Water Supply Options for Melbourne

An examination of costs and availabilities of new water supply sources for Melbourne and other urban areas in Victoria

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Summary

Melbourne's water supply is suffering from a combination of drought and a failure to build new storage facilities over the past 23 years when the population has increased by over 30 per cent. These matters may be aggravated by long term climate change diminishing the precipitation to the traditional sources in the Melbourne catchment.

The government policy of matching supply and demand has been, and largely remains, directed at measures that curtail demand; supply side measures have focused on tapping local sources, mainly through household water tanks. Additional supply sources have been proposed over the past year or so. These include moves to 'create' additional supplies through engineering works in the northern Victorian irrigation areas with some of the savings earmarked for Melbourne via the Sugarloaf pipeline. They also include an expensive desalination plant at Wonthaggi.

The most economical supply sources remain traditional supply sources available south of the Great Divide. Of the more exotic supply sources the lowest cost appears to be stormwater harvesting, though the commercial potential for this is limited to major new greenfield developments. Recycling Eastern Treatment Plant (ETP) water appears to be prohibitively costly, while releasing treated water and substituting it for other sources is also expensive. Some variations of household rainwater tanks rival the Wonthaggi desalination plant proposal in providing the most expensive solutions. Less expensive is the government's Sugarloaf approach, but this still entails water costing two and a half times that from a new dam in the Melbourne catchment.

The table below summarises the estimated costs and potential additional water supplies from the more realistic options available. A major new Gippsland dam is the lowest cost option, though a river diversion into the existing Thomson reservoir, perhaps from the Aberfeldy, may be a cheaper alternative than those identified.

Traditional types of supply not only remain most economical but major storages offer a supply reliability that rivals the 'in principle' unlimited reliability of supply offered by desalination. Reliability of supply is a particularly important consideration for Victoria given the state's fluctuating rainfall and history of long droughts.

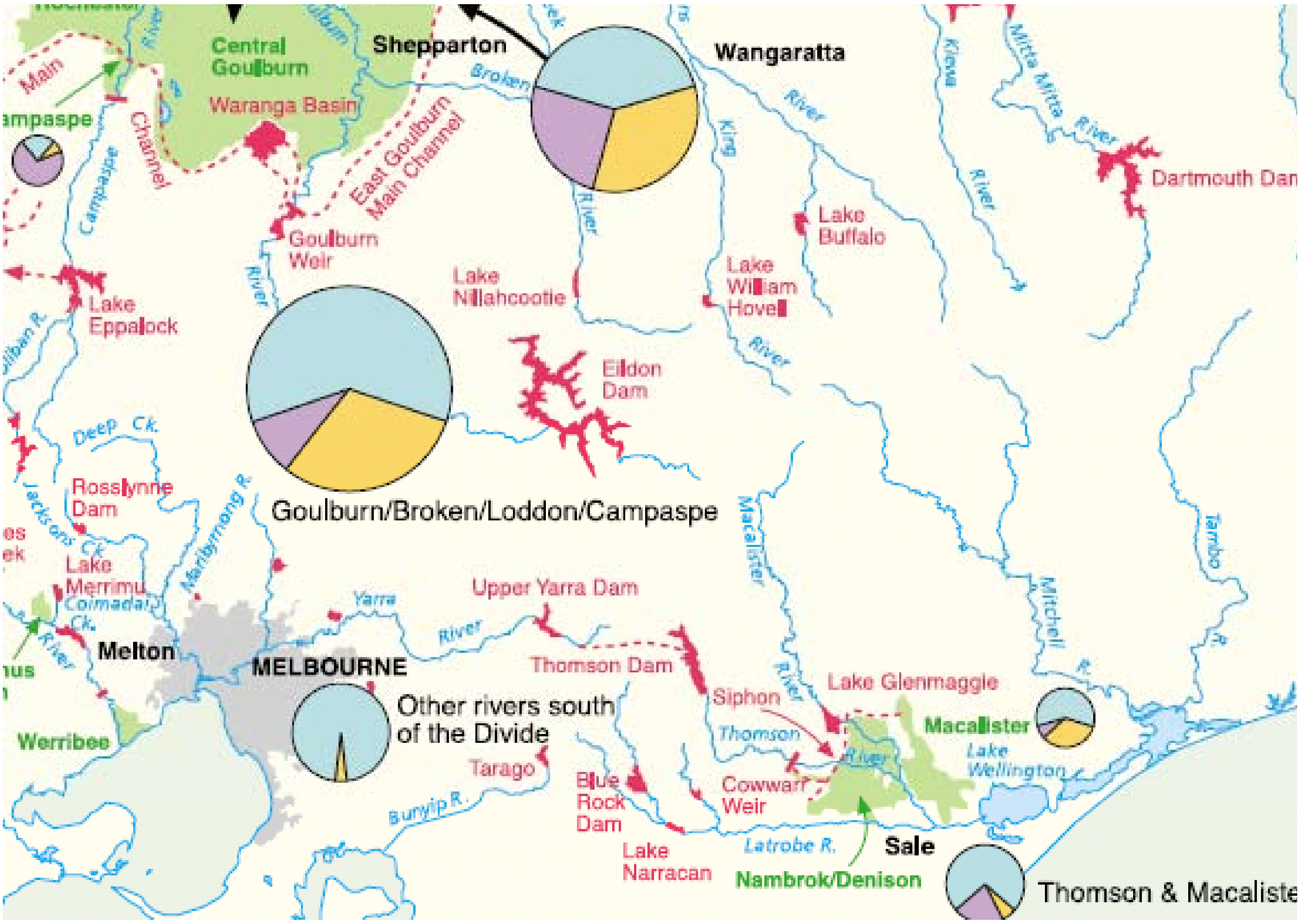
Map 1 shows the main river system that could provide sources of water for Melbourne.

Summary table

	Size GL/annum	Capital cost cents per kL	Transmission/ Operating cost cents per kL	Total cost cents per kL
Macalister Mt Useful Dam (a)	150	42	20	62
Macalister Mt Useful Dam (b)	85	52	20	72
Mitchell Dam	150	81	37	118
Latrobe Dam	150	60	24	84
Urban Stormwater Harvesting (best case)	~16 (after 20 years)	63-110	-	63-110
ETP Released Water	90	80	29	109
Sugarloaf	75	146	20	166
Rainwater tanks*	n.a.	263-670	-	200-670
Local Rivers Stormwater Harvesting (best case)	26	102	100	202
ETP Recycling	115	179	63	242
Wonthaggi Desal.	150	213	88	301

* Rainwater tanks also entail savings in local distribution costs, estimated at 44.8 cents per kL (see p. 6).

Map 1: The Main Melbourne Water Sources



Introduction

On October 3 2007 both of Victoria's major newspapers carried opinion pieces on water. *The Age* had a piece by Professor John Langford, who argued that climate change is almost certain to mean less rainfall and, 'we cannot sit around waiting for rain'. He said that last year was the worst for 116 years for Murray irrigators. He also pointed to melting Arctic ice, hypothesising that the Arctic might be ice free in 23 years.

Professor Langford argued that we cannot rely on dams for Melbourne's water in an era of declining rainfall. He favoured the building of the $3.1 billion desalination plant plus mandatory measures to reduce water usage in the home. In his view, water prices would double as a result of increased demand and climate induced supply reductions.

In the *Herald Sun*, Australia's premier historian Professor Geoffrey Blainey agreed that the present drought is very serious for farmers. However, observing a long history of volatility in Victorian rainfall patterns stretching back 150 years, he said, 'We should be alarmed, but not surprised by this present drought.' Although not discounting the possibility of climate change, he pointed out that the two worst rainfall years on record were 1902 and 1905; he also said that Victoria was relatively dry in the half century prior to 1945 and then considerably wetter for 30 years.

Professor Blainey noted that previous administrations, recognising the instability of the weather patterns, had built a series of dams. He went on to say, 'In the last quarter century, for the first time in Australia's history, dam-building has often been regarded as a sin. No voices were louder than the city-based greens in calling for an end to plans for new reservoirs.'

Although most of Australia is desert, rainfall per capita is, after Iceland and Russia, the third highest in the world. And although most of the rainfall is in the monsoonal far north, the eastern and southern seaboards have more rainfall per person than the southern European countries of the Mediterranean, the name of which describes their climate type.

Victorian rainfall is lower than the average in Australia but is nonetheless much higher than that of most other countries around the world and far more so on a per capita basis.

Some 85 per cent of the water that is actually used in Australia and Victoria is for irrigation and other farm uses.

On coming into office the present government abandoned Melbourne Water's long standing plans for sequential dam construction. This meant the latest dam was built over 20 years ago to service an urban population that had grown by over 30 per cent in the interim. With the present drought, whether or not it is exacerbated by lower rainfall caused by global warming, the effects are readily apparent.

The issue now is how to resolve the supply crisis. The metropolitan utilities have developed a 50 year plan, the Water Supply-Demand Strategy[1], which is to be updated every five years. The current version of the plan is predicated on projections of declining flows into Melbourne's catchment areas. It is however shaped by the rather outdated 2004 release *Our Water Our Future* and the following key policy decisions:

- No new dams for Melbourne
- Water cannot be traded between Melbourne and northern Victoria (a policy that has since been abandoned)
- No water recycling for drinking purposes in the short to medium term

The strategy has targets like achieving a 30 per cent reduction in per capita drinking water consumption by 2020. This is in spite of per capita consumption already having dropped 'by 22 per cent since the 1990s', a reduction which makes further cuts more difficult to achieve.

It patronisingly argues that 'Melbourne consumers have worked hard to reduce their water use'. In fact, the hard work stemmed from regulatory requirements that water use be curtailed rather than some variant of public spirit. These regulatory requirements have entailed additional costs of employing 'water conservation officers'.

The strategy's recommendations cover:

- further curtailment of use through such measures as requirements on new homes and on shower heads and other equipment
- increased use of 'local water supply' through water tanks, stormwater use and dual pipe recycling, especially in new developments
- harnessing further supplies by interconnection with the Blue Rock Lake and exchanging water with the Latrobe Valley generators using recycled water from the Eastern Treatment Plant.

Water Usage and Availabilities

The availability of water in the State is about 15 million ML. Of this some 40 per cent is allocated in entitlements, with a little over one quarter actually used in 2006/7.

Table 1 summarises usage for production and consumption. (Appendix 1 provides more detail about river flows and usages.)

Melbourne residential and industrial/commercial customers consume about 11 per cent of the State's water use. Another 140,000 ML (three per cent) is used in the Latrobe Valley, largely by the power stations supplying Melbourne; the rest of Victoria accounts for a further 218,000 ML (a little over five per cent).

Table 1: Victorian water availability and total water usage

	Surface Water (ML)	Groundwater (ML)	Recycled water (ML)
Total resource	15,312,200	N/A	440,000
Entitlement/ allocation	6,216,340	879,900	N/A
Water used	4,921,360	366,300	95,740

Source: DSE State Water Report 2005/6

Melbourne Water supplied some 444,000 ML of water to Melbourne in 2005/6, up from 441,000 ML the previous year. Of the Melbourne supply, 129,000 ML came from the Thomson dam, representing a quarter of the Thomson catchment inflow. The Thomson dam comprises about 60 per cent of the Melbourne Water storage capacity and until the recent drought, the basin has accounted for over half of the Melbourne supply.

Figure 1: Victorian water usage

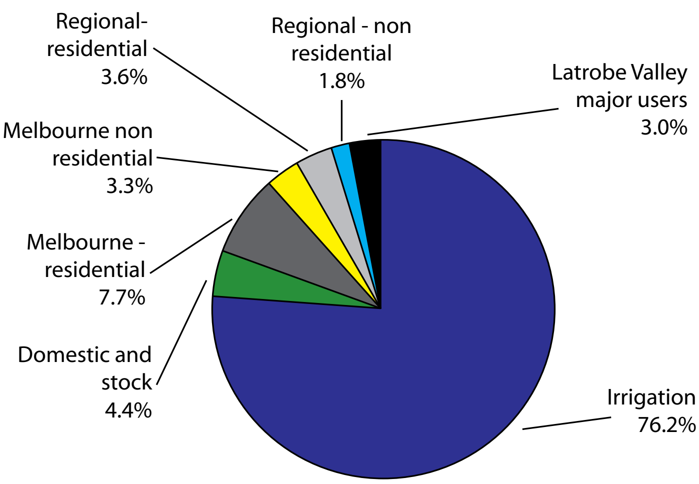


Figure 1 illustrates usage.

The Latrobe and Mitchell catchments have similar inflows to that of the Thomson. Unlike the Thomson, neither has substantial irrigation usages (as Appendix 2 shows, the Thomson catchment had a net irrigation outflow of 145,000 ML in 2005/6 and outflows to the Latrobe and Lake Wellington were 268,000 ML; annual inflow to the Thomson reservoir over the past 25 years has averaged 211,500 ML).

Beyond the Latrobe and Mitchell catchments is the Tambo, the inflow of which is about one third of the other basins. There is negligible irrigation use in the Tambo Basin.

There is also considerable scope to increase the diversion of water from the Thomson catchment, outflows of which were 217,000 ML last year. This could be undertaken by building a storage reservoir on the Macalister River upstream of Glenmaggie Reservoir or supplementing flows into the existing reservoir from the Aberfeldy River. Significant volumes flow along this river to the sea and in some years, as occurred twice in 2007, cause flooding.

Glenmaggie Reservoir has a storage capacity of only 190,000 ML supplying the Maffra/Macalister Irrigation District. A second storage upstream of Glenmaggie could supplement supplies to Melbourne from the Thomson, possibly by arranging swaps with irrigators. This would also improve irrigators' security of supply.

Water Supply Costs for Melbourne

Means of Establishing the Cost of Water in Melbourne

The cost of water within cities includes the cost of dams, treatment plants, pipes and other infrastructure. Although much of this is sunk, all such facilities in the end need to be replaced and these replacement costs (often estimated on the basis of Long Run Marginal Cost (LRMC)) need to be factored into the costs to the consumer.

Marsden Jacob applied this methodology together with a uniform six per cent rate of return on investment to estimate costs of water in all of the capital cities. It is important to incorporate a rate of return on investment because capital has an opportunity cost (Sydney Water is seeking a real return of seven per cent on its desalination plant). Marsden Jacob derive a levelised cost per kilolitre which is shown in Table 2.

Table 2: Estimated full cost of water supply

City	Full annualised cost ($ million)	Cost per property per annum ($)	Levelised Cost (cost per kilolitre - $/kL)
Sydney	775	460	1.47
Melbourne	633	413	1.47
Brisbane[(a)]	219	522	0.86
Adelaide	255	517	1.54
Perth	360	554	1.59
Hobart[(b)]	26	312	0.63
Darwin	37	863	1.06
Canberra	82	601	1.56

Notes: (a) Includes bulk water purchases from SEQWater
(b) Costs for Hobart exclude the retail costs associated with the councils that Hobart Water supplies.

Source: WSAAfacts 2005 and Marsden Jacob analysis

Marsden Jacob also concluded that there is some considerable degree of under-recovery of costs at the present prices and in setting their levelised costs once they incorporated a six per cent return on the capital (valued at replacement cost). They put the under-recovery for Melbourne at 48 per cent. This does not include any contingency for a different profile of future water supply. This, the marginal cost of new supplies, would be particularly important if it were to require much higher costs, like those involved with desalination, for new sources.

The under recovery estimated for Melbourne seems high and its collection also presents complications since many properties have paid development contributions, much of which were tied to water and sewerage costs (and would, arguably, warrant a dividend). According to work by UrbisJHD, in 2006, 'New houses in Melbourne incur total infrastructure charges of $7,848 compared to an actual direct infrastructure cost estimate of $2,000[2].' The charges have varied considerably over recent years.

The Water Supplying Companies as Businesses

Although Victoria has split its water and sewerage businesses into three retailers and one wholesale water-supplier cum sewerage disposal business, this may not be the ideal corporate structure to cover water provision and sewerage disposal. The Victorian Competition and Efficiency Commission (VCEC) inquiry into the metropolitan retail sector speculated whether the retail businesses should be amalgamated, but showned little curiosity regarding the functions of those businesses, and whether it might be appropriate to divest some of them or disaggregate their different activities.

Remarkably in view of the heavy regulatory oversight, there is no data on the costs of the different features of the water businesses. Even though water bills are itemised with separate charges for sewerage, water and trade waste, the basis for these charges is unclear. There is no indication of the relative cost components attributable to dams, major pipelines, reticulation systems, drainage control, retail and other activities the businesses are engaged in. This means the cost estimates developed in this paper have had to be made from fragmentary evidence and statements.

There is no justification for this cost accounting secrecy. Unlike when firms are in competition, 'commercial in confidence' considerations are absent in water supply.

Existing Costs of Supply to Melbourne

Although neither the water supplying businesses nor the Essential Services Commission (ESC) allow the calculation of accurate costs of water and the various services associated with its delivery, some estimates are made possible from Commonwealth sources.

Average costs of water for the three Melbourne utilities are published in the Commonwealth's National Performance Report.[3] For 2005/6, costs were as in Table 3.

Based on the Melbourne Water data published in the same report, the average wholesale price of water sold in 2005/6 was 40.6 cents per kL. These costs incorporate a low rate of return on the assets of the companies concerned—Melbourne Water's overall return for water and sewage services was 2.1 per cent in 2005/6. They may also understate average costs as they are based on an average annual residential bill for consumption of 250 kL.

Added to the 40.6 cent per kL wholesale cost of the water from Melbourne Water are the reticulation costs of the three utilities. In 2005/6 these averaged 71.2 cents per kL, comprising a 'service availability' fixed component of 26.4 cent per kL and an operating cost of 44.8 cents per kL.

Table 3: Average cost of reticulated water (cents/kL)

	City West	SE Water	Yarra Valley	Mean
Water	83.3	86.7	86.2	85.4
Fixed	38.6	17.5	23.1	26.4
Total	121.9	104.2	109.3	111.8

Meeting Melbourne's Needs

There are two basic means of ensuring a better balance of supply and demand for water—reducing demand and expanding supply. The present Victorian government has placed particular emphasis on the former.

In the 2004 *Our Water Our Future* paper, the Minister, Mr Thwaites, emphasized

- improved water efficiency, conservation or recycling;
- improved river health;
- leveraging other sources of funds for infrastructure, recycling and other water projects.

Introducing the White Paper *Securing Our Water Future Together* in October 2005, Mr Thwaites continued this same theme when he said,

> We will support smarter urban water use across Victoria with a range of initiatives including education and incentive programs, regulations and legislation, and smarter water pricing to reduce demand and increase recycling.
>
> We will ensure that our water management provides security for agriculture and other businesses that rely on water with reliable, secure entitlements, the flexibility and option to trade water for financial return and investment into more efficient irrigation systems and on-farm water use.
>
> We will also put water back into our waterways.

> Rivers and groundwater are the lifeblood of our economy and underpin our communities, economy and environment. By recognizing environmental water rights we will in turn secure the long term health of our irrigation industry and tourism and recreation activities.

The focus of these statements is on conservation and 'smarter urban use'—a euphemism for controls on use by restricting supply. Inactivity in commissioning or even searching for new supply, founded upon an ideologically optimistic predisposition in favour of demand restraint, has resulted in the state's urban water shortages.

Regulatory restraints are an alternative to using prices to reduce usage. Yet regulations can usually be expressed as a price or tax—they mandate certain forms of usage restraint rather than allowing consumers to decide on the form of restraint they would choose in response to the higher price.

One indication of the effect of relying solely on pricing activity to choke off demand can be seen from the work of Young et al.[4] They model the effect of a 25 per cent population increase, assuming a 15 per cent reduction in water availability due to climate change but an increase in water use efficiency of 22 per cent. Though not specifying the demand response to price increases (the elasticity of demand) they estimate price increases summarised in Table 4 would be necessary to choke off the excess demand.

For Melbourne this entails a fivefold price increase

Table 4: Estimated water price required to reduce demand

	Water price (2005 $/kL)	
	Current price	Projected price
Sydney	1.36	8.09
Melbourne	1.17	5.96
Brisbane-Moreton	1.27	10.51
Adelaide	1.30	1.42*
Perth	1.12	11.40
ACT	1.11	3.23

* The low price for Adelaide may be due to some (probably optimistic) costings of new pipelines in SA.
Source: Young *et al*

In January 2007, Minister Thwaites recognised that curtailing demand could not be relied on to ensure adequate availability. He announced that a desalination plant was 'inevitable'. This was further described in the statement of the then Premier in June 2007 which announced a desalination plant at Wonthaggi to cost $3.1 billion and to produce 150 GL per annum.

Simultaneous to this was the announcement of a 70 kilometre pipeline from the Goulburn to the Sugarloaf Reservoir at a cost of $750 million to allow the annual transfer of 75 billion litres of water to Melbourne by 2010. The water was to be saved by reducing losses from the Victorian irrigation areas, with the savings to be shared between irrigators, the environment and Melbourne. If accompanying measures are included in the costs of this source of supply, (Melbourne water suppliers' contribution of $300 million and the $600 million Food Bowl Modernisation—a form of payment for the water) the total cost of the project becomes $1650 million.

Australian Measures of Costs of Supply Augmentations

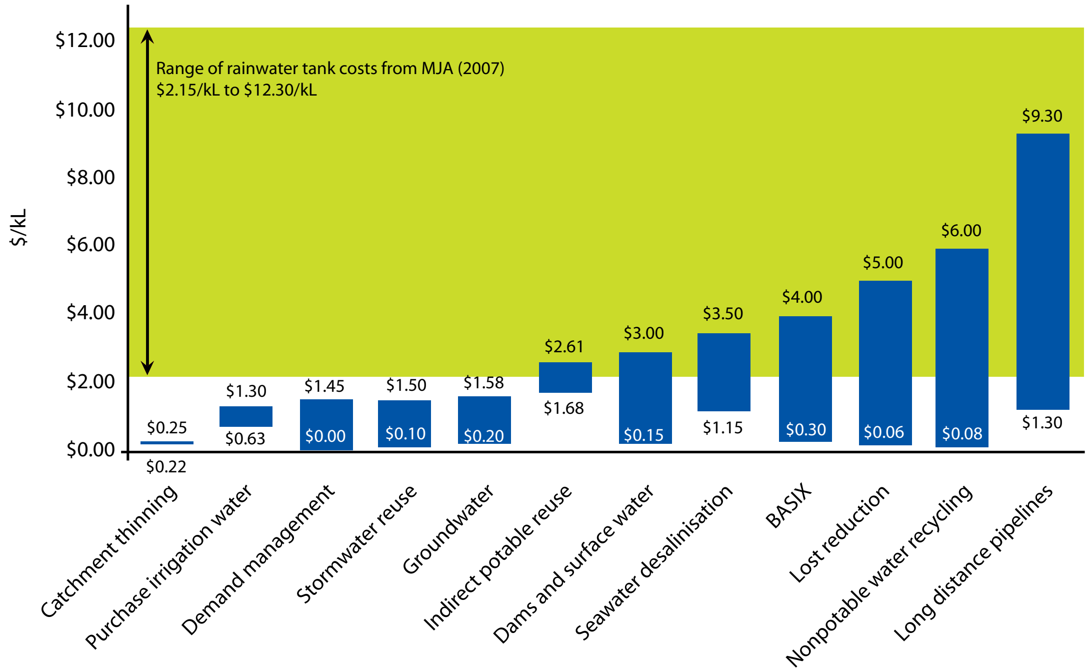
In their work for the National Water Initiative, Marsden Jacob assembled a number of studies that identified a broad range of costs for new supplies of water across four Australian cities. These included catchment thinning, buying irrigation water, stormwater reuse, desalination, dams, groundwater, the Five Star building regulations (BASIX in NSW) and loss reduction.

In Chart 1, these solutions were measured against a range of costs for rainwater tanks that they had been commissioned to estimate.

Some further indication of the potential savings available from schemes not involving new dams is offered by the Marsden Jacob analysis of Sydney in Chart 2. This suggested that, though on some estimates savings could be made at low cost by stricter standards, attention to leakages and so on, substantial augmentation were available only be increasing supply through new sources and extensive recycling. For both recycling and desalination, the costs of the water alone are in excess of the existing costs of water delivered to the consumer.

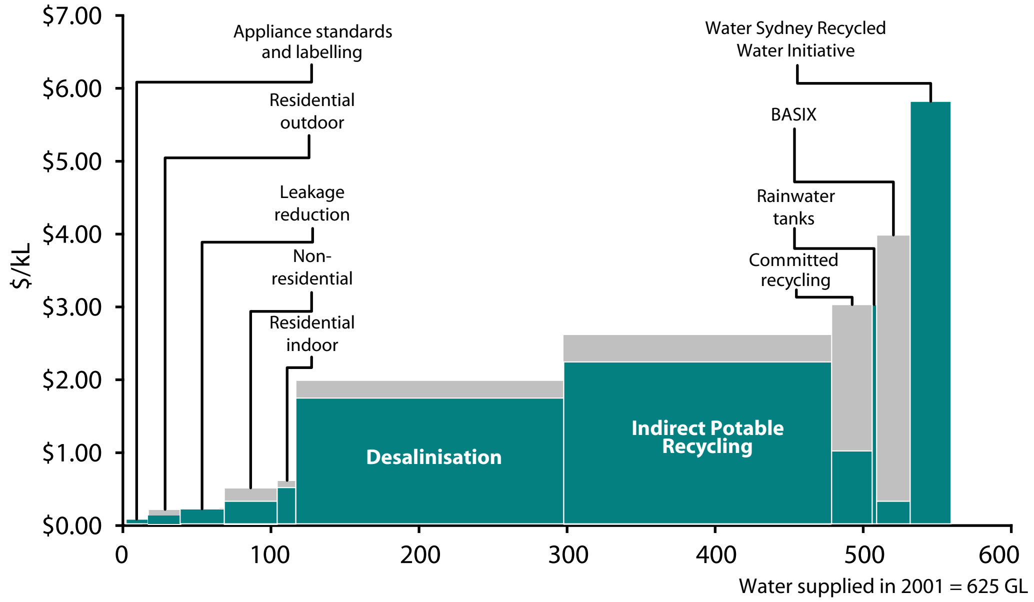
The Business Council of Australia[5] developed cost options for Adelaide based on estimates previously made by the South Australian Government. Compared with the then price of 125 cents per kL for existing water supply, it estimated limited amounts were available at a premium of up to 100 cents from plugging leaks, local groundwater, buying from irrigators and new reservoirs. Major augmentations were estimated to be from desalination and from ground and surface water from further afield. The costs and magnitudes are shown in Chart 3.

Chart 1: Water augmentation costs, Adelaide, Sydney, Perth and Newcastle



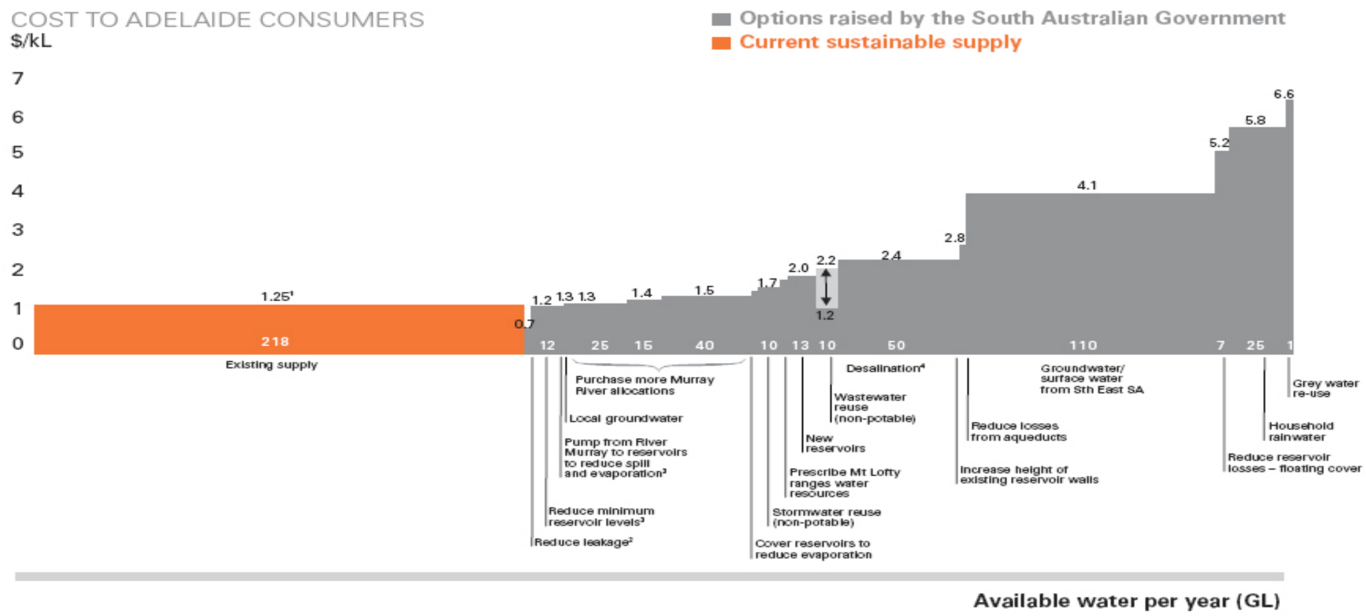
Source: Marsden Jacob, *The cost-effectiveness of rainwater tanks in urban Australia*, National Water Commission

Chart 2: Costs and availability of water augmentations in Sydney



Source: Marsden Jacob, *Securing Australia's Urban Water Supplies: Opportunities and Impediments*, Department of the Prime Minister and Cabinet

Chart 3: Current price of Adelaide water compared to alternative sources of supply



Source: Business Council of Australia, *Water under Pressure*

Some qualifications to these estimates are appropriate. First, although there are doubtless measures that can be taken to reduce waste from leaks and evaporation, estimates of this often prove to be optimistic. For example, Murray Irrigation Limited (MIL) has found that their seepage loss is only one per cent of total water available (a further 7 per cent is lost through evaporation and 10 per cent through measuring inaccuracies).[6] The Victorian system may lose much more than this to seepage, as a result of it having tenfold the number of outlets and being older and less well maintained, but the actual outcome for MIL (revealed as a result of calculations made possible by the drought) is rather less than had been expected.

Secondly the cost of purchasing irrigation water would have increased substantially since the estimates were made. Irrigation water entitlements in South Australia are presently trading at over $2,000 per ML up from around $300 five years ago. Added to this is the cost of piping it to Adelaide.

Alternative Means of Augmenting Supply to Melbourne

New Sources of Piped Water

From information on the public record and building in a rate of return on investment at six per cent per annum estimates can be made of the existing and alternative costs of new water sources. These costs are inferred from:

- Melbourne Water's present operating costs;
- the Wonthaggi desalinisation plant ($3.1 billion)
- the cost of a new dam at $1.35 billion on the Mitchell and $398-694 million on the Macalister[7]; and
- the reported costs of the Sugarloaf scheme ($1,650 million).

Desalinisation

Though desalination plants are inevitably a costly means of producing water, the costs with respect to the Wonthaggi desalination proposal are particularly high. From public information its cost of water delivered to the local distribution businesses is 301 cents per kL (213 and 88 cents for capital and operating costs respectively).

The costs of water from the existing Kwinana 45 GL desalination plant are given as 117 cents/kL[8], though this does not include a return on capital. The Premier of Western Australia, in announcing an estimated cost for a new plant with a comparable capacity to be operating by 2011, has put its cost at $640 million. This is nearly 70 per cent greater than the cost of the current plant.

Having abandoned previous plans to build a desalination plant in November 2006, in June 2007 the NSW Premier announced a 250 ML/day (90 GL/annum) plant to be run on green energy. This was estimated to have a capital cost of $960 million plus a further $500 million on distribution and $300 million on operational costs[9,10]. According to the Sydney Water submission to IPART[11], total project costs are $1833 million for assets with lives averaging 47 years. With a six per cent return on investment and operating costs stated to be 61 cents per kL this works out at 214 cents per kL delivered to the distribution network.

The costs of the Adelaide desalination option are estimated at 240 cents per kL.

Israel's Ashkelon Desalination Plant, Seawater Reverse Osmosis (SWRO) Plant is apparently producing 100 gigalitres per annum, around 13% of the country's domestic consumer demand, or equivalent to 5–6% of Israel's total water needs. Its cost was $US250 million in 2002 prices. Its planned 25 year life and its capital cost of $US2.5 per gigalitre implies a capital cost of only 20 US cents per kL per year. Though transmission costs would be additional, this is far lower than any costs estimated for Australia.

Even if a Victorian desalination plant were to weigh in at half of its presently announced costs, it would remain a very expensive option.

Recycling

Recycling of waste water, particularly sewerage, is strongly opposed and presently politically impossible even though it is common for inland cities around the world and, when competently undertaken, poses no health risk. Some treated water is currently used for non-drinking purposes and more is planned. Table 5 shows this, though the quantities include, in the case of Victoria, water that is fed into the bay to improve its quality; few would consider this recycling. Later data indicates Victoria is meeting its recycling target though this is largely because its definition of recycling includes re-use.

Table 5: Recycled water use as a proportion of treated water

	1996–97	2001–02	2004-05	Targets (%)
State/ Territory				
NSW	7.3	8.9		
Victoria	4.6	6.7		20 (2012)
Queensland	11.6	11.2		
South Australia	9.9	15.1		30 (2025)
Western Australia	6.1	10.0		20 (2012)
Tasmania	2.3	9.5		
ACT	0.8	5.6		20 (2013)
Northern Territory	4.8	5.2		-
Australia	7.3	9.1		
Capital cities				
Sydney		2.2	2.8	12 (2011)
Melbourne		5.7	11.6	
Brisbane		4.0	5.0	
Adelaide		15.1	20.7	
Perth		3.8	3.6	
Hobart				

Source: ATSE (2004) *Water Recycling in Australia*, p. 7, *WSAAfacts 2005*

In the main, recycled water is used for purposes other than domestic consumption, though the latter use is increasing. Table 6 shows Marsden Jacob's assessment of the projects underway and the costs of the water they provide.

One of the two Melbourne sewerage treatment facilities, the Eastern Treatment Plant (ETP) will be upgraded by 2012 from providing Class C water to providing Class A water which can be used for many purposes (including gardening and toilet use). The cost is approximately $300 million[12]. Building on this, the Department of Sustainability and Environment has also proposed to upgrade the ETP looking at two opportunities to use high quality treated water from it in order to free up additional potable supply to Melbourne:

- the Eastern Water Recycling Proposal (EWRP),

Table 6: Cost of recycled water by scheme

Location	Use of recycled water	Cost estimate ($/kL)
Western Sydney Recycled Water Initiative[1]	Environmental flow replacement, residential and agriculture	$5.80
Rouse Hill, NSW (existing)[2]	Residential	$3.00-$4.00
Melbourne Eastern STP[3]		>$3.00
Sydney Water Indirect Potable Reuse[4]	Indirect Potable	$2.23-2.61
Olympic Park, NSW (existing)[2]	Residential	$1.60+ (operating costs only)
Redcliffe City opportunities, QLD[5]	Irrigation and Residential	$2.50
Springfield, QLD (existing)[2]	Residential	$1.45
SA opportunities[6]	Industrial and municipal	$1.40
High quality industrial water[7]	Industrial	$0.85 - $1.40
Redcliffe City opportunities, QLD[5]	Irrigation	$0.80
Logan City opportunities, QLD[5]	Parks and gardens	$0.80
Toowoomba opportunities, QLD[5]	Agriculture	$0.45
Some rural and regional towns [7]	Golf Courses and Parks	Least cost disposal method (i.e., <0)

Sources:
1. Institute for Sustainable Futures, ACILTasman and SMEC (2006).
2. Parliamentary Library (2005) "Issues encountered in advancing Australia's water recycling schemes"
3. AWCRRP Seminar Presentation (2004) 'The Big Picture'
4. Sydney Water, Indirect potable recycling and desalination - a cost comparison. Asset lives not provided in fact sheet – range represents 25-100 year life, discounted at 6 per cent real pre-tax.
5. IPWEAQ Conference Paper (2003) "Integrated Urban Water Management and Water Recycling in SE Queensland – Recent Developments"
6. SA Government "Waterproofing Adelaide Information Sheet: Large Scale Wastewater Reuse" (unit cost derived based on 6% return and 50 year average asset life for treatment and pipes).
7. MJA Analysis

where recycled water is sent to the Latrobe Valley for use by industry, substituting their current regional water supplies and releasing a proportion of these supplies for augmentation of Melbourne's supply, ('ETP Recycling')

- the 'ETP to Yarra' option of adding recycled water to environmental flows in the Yarra River below Yering Gorge, allowing additional water to be harvested from the Yarra River into Sugarloaf Reservoir for conventional treatment for potable supply, ('ETP Released Water').

On the data provided, both of these options would appear to be very expensive. The costs of plant and pipes plus the operating costs in the recycling option appear to be about 204 cents per kL per annum. The substitution of recycled water into the Yarra is less expensive at 114 cents per kL per annum. This might be reduced further since there is a small scale plant near the ETP reportedly selling recycled (Class C) water for irrigation at 25 cents per kL though information on the level of subsidy to this plant is not available.

A further unconventional source is stormwater harvesting from the Yarra, Patterson and Maribyrnong Rivers. Sinclair Knight Merz[13] reviewed cases of such harvesting in Santa Monica, Adelaide and Singapore. None are large—that for Singapore supplies about 1 per cent of usage. Various options using the Yarra and Patterson Rivers were examined. The maximum yield of all the schemes examined was 26 GL per annum and none of them would provide water at less that 200 cents per kL per annum once the standard six per cent per annum return on capital was included.

This generally pessimistic set of findings is consistent with those of the CSIRO[14], which could not find financial justification for reuse except by using some very high values for environmental savings.

Major New Dams

The cost of a new dam duplicating the Thomson facility on the Mitchell River is $1.35 billion according to a 2005 study undertaken by SKM, released by the Government in August 2008. The SKM study claimed that the present annual average recommended yields of 111 GL/year might be reduced by climate change by 20 per cent by 2050. Should such reduced levels of availability have any credibility they would suggest a need to plan for more additional capacity. The SKM study estimated capital costs for a dam on the Macalister, like that on the Mitchell designed to be linked into the Thomson, would be $398-694 million.

Based on these estimates of capital cost and operating costs available from Melbourne Water and the local distribution businesses, a new storage dam on the Macalister is estimated to deliver water at less than a quarter of the cost of the desalination proposal and at 40 per cent of the (probably optimistic) costs of the Sugarloaf scheme.

Although not costed, the cheapest option might be a diversion from the Aberfeldy into the Thomson dam. This would use water more conveniently located to Melbourne and perhaps entail lower engineering costs.

There are other options from north of the Great Divide, the costs of which have not been estimated. In the past, Melbourne Water has considered plans to take water from the Big and Black Rivers feeding it into the Upper Yarra Dam. The Sugarloaf proposal is a variation of these. It carries relatively high costs because the level of Sugarloaf is 178 metres compared to the Upper Yarra Dam at 366 metres.

Table 7 offers cost estimates of some possible alternatives for major supply augmentations. Appendix 2 offers data on water availability from prospective sources south of the Great Divide.

Local Sources

Water delivered from home rainwater tanks by definition does not make use of the local reticulation system. Such water does not incur a charge from the local water suppliers. However, water charges, reflecting the nature of its cost, comprise a fixed charge and a volumetric charge. The former is imposed on all connected users irrespective of usage. Unless the household is disconnected from the water supplier, the grid is, at the very least, a back-up and connected properties should therefore pay a share of the fixed costs.

This application of the local reticulation charge is less problematic in the case of waste water reuse since the piping system is unique to the source of water and incurs its own separate pipe charges.

Table 7: Major supply possiblities

	Size GL/ annum	Capital cost cents per kL	Operating cost cents per kL	Total cost cents per kL
Macalister Mount Useful (a)	150	42	20	62
Macalister Mount Useful (b)	85	52	20	72
Mitchell	150	81	37	118
Latrobe	150	60	24	84
ETP Released Water	90	80	29	109
Sugarloaf	75	146	20	166
Paterson River Stormwater (best case)	26	102	100	202
ETP Recycling	115	179	63	242
Wonthaggi Desal	150	213	88	301

Note: Capital cost is annualized over the expected life and with a 6 per cent return on capital.

Rainwater Harvesting

According to the ABS, some 17 per cent of Australian homes have a rainwater tank installed.

In Victoria, from 1 July 2005, it was made compulsory for new houses to have:

- a 5 Star energy rating for building fabric (walls, ceilings, windows, floors and water saving measures)
- a rainwater tank for toilet flushing or solar hot water system.

These provisions built on others of 1 July 2004 requiring new houses:

- install water saving tapware and flow reducing showerheads (flow rates to be 7.5–9 litres per minute)
- reduce water pressure to 500 kilopascals at outlets within buildings.

Reviewing these measures, the Allen Consulting Group[15] found that the benefits provided by the rainwater tank are not sufficient to justify the added investment costs:

> … in the long run, Victoria is better off in economic welfare and [gross state product] terms under the 5 Star housing standard alone than a regulatory option that requires investment in rainwater tank equipment. (p. 5)

Despite these findings, regulations were introduced to mandate either an approved solar water heater or rainwater tank for toilet flushing. The HIA claimed mandatory water saving measures would add about $2,500 to the cost of an average $150,000 house (equal to about 1.7 per cent).

While not endorsing those precise numbers, the VCEC agreed with the position that the regulation was not justified. It drew upon tank cost estimates from the Centre for Design study ($1268.50 for the tank, pump and installation, and a further $350 to replace the pump after 15 years). With electricity costs at $3.50 each year to operate the pump, the net present value of installing a rainwater tank for flushing the toilet was estimated to be negative $808 over the 30 year life of the tank (using a 5 per cent real discount rate).

The VCEC estimated that if the collected water were used on the garden too, the net present value would be negative $459. While this improves the economic efficiency of installing a rainwater tank, it still is less efficient than relying on mains water.

The Government responded by introducing further measures including rebates. These have progressively expanded and currently include:

- $500 on permanent grey water diversion/treatment systems
- $150 on rainwater tanks (600 litre minimum), this does not apply to rainwater tanks purchased to achieve the 5 Star standard during the construction of a new home
- $50 on dual-flush toilets
- $10 on 3 Star (AAA) showerheads
- $30 on water conservation audits
- $30 on high-pressure cleaning device

The program was maintained and expanded in July 2007, with new products and services included in the Rebate scheme. (See Table 8) The rebates available for rainwater tanks are:

Table 8: Victorian rebates for water saving measures

PRODUCT	REBATE
Dual flush toilet	$50
Greywater permanent system	$500
Hot water recirculating devices	$150
Rainwater tank – 600 litres or greater	$150
Rainwater tank to toilet connection (tanks 600 to 1999 litres)	$150
Rainwater Tank connected to Toilet OR Laundry (tanks 2000 to 4999 litres)	$500
Rainwater Tank connected to Toilet OR Laundry (tanks 5000 litres or greater) Rainwater Tank connected to Toilet AND Laundry (tanks 5000 litres or greater)	$1000
Water conservation audit	$50
AAA showerhead – now two available per household	$10 – rebate per showerhead costing between $30 and $100$20 – rebate per showerhead costing over $100
Basket of goods: Mulch (organic and inorganic), flow control devices, soil wetting or moisture agents, compost or mulch bin, soil moisture & rain sensors, garden tap timers, drip watering system or weep hoses, trigger nozzles, temporary greywater diverters, rainwater diverters, waterless car cleaning products, shower timers, toilet flush interrupter devices	$30 rebate is available when one or more of products with total combined value of $100. One basket rebate per customer per year

- $1,000 rebate for tanks 5,000 litres or greater which are plumbed to the toilet and laundry;
- $500 rebate for tanks between 2000—4,999 litres which are plumbed to either the toilet or laundry; and
- $150 rebate for tanks 600 litres or greater—no plumbing required.

The Water Minister, Mr Holding[16], claims that some $12 million has been paid in rebates since 2003 and this has helped reduce water usage by 28 per cent compared with the levels of the 1990s. Rationing the water is, of course, the overwhelming cause of lower usage.

Marsden Jacob[17] estimated the yield from a 5 kL tank in Melbourne was 24 kL for a 50 square metre roof and 6 kL for a 200 square metre roof. They use an average of 71 kL per year for tanks plumbed for both indoor and outdoor usage. After accounting for maintenance, pumps and other costs, they find the average costs of rainwater tanks to be very high. In the most favourable comparison with mains water, tanks were 80 per cent higher than mains water and at their least favourable they were fifteen fold the cost. The cheapest water available from rainwater tanks was 263 cents per kL.

Table 9 summarizes the costs of different options estimated by Marsden Jacob.

Table 9: Levelised cost of rainwater tanks (indoor and outdoor use) ($/kL) Melbourne

Tank size	2 kL		5 kL		10 kL		Price of mains water
Roof area	50 m²	200m²	50m²	200m²	50m²	200m²	
	8.40	3.00	9.12	2.63	10.41	2.64	0.81-1.55+

Mitchell, Taylor, Fletcher and Deletic estimated similar high costs. For household tanks they estimated the annual cost of water collection varied between $2,000 per ML (residential areas 15 households per hectare using 5 kL tanks) and $8,120 per ML (residential areas of 40 households per hectare using 2 kL tanks). This puts the cheapest supply at 200-256 cents/kL. (see Charts 4 and 5)

However, in order to compare these costs with those of reticulated water supplies a saving in operational costs of around 45 cents per kL should be included. On the most optimistic estimates, this would reduce rainwater tanks' costs to levels considerably below those estimated for the Wonthaggi desalination plant and comparable with the costs of the Sugarloaf supply.

Stormwater Use

Wastewater reuse has been strongly opposed and is not likely to be socially acceptable in the foreseeable future. Stormwater reuse does not carry the same social opposition.

As well as their estimates of the potential for rainwater collection tanks, Mitchell, Taylor Fletcher and Deletic[18] modeled Melbourne stormwater reuse in a variety of situations. Their preferred model application (Metric 2) estimates the costs of the water and also takes account of the additional benefit of avoided nitrogen treatment costs.

Harvesting residential stormwater was more economical in spite of it being necessary to install an additional area reticulation system so that its use is confined to garden clothes washing, toilet and (on some scenarios) hot water provision. For standard housing estates at 15 households per hectare, costs as low as $630 per ML were estimated. (see Charts 6 and 7)

Relatively conservative assumptions were used. For example a discount rate of 5.2 per cent was employed and historical levels of precipitation (and evapotranspiration) were reduced (increased) to take into account estimates of climate change effects.

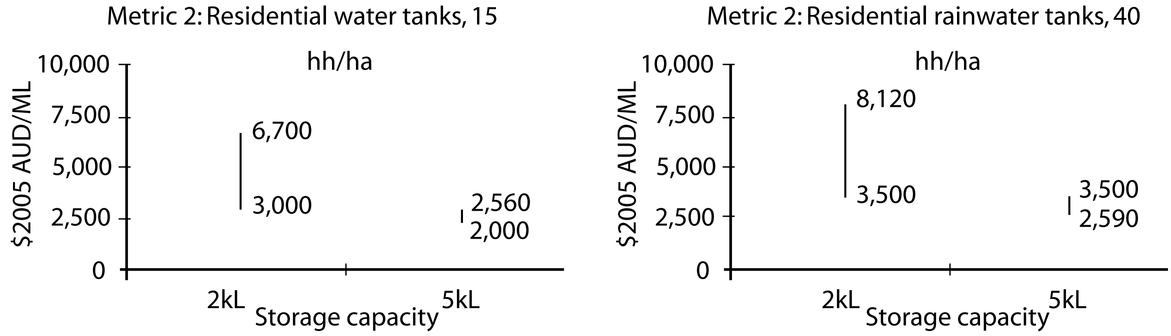
The areas modeled (Laverton, Craigieburn and Scoresby) vary in precipitation from 549 mm/y to 891 mm/y.

On the basis of the optimum level of storage being installed, the authors' estimate is that around 47 ML / year per 1000 lot development can be harvested. New releases of greenfield land in the Melbourne area have fallen from around 20,000 lots in 2003 to 10700 in 2006/7.[19] Future plans have been changed a number of times. The 2030 plan implied only a little over 7,000 per annum in greenfield sites. Former Premier Bracks in *A plan for Melbourne's growth areas* cited numbers equating to an underlying supply of 8,800 lots per annum.

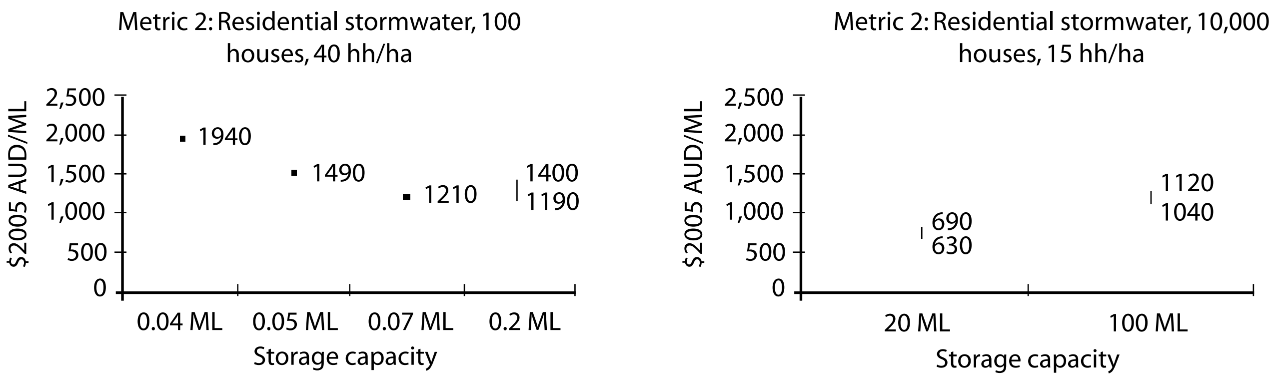
Doubtless these numbers will change again and, given recent government statements on land release, we would expect at least 15,000 greenfield lots per annum and possibly 20,000. Based on the Mitchell, Taylor, Fletcher and Deletic estimates, this suggests 700-900 ML each year being possible from stormwater harvesting if the water were to be available for toilet, clothes washing and garden usage. Over a 50 year time horizon, this amounts to 35-45GL which would represent a higher share of urban water from harvesting than is currently seen anywhere in the world.

Mitchell et al see some prospects of lower costs than this from harvesting stormwater, especially from relatively low density developments of 15 homes per hectare. They estimate costs could be as low as 63-69 cents per kL. However these costs would increase if the developments also had rainwater

Charts 4 and 5: Cost & storage capacity of rainwater tanks



Charts 6 and 7: Cost & storage capacity of stormwater facilities



tanks (since these would reduce the prospective stormwater to be captured). The potential volume of new supplies from stormwater capture is limited because such projects are only viable for new greenfield developments.

The cost of providing water from local sources allows some savings because no long distance transmission is required. Even so, on the estimates that have been assembled, local supply through rainwater collection or from stormwater costs far in excess of long distance transmission from dams, especially along gravity fed pipelines.

Concluding comments

Costs of delivering new sources of water to the Melbourne local reticulation system from major sources are estimated to vary from around 65 cents/kL (and possibly even lower) for new dams/diversions and up to 300 cents for a desalination plant.

Melbourne suffers no chronic permanent shortage of water from natural sources. Water is available in quantities far in excess of those required for urban use from the catchments to the north east of Melbourne and channeled through the basins of the Thomson/Macalister, Latrobe and Mitchell. Other resources are available from further afield, albeit at high cost.

Building a new dam to collect water from the Thomson/Macalister, Latrobe or Mitchell basins is the most cost-effective approach, and in some cases may provide a bonus of better flood mitigation and improved water security for Gippsland farmers. This should be the preferred approach.

Water can also be brought from north of the Great Divide as is being proposed with the Sugarloaf scheme but this would be at higher cost due to the need for pumping and creating water savings or compensating those presently using it for irrigation purposes.

Governments should also explore further the possibilities of stormwater collection in greenfield urban developments. Some of these appear to be approaching cost-viability. New developments should not be obligated to pay any additional costs of such collection schemes as this would penalize them vis-à-vis others within the community. They are not however likely to be major supply sources.

Rainwater tanks have a higher potential yield than urban stormwater collection but they somewhat cannibalize the latter. However, though potentially less expensive than some options, rainwater tanks are uneconomic and impose needless costs on new house developments (where they are mandatory) and on the taxpayer (where the tanks are subsidized). Regulations requiring their installation should be removed and subsidies to their installation should be discontinued.

Similarly uneconomic are the proposals for recycling of water from the Eastern Treatment Plant and for desalination. The proposed Wonthaggi desalination plant would, according to the estimates provided by the government, result in excess capital costs of $2 billion and considerably higher operating costs compared with making use of water from the catchment area. The option should be rejected.

Various options for the Eastern Treatment Plant, including exchanging treated water for additional harvesting from the Yarra, appear to be high cost approaches but could be further investigated.

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Appendix 1 Victorian Water Resources

Streamflows

Basin	Average annual streamflow (ML)	2005/06 streamflow		2004/05 streamflow	
		(ML)	(% of average)	(ML)	(% of average)
Murray	7,000,000,	4,364,300	63%	5,569,900	51%
Kiewa	339,500	657,500	194%	648,600	191%
Ovens	1,692,000	1,423,800	84%	1,506,900	89%
Broken	326,000	257,200	79%	220,400	68%
Goulburn	3,366,000	1,955,900	58%	2,300,400	68%
Campaspe	305,000	83,400	27%	113,400	37%
Loddon	415,000	116,000	28%	155,100	37%
Avoca	136,200	24,500	18%	25,200	19%
Mallee	0	0	NA	0	NA
Wimmera	316,400	109,600	35%	73,900	23%
East Gippsland	1,122,000	508,600	45%	159,300	14%
Snowy	1,447,280	1,078,300	75%	530,200	37%
Tambo	570,000	167,500	29%	97,400	17%
Mitchell	1,355,000	675,700	50%	614,300	45%
Thomson	1,414,000	498,700	35%	688,800	49%
Latrobe	875,000	507,800	58%	780,500	89%
South Gippsland	1,157,000	633,200	55%	1,120,100	97%
Bunyip	541,000	485,600	90%	463,200	86%
Yarra	1,054,000	589,800	56%	1,008,700	96%
Maribynong	113,000	30,400	27%	37,000	33%
Werribee	102,000	21,600	21%	83,600	82%
Moorabool	97,000	47,900	49%	108,000	111%
Barwon	360,000	142,000	39%	189,200	53%
Corangamite	316,000	71,000	22%	263,000	83%
Otway Coast	884,000	467,300	53%	981,420	111%
Hopkins	635,000	154,900	24%	395,100	62%
Portland Coast	361,000	69,600	19%	607,200	168%
Glenelg	964,000	140,700	15%	177,200	18%
Millicent Coast	0	0	NA	200	NA
Total	**27,263,400**	**15,312,200**	**56%**	**16,918,200**	**62%**

Water Allocated for Consumptive Use

Entitlement	Volume 2005/06 (ML)
Surface Water	
Bulk entitlements	5,413,590
Licences	279,550
Small catchment dams	523,200
Groundwater	
Licences	879,900
Total water entitlements	7,096,240

Water Availability and total Water Usage

	Surface water (ML)	Groundwater	Recycled water
Total resource	15,312,200	NA	440,000
Entitlement/allocation	6,216,340	879,900	NA
Water used	4,921,360	366,300	95,740

Water Usage Breakdown

	Residential (ML)	Non-residential (ML)	Total (ML)	Percentage of state use
Irrigation		3,043,010	3,043,010	76.2
Domestic and stock		176,130	176,130	4.4
Melbourne	306,290	131,660	437,950	11.0
Regional	142,540	75,320	217,860	5.4
Latrobe Valley major users		120,460	120,460	3.0
Total	**448,830**	**3,546,580**	**3,995,410**	

Appendix 2 Readily Available Water Resources in Eastern Melbourne (2005/6 State Water Report)

Thomson Catchment

Water account component	2005/06 (ML)	2004/05 (ML
Major on-stream storage		
Volume in storage at start of year	533,400	465,300
Volume in storage at end of year	450,100	533,400
Change in storage	**-83,300**	**68,100**
Inflows		
Catchment inflow	498,700	688,800
Transfers from other basins	0	0
Return flow from irrigation	40,000	18,600
Treated wastewater discharged back to river	33	40
Sub-total	**538,700**	**707,400**
Usage		
Urban diversions to towns in Thomson River basin	1,750	2,000
Transfers to Yarra River basin for urban use	129,090	71,710
Irrigation district diversions	166,900	274,600
Licensed private diversion from unregulated streams	11,600	11,600
Small catchment dams	7,000	7,000
Sub-total	**316,300**	**366,900**
Losses		
Net evaporation losses from major storages	15,800	14,900
Evaporation from small catchment dams	2,500	2,500
In-stream infiltration to groundwater, flows to floodplain and evaporation	19,700	14,700
Sub-total	**38,000**	**32,100**
Water passed at outlet of basin		
River outflows to the Latrobe River	216,700	168,600
River outflows direct to Lake Wellington	51,100	71,700

Latrobe Catchment

Water account component	2005/06 (ML)	2004/05 (ML
Major on-stream storage		
Volume in storage at start of year	220,200	179,500
Volume in storage at end of year	197,600	220,200
Change in storage	**-22,600**	**40,700**
Inflows		
Catchment inflow	507,800	780,500
Transfers from other basins	0	0
Return flow from power stations and major industry	48,000	55,600
Return flow from irrigation	0	0
Treated wastewater discharged back to river	4,110	4,360
Sub-total	**559,900**	**840,500**
Usage		
Urban and industrial diversions	125,580	130,890
Licensed private diversions from regulated streams	6,700	7,000
Licensed private diversion from unregulated streams	13,000	10,800
Small catchment dams	20,500	20,500
Sub-total	**165,800**	**169,200**
Losses		
Net evaporation losses from major storages	10,200	3,700
Evaporation from small catchment dams	5,700	5,700
In-stream infiltration to groundwater, flows to floodplain and evaporation	0	0
Sub-total	**15,900**	**9,400**
Water passed at outlet of basin		
River outflows to the Gippsland Lakes (excluding Thomson River)	400,800	621,200
River outflows to the Gippsland Lakes (including Thomson River)	617,500	789,800

Tambo Catchment

Water account component	2005/06 (ML)	2004/05 (ML)
Major on-stream storage		
Volume in storage at start of year	0	0
Volume in storage at end of year	0	0
Change in storage	**0**	**0**
Inflows		
Catchment inflow	167,500	97,400
Transfers from other basins	0	0
Return flow from irrigation	0	0
Treated wastewater discharged back to river	0	0
Sub-total	**167,500**	**97,400**
Usage		
Urban diversions	60	60
Licensed private diversions from unregulated streams	1,400	2,500
Small catchment dams	3,900	3,900
Sub-total	**5,400**	**6,500**
Losses		
Net evaporation losses from major storages	0	0
Evaporation from small catchment dams	2,100	2,000
In-stream infiltration to groundwater, flows to floodplain and evaporation	0	0
Sub-total	**2,100**	**2,000**
Water passed at outlet of basin		
River outflows to the ocean	160,000	88,900

Mitchell Catchment

Water account component	2005/06 (ML)	2004/05 (ML)
Major on-stream storage		
Volume in storage at start of year	0	0
Volume in storage at end of year	0	0
Change in storage	**0**	**0**
Inflows		
Catchment inflow	675,700	614,300
Transfers from other basins	0	0
Return flow from irrigation	0	0
Treated wastewater discharged back to river	0	0
Sub-total	**675,700**	**614,300**
Usage		
Urban diversions	4,380	4,830
Licensed private diversions from unregulated streams	8,700	9,000
Small catchment dams	4,500	4,500
Sub-total	**17,600**	**18,300**
Losses		
Net evaporation losses from major storages	0	0
Evaporation from small catchment dams	1,100	1,100
In-stream infiltration to groundwater, flows to floodplain and evaporation	400	300
Sub-total	**1,500**	**1,400**
Water passed at outlet of basin		
River outflows to the ocean	656,600	594,600

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