programs to improve the efficiency of water using equipment and processes in the buildings they control. This includes offices, hospitals, schools, depots.	1-4	S		This can take the form of a policy requiring the actions, along with a revolving loan fund to support the implementation.

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Hotel water efficiency program	Demand reduction	A requirement that all hospitality service providers implement systems to educate guests and staff (e.g. cleaners) regarding the water situation and provide encouragement and incentives to conserve water.	1-4	S		This option has wider publicity and awareness benefits and also has an impact on a sector with high water use per capita.
Conservation credits	Enabling process	A financing scheme where government or the utility provides an agreed and pre-determined amount of funding to agencies, organisations or firms where a structural water saving will be achieved and can be demonstrated.	1-4	S		This has been used in California by bulk water agencies to provide incentives to municipalities to conserve. It is similar to the rebate or discount for reduced water use to households in Sao Paulo, but aimed at enabling private sector or organisational responses.

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