When the Billabong Runs Dry – A Review of the Australian Water Industry

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Abstract

The billions of dollars being spent on new water infrastructure in Australia is in response to the twin drivers of ongoing drought and population growth. An overview is presented of population forecasts, demands for water from the urban, industrial and agricultural sectors, surface water and groundwater resources, the drought of the last decade and its impact on yields and reserves. For the three eastern seaboard states of Queensland, New South Wales and Victoria the infrastructural and water policy responses to this overview are described, and some commentary provided on the appropriateness of the responses and the lessons that New Zealand could learn from current events in the Australian water industry.

Keywords

Australia, drought, population growth, infrastructure, indirect potable reuse, desalination

1. Introduction

The twin drivers of ongoing drought and population growth in Australia have, and will continue to, require billions of dollars to be spent on new water infrastructure. This paper presents an overview of the water industry in Australia by describing: population growth forecasts, demands for water from the urban, industrial and agricultural sectors, surface water and groundwater resources, the drought of the last decade and its impact on yields and reserves, the infrastructural responses, and the policy responses. It covers the three eastern seaboard states of Queensland, New South Wales and Victoria; but focuses more on Victoria.

2. Population

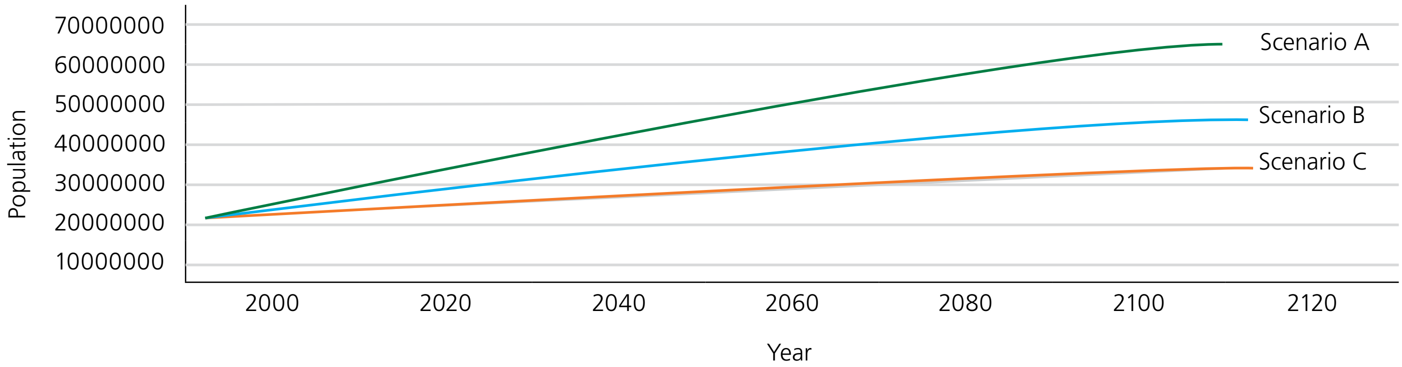
The current population of Australia is 21.8 million people (Trewin, 2006). Estimates of future growth by the Australian Bureau of Statistics (ABS) are for three different population growth scenarios stretching from 2006 to 2101, and these are presented in Figure 1. The scenarios take into account estimates of fertility, life expectancy at birth and overseas and interstate migration. Scenario A and Scenario C assume high and low values respectively. Scenario B assumes current trends will hold for the projected time period.

Scenario B, based on extrapolating current demographic trends, estimates a population of 44.7 million people in 2101, i.e., more than doubling by the end of this century.

The majority of Australia's population growth is through overseas migration. For the year ending 31 December 2008, Australia's population grew by 1.9%, the highest since the 1950s and 60s post-war migration. 62% of this growth was from overseas migration, the remaining growth from natural increase.

As for New Zealand, population growth can be stimulated or restrained by the government's policy on immigration. Scenario B assumes that the Federal Government's immigration policy remains unchanged.

Figure 1: Population Growth Scenarios



3. Demands for Water

3.1 Sector Demand

Australia's economy is built on primary production, with the key sectors of agriculture, mining, and oil & gas production. The agriculture industry is the main consumer of water. Data obtained for the year June 2004 to June 2005 showed that agriculture accounted for 65% of Australia's total water consumption (Trewin, 2006). The largest consumers within the agriculture sector include livestock, pasture, grains, dairy farming, sugar and cotton.

Figure 2 shows total water consumption by sector for three separate one-year periods (1996/97, 2000/01, and 2004/05).

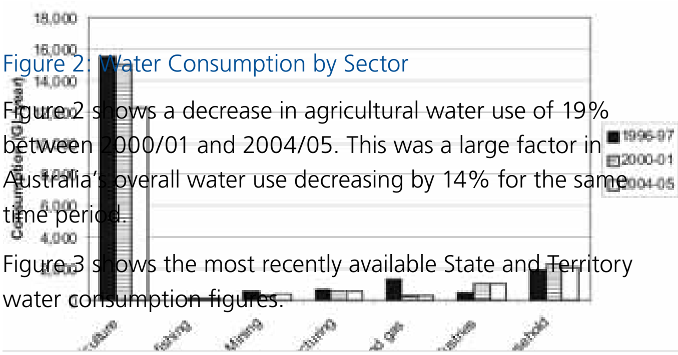


Figure 2: Water Consumption by Sector

Figure 2 shows a decrease in agricultural water use of 19% between 2000/01 and 2004/05. This was a large factor in Australia's overall water use decreasing by 14% for the same time period.

Figure 3 shows the most recently available State and Territory water consumption figures.

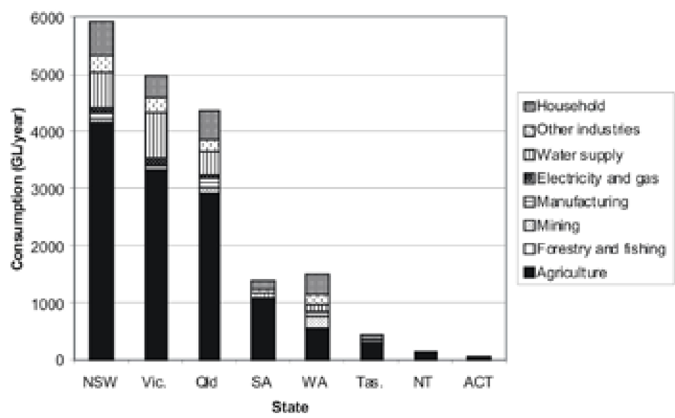


Figure 3: Water Consumption by State/Territory for 2004-05

Water consumption for individual states shows a similar trend to national data, with seven out of eight states having agriculture as the primary water consumer. Western Australian and Northern Territory also show significant water use contributions from mining and industrial sectors.

4. Water Resources

4.1 Climate

The spatial rainfall variation in Australia ranges from an average of 2400 mm/year in parts of the tropics of Queensland and the west coast of Tasmania, through 1200 – 2000 mm/year along most of the NSW, Queensland and Northern Territory coastline, to less than 200 mm/year in inland areas.

The temporal variability is moderate to very-high across most of the country, with low and low-to-moderate variability occurring only in Tasmania, the southern parts of the eastern states, and the northern tips of the country. Typically, high temporal variability is associated with low annual rainfall. (Letcher & Powell, 2008).

Evapotranspiration, which is a significant determinant of water availability particularly during times of drought, increases to the north due to higher solar radiation, and decreases to the east coast due to cloudiness. Potential point evapotranspiration varies from about 1000 mm to 3400 mm/year, and for much of Australia it exceeds the annual rainfall.

4.2 Surface Water

Australia's average annual runoff is estimated at 397,000 GL, which is equivalent to 52 mm/year of runoff, or just 11% of the mean annual rainfall. (Phillips, 2006). If compared with total water consumption (refer Figure 2) of about 20,000 GL/year, consumption represents about 5% of average annual runoff. However, this percentage belies the fact that some of the heaviest rainfall areas in northern Australia and in Tasmania are well away from the main population centres.

Australia's average annual runoff is the lowest of all the other continents (excluding Antarctica), as demonstrated in Figure 4 (BOM, 1999). In somewhat greater contrast to Australia, the islands of New Zealand have an average runoff value (1995 to 2001) of 870 mm, and an averaged annual precipitation of 1700 mm (1995 to 2001); i.e., slightly more runoff and rainfall than South America.

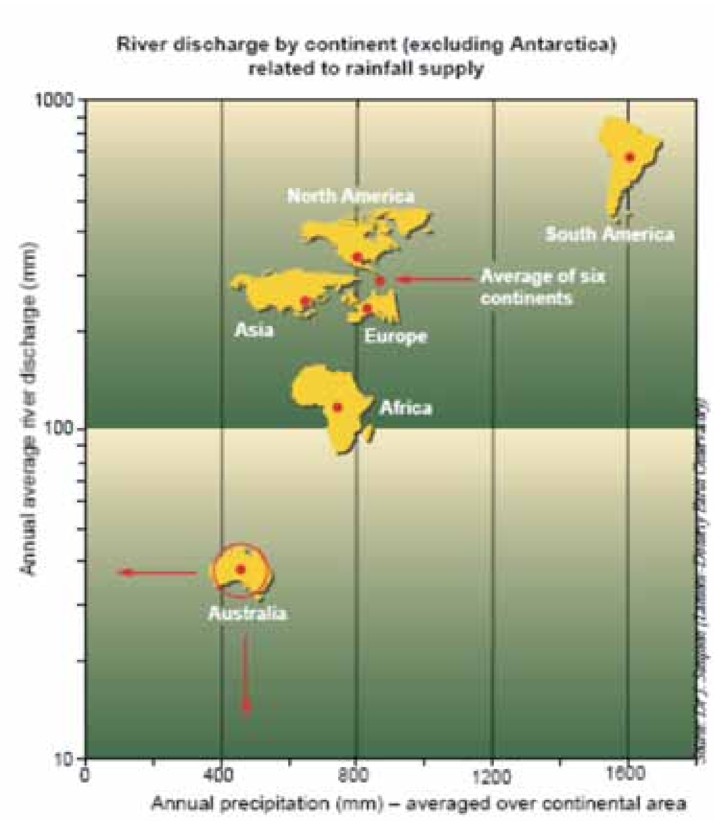


Figure 4: Runoff Depths for Different Continents

An audit undertaken in 2000 found there were 447 large dams, with a combined capacity of 79,000 GL (Letcher & Powell, 2008), representing about 4 years' worth of the annual consumption in that year.

4.3 Groundwater

The National Land and Water Resources Audit 2001 estimated the sustainable yield of groundwater of a salinity of less than 1500 mg/L to be about 21,000 GL/year (ABS, 2005). About 80% of total water consumed in Australia is surface water and about 20% is groundwater, but this ratio has not been updated since 1996-97 (ABS, 2007).

The Great Artesian Basin is Australia's largest ground water resource. It is the largest and deepest artesian basin in the world, covering 1.7 million km^2 or 23% of Australia's land area, and is supplying 570 GL/year for mining and grazing. (Letcher & Powell, 2008).

4.4 The Drought

4.4.1 The Last Decade

Rainfall has been below average across much of southwest and southeast Australia since 1997, while the Murray-Darling Basin has experienced below average rainfall since 2002.

For the 24-month period from July 2007 to June 2009, serious to severe rainfall deficiencies are evident across much of southeast Australia and parts of central Australia. These deficiencies cover most of the agricultural areas of SA, much of Victoria, eastern and northern Tasmania and some southern border areas of NSW.

For the 6-month period from January to June 2009, serious to severe rainfall deficiencies are evident over most of central, southern and eastern Victoria as well as the Lower South East district in SA. Victoria has now experienced its fourth driest January to June period on record. A large area of lowest on record rainfall for the six months was recorded in Melbourne and adjacent parts of Gippsland. A few very isolated areas of serious to severe deficiencies are also evident across the far southeast of NSW, central Australia and southwest WA. When compared to a month ago, good rainfall over southwest WA during June has relieved most of the short-term rainfall deficits that existed in the 5-month period ending May 2009. (BOM, 2009).

Near- to above-average rains in the twelve months ending October 2008 eased the situation slightly in the northern half of the Murray-Darling Basin (northern NSW and southern inland Queensland) and in south-east Queensland, though large deficiencies remain. In contrast much of northern Australia continued to experience well above average rainfall, with record high rainfall widespread about the Top End, Kimberly and parts of Cape York Peninsula over the 3 to 10 year timeframe. (BOM, 2008). Most of central and northern Queensland recorded average to above-average rainfall over the 2008/09 summer rainfall season (DERM 2009).

Much has been made of climate change in explaining the drought, and many governments and water authorities believe that the drought represents a step change in Australia's climate towards a permanently drier regime – "drought is the new reality!". It pays to bear in mind, however, that Australia has a relatively short hydrological record, and the geophysical and other paleo-data reveal greater climate extremes in the past than are currently being experienced (refer, for example: Plimer, 2009).

4.4.2 Melbourne

Since 1997 surface water inflows into the Melbourne water supply reservoirs have generally been well below the long term average observed since 1913. The years 1997/98, 2002/03 and 2006/07 were major droughts, with the 2006 calendar year the lowest inflows on record. Figure 5 shows annual inflow data for the period from 1913 to 2007 for Melbourne's four main harvesting reservoirs (Thomson, Upper Yarra, O'Shannassy and Maroondah). (DSE, 2008b).

The step change in inflows since 1997 that is shown in Figure 5 was also experienced in the Perth water supply system.

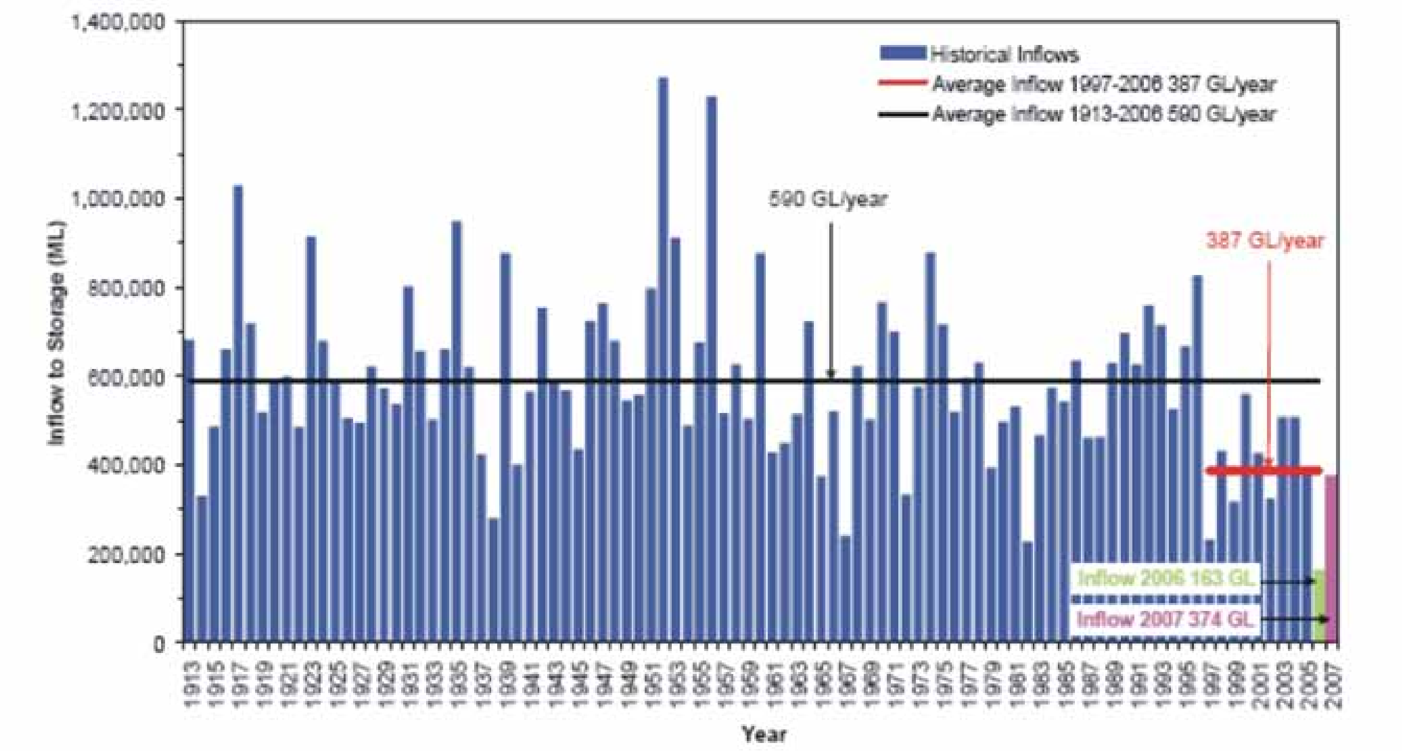


Figure 5: Annual Inflows for Melbourne's Main Reservoirs

The reduction in reservoir inflows since 1997 from a long term average of 590 GL/year to a figure of 387 GL/year shown in Figure 5 is reflected in steadily declining reservoir levels. Melbourne's storages dropped to only 26.3% full in autumn 2009, and had recovered slightly to 27.1% at the time of writing. For water supply planning engineers, these were, and still are, very worrying trends.

5. Intrastructural Responses

5.1 National Overview

In its National Performance Report 2007-2008 the National Water Commission reported "With decreasing rainfall, lower inflows and falling storage levels in many major reservoirs, water utilities around Australia have embarked on an unprecedented capital expenditure program over the past few years and this will continue for a number of years to come. The capital expenditure programs aim to restore the supply/demand balance which in recent years has featured demand outweighing supply, causing the introduction of widespread water restrictions." Capital expenditure has almost doubled over the past five years as the prolonged drought in many metropolitan areas has driven investment in new water supply infrastructure. Reflecting this, the report shows large increases in capital expenditure across utilities, up from $3.2 billion in 2006-07 to $4.5 billion in 2007-08." These figures exclude many of the major capital projects that have been funded by State governments directly or by Public-Private Partnerships (PPPs), rather than by the utilities themselves. (NWC, 2009).

5.2 Victoria

5.2.1 2004 White Paper

The Victorian Government's 2004 White Paper, Securing Our Water Future Together, was a bold initiative to address the need for sustainable water supplies to meet the twin drivers of drought (then in its eighth year) and growth, as well as restoring the poor and degraded condition of many of the State's rivers.

Some of the key principles/actions contained in the White Paper were:

- providing additional water to the River Murray and two Gippsland rivers
- improving rural water trading by unbundling water rights from land title
- no new dams as these would only take water from the environment or from farmers
- a target of a 15% reduction in per capita consumption of drinking water
- introduction of rising block tariffs for domestic consumers to encourage conservation
- a target of 20% recycling by 2010
- investigation of two major recycling schemes – one to pipe Melbourne's effluent 135 km to the Latrobe Valley for use in power stations and other non-potable uses, and reassign the

freed up water to the environment and Melbourne's drinking water sources (subsequently known as the Eastern Water Recycling Proposal)

- water authorities required to consider opportunities for third pipe systems, stormwater use, greywater reuse, and aquifer storage/recovery
- no indirect potable reuse
- investigation of large scale applications of desalination.

When the draft Central Region Sustainable Water Strategy was released in April 2006, it stated that "The Government does not propose to pursue large-scale desalination, but will monitor the rapid advances in desalination technology and the potential for green energy".

However, four months later when the final version was released in October, the Government's stance had changed significantly. The final version noted that:

"Inflows into Melbourne's reservoirs over the past 10 years have been significantly lower than in the previous 100 years. With climate change likely to significantly reduce water availability for Melbourne in the future, it is necessary to plan for the large–scale augmentation of Melbourne's water supplies.

"The Government therefore commits to the next stage of the Eastern Water Recycling Proposal - preparing a business case. The Government will also initiate full feasibility studies and, if appropriate, proceed to business cases for seawater desalination and the reuse of stormwater collected near Dights Falls."

By 2007, with the publication of Our Water Our Future: The Next Stage of the Government's Plan, and with no end to the drought apparent, there were four key infrastructural responses proposed:

- New desalination plant for Melbourne
- Modernising Victoria's Food Bowl irrigation system
- Expansion of Victoria's water grid
- Upgrading Melbourne's Eastern Treatment Plant to provide over 100 GL of recycled water in 2012 and assessing a range of alternative uses of this water.

5.2.2 Food Bowl Modernisation

The Goulburn-Murray district of Victoria is commonly known as the 'food bowl' of Australia. It contributes around 26% of Australia's milk production, 95% of Australia's tomato processing capacity, and 95% of Victoria's grape production (Victorian Government, 2007). Income from irrigated agriculture exceeds $9 billion annually. Over 3,000 GL of water flows through the Goulburn-Murray irrigation scheme each year, but around 30% (900 GL) is lost through system inefficiencies (Victorian Government, 2007).

Modernising Victoria's Food Bowl region will take up to eight years to complete and will involve a total investment of up to $2 billion. The plan will initially automate regulators in major irrigation channels. Running in parallel to this, reconfiguration and upgrades will be made to the irrigation network to meet future demand.

The project is expected to halve current network losses, and the water savings of up to 225 GL annually, will be shared equally with the irrigators, the environment and Melbourne. The first savings from the project will be made available to Melbourne via a new pipe – the Sugarloaf Interconnector – linking the Goulburn River to Melbourne.

5.2.3 Sugarloaf Interconnector

The Victorian Government expects around 75 GL of water a year to be available to augment Melbourne's supply. In order to transfer this water to Melbourne a new 70 km pipeline is being constructed from the Goulburn River to Sugarloaf Reservoir in the Yarra Ranges.

The pipeline is 1.75 m diameter for 50km and 1.4 m diameter for the remaining 20km. Two pump stations are being constructed for the pipeline, a low lift station at the Goulburn River and a high lift station south of Yea. The project cost, including improvements at the reservoir, Winneke WTP and distribution network to accept this new source, is $0.75 billion.

Construction of the Sugarloaf Interconnector is expected to be completed in early 2010.

The project has been very controversial with farmers, and their cause was given more credibility in June when the Victorian Office of Water chief David Downie was giving evidence in a freedom of information case in the Victorian Civil and Administrative Tribunal. Mr Downie said factors such as expected flows, water quality and rainfall predictions had experienced substantial changes, affecting the amount initially predicted to be saved and sent down the pipeline. He also said that work started on the pipeline project before the business case was done. (Country News, 2009).

Preliminary estimates from the Goulburn Valley's state irrigator (Goulburn-Murray Water) for the 2008-09 irrigation year show that 343 GL were lost, reflecting the reduced flows from the drought that have been sent through the system, far less than the historical average of 900 GL (Morton, 2009). Thus, unless the drought eases, it seems unlikely that the expected savings will be realised, meaning less water will be available for Melbourne.

5.2.4 Desalination

At the time of writing, the Victorian Government had just announced that Aquasure was the successful consortium to build the $3.5 billion desalination plant at Wonthaggi on the Bass Strait coast, under a Public-Private Partnership (PPP). The plant will provide Melbourne with 150 GL of water per year by the end of 2011, consume an estimated 90 MW of power, and have an operational cost of $130 million per year (Melbourne Water/GHD (2007)).

The desalination plant includes an offshore intake structure and a brine discharge structure, a screening and pre-treatment facility, with reverse osmosis membranes removing the majority of salt and other seawater impurities. Water will be conveyed to the Melbourne system through an 85 km pipeline.

Modelling undertaken by DSE (DSE, 2008b) confirms the need for the desalination plant if inflows into the reservoirs follow the pattern of the calendar years of 2006/2007/2008. Assuming that 75 GL/year is available from the Sugarloaf pipeline, it shows that Stage 4 water restrictions (no outdoor watering) would be in place for the foreseeable future and that the reservoirs would drop to a low of 5% full from 2034 onwards. However, if the yield from the Sugarloaf pipeline is say only a third of what is expected (i.e. 25 GL/year, not 75 GL/year) then Melbourne's reservoirs would reach empty within 5 years under this inflow scenario and without the desalination plant.

5.3 New South Wales

In 2006, in response to the second worst drought on record and a predicted population growth from 4.3 to 5.3 million over 25 years, the NSW Government put in place a long term water demand and supply plan for Sydney called the Metropolitan Water Plan (NSW Govt, 2006). The plan identified four main areas:

- increasing supplies through optimising existing dams and abstractions, groundwater, and desalination;
- increasing recycling
- reducing demand
- improving catchment and river health.

At that time Sydney's dams were at 44% of capacity, but dropped to a low of 34% in February 2007, and have since recovered to be a little under 61% at the time of writing.

Sydney Water, the State entity responsible for providing water to Sydney, made its final decision to go ahead with the construction of a 250 ML/day desalination plant when the dams had less than two years of supply remaining, and allowed for a two-and-a-half year construction period (Swinton, 2009). At the time of writing the plant is 80% complete, and due for completion by the 2009/10 summer. The intention is that the plant will supply Sydney with water while storage levels are low, and once levels rise to 70%, the plant will scale back production until levels drop back below critical. The plant is to be powered by 100% renewable energy from a new 140 MW wind farm.

Recycled water targets are for Sydney to recycle 70 GL a year by 2015 (about 12% of water needs), and 100 GL a year by about 2032 (about 17% of water needs). One of the major initiatives is the construction of an advanced water treatment plant and pipeline at St Marys. From 2010 the plant will replace 18 GL/year of water, which is currently released from Warragamba Dam into the Hawkesbury-Nepean River to provide environmental flows.

Another key recycled water project is the expansion of the Rouse Hill dual pipe recycling scheme, to eventually supply 4.2 GL of recycled water to 36,000 houses.

There has also been a push by the NSW Government to increase water efficiency. Laws have been passed to make new houses more water efficient. Incentives have also been provided for residents to buy more efficient appliances.

5.4 Queensland

The Queensland Government set up the Queensland Water Commission in June 2006 in response to a worsening drought situation and predictions of rapid population growth in South East Queensland (from 2.7 to 3.7 million by 2026). If the inflows experienced in 2004/05 had continued, the region was projected to run out of water in December 2008.

Figure 6: South East Queensland Water Grid Project

The Tugun Desalination Plant is located on the Gold Coast. The recently completed $1.2 billion plant has a capacity of 133 ML/day. However, a recent news article states the plant is operating at only 33% capacity and is suffering from serious construction defects (Stolz, 2009). The Queensland Government is refusing to take ownership of the plant until the problems are fixed and the plant is operating according to specification.

The recycled water component of the strategy is the $2.5 billion Western Corridor Recycled Water Project, on which construction was completed at the end of 2008. With a capacity of 230 ML/day it is the largest recycled water scheme in the Southern Hemisphere, and the third largest in the world. Stringent water quality testing undertaken on the Bundamba AWTP has shown that the recycled water meets Queensland regulatory requirements, and is suitable for release into the Wivenhoe Dam, thereby allowing for the possibility of Indirect Potable Reuse (IPR) as the Wivenhoe Dam is a raw water source for the region's water supply. At the time of writing the other two AWTPs (Luggage Point and Gibson Island) are undergoing validation testing.

South East Queensland's reservoirs reached a low of 16.7% full in August 2007; recovered to about 40% full after heavy rains in early 2008, and from heavy rain in early 2009 had recovered to nearly 77% full by the end of July 2009. During periods of low storage levels the Government has been proactive in using water restrictions. The 'Target' programme has been used at varying levels depending on water storage capacity. The targets encourage residents to keep their water consumption below a specified level. For example 'Target 140' was developed and used during the extreme drought conditions and aimed to drive consumption below 140 L/person/day, and achieved it. Now that combined dam levels for South East Queensland exceed 50%, the region has to Medium Level Restrictions and "Target 200".

6. Policy Reponses and Discussion

6.1 IPR and Queensland

In such an extreme drought event, together with a real acknowledgement by all in the wider industry and the public of the value of water recycling, it was inevitable that IPR would come onto the agenda.

The first notable event was on the Sunshine Coast in Queensland. The Maroochy and Caloundra councils proposed a scheme to augment dwindling water supplies with recycled water, which was modified after strong opposition from the local community. Community action groups used media releases to warn the community about the "potential shrinking and deforming of male sexual organs because of gender-bending hormones in wastewater". (Po et al, 2003) The 10 ML/day Caboolture advanced water treatment plant included membrane bioreactors, coagulation, in-filter dissolved air flotation, pre-ozonation, biological activated carbon filtration, followed by ozonation. The intention was for IPR, but due to public opposition, the majority of recycled water is still disposed to Caboolture River. (Foley et al, 2007). This project is often cited as a case-study in poor public consultation.

The second, and higher profile event, was a referendum to implement IPR in the city of Toowoomba, 100 km west of Brisbane, and with a population of 125,000. The Mayor of Toowoomba was a courageous advocate for IPR, but her initiative was scuttled by a vigorous campaign of misinformation and emotive language. The result of the referendum in July 2006 was a 62% 'no' vote, thereby continuing the discharge of secondary effluent from the city's WWTP into Gowrie Creek, for the citizens of Dalby downstream to abstract for its water supply – i.e., unplanned indirect potable reuse. Despite public acknowledgement that unplanned indirect potable reuse occurs in many parts of Australia, with no reported adverse health impacts, some water professionals still raised concerns in the lead up to the Toowoomba referendum about IPR. (Law, 2006).

The third, and highest profile, event was the announcement in November 2006 by the Queensland Premier that in March 2007 South East Queensland residents would have a say by plebiscite (referendum) on introducing recycled water into existing water supplies (i.e. IPR). The Premier told the Parliament that "The reality is that the prospects for rain are not good and we must continue to look at all options for future water supply. One option is recycled water for residential use, not as part of our drought response, but as part of our on-going water supply in good times and bad." However, by January 2007 the drought situation had deteriorated to the extent that the government cancelled the plebiscite, and announced its intention of connecting the Western Corridor Recycling Project to the Wivenhoe Dam, thus facilitating planned IPR. In November 2008, as reservoir levels recovered, the Premier announced that recycled water would only be sent to the Wivenhoe as a last resort. Since then, the Queensland Water Commission has recommended that the government consider implementing IPR when storage levels drop to 40%.

6.2 Victoria

In Victoria, many industry and media commentators have remarked on the refusal of the Victorian Government to entertain IPR. The Melbourne newspaper, The Age, commissioned a poll in February 2007 and found that 78 per cent of those surveyed were in favour of the use of recycled sewage in home-use water supply, with only 19 per cent against. The editorial of 8 December 2008 noted "It could be argued that instead of the population being sensitive, the Victorian Government has exercised over-sensitivity on its own behalf and has steadily refused to take the risk of entertaining even the idea of water recycling."

The decision to commit to a $3.5 billion desalination project reflects a boldness and confidence in Victoria's future. However, industry commentators have noted that the desalination plant's capital and operational costs are likely to be greater than reuse of effluent from Melbourne's Eastern Treatment Plant, and also that it will have greater energy use (at least twice that of effluent reuse).

6.3 Rural to Urban

There is one other source of water for urban use that receives very little attention, and that is shifting water from rural to urban use. Although bodies such as the Productivity Commission, Business Council of Australia, and WSAA have all seen an economic case for a trade in water between the irrigation and urban water sectors, it has not won general community or political acceptance (Edwards, 2008). Crase & Dollery (2008) summarise the situation with "At the state level, the urban water reforms are characterised by mandated water restrictions, compulsory water saving targets, and punitive measures against recalcitrant customers. Moreover, whereas urban authorities have access to the water market, unfettered access is either administratively or politically curtailed. By way of contrast, in irrigation, administrative and political impediments to market participation are largely on the decline.".

In 2005 the Water Services Association of Australia made the case that with the exception of Sydney, all the state capitals had the opportunity to access water from agriculture through water markets without the need to build substantial infrastructure (Edwards, 2008). In fact, this trade has not happened as it is obviously considered too sensitive and risky. The Sugarloaf Interconnector in Victoria was not done by market trading as such, but by investing $2 billion in improving the irrigation infrastructure and agreeing a rural-to-urban transfer share of the savings.

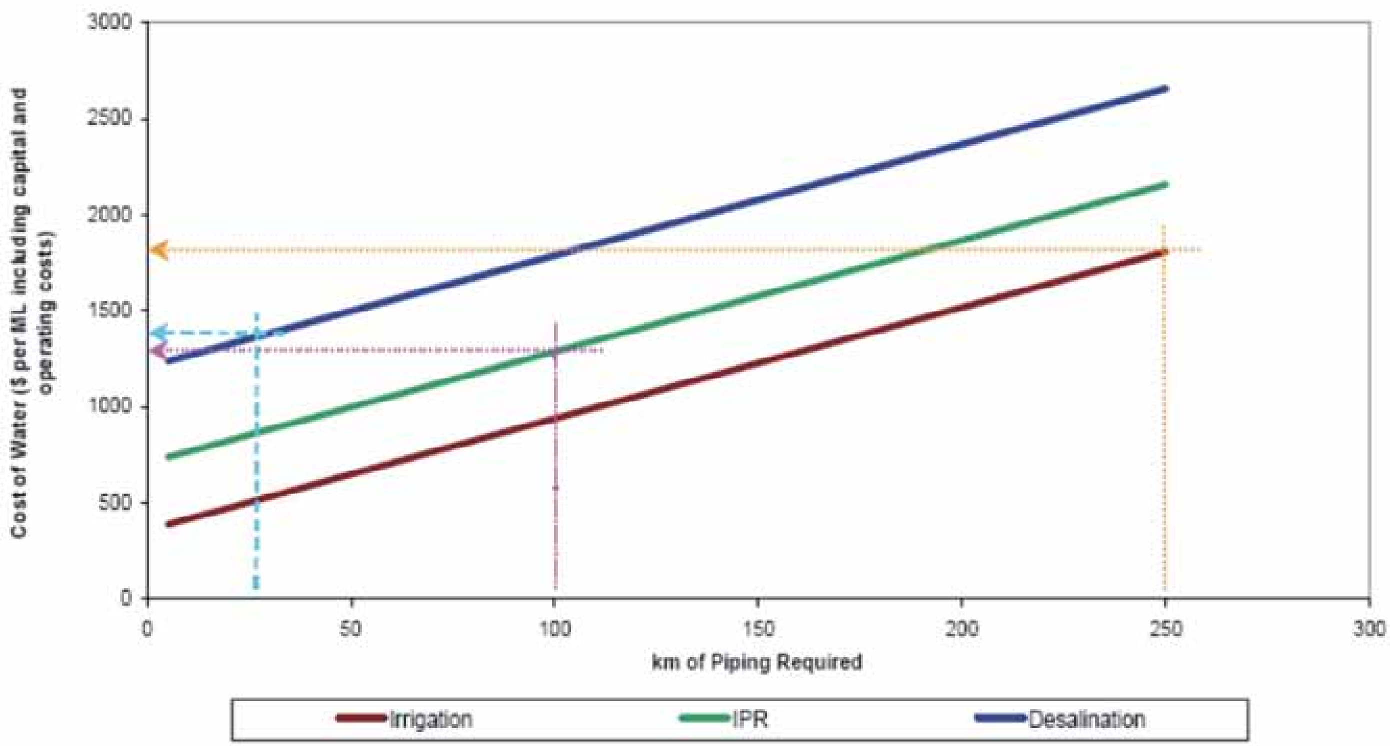
6.4 Water Source Options

In a hypothetical case study for a coastal city needing 100 ML/day of additional water, a study (NWC, 2007) estimated the total costs (capital plus operating) for desalination, IPR and rural water. When delivering the treated water the same distance, for example 50km, the study found the costs were:

- desalination - $1,500/ML
- IPR - -$1,000/ML
- rural water - $650/ML

Because transportation distances for each city would be different for the different options (refer Figure 7 below – the dotted lines show an example), the study illustrates the importance of determining costs on a case-by-case basis. Interestingly, Law (2008) makes the case for direct potable reuse (DPR), as transportation distances are invariably much less for DPR than they are for the three source options considered in the NWC study.

Figure 7: Costs per ML for Three Source Options



7. Concluding Remarks

Australia is in the middle of what might in the future be called the golden decade of urban water:

- billions of dollars of spending on new water infrastructure
- a tentative embracing of the new paradigm that allows sewage to be transformed into water (and the consequent shattering of the public health principles we have practised since Dr Snow and the Broad Street pump)
- adopting and implementing new treatment technologies
- significant capacity building across all sectors of the water industry – policy makers, regulators, researchers, state & federal infrastructure departments, water authorities, consultants, equipment vendors, contractors and operators.

When the severity of the drought was appreciated, and the state governments (and their political masters) faced with prospect of running out of water, they reacted with boldness and set about delivering the new infrastructure to match the need. In South East Queensland in particular this was not just an engineering response, but required the political courage and vision to dismantle a number of councils and the creation of completely new organisations to regulate and deliver the infrastructural response.

The Queensland situation illustrates the potential political risks of responding boldly when reservoirs start to refill and the public's memory of the drought starts to fade. It is tempting to pose the question, if climate change had not been such a high profile issue, and if the Australian economy had not been so strong, would the infrastructural responses have been as bold? It is also tempting to speculate how such responses would be delivered in the New Zealand context under the Resource Management Act, with its inherent uncertainties over outcomes.

If individual states, or Australia as a whole, shift to a cycle of wetter-than-average years, there is a risk that the desalination plants will be seen by some as white elephants. This would be unfortunate, but would reflect the reality of dealing with the vagaries of the highly variable climate, and the consequent "dammed if you do, dammed if you don't" in the highly political landscape that is Australia. For Victoria, with its drought continuing, the new infrastructure shows every sign of being essential to sustain the city of Melbourne for the foreseeable future.

Once the Melbourne desalination plant is completed in 2011, that will end the current spate of very large iconic projects. How IPR develops from here will depend on a number of factors:

- whether the drought in Victoria does pass or whether, as many claim, that the drought is the new hydrological reality
- whether drought conditions return in Queensland
- Australia's carbon trading response to climate change and whether this forces energy costs up significantly, thereby making desalination more expensive relative to less energy intensive alternatives
- whether the sensitivities around rural to urban transfers can be overcome
- whether the politicians' and the public's confidence in the treatment technology can be fostered, and whether there are public health incidents associated with recycled water either within Australia or internationally that could undermine that confidence.

What lessons can New Zealand learn from Australia? While it is hard to imagine a drought event of the Australian magnitude in New Zealand, drought is an entirely relative phenomenon – if the infrastructure is not designed to cope with unusually dry conditions, then an infrastructural response to those drought conditions is still necessary. Probably the only time this has occurred on a significant scale in the recent past in New Zealand was the 1994/95 drought in Auckland.

The relatively short time series of hydrological data that exists in both countries makes predicting, or even contemplating, such extremes very difficult. The greater per capita domestic usage of water in New Zealand, means that we have more room to conserve before acting, but that may lead to a temptation to leave acting until it is too late. Would we have the political and technical leadership, the organisational capacity, and the resources? Should such an event occur in New Zealand, there is certainly much that could be gleaned from the Australian experience from all players and sectors in that industry.

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References

1. ABS, 2005. Year Book, Australia 2005.
2. ABS, 2007. Water in Australia, in: Australia's Environment: Issues and Trends, 2007
3. BOM, 1999. Australia: Climate of Our Continent.
4. BOM, 2008. Special Climate Statement 16: Long-term rainfall deficiencies continue in southern Australia while wet conditions dominate the north. Issued 10th October 2008, National Climate Centre
5. BOM, 2009. Drought Statement For the 6 and 24-month periods ending 30th June 2009. Issued on 6th July 2009 by the National Climate Centre. Webpage www.bom.gov.au accessed 1 August 2009.
6. Country News (2009). Pipeline Forecasts Challenged. 26 July 2009.
7. Crase, L and Dollery, B (2008). The Institutional Setting, in Water Policy in Australia, Ed. L Crase, RFF Press, Washington DC, USA, 2008.
8. Davies, K (2009). Bundamba Advanced Water Treatment Plant: Water Quality. Water, Vol. 36, No. 2, May 2009.
9. DERM, 2009. Drought Situation Reports: Seasonal Conditions Report As At 30 June 2009. Webpage http://www.longpaddock.qld.gov.au accessed 2 August 2009.
10. DSE (2007). Modernising Victoria's Food Bowl, Irrigation Modernisation. Victorian Government, Department of Sustainability and Environment. Webpage www.ourwater.vic.gov.au accessed 22 July 2009.
11. DSE (2008a). Our Water, Our Future: Victoria's Desalination Project. Victorian Government, Department of Sustainability and Environment. Webpage www.ourwater.vic.gov.au accessed 23 July 2009.
12. DSE (2008b). Augmentation of the Melbourne Water Supply System: Analysis of Potential System Behaviour. Victorian Government, Department of Sustainability and Environment, August 2008
13. Edwards, G (2008). Urban Water Management, in Water Policy in Australia, Ed. L Crase, RFF Press, Washington DC, USA, 2008.
14. Foley, J, Batstone, D and Keller, J (2007). The Challenges of Water Recycling: Technical and Environmental Horizons. Advanced Wastewater Management Centre, The University of Queensland, February 2007.
15. Law, IB (2006). Indirect Potable Reuse – Post Toowwomba. Water, Vol. 33 No. 6, September 2006.
16. Law, IB (2008). The Future Direction for Potable Reuse. Water, Vol. 35, No. 8, December 2008.
17. Letcher, R & Powell, S (2008). The Hydrological Setting, in Water Policy in Australia, Ed. L Crase, RFF Press, Washington DC, USA, 2008.
18. McLennan, W. (2000). Water Account for Australia, 1993-94 to 1996-97. Australian Bureau of Statistics. Webpage www.abs.gov.au accessed 21 July 2009.
19. Melbourne Water/GHD (2007). Seawater Desalination Feasibility Study. June 2007
20. Morton, A (2009). North-South pipeline promises undermined. The Age, 8 June 2009.
21. New South Wales Government. (2006). Metropolitan Water Plan. Webpage www.waterforlife.nsw.gov.au accessed 27 July 2009.
22. NWC (2007). Using recycled water for drinking: An Introduction. Waterlines Occasional Paper No 2, June 2007.
23. NWC, 2009. National Performance Report 2007–2008: Urban Water Utilities. National Water Commission, March 2009.
24. Phillips, BC (2006). Water Cycle Management. A Draft Position Paper prepared by the National Committee on Water Engineering, Institution of Engineers Australia
25. Plimer, I (2009). Heaven and Earth: Global Warming – the Missing Science. Connorcourt Publishing.
26. Po, M, Kaercher, JD and Nancarrow, BE (2003). Literature Review of Factors Influencing Public Perceptions Of Water Reuse, CSIRO Land and Water.
27. Queensland Government. (2009). South East Queensland Water Grid. Department of Infrastructure and Planning. Webpage www.dip.qld.gov.au/seqwatergrid accessed 27 July 2009.
28. Stolz, G. (2009). $1.2b Gold Coast Desalination Plant a Dud. The Courier Mail, 2 July 2009. Webpage http://www.news.com.au/couriermail/story/0,23739,25720296-952,00.html accessed 30 July 2009.
29. Swinton, EA (2009). Membranes and Desalination Specialty Conference III. Water, Vol. 36 No. 2, March 2009.
30. Trewin, D. (2006). Water Account, Australia, 2004-05. Australian Bureau of Statistics. Webpage www.abs.gov.au accessed 21/07/09