Not relevant

608 INTERIM REPORT OF THE **D**ESALINATION WORKING GROUP (Karlene Maywald) - NOTE**D**

Not relevant

608

MINUTES *forming* ENCLOSURE TO **MWSCS07/054**

TO: PREMIER FOR CABINET TO NOTE

RE: INTERIM REPORT OF THE DESALINATION WORKING GROUP

1. PROPOSAL

1.1 That Cabinet notes the interim report of the Desalination Working Group.

2. BACKGROUND

2.1 On 6 March 2007, I announced the establishment of the Desalination Working Group (DWG). The group is chaired by SA's independent Murray-Darling Basin Commissioner, Ian Kowalick, and has representatives from the Department of Treasury and Finance, Department of Transport, Energy and Infrastructure and SA Water.

2.2 While the DWG is not due to report until September 2007, the group has provided an interim report, a copy of which are attached. Ian Kowalick briefed Cabinet on the interim report at its meeting on 20 August 2007.

3. DISCUSSION

3.1 The DWG's interim report notes that Adelaide's current water supply is relatively secure, except in extreme drought years. The existing Water Proofing Adelaide provides for the city's average needs. The water security challenge is providing for variability – ie the extreme years. Going forward, Adelaide's water security also will be subject to both the efficient management of the Murray-Darling Basin and any climate change impacts.

3.2 The report notes that Adelaide's water consumption is not a major impost on the River Murray. The whole state of South Australia is responsible for only 6% of extractions from the river. Adelaide is responsible for only 1% extractions. Continued reliance on the river remains as a policy choice.

3.3 The report also notes that all future options are capital and energy intensive. Increased water security is likely to cost in excess of $1 billion, and result in real increases in the price of water for urban customers. Ultimately, the level of water security to be targeted is a matter of policy choice.

4. RECOMMENDATION

4.1 That Cabinet notes the interim report of the Desalination Working Group.

K Maywald

Karlene Maywald
MINISTER FOR WATER SECURITY

23 August 2007

In Cabinet
27 AUG 2007
NOTED
ACTING PREMIER

Confidential

Desalination Working Group

Interim Report July 2007

For Cabinet Consideration

Issues

23 July 2007

1. Introduction

To be able to report to the Minister for Water Security on how desalination fits with the Water Proofing Adelaide strategy for an integrated and diversified water supply system, the Working Group has to consider two important policy issues, viz:

1. To what extent should Adelaide's water supply rely upon water pumped from the River Murray?
2. What levels of water security do members of the public seek and consequently what price are the public prepared (or should be required to pay) for a secure water supply?

These issues are not simply matters for a technical or economic analysis. They are policy issues that are primarily a matter for the SA Government to judge before the Working Group makes its final recommendations. This report discusses these and other issues.

2. How Secure is Adelaide's Water Supply?

A record drought, very low flows into the River Murray, and the widespread belief that the Murray Darling Basin is in crisis may lead to a misleading view that Adelaide's water supply is very insecure and Adelaide's dependence on River Murray water is inherently a bad thing.

A study commissioned by the SA Water Corporation to investigate Adelaide's water supply security shows that *based on historical data*:

- The low 12-month flows in the period ending December 2006 should occur at a rate less than 1 in 200 years.

- If SA Water is able to utilise its rolling 650 GL over 5 years licence plus the additional 16 GL of annual licence that it has purchased, the reliability of Adelaide's water supply compared to targets set for other major cities is shown below in Table 1.

The targets shown in Table 1 are prior to construction of desalination plants. For example, both Sydney and the ACT now aim to never require restrictions greater than Level 3.

Table 1

Location	Average Recurrence Interval (ARI)		
	L3 restrictions	*L5 restrictions*	*Run out of water*
Sydney	<1:10 yrs	<1:10 yrs	<1:100,000 yrs
Melbourne	<1:20 yrs	Never	Not defined
ACT	<1:10 yrs	<1:50 yrs	<1:1,000 yrs
Perth	Permanent (Sprinklers only 2 days per week)	<1:200 yrs	Not defined
Adelaide	1:101 yrs	1:228 yrs	1:320 yrs

Clearly, given the acceptance of temporary Level 3 restrictions and assuming the ability to buy additional water on the market, Adelaide's existing infrastructure provides a secure water supply provided:

1. The Murray Darling Basin is efficiently managed, and
2. Climate change does not in the future result in a significant reduction in inflows that require large reductions in the diversion of water from the River Murray.

Adelaide's water security compares very favourably to other major cities, except it is less able to manage the variability in inflows during extreme drought events when extractions from the River Murray may not be available.

Adelaide has much less local storage per capita than both Sydney and Melbourne.

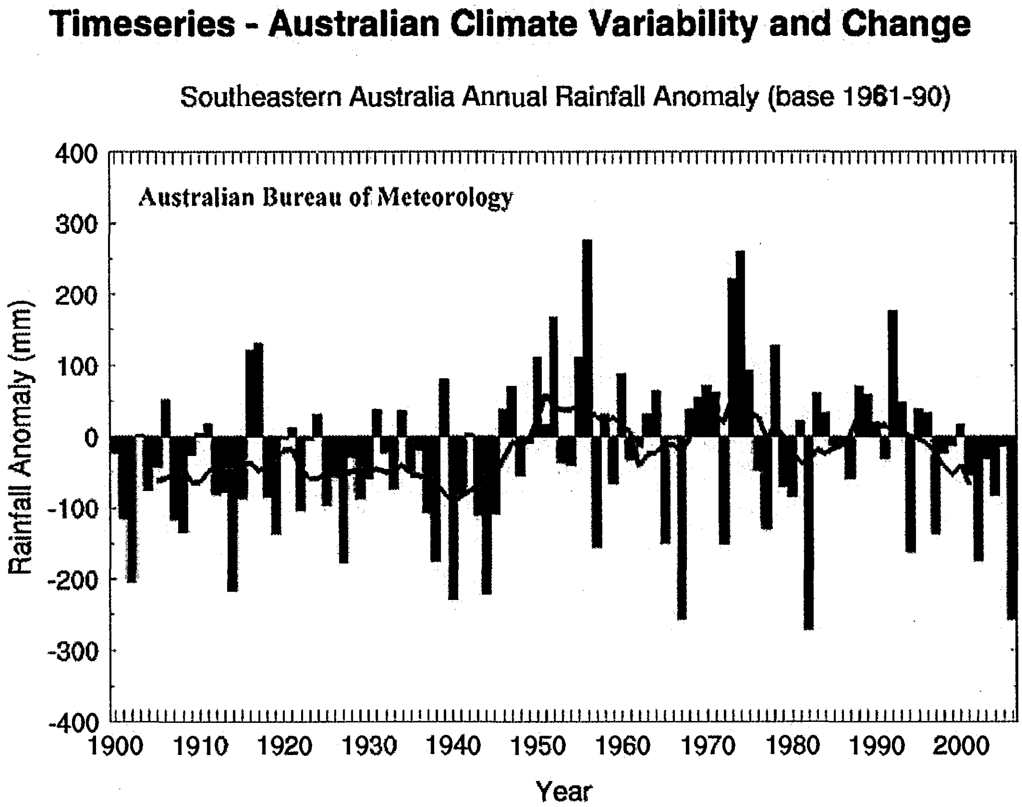
Increased demand due to future population growth will largely be offset by savings made from implementation of Water Proofing Adelaide. However, improving the efficiency of overall outdoor water use will be an impact on water security. As more outdoor efficiency gains are made and applied to meet future demand, drought response measures (ie restrictions) will be less effective if they need to be implemented.

The water supply system reliability for future operating scenarios is currently being considered.

3. Climate Change

It is clear that there are long-term cycles of rainfall in South Eastern Australia that includes the catchment area of the River Murray that is most important to South Australia during a drought. Chart 1 which shows rainfall anomaly in SE Australia, against a 1961-1990 base, demonstrates that average rainfall in the period from 1946 to 1990 was greater than for the period 1900 to 1946.

Chart 1[1]



11-year running averages shown by black curve

This variation is mostly a function of long-term natural variation in weather patterns and cannot be attributed solely to climate change caused by Greenhouse emissions. However, future climate change impacts due to Greenhouse effects may be in addition to these cyclical climatic effects and that may increase the frequency of droughts.

It is important to note that the period of greatest economic development built upon diversion of Murray Darling Basin water occurred during a period when it may be that rainfall was atypically higher than the long run average. If the rainfall returns to the pattern that applied in 1900 to 1946, the impact of the changed weather pattern on rainfall in the River Murray catchment would be a ~15% reduction.

Chart 2 shows the very similar pattern that applies to the whole Murray Darling Basin

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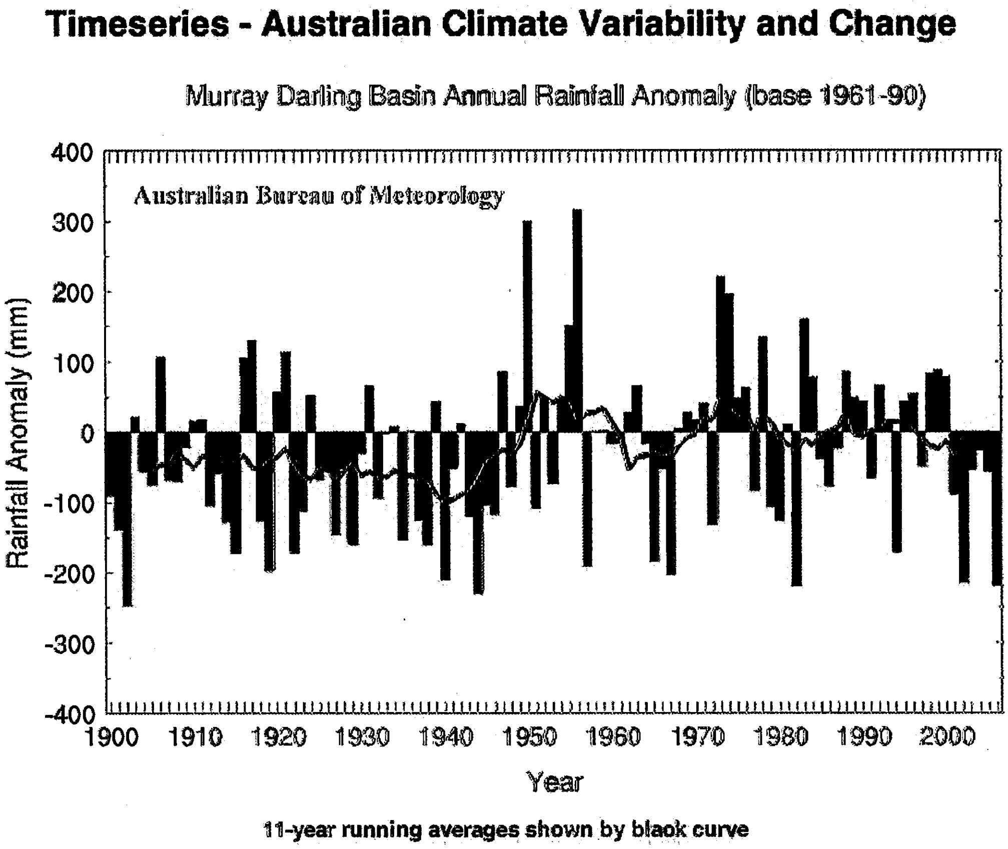
[1] Bureau of Meteorology Data

Chart 2[2]



Based upon the historical data, it would be prudent for the long term planning of water usage from the Murray Darling Basin to assume at least a ~15% reduction in rainfall, which on average could result in a greater than 15% reduction in inflows. The extent to which Greenhouse induced climate change will further reduce these inflows is a matter now being studied as part of the Commonwealth Government's proposals for future management of the Murray Darling Basin.

Some commentators predict that inflows could over time be reduced as much as 30% but at this stage there is little robust science available to the Working Group to predict that outcome. Such predictions are inherently speculative because they have to assume a new paradigm for weather and are model-based predictions, rather than a prediction of a long-term cyclic shift the impact of which is based on historic data.

Nevertheless, whilst there may be a case for scepticism about the more extreme claims for the impact of greenhouse gases, the scientific consensus is now sufficiently compelling to conclude that it cannot be ignored.

The anomaly in inflows to reservoirs in the Mt Lofty Ranges is presented in Chart 3 against a base of 1951-2000. This shows slightly higher inflows in the first half of the century compared to the second half, which is opposite to the trend seen in South Eastern Australia.

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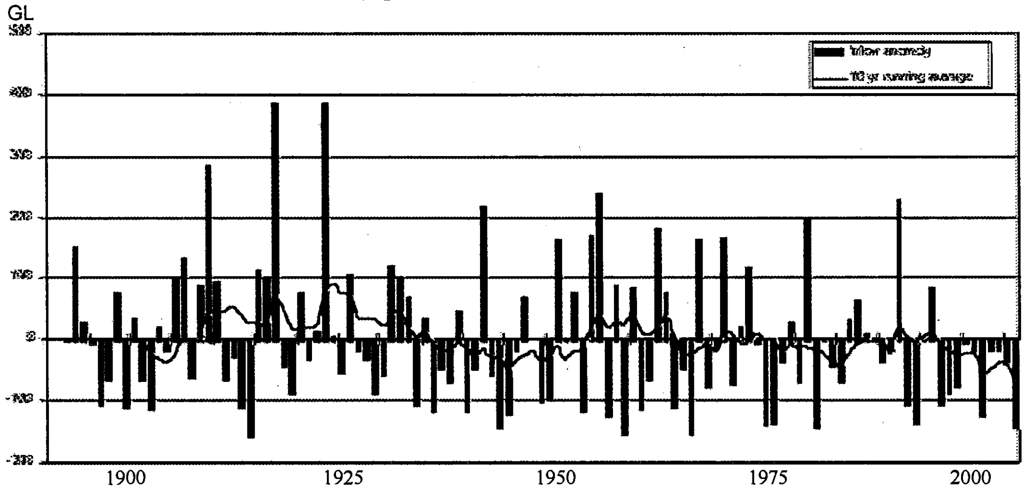
[2] Bureau of Meteorology data

Chart 3

Inflow Variability in the Mt Lofty Ranges
(against a 1951 - 2000 base)

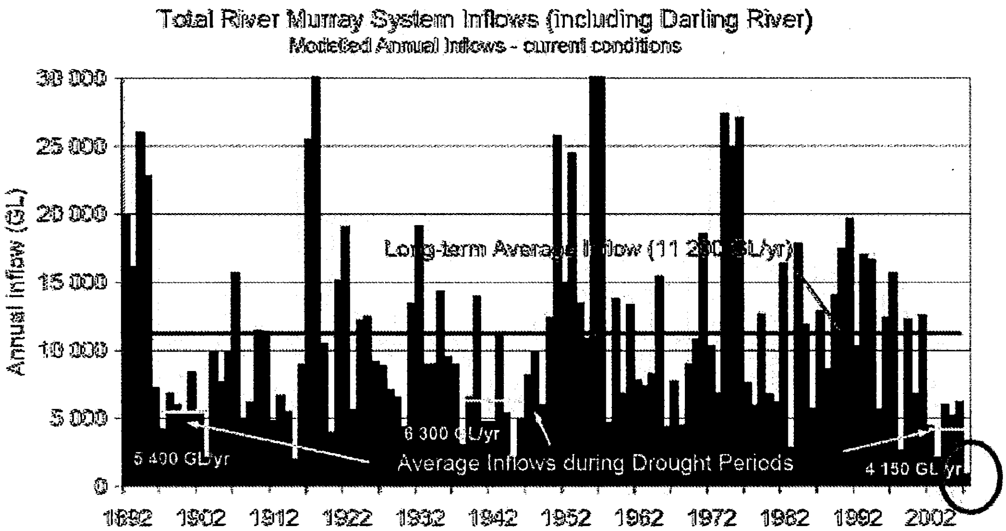


4. Management of the Murray Darling Basin

Historically, below average rainfall in the Basin has extended for periods of up to 11 years. But there is an essential difference with managing in the current drought. The most telling difference is not global warming (and more generally the greenhouse debate) but that meteorologists now have a much better understanding of global weather cycles and are able to measure parameters that predict the risk of extended El Nino – Southern Oscillation induced drought events.

Chart 4 shows the long-term pattern of inflows into the Basin.

Chart 4[3]



It is never possible to fully anticipate very rare natural events. However, with existing

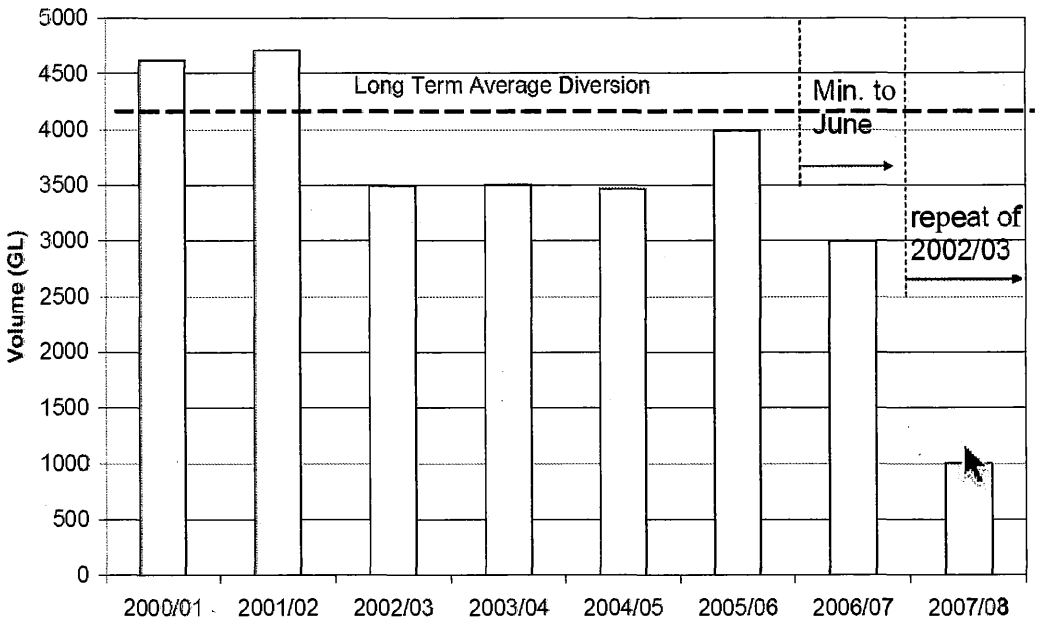
[3] Murray Darling Basin Commission

scientific knowledge it was foreseeable that the current period of low rainfall was possible and history should have indicated there was a risk it could last for several years. However, (notwithstanding the efforts of many of the people involved) the governance framework for the Murray Darling Basin has sometimes lead to decision making that is self interested and inherently biased against a medium to longer-term approach to allocation of water, which has had two effects, viz:

1. over allocation of entitlements, especially by successive governments in NSW, and
2. an inability to undertake adequate contingency planning that anticipates periods of risk longer than one or two years.

Chart 5 shows the pattern of diversions from the system.

Chart 5[4]
Total River Murray System Diversions



The chart shows the net result of the current management paradigm - diversions were not reduced sufficiently during a period of drought to offset inflows less than 50% of the long-term average and we have ended the driest period on record with little or no water in storage in the Murray Darling Basin. The inherent weakness of the management framework that has been in place for many years has been exposed by the drought. The impact on the Basin and water storage will take several years to correct. The MDBC was not able to act to anticipate what could happen if we had a record-breaking drought, i.e. the Murray Darling Basin Agreement has not enabled contingency planning for improbable, but possible, events.

Clearly it is very important to ensure that any new arrangements will be better at managing diversions and at ensuring that there is adequate warning of the need to reduce diversions to deal with drought conditions.

[4] Murray Darling Basin Commission

5. Adelaide's Usage of River Murray Water.

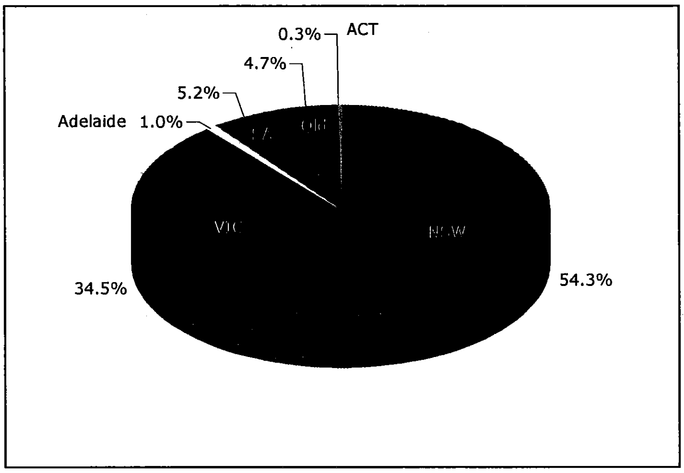
There are a number of misconceptions about Adelaide's dependence upon the River Murray. On average Adelaide's water supply is met from diversions from the River Murray – 40% and the Mt Lofty Ranges catchments 60%. In periods of drought in the Mt Lofty ranges, up to 90% of demand can be met from the River Murray and in wet years only 10% needs to be supplied from the Murray.

Inflows from the Mt Lofty Ranges are subject to significant existing variability. The extent of current variability is evident from Chart 3. This existing variability is managed by extracting water from the River Murray.

On average, Adelaide and all South Australian users of River Murray water represent only 6% of diversions in the system, with Adelaide's use being only 1% of basin-wide diversions.

Chart 6 shows the proportional usage of water by the states.

Chart 6
Share of Diversions from the Murray Darling System



Clearly, whether or not the Murray Darling Basin system can sustain ongoing diversions is mostly a function of future usage in NSW and Victoria. In particular, Table 2 shows the high proportion of usage of diversions for agricultural use, much of which could be reduced by improving delivery efficiency of irrigation schemes and improving efficiency of on-farm use. It has been estimated that only approximately 42% of water diverted in the Murray and Murrumbidgee regions is beneficially used for transpiration by productive crops[5].

[5] Meyer, W (2005). *The Irrigation Industry in the Murray and Murrumidgee Basins.* CRC for Irrigation Futures Technical Report No. 03/05, CSIRO.

Table 2. Average Annual Water Use (GL/year)[6]

System	Surface Water Use (GL/year)	Ground-water Use (GL/year)	Total Water Use (GL/year)
New South Wales			
Border Rivers*	176	71	247
Gwydir	344	85	429
Namoi/Peel	338	226	564
Macquarie/Castlereagh/Bogan	468	99	568
Barwon-Darling Lowwer Darling	310	10	320
Lachlan	334	194	528
Murrumbidgee	2358	258	2616
Murray	1926	92	2018
Total NSW	6255	1034	7289
Victoria			
Goulburn Broken Loddon	2034	70	2104
Campaspe	122	19	141
Wimmera-Mallee	162	17	179
Kiewa Ovens Murray	1656	27	1683
Total Victoria	3974	133	4108
South Australia			
Metro-Adelaide & Associated Country Areas*	119		119
Lower Murray Swamps	104		104
Country Towns	50		50
All Other Uses of Water from the River Murray	441	29	469
Total South Australia	713	30	742
Queensland			
Condamine/Balonne*	346	175	521
Border Rivers /MacIntyre Brook*	175	10	185
Moonie*	14	0	15
Warrego*	8	2	10
Paroo*	0	0	0
*Total Queensland**	544	187	731
Australian Capital Territory*	32	1	34
Total Murray-Darling Basin	11518	1385	12903

Note: The average surface water use has been taken as the Cap figure where available and as the average surface water use over eight years 1997/98-2004/05, where the Cap figure is not available (*). The average groundwater use figure is the average groundwater use over 6 years from 1999/00-2004/05 for which groundwater use figures over the Basin are available. The sources of this data are the annual MDBC Water Audit Monitoring Reports.

Among the key tenets of reform of the management of the Basin are better allocation of water and further development of an efficient market for water so that the market determines the optimal price and allocation of water. Given that water has been over allocated, it is inevitable that a free market for water will lead to higher long run real prices and, at the margin, that will either make some rural production activities uneconomic, or it will encourage the more efficient use of water, or it will be more attractive for less profitable users to sell their water allocations.

[6] Murray Darling Basin Commission

Whilst much of the agricultural production in the Basin has been profitable and has the capacity to adapt to higher real prices, it is also true that there are many activities that provide marginal returns and landowners are locked into these activities because they have had no exit strategy available to them. A market for water will help structural adjustment by providing an exit, but it may not be sufficient to deliver the desired policy outcome without additional intervention by governments.

If climate change proves to be a very significant factor driving reduced inflows, the price of water will be higher, and other climate changes effects such as a rise in temperatures will impact on rural production and the structural adjustment needs in sectors of the rural economy will be greater.

It is clear that Adelaide's use of Murray Darling water is not a major impost on the viability of the Basin, nor inappropriate given Victoria's proposals for usage of Goulburn water to supply Melbourne, but increased use of Murray-Darling water is likely to require purchases on the market at higher real prices. Following the principles of efficient resource allocation (where water is used for its highest value use), Adelaide's continued or even increased River Murray extraction would be justified.

The fundamental question that remains is:

> *To what extent should Adelaide's water supply rely upon water pumped from the River Murray?*

That is a basic policy issue as well as an economic and engineering matter, but it is not a matter about which there is any moral high ground in reserving water for irrigation purposes.

6. Supply Options

There are sixteen strategies relating to the provision of additional water supplies and fostering innovation in the Water Proofing Adelaide Strategy. There are also measures for greater water efficiency that will not be discussed here; rather this discussion will focus on potential sources of additional supply.

Options for additional water supply to Adelaide that have most often been canvassed publicly include:

1. Purchase of additional water licenses

2. Additional Mt Lofty Ranges storage filled by increased pumping from the River Murray during period of good flows;

3. Desalination plants;

4. Treatment of waste water to potable quality for reuse; and

5. The capture, storage and reuse of storm water.

SA Water has already analyzed the last three options in the development of the Water Proofing Adelaide Strategy.

The common factors that determine their cost structure and competitiveness include:

- Capital cost of processing plants;
- Operating costs including the variability of these costs;
- The availability and cost of energy (i.e. electricity):
- Environmental management costs;
- The flexibility of supply i.e. does the supply need to be base load or can it be regarded as peaking supply in periods of high demand? ;
- The location of any plant and the cost of dealing with site constraints;
- The cost of linking the plant to existing water infra structure given that the existing infrastructure is designed to accept water from Mt Lofty catchments or the River Murray;
- Variability of source water quality and quantity.

In addition to these common factors there are issues specific to each option.

This report does not seek to give definitive answers on each of the options because much work remains to be done. However, it is possible to identify many issues and draw some preliminary conclusions about the comparative benefits of each option.

7. Purchase of additional water licenses

Purchasing additional water licenses would increase SA Water's share of the total water available and could ensure that even when all users are subject to restrictions the allocation to SA Water would still be adequate to meet critical urban demands.

In the scenario when there is very little water available from the River Murray, a limiting factor will be the effect of river system losses which need to be met in order to be able to deliver water from the MDBC storages to SA Water's major pump off-takes. It is estimated that the evaporative and channel losses are around 1100 GL, which is more than 10 times Adelaide's annual average extraction from the River Murray.

A strategy of purchasing additional water licenses on the open market would not be successful in maintaining reliability during periods of extreme drought. To cover this scenario, SA Water would need to have access to a strategic reserve of water held in MDBC storages that would meet both the critical urban demands and the system losses. The volume represents 15% of the total volume of Hume and Dartmouth Reservoirs – the most valuable storage in drought since it would need to be the bottom 15%.

While the purchase of additional allocations might appear to be a cost effective option, it is most unlikely that the other states would agree to the necessary changes to make it effective. It is even more unlikely that South Australia would be able to draw from the bottom 15% of MDBC storage during extreme drought unless other critical needs in rural NSW and Victoria were also being satisfied. It therefore follows that this option can only be successful if it is part of an integrated strategy for the whole of the Murray Darling Basin.

While the Desalination Working Group continues to investigate other options, the concept of a Strategic Reserve of water in MDB storages is being pursued as part of the negotiations over the transfer of powers for the management of the River Murray to the Commonwealth. While a Strategic Reserve may not be the total answer to Adelaide's water security, it would nevertheless be a worthwhile factor.

8. <u>Increased Mt Lofty Ranges Storage.</u>

As noted above, with an efficient market for water it is possible that water, in addition to existing Murray Darling Basin entitlements, could be bought on market to put into storage in the Mt Lofty Ranges without putting additional stress on the Basin. This option has already been made public as a proposal to increase the storage capacity of the Mt Bold Reservoir. Under this proposal, the existing pumping infrastructure could be used to put additional water into storage in periods when there is adequate flow in the River Murray. Storage dams are costly (in this case the current estimate is around $880 million including ancillary works) and will take about seven years to design and construct (including obtaining environmental approvals) and up to three years to fill. It should be noted that the current Mt Bold estimate may change as more detailed investigation works progress.

Constructing an enlarged Mt Bold storage would result in a 21% increase to residential water charges. An average residential customer using 250 kL/a of water would be subject to a $75 per year increase to their water bill.

There are many technical and geotechnical issues that will need to be resolved before a commitment could be made to a site. Any additional storage in the Mt Lofty Ranges will also raise environmental conservation issues. The advantages of this option include that existing major pipeline infrastructure (including pump stations) can be used. A proportion of the total capital cost of this option will be attributable to transporting water from the storage to areas within the Metropolitan Adelaide Water Supply System (MAWSS).

More importantly, this option has several benefits both for the reliability of Adelaide's supply and for the management of the Murray Darling Basin system. At present the major storages for water are upstream in the catchments (Dartmouth and Hume) or are shallow water dams (Lake Victoria) that have very high evaporation rates. In addition, there are significant river channel and evaporation losses within the system. As discussed in Section 7, the annual River Murray system losses are a factor of 10 times Adelaide's annual average River Murray extractions.

In order to meet Adelaide's River Murray demand, the system losses need to be met to ensure sufficient quantity and quality of water. During drought conditions with low river flows the quality of this water is seriously degraded by saline inflows. Storage of water in the Mt Lofty catchments during periods of flows surplus to both diversions and the environmental needs of the river, for later use during drought conditions, would place less stress on the river system.

This option will inevitably provoke instinctive opposition based on political positions, or environmental values but it deserves careful consideration because carefully managed it can provide benefits to the sustainable management of the River Murray as well as increased water security for Adelaide.

9. Desalination

Investment in desalination plants is seen to be the solution to water supply problems around the world in locations such as California, Spain, Singapore, the Gulf states and in Australia a plant is now operating in Perth. New large-scale desalination plants are now being constructed on the Gold Coast in Queensland and Botany Bay in NSW, while plants are also proposed for the Bass Coast in Victoria and a second plant for Perth near Binningup. There are estimated to be ~2,000 desalination plants worldwide with several hundred of these being of the scale proposed for Australia.

All plants being constructed or proposed in Australia use reverse osmosis as the desalination process. Reverse osmosis is currently considered to be the most energy efficient technology. Many of the plants constructed in the Middle East use thermal processes which use much greater amounts of energy per unit of water produced, but more recent plants have been based on reverse osmosis technology. If a cheap source of fuel is available, the thermal process can be cost effective especially where power and water are co-generated. Thermal plants are also used when very high quality water is needed.

The benefits of desalination principally arise from saline or brackish water being readily available. However, desalination is not a "magic bullet" solution to Adelaide's water supply. Desalination requires large amounts of electricity and produces a concentrated waste brine stream that has to be dispersed with great care to avoid serious environmental damage. It is not a "green" water source but with careful planning it can be part of a suite of water supply options.

In a low probability but high impact drought event, there may be little water available for extraction from both the River Murray and Mt Lofty Ranges. More work is being done to confirm likely supply shortfalls under such a scenario. However, it is likely that to 'drought-proof' Adelaide a large desalination plant producing around 100 GL per year would be required to ensure supply.

A smaller plant of 50 GL per year would deliver water security benefits. However, in a high impact drought scenario a 50 GL plant may not provide enough capacity to ensure security of supply. In an extreme drought situation, other contingency measures may still be required. If a 50 GL plant was built it would be prudent to construct ancillary infrastructure for an ultimate plant capacity of 100 GL to allow for future expansion. Environmental approvals should also be obtained for the ultimate plant size.

A 100 GL desalination plant at Pt Stanvac is likely to have a peak power load around 50 MW and an annual energy requirement of around 400 GWh. This energy requirement is equivalent to the annual electricity used by around 67,000 homes or 3% of South Australia's 2005/06 total electricity consumption[7].

A comparison with recently commissioned plant in Perth, which is often used to argue the case for a desalination in Adelaide, provides both a good way of understanding the issues that we need to consider and illustrates the fact that the Perth plant is not a good basis for comparison with Adelaide.

The Perth plant is located on the shores of Cockburn Sound amongst existing heavy industry that has probably in the past degraded the marine environment; it is adjacent to a power station and close to Perth's existing water infrastructure. The marine environment in Cockburn Sound has been researched for many years, it is not an important fishery, and the Sound has access to the Indian Ocean and is subject to movement by coastal currents. The WA Water Corporation carried out two years of environmental assessment studies prior to a commitment to desalination. Whilst the plant is connected to the electricity grid (i.e. it gets its electrons from the plant next door) the plants CO_2 impact is offset by a wind power facility elsewhere in WA.

The Perth plant is also base load water supply because the decline in Perth's supply from existing sources means that it is desirable to run the desalination plant year round.

In Adelaide by comparison, the Gulf St Vincent is a commercial fishery and fish breeding ground, the water movements in the Gulf have not been extensively studied and the most recent studies indicate water interchange issues so that brine dispersion will require careful analysis and design to avoid environmental damage[8].

Rather than disposing of the desalination plant concentrate (brine), one often cited end-use for the desalination plant waste stream (concentrated brine) is as a feed for a salt processing facility. However, the evaporation basin area required for a 100 GL/a desalination plant is estimated to be approximately 8000 ha or 80 sq km (assuming an evaporation rate of 1.45 m per year). This is around 10 times larger than the existing Penrice salt pans at Dry Creek. Therefore, a significant area of land would need to be reclaimed for this purpose.

The existing major pipelines from the River Murray and the storage reservoirs are many kilometers from the sea and any desalination plant. Therefore, there will be

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[7] Essential Services Commission of South Australia (2006). *2005/06 Annual Performance Report. Performance of South Australian Energy Retail Market. SA Energy Retail Market 05/06.* ESCOSA.

[8] The conditions in the Upper Spencer Gulf are very different. Developments such as the Port Bonython gas facilities, Whyalla Steelworks and fisheries have required a much greater understanding of marine conditions in Spencer Gulf than gulf St Vincent. Thus Spencer Gulf is better understood to allow environmental impact assessment and design to proceed.

significant infrastructure and energy costs to integrate a desalination plant into the existing water supply system.

As noted earlier, Adelaide's water supply is relatively secure except in infrequent severe droughts and the continued use of water from the River Murray is an ongoing option. Thus operationally a desalination plant need not be base load supply. However, desalination plants and associated infrastructure have high fixed costs ~50% capital and significant, fixed, unavoidable operating costs so that up to 70% of the costs are incurred whether, or not, the plant is used. In these circumstances it is possible to use a desalination plant for peaking supply as "water security insurance" but the cost per kilolitre for water to consumers is significantly increased. Most desalination plants are operated as base load supply for this reason.

A 100 GL plant to supplement Adelaide's water supply is likely to cost $1.42 billion with net annual operating costs of around $70 million (including the purchase of green power to offset greenhouse gas emissions and savings made from less Murray pumping and conventional treatment). The effect on an average household consuming 250 kL of water per year would be to increase the annual water bill 51% from $365 to $550; an increase of $185.

A cost comparison between a 50 GL and 100 GL plant is shown in Table 2 based on preliminary information. Estimates will be updated as more detailed information comes to hand. Note that the costs estimated here are for a desalination plant located at Pt Stanvac. More detailed estimates will be developed for the other plant sites.

Table 2: Cost impact of a seawater desalination plant at Pt Stanvac

Item	50 GL/a plant	100 GL/a plant
CAPEX	$900 m	$1,400 m
Net OPEX	$35 m	$70 m
Average residential bill (based on 250 kL/a)	$478	$550
Residential bill increase (based on 250 kL/a)	$113	$185
Water charge increase	30%	51%

Thus whilst a desalination plant is an option, it provides expensive water, it uses large amounts of electricity which in peak periods may not presently be available, and will require at least two years of baseline environmental studies to be able to design a brine dispersal system that does not damage the marine environment.

10. <u>Indirect Potable Re-use of Waste Water.</u>

The treatment of wastewater to potable standards to supplement water supplies is a strategy adopted in several places around the world, and is soon to be implemented in Queensland and the ACT. In SA's case there are a number of factors that militate against this option in the short run.

The existing wastewater treatment plants were developed in an era when recycling of wastewater was not a conceivable option. Thus existing plants (such as those at Bolivar and Christies Beach) that are able to deliver water of adequate quality for agricultural use would require substantial upgrading. Potable quality water could be generated at an additional treatment cost of around $0.70/kL to treat 50 GL of wastewater to potable standards. However, other significant capital and operating costs would be incurred for transportation of water, solids/sludge handling and storage of water. Further additional work is required to develop a scheme cost estimate.

Planned indirect potable schemes must include a reverse osmosis (RO) stage similar to that employed in desalination plants to ensure water quality. The main advantage over a seawater desalination plant is that the input water has a significantly lower concentration of salts than seawater so the processing costs can be more competitive than a seawater desalination plant. However, it is considered essential that treated wastewater not be delivered directly into the distribution system but is fed into storage for mixing with other water for a holding period of at least six months[9] so that the risk of system failure is significantly mitigated (hence it is often described as Indirect Potable Recycling, IPR).

The linkage of existing wastewater treatment plants to a central processing location and then transporting the treated water to storage reservoirs in the Mt Lofty Ranges would add significantly to the capital and operating cost of the scheme and in Adelaide's situation the cost of the overall scheme might be comparable to seawater desalination.

Depending on where the IPR scheme was located, it is likely that three of Adelaide's four major wastewater treatment plants would have to be used to generate 50 GL of potable water. A maximum of 70 GL would be available if all major metropolitan plants were linked together. Therefore, the IPR scheme is only comparable to the smaller of the desalination plant options.

As part of their investigations into seawater desalination, Sydney Water looked at the feasibility of an IPR scheme[10]. They concluded that the actual treatment costs of IPR would be less than for seawater reverse osmosis. However, the transportation of water between wastewater treatment plants and the transportation of potable quality water to reservoirs would cost significantly more than integrating a seawater desalination plant into their water supply system. Sydney Water claimed that the capital cost of their desalination plant would be around $2.5 billion with operating costs of around $165 million, while the IPR scheme would cost around $3.8 billion with annual operating costs of $175 million.

One of the main components of cost in an IPR scheme is the transfer of water into balancing storage so that water can be detained for at least six months in an environmental buffer. There are advocates of the direct feed of treated water into the distribution system, sighting that treated water directly from the plant would meet health standards. However, that is likely to encounter public resistance and is considered by some scientists to introduce an unacceptable risk of epidemics caused by bacterial infections. In fact, Professor Don Bursill (ex-Chief Scientist of the

[9] GHD (2007). *Using Recycled Water for Drinking – An Introduction. Waterlines Occasional Paper No. 2, June 2007*. GHD on behalf of the National Water Commission, Canberra.

[10] Sydney Water (2006). *Indirect potable recycling and desalination – a cost comparison*. SW 134 03/06.

Australian Water Quality Centre, SA Water and CEO for the Cooperative Research Centre for Water Quality and Treatment) has been quoted in The Age newspaper on 5 June 2007 as saying that he was concerned more about human error than failure of technology[11].

There is also a significant risk associated with the removal of endocrine disrupting compounds (EDCs[12]) in conventional wastewater treatment processes. While, the removal efficiency of EDCs through advanced treatment technologies such as reverse osmosis is greatly improved, some chemicals are known to pass through membranes, albeit at very low concentrations[13]. Most of these chemicals are thought not to have any negative health impacts on humans. However, national and global research capability needs to be increased in this area before we can unequivocally state that all EDCs are removed in advanced membrane treatment processes such as reverse osmosis.

A recent report published by the National Water Commission indicated that only one example of direct potable recycling could be found, in one small town in Namibia[14]. The Water Services Association of Australia (WSAA) also concludes that there is a significantly greater level of risk associated with direct potable recycling and that this is at variance to the 'multiple barrier' approach to maintaining drinking water quality because no natural environmental buffer is provided[15].

Treatment of wastewater to a potable quality for use in IPR will produce a concentrated waste stream, which may exacerbate the existing problems of effluent discharge into Gulf St Vincent. One often quoted benefit of IPR is that the nutrient load to Gulf St Vincent would be reduced, which would have many benefits for seagrass meadows and marine organisms as identified in the Adelaide Coastal Waters Study (ACWS). However, in treating wastewater to potable standards, salt and nutrients are concentrated and removed from product water and then requires disposal. The disposal path is usually through ocean outfall. However, given the concentrated nature of nutrients in the waste stream, ocean disposal may be contradictory to the outcomes of the Adelaide Coastal Waters Study. It is also very difficult to separate nutrients from the salt in the waste stream and because of the salt content it is unlikely that the waste would be suitable for any agricultural purposes. Therefore, the concentrated salt and nutrients mixture becomes a solid waste disposal problem. Disposal of this stream would require substantial additional cost and would require careful environmental planning.

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[11] http://www.theage.com.au/news/national/recycling-sewage-should-be-a-last-resort-expert/2007/06/04/1180809426583.html

[12] An EDC is a chemical (eg pharmaceuticals) that when taken up by an organism affects the actions of hormones and can disrupt physiological processes.

[13] WSAA (2006). *Refilling the Glass. Exploring the issues surrounding water recycling in Australia. WSAA Position Paper No. 02, November 2006.* Water Services Association of Australia

[14] GHD (2007). *Using Recycled Water for Drinking – An Introduction. Waterlines Occasional Paper No. 2, June 2007.* GHD on behalf of the National Water Commission, Canberra.

[15] WSAA (2006). *Refilling the Glass. Exploring the issues surrounding water recycling in Australia. WSAA Position Paper No. 02, November 2006.* Water Services Association of Australia

About 20% of the existing wastewater stream is diverted for open space or agricultural irrigation from the Aldinga, Christies Beach, Glenelg and Bolivar wastewater treatment plants (this percentage was increased in 2006/07 because of ongoing dry conditions).

Increasing usage of recycled water in locations with relatively easy access to the treatment plants may relieve some demand on potable water or raw bulk water supplies and have a greater net benefit than recycling to potable standards. More generally, increased use of wastewater in non-potable applications that reduces demand on potable sources is a desirable long-term objective. This can be achieved to some extent in the urban sector (ie substitution for open space irrigation). However, if agricultural irrigators using bulk raw water supplies can be encouraged to relocate to the recycled water schemes in the Willunga Basin and Virginia, there may exist an opportunity to substitute large volumes of recycled water for bulk potable water via the agricultural sector. The main benefit for irrigators using recycled water sources is that they can achieve a high level of water security and are not subject to harsh water restrictions.

11. Storm water

The capture, storage and re-use of storm water, as a potable water supply is an important source in many places around the world. A good example of storm water usage is Singapore, where extensive storm water catchments schemes operate, including the water falling on Changi Airport. It is not a cheap source of water; in Singapore's case it is important for water security reasons rather than cost. There are good examples of smaller scale storm water management in the northern suburbs of Adelaide, especially the Salisbury Council area.

There is an almost intuitive appeal in the notion of recycling storm water that (as a potable water source) is not always justified by the facts. There are inherent difficulties with storm water as a major source of potable water for Adelaide; the infrequent rainfall, the dispersal of storm water systems, and the infrastructure cost of collection, treatment and connecting into the distribution system makes storm water an expensive source of potable water. Storm water is often polluted, particularly the first flush, so the treatment to potable standards is a non-trivial cost. A consulting firm involved in the Singapore projects has advised that total costs for collecting, treating and distributing stormwater on a large-scale in Adelaide would most likely exceed the cost of desalinated seawater. In periods of prolonged drought storm water becomes an unreliable source of potable water unless it can be stored in secure aquifers or existing reservoirs.

According to Water Proofing Adelaide, 160 GL of stormwater is currently available from Adelaide in an average year (although this will reduce if the Water Proofing Northern Adelaide project proceeds as planned). However, in a dry year as little as 50 GL of stormwater is available. In the Metropolitan Adelaide Stormwater Management Study (MASMS)[16] it was recognized that the potential for stormwater

[16] KBR (2004). *Metropolitan Adelaide Stormwater Management Study. Part B – Stormwater Harvesting and Use.* Prepared by KBR for the Metropolitan Adelaide Stormwater Steering Committee

harvesting within the current Urban Growth Boundary was likely to be around 25 GL/a (not including rainwater tanks). This number is consistent with the stormwater reuse and Water Sensitive Urban Design target of 13 GL/a in the Water Proofing Adelaide strategy and the potential reuse volume of 12 GL/a in Water Proofing Northern Adelaide.

The MASMS report made a preliminary assessment of whether large-scale stormwater harvesting could be employed within Adelaide (based on a proposal by Clark (2003)[17]). The MASMS concluded that around 120 GL/a could be harvested using 480 ASR wells for storage over 240 different sites across Adelaide. Each site would need to be around 4 Ha in size, which means around 1000 Ha of land would be required in total for the combined stormwater harvesting and ASR facilities. To put this into perspective, this is equivalent to the land area occupied by around 10,000 homes, or equivalent to a suburb the size of Adelaide (CBD plus the Park Lands). One of the major challenges with large-scale stormwater harvesting is the large area required.

The MASMS estimated the cost of the ASR infrastructure alone to be around $600 million (in July 2004 dollars or around $700 million if converted to March 2007 dollars using the non-residential construction Producer Price Index). This cost does not include the cost of additional treatment infrastructure at each extraction bore thought to be required to maintain the multiple barrier approach to water quality management or the cost of land purchase. It is acknowledged that some ASR facilities could be established at greenfields sites. However, only a small proportion of the total required volume could be achieved by developing greenfields sites. The cost to retrofit such a proposal to brownfields or fully developed areas would be substantial. Additional work is required to develop a total scheme cost estimate for this option.

Notwithstanding the above, localized storm water recycling schemes that provide non-potable water can be a very important adjunct to water supply by relieving demand on other potable sources, especially for the watering of public spaces and in new developments where parallel grey water infrastructure is installed by developers.

It is clear that storm water can be a useful niche and planning and development policies should encourage its use for non-potable purposes, especially in new developments. There are good examples in Adelaide of local solutions developed by Councils to cut their demand on mains water and these should be encouraged.

Storm water for non-potable usage could increasingly be a useful addition to water supply but by itself it would not be sufficient to greatly enhance Adelaide's water security. Strategies to increase storm water usage have already been outlined in the Water Proofing Adelaide Strategy.

The Water Proofing Northern Adelaide strategy proposed by the Cities of Salisbury, Playford and Tea Tree Gully is a good example of how stormwater resources should be integrated into the urban water environment. It is estimated that around 12 GL of potable water can be substituted by stormwater for non-potable uses from this project.

[17] Clark, R. (2003). Water proofing Adelaide – modelling the dynamic water balances. *Australian Water Association – SA Branch Regional Conference, 6 August 2003, Stamford Grand, Glenelg,*

Although, it should be recognized that some of the 12 GL potable savings planned for Water Proofing Northern Adelaide is future urban open space irrigation demand.

12. Timeframes.

It is unlikely that supply from the Murray Darling Basin will be restored to a more normal position in less than two or three years because upstream storage needs to recover post a drought, water quality will be degraded for a period by salinity percolating into the system and there will be a need for good environmental flows to ensure the river system is returned to a sustainable condition.

None of the options canvassed above can provide risk free *short-term* solutions for additional water supplies. Constructing a larger Mt Lofty storage will take (say) seven years of approvals, design and construction, plus storage filling time, a desalination plant requires at least two years of environmental baseline studies to enable the design of brine dispersal systems and a construction time of three years. Similarly, recycling and storm water use could not have much impact in the next four years due to the scale of works required. Thus it is likely demand management will need to be maintained for at least two years. If flows into Murray-Darling Basin reservoirs are sufficient to offer re-opening of the water market, then purchase of additional water may be an option to reduce the impact of ongoing water restrictions.

If the public wants higher levels of water security then capital expenditure of the order of one billion dollars will be required and that expenditure needs to be carefully planned.

13. What Level of Water Security and at What Cost?

The drought has exposed the inadequacy of water supply in some states; especially Queensland, NSW and Victoria where population growth has far exceed investments in infrastructure. WA has had long run problems caused by the decline in rainfall in South Western Australia over 30 years that have been and are being addressed by investments in desalination plants. (It is worth noting that a second desalination plant was not the automatic choice in WA – a large amount of work was undertaken to examine the possibility of greater ground water usage.) As noted in Sections 2 and 4 above, SA's water supply is reasonably secure if the Murray Darling Basin is well managed except for periods of severe drought.

Adelaide's water supply will need to be supplemented if the economic growth objectives of the State Strategic Plan are achieved, but in the short to medium term much of that could be accommodated by efficiency measures, better management of storm water and waste water and some investment in new technology. These measures have been detailed in the Water Proofing Adelaide strategy.

If the residents of Adelaide want a water supply where (after implementation of efficiency measures) there is a vanishingly low probability of water restrictions, then the cost of servicing a billion dollar investment will be a substantial permanent increase to the cost of supplying water, which will be passed on to customer's water charges.

Studies carried out in the planning of the Sydney plant indicate that many people are prepared to pay for higher water security when the cost is translated into an equivalent cost i.e. $200 per year equals 67 Cappuccinos or 112 bottles of spring water.

Whilst the anecdotal evidence is that many Adelaide consumers would be prepared to pay during a drought, what is less certain is whether they would be happy in periods when (say) a desalination plant is ho longer necessary for water security because of good rainfall in the Mt Lofty catchments and there are good flows in the River Murray- but the costs of a desalination plant will still need to be recouped.

Whilst this issue is amenable to further research, the Government will be faced with a public policy judgment about what is an appropriate level of water security and at what cost to the community?

14. Funding and Procurement Aspects

There are several ways that investments in new water sources can be funded either by the State, or by the private sector. The central question for private funding of infrastructure is the stability of the income stream so that any arrangement will have some "take or pay" component. Whatever funding method is used, full cost recovery will need to be pursued in-line with COAG and the NWI agreements. Therefore, achieving a high level of water security will result in a significant increase to water charges.

Recovery of the increased costs from consumers will require careful consideration. Simply increasing the price of water could lead to proposals by private operators for third party access to SA Water's major pipelines in order to provide cheaper water from the River Murray, in competition to the desalinated water. Since most of the costs of both desalination and increased storage will not be affected by water consumption levels, it is likely to be appropriate for a large proportion of the increased costs to be recovered from increased supply charges rather than the per kl water usage charge.

15. Current work program.

The current work program that will allow us to report in September 2007 is considering the following issues:

- Potential sites for desalination plants.
- Availability of power and future costs of energy.
- Desalination technologies -RO versus thermal.
- Cost of linkage into existing infrastructure.

- Other infrastructure that may be required.
- The cost of alternatives such as recycling
- Environmental Baseline Studies

The work prior to September will allow the options to be short listed, but studies will need to continue beyond that time, particularly the environmental studies, before committing to a preferred option.

16. Conclusions.

As noted in Section 1, the Government has to consider two important policy issues, viz:

1. To what extent should Adelaide's water supply rely upon water pumped from the River Murray?
2. What levels of water security do members of the public seek and consequently what price are the public prepared (or should be required to pay) for a secure water supply?

Current messages from different areas of government about saving the River Murray have the potential to be confusing to the public. If Adelaide's water supply is to continue to rely on the River Murray it is essential that a uniform policy position is adopted by all agencies.

Continued use of the River Murray as a source of water is not inconsistent with the policy position of reducing Adelaide's reliance on the river or increasing its ecological health. Measures that provide a multi-year and more flexible approach to managing the State's extractions from the river (such as additional storage) and/or provide alternative sources of water would both provide Adelaide with greater independence from the year-to-year conditions of the river. There would also be beneficial synergies, such as managing extractions to better mimic natural wet and dry cycles, or water set aside for environmental purposes in most years also being 'emergency' backup in dry years.

If the Government considers a higher level of water security is warranted then there are several options. All options considered to be effective in securing Adelaide's water supply will require capital investments of the order of $1 billion.

Potable stormwater use and IPR of wastewater are technologically possible. However, there exists an additional risk to human health and there are significant public acceptance issues surrounding both options. In addition, the cost of delivering a potable stormwater or IPR scheme is comparable in cost to the seawater desalination or Mt Bold options. Therefore, at this stage the potable reuse of stormwater and IPR are not considered to be attractive options to secure Adelaide's water supply.

Desalination is one option for increased water security but it is much more costly than some Federal and State politicians suggest and it cannot be achieved in the timeframes often postulated because the comparisons being made with other plants ignore environmental and locational factors unique to Adelaide.

If desalination is to be chosen as the option for increased water security, it will require careful environmental planning before any commitment can be made to a site and to brine dispersal designs and that analysis could take up to 2 years unless the Government is prepared to "bet the environment".

Notwithstanding any decision to invest in desalination, the development of increased storage in the Mt Lofty ranges to hold River Murray water has merit for the sustainable management of the Murray Darling Basin and should be promoted to the Commonwealth for their financial consideration.

There is one important consideration with all the options. Future water supply is dependent upon technologies that are both capital intensive and large consumers of electricity. As a consequence there will be a significant increase in the real cost of water and the cost of water will be more directly linked to the cost of electricity and that is also expected to increase.

South Australians need to become accustomed to notion of an unavoidable real increase in the cost of water. That message has already been clearly communicated to the public in WA, NSW, Vic and Queensland.

Desalination Working Group
23 July 2007