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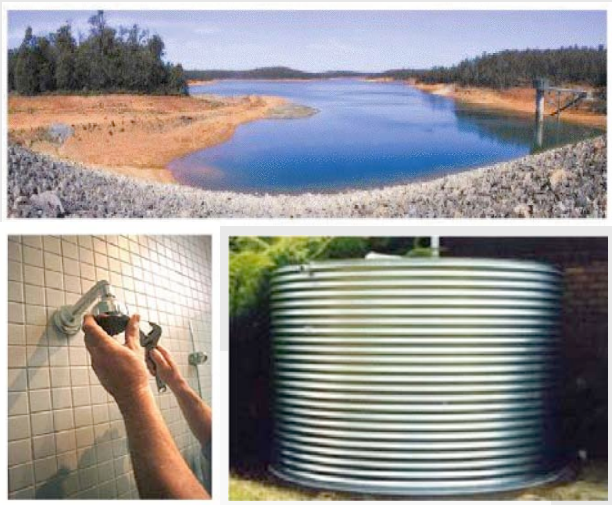

ACT Water Strategy

Preliminary Demand Management and Least Cost Planning Assessment

Final Report

Prepared by

Institute for Sustainable Futures

For

ACTEW Corporation Ltd

Institute for Sustainable Futures

ACT Water Strategy

Preliminary Demand Management and Least Cost Planning Assessment

Final Report

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Institute for Sustainable Futures

The **Institute for Sustainable Futures (ISF)** was established by the University of Technology, Sydney in 1996 to work with industry, government and the community to develop sustainable futures through research, consultancy and training. Sustainable futures result from economic and social development that protects and enhances the environment, human well-being and social equity.

Where possible, we adopt an approach to our work which is inter-disciplinary and participatory. We aim to engage with our partners, funding agencies and clients in a co-operative process that emphasises strategic decision making. The results are client-directed relevant solutions that work.

Readers wishing to obtain more information could contact ISF on (02) 9209 4350 or at isf@uts.edu.au. The ISF website can be visited at www.isf.uts.edu.au.

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ABBREVIATIONS

CARL	Current annual real losses
C/I	Commercial/Industrial
CMD	Chief Ministers Department
DCP	Development Control Plans
hh	Households
ISF	Institute for Sustainable Futures
I	Institutional
kL	Kilolitres
kL/hh/a	Kilolitres per household per annum
LCD	Litres per capita per day
LCP	Least Cost Planning
M	Million
ML	Megalitres
ML/a	Megalitres per annum
MR	Multi residential
MWEPS	Minimum water efficiency performance standards
NCERS	North Canberra Effluent Reuse Scheme
PH	Public housing
SR	Single residential
UARL	Unavoidable annual real losses
UFW	Unaccounted for water
WSAA	Water Services Association of Australia

EXECUTIVE SUMMARY

Background

Potable water demand in the Canberra area is expected to rise from the current 63,000 ML/a to 84,000 ML/a over the next 50 years as the population in Canberra and the adjacent Queanbeyan grow. This population rise together with other issues associated with drought security, climate change and catchment regeneration after the 2002/03 bush fires are indicating that another supply source may be required before 2020. However, as part of the World Environment Day Assembly Motion, the ACT Government passed a motion, which agreed that:

'as far as possible the building of further water supply dams in the ACT should be avoided'.

To assist in achieving this goal, demand management and other targets (based on the base year of 2003) have been set by the ACT Government as indicated below:

- by 2013 reduce per capita potable demand by 12%;
- by 2023 reduce per capita potable demand by 25%;
- by 2013 increase effluent reuse from 5% to 20%; and
- limit stormwater flow in new developed areas to the same amount that flowed before development.

In August 2003 ACTEW Corporation (ACTEW) commissioned the Institute for Sustainable Futures (ISF) to provide assistance in developing the ACT Water Resources Strategy, which is being developed as a long term strategy aiming to set directions for water resource management until 2050 and is required to take into consideration policies, agreements and legislation including the targets indicated.

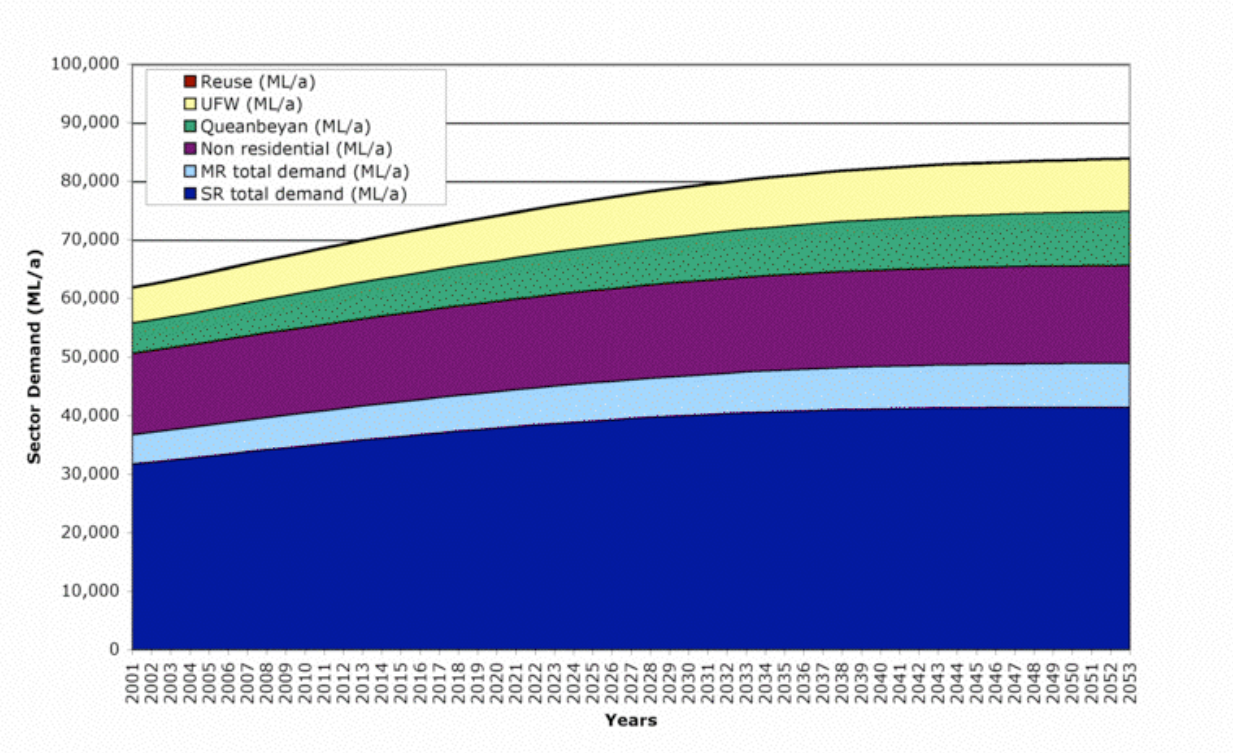
This report summarises the findings of the preliminary analysis undertaken by ISF, which has concentrated on:

- identifying the demand management and source substitution options available to achieve the identified 12% and 25% per capita demand management targets in 2013 and 2023 respectively;
- identifying the whole of society costs associated with these options and where possible highlighting the associated benefits;
- comparing (using levelised costs) these options with other reuse and supply options being evaluated by ACTEW; and
- providing recommendations for further investigation.

Findings

Potable water demand is expected to grow as indicated in Figure 1 with the single residential and the top 150 non residential high water users (which together currently use just under two thirds of potable water) continuing to dominate potable demand in the future.

Figure 1 – Disaggregated Reference Case Demand



To achieve the 2013 and 2023 demand management targets a selection of options have been considered that cover all sectors (e.g. residential, commercial/industrial, institutional and unaccounted for water/leakage) and both existing and new properties. These options have been grouped as indicated below and compared against a selection of supply options investigated by ACTEW:

- demand management;
- source substitution;
- Queanbeyan; and
- reuse.

The potential cumulative savings that can be achieved from these options are illustrated in Figures 2 and 3 in terms of ML/annum and litres per capita per day (LCD) respectively. As indicated the suite of options developed achieve the 2013 and 2023 targets.

Table 1 provides summary details on each of the options considered, required program participation rates, present value total costs and levelised costs and anticipated savings in 2008, 2013, 2023 and 2053. In addition the table shows similar details for the selected three supply options investigated by ACTEW.

Figure 4 illustrates a comparison of the levelised costs of each of the options considered.

Figure 2 – Potential Savings (ML/annum)

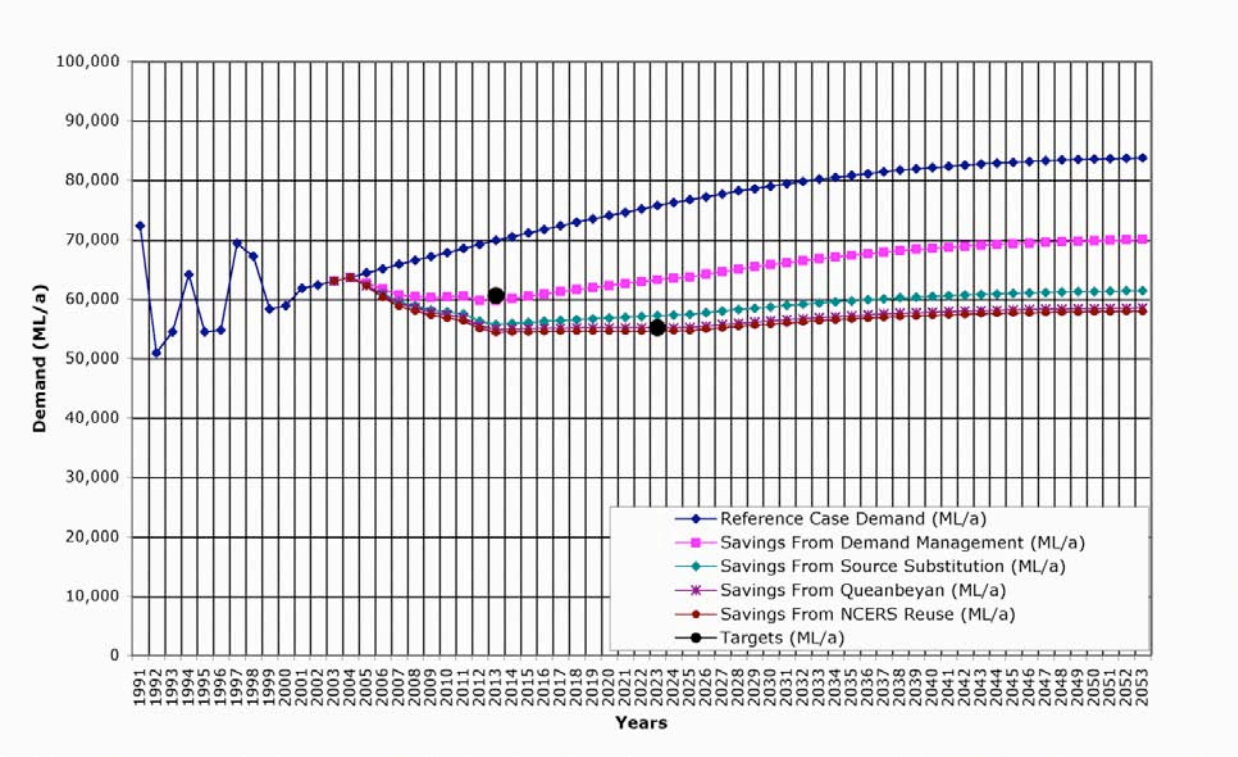


Figure 3 – Potential Savings (litres/capita/day)

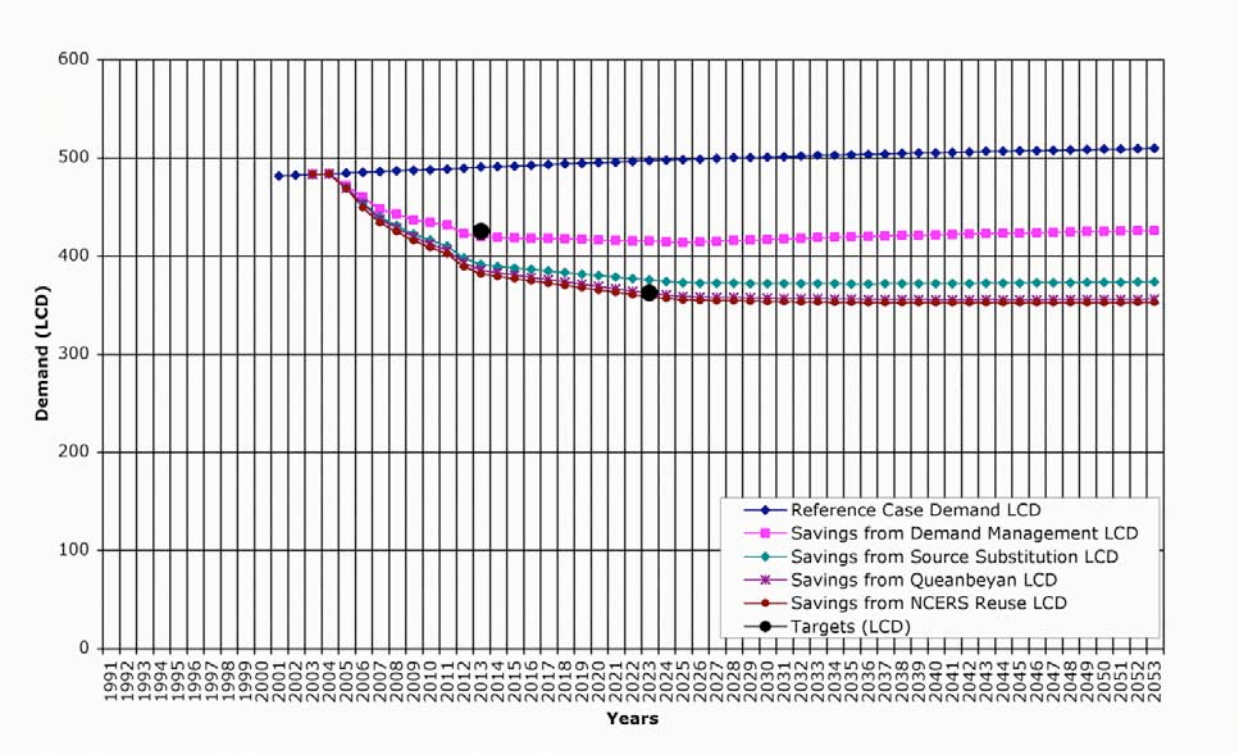


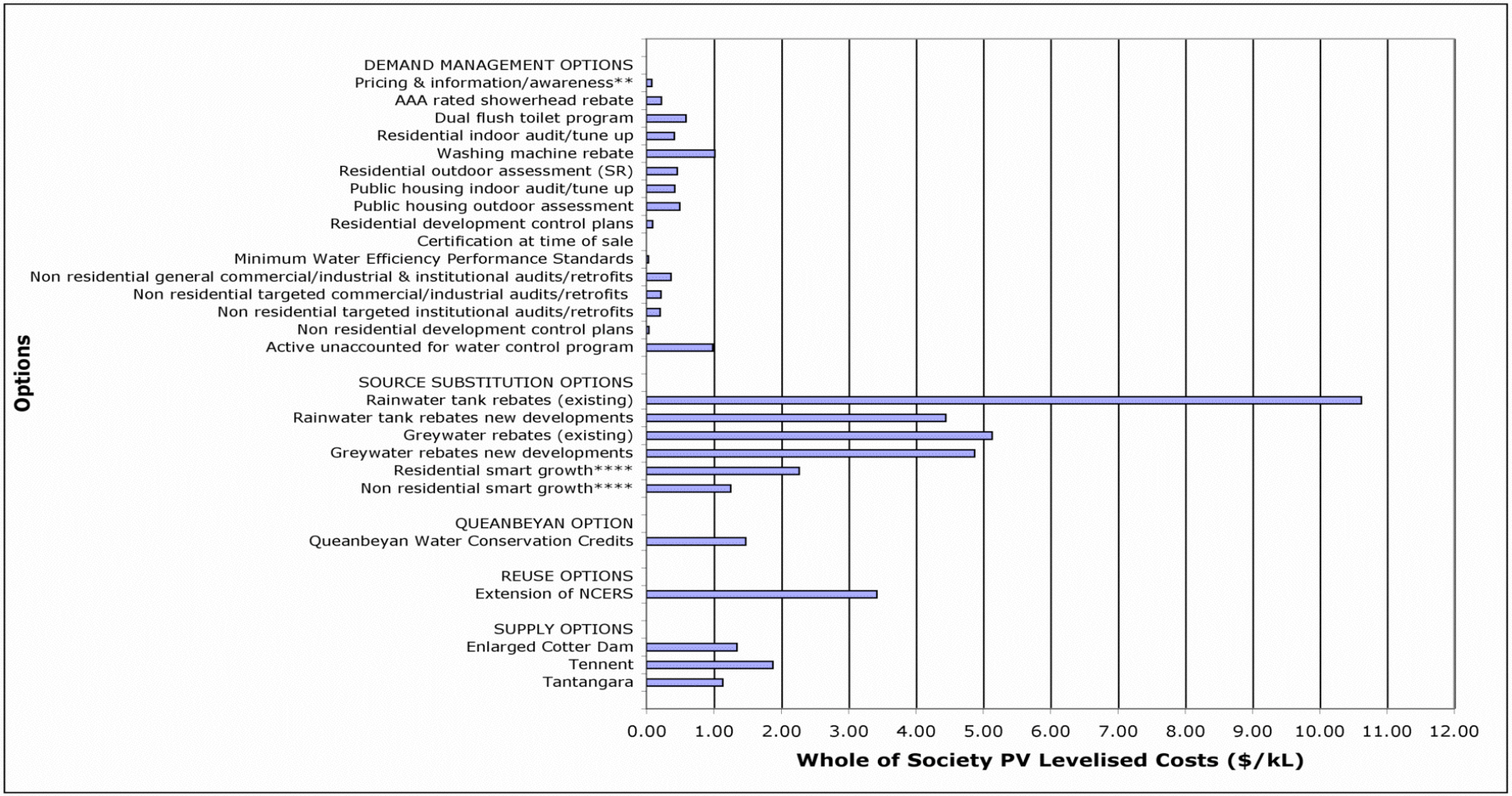
Table 1 – Option Summary Table

Summary Tables								
Options	**Program participants assumptions**	**PV Costs* ($M)**	**PV Levelised Unit Cost ($/kL)**	**Average Annual Cost ($M/a)**	**Savings in 2008 (ML/a)**	**Savings in 2013 (ML/a)**	**Savings in 2023 (ML/a)**	**Savings in 2053 (ML/a)**
Demand Management Options								
Pricing & information/awareness**	75% of existing SR hh affected from 2005	1.33	0.08	0.22	937	1,171	1,171	1,171
AAA rated showerhead rebate	15% all existing SR & MR hh (- PH hh) over 3 years	1.00	0.22	0.28	304	304	304	304
Dual flush toilet program	15% all existing SR & MR hh (-PH hh) over 9 years	4.38	0.59	0.52	267	600	600	600
Residential indoor audit/tune up	40% of all existing SR & MR hh (- PH hh) over 9 years	5.33	0.42	0.64	456	1,027	1,027	1,027
Washing machine rebate	30% of existing hh with top loaders needing replacement over 5 years	0.63	1.02	0.11	35	44	44	44
Residential outdoor assessment (SR)	75% of all existing SR hh (- PH hh) over 9 years	11.33	0.46	0.50	886	1,993	1,993	1,993
Public housing indoor audit/tune up	100% of all existing SR & MR PH hh over 9 years	1.21	0.42	0.16	103	233	233	233
Public housing outdoor assessment	100% of all existing SR PH over 9 years	1.19	0.50	0.05	86	193	193	193
Residential development control plans	75% of all new SR & MR hh from 2005 to 2009 & then 50% from 2010	0.90	0.09	0.03	253	472	820	1,277
Certification at time of sale		0.00	0.00	0.00	0	0	0	0
Minimum Water Efficiency Performance Standards	100% of washing machines from 2010***	0.54	0.03	0.19	0	313	1,999	2,363
Non residential general commercial/industrial & institutional audits/retrofits	50% of existing properties in 5 years	3.14	0.37	0.62	493	616	616	616
Non residential targeted commercial/industrial audits/retrofits	Top 100 high users in 3 years	2.80	0.22	0.79	874	874	874	874
Non residential targeted institutional audits/retrofits	Top 50 high users in 3 years	3.64	0.21	1.02	1,189	1,189	1,189	1,189
Non residential development control plans	75% of all new properties from 2005	0.27	0.03	0.01	160	349	684	1,152
Active unaccounted for water control program		7.51	0.99	0.36	0	750	750	750
Sub Total		**45.19**		**5.50**	**6,044**	**10,129**	**12,498**	**13,787**
Source Substitution Options								
Rainwater tank rebates (existing)	25% of existing SR hh (- PH hh) over 9 years	102.91	10.62	5.47	347	782	782	782
Rainwater tank rebates new developments	25% of all new SR hh from 2005	16.08	4.45	0.94	77	169	325	502
Greywater rebates (existing)	25% of existing SR hh (-PH hh) over 9 years	102.85	5.13	5.47	719	1,617	1,617	1,617
Greywater rebates new developments	25% of all new SR hh from 2005	23.21	4.87	1.71	102	223	428	661
Residential smart growth****	25% of all new SR and MR hh from 2006 to 2009 & then 50% from 2010	56.35	2.27	5.05	252	966	2,344	4,126
Non residential smart growth****	25% of all new properties from 2006	7.14	1.25	0.48	96	248	515	890
Sub Total		**308.54**		**19.13**	**1,593**	**4,005**	**6,012**	**8,577**
Queanbeyan Options								
Queanbeyan Water Conservation Credits	Equivalent demand management & source substituion options*****	29.59	1.48	1.56	319	810	2,093	2,913
Sub Total		**29.59**		**1.56**	**319**	**810**	**2,093**	**2,913**
Reuse Options								
Extension of NCERS	Potential identified customers only	26.03	3.42	0.76	515	515	515	515
Sub Total		**26.03**		**0.76**	**515**	**515**	**515**	**515**
Total Savings		**409.36**		**26.95**	**8,471**	**15,458**	**21,119**	**25,792**
Supply Options								
Enlarged Cotter Dam		55.57	1.34	3.43	0	0	3,695	11,744
Tennent		77.39	1.87	4.22	0	0	3,695	11,744
Tantangara		47.01	1.14	3.94	0	0	3,695	11,744
Sub Total		**179.97**		**11.60**	**0**	**0**	**11,085**	**35,233**

Notes

* Costs for utility + government + customer (Total Resorce Cost (TRC))
** Pricing & information/awareness modelled together at this time
*** MWEPS would also capture taps and showers and effectively maintain the savings in other indoor demand management options
**** Similar concept to water sensitive urban design (WSUD)
***** Equivalent demand management & source substituion options scaled down (10%) to achieve 25% target in 2023
hh - households
SR - single residential, MR - multi residential
PH - public housing
L - Low, M - medium, H - high, Y - Yes
Areas in grey not included yet

Figure 4 – Comparison of Levelised Costs



Notes - **Pricing & information/awareness have been modelled as one option at this stage, ****Smart growth is a similar concept to water sensitive urban design (WSUD)

Preliminary investigations indicate that demand management options alone can achieve the 2013 demand management target of a 12% reduction in per capita demand (based on 2003 levels) and that by 2023 demand management options would be providing a combined saving of 12,500 ML/a (equivalent to a 16.5% reduction in potable demand rather than the proposed 25% reduction target associated with per capita demand). Therefore to achieve the 2023 target of a 25% reduction in demand a combination of source substitution, a similar demand management and source substitution program in Queanbeyan and reuse options will also be required which have higher levelised costs than the suite of demand management options developed. Hence a potential strategy has been developed for consideration.

Potential Strategy

A strategy could be developed where a suite of lower levelised cost demand management options of the type identified in this report could be implemented slowly over the next 10 years. During this time the reference case ('base case') demand could be projected with greater certainty and allow for the complex issues associated with peak demand, drought security, the effects of climate change and catchment regeneration to be considered. Over this 10 year period the demand management options alone could achieve the 2013 target and the other reuse and source substitution options could be further investigated and where found to be cost effective, implemented, ultimately assisting in achieving the longer term 2023 target.

By 2013 or earlier, if required, the supply options could then be re-evaluated together with any available flows that can be contributed from re-evaluation of the environmental flows policy. If it was found at this time that:

- the reference case was growing faster than originally anticipated (due to higher than expected population growth);
- additional communities such as Yass and Goulburn were requesting to be supplied by ACT water supplies;
- climate change was reducing the security of supply more than anticipated; and/or
- the catchment regeneration was reducing catchment inflows to the dams by more than originally anticipated

then one of the supply side options could be implemented to augment supplies. This would be done with the knowledge that the Canberra area would be using all existing and new potable water supplies with the maximum efficiency because demand management initiatives would already have been implemented.

Conclusions & Recommendations

The demand management options required to achieve the 2013 target of a 12% reduction in per capita demand (based on 2003 levels) are estimated to have a present value cost of $45.2 M and levelised cost of $0.30 /kL.

This suite of options effectively cap average demand at 70,000 ML/a in 2053, which is similar to the peak historic demands in 1991 and 1997. The suite of demand management options developed could potentially defer supply augmentation requirements for many years (reference case demand indicates augmentation required in 2017 when demand is greater than 70,000 ML/a). The actual number of years needs further investigation as other factors such as peak demand, drought security, the effects of climate change and catchment regeneration also need to be considered.

To achieve the 2023 target of a 25% reduction in demand a combination of source substitution, Queanbeyan and reuse options will also be required which have higher levelised costs than the suite of demand management options developed. The options include:

- Demand management – saving of 12,500 ML/a in 2023 at a present value cost of $45.2 M and levelised cost of $0.30 /kL.
- Source substitution – saving of 6,000 ML/a in 2023 at a present value cost of $308.5 M and levelised cost of $4.50 /kL.
- Smart growth (which is a lower cost subset of the suite of source substitution options) – saving of 2,800 ML/a in 2023 at a present value cost of $63.8 M and levelised cost of $2.08 /kL.
- Queanbeyan – saving of 2,100 ML/a in 2023 at a present value cost of $29.6 M and levelised cost of $1.48 /kL.
- NCERS reuse – saving of 500 ML/a in 2023 at a present value cost of $26 M and levelised cost of $3.42 /kL.

For comparison the supply options considered are identified below:

- New Cotter Dam – supply of 3,700 ML/a in 2023 at present value cost of $55.6 M and levelised cost of $1.34 /kL.
- Tennent - supply of 3,700 ML/a in 2023 at present value cost of $77.4 M and levelised cost of $1.87 /kL.
- Tantangara - supply of 3,700 ML/a in 2023 at present value cost of $47 M and levelised cost of $1.14 /kL.

It should be noted that in 2023 each of the supply resources would be under utilised even though the capital costs of $100 M, $140 M and $80 M respectively would be incurred before 2018 when such supplies would be expected to be operational. By 2053 each option could supply 11,750 ML/a and would be able to provide even higher volumes after 2053.

None of the options developed take into consideration benefits associated with reduced system and property energy demand, reduced green house gas emissions, contribution to the reuse and stormwater targets, deferring specific geographical system constraints or deferring supply options. The present value costs of demand management, source substitution, Queanbeyan and reuse options can be significantly reduced by incorporating these benefits. In addition when externalities associated with environmental and social benefits are also considered and the issues associated with the risk of investing in large water supply schemes that are not utilised for many years, these options become even more economically, socially and environmentally attractive.

The complex issue of ‘who pays’ have not been investigated in this Study. The costs currently assume that the government or ACTEW pays for the whole cost of each option as would be assumed if a supply side option (a dam) was being constructed. This allows high levels of participation in the programs to be assumed to gain maximum savings. It should be noted that the less government contributes to each option the lower the participation rate and ultimate savings are likely to be, unless innovative loan systems can be offered which allow customers to contribute to the cost of the programs with the benefits they accrue.

At the end of each Section within this report data limitations and recommendations for further investigation have been provided to assist in identifying necessary next steps following this preliminary assessment. Key recommendations are as follows:

- It is recommended that further data gathering and analysis is undertaken to assist in improving the accuracy of the reference case demand. For example more detailed historical disaggregation of customer metered demand, bulk water demand and seasonal demand, Canberra and Queanbeyan demographics, Queanbeyan disaggregated water demand and unaccounted for water. In particular it is recommended that investigation into end use analysis specifically for the Canberra area is undertaken and the development of an end use model.

- It is recommended that further investigation is undertaken into implementation, how specific customers could potentially reduce potable demand and how low cost options such as pricing and minimum water efficiency performance standards (MWEPS) can be utilised to reduce demand. In addition several options developed as part of this preliminary investigation should be refined in terms of potential savings/supply.

- It is recommended that the potential strategy identified, including a 10 year plan which implements a suite of demand management options to achieve the 2013 target and allows time for further investigation of the reference case and options considered, is taken forward for further consideration.

- It is also recommended that Canberra takes advantage of the opportunities available due to combined water and electricity service provision and extensive government ownership/ management of properties to produce innovative sustainable solutions for service provision that can show case best practice sustainable design for the rest of Australia.

1 INTRODUCTION

1.1 Background

In August 2003 ACTEW Corporation (ACTEW) commissioned the Institute for Sustainable Futures (ISF) to provide assistance in developing the ACT Water Strategy, planned to be released for public consultation in October 2003.

This report summarises the findings of the preliminary analysis undertaken by ISF, which has concentrated on:

- identifying the demand management (water efficiency) and source substitution (e.g. rainwater tanks and greywater reuse) options available to achieve the identified 12% and 25% per capita demand management targets in 2013 and 2023 respectively;
- identifying the whole of society costs associated with these options and where possible highlighting the associated benefits;
- comparing (using levelised costs[1]) these options with other reuse and supply options being evaluated by ACTEW; and
- providing recommendations for further investigation.

The analysis undertaken is preliminary and has been based on available data. Where data is limited recommendations for further investigation have been made.

1.2 Report Structure

The structure of this report is as follows:

- Introduction
- The demand for water
- Options
- Savings & costs
- Conclusions and recommendations
- References

Additional material has been provided in the form of appendices, which give details on:

- Additional demographic data
- Examples of non residential smart growth

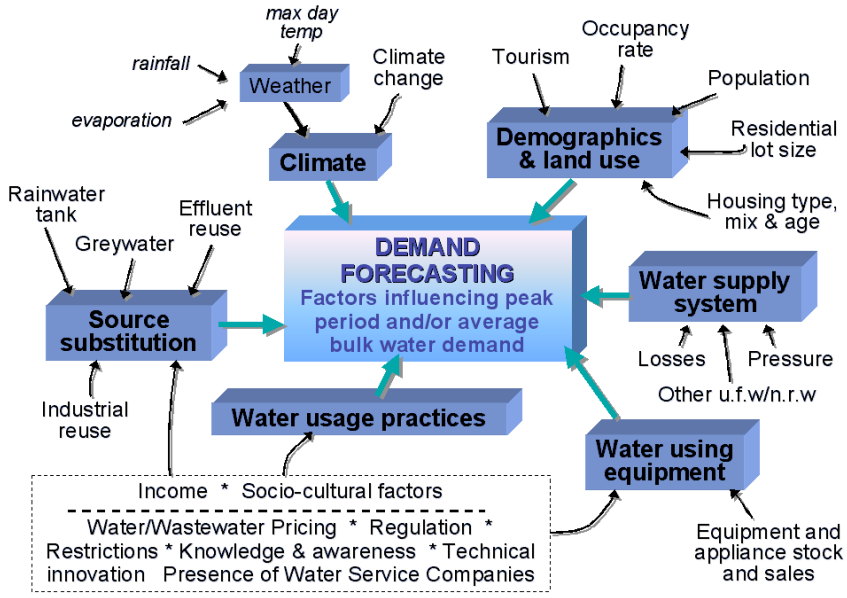
[1] Levelised cost is used as a measure of the present value unit cost of water saved or supplied. It is defined as the present value of the stream of costs over a set period divided by the present value of the stream of water demand saved or supplied over the same period.

2 THE DEMAND FOR WATER

2.1 Factors Affecting Demand

To determine how and where water can be saved through options associated with demand management (water efficiency) and source substitution (the replacement of potable water demand with another source of water such as rainwater and greywater), it is essential to understand where water is currently being used and lost. In addition, it is also essential to understand what key factors are likely to affect water demand in the future. Figure 2.1 illustrates key factors that can affect water demand and how it is projected.

Figure 2-1 Key Factors Affecting Water Demand



Source – White, 2003

Limited data is currently available to undertake a detailed assessment of current water demand and demand projections. However, analysis has been undertaken using:

- a snap shot year (2001/2002) of water demand based on ACTEW bulk water and customer meter readings (Goonrey e-mail 08/09/03);
- customer meter readings of the top 150 water users (Goonrey e-mail 09/09/03);
- ACTEW and Environment ACT data on residential indoor and outdoor demand (ACT Government, 2003);
- discussions with Queanbeyan City Council on current customer water demand (pers comm. Greg Fogarty) and data from Water Services Association of Australia (WSAA, 2001);
- demographics (e.g. population, single and multi residential dwellings, occupancy ratios within dwellings and non residential property numbers) based on Australian Bureau of Statistics data, discussions with the Chief Ministers Department (pers comm. Tim Carlton) and ACTEW database queries; and

- relevant research undertaken by ISF on end use analysis[2] around Australia.

This data has been used to determine the reference case demand for the next 50 years, which represents the demand for potable water if no demand management or source substitution initiatives are implemented.

By disaggregating current demand into various sectors (e.g. residential, non residential and unaccounted for water[3]/leakage) we can understand how much water is being used on average by: each household and each person within a household; each commercial/industrial/institutional property; and how much is lost in unaccounted for water/leakage per connection. Understanding demand in this detailed way allows us to project water demand in the future (the reference case) more accurately as we will know the number of people and occupants in a residential household and can estimate how many households and people within each household there will be in the future, the number of commercial/industrial/institutional properties needed to service that population and thus how many will be required to service the growing population and the growing total amount of leakage as the number of connections serviced grows. This more accurate demand projection[4] can then be used to identify how demand management and source substitution options can be implemented to reduce potable water demand by targeting existing and new households/properties, achieve identified targets and defer supply augmentation (e.g. construction of dams, inter catchment transfer and raising of weirs).

An even more detailed projection of demand can be undertaken through the use of end use analysis. This analysis attempts to understand for example the demand per household and person for various end uses (e.g. toilets, showers, baths, taps, laundry, garden watering). By understanding demand in this very detailed way the reference case demand can be further refined to allow for the gradual change in stock of inefficient showerheads with AAA rated showerheads, the gradual change from single flush toilets to efficient 6/3 litre dual flush toilets (which can use 60% less water) and the gradual increase in stock of AAAA rated water efficient front loading washing machines. This detailed level of analysis has not been undertaken at this stage to determine the reference case demand due to time limitations but has been used to assist in the development of demand management and source substitution options.

2.2 Current Water Demand

Figure 2.2 shows a snapshot of current water demand for each of the major sectors and currently available individual customer types:

- single residential dwellings (e.g. detached houses);
- single residential dwellings associated with public housing;
- multi residential dwellings (e.g. duplexes, town houses, units and flats);

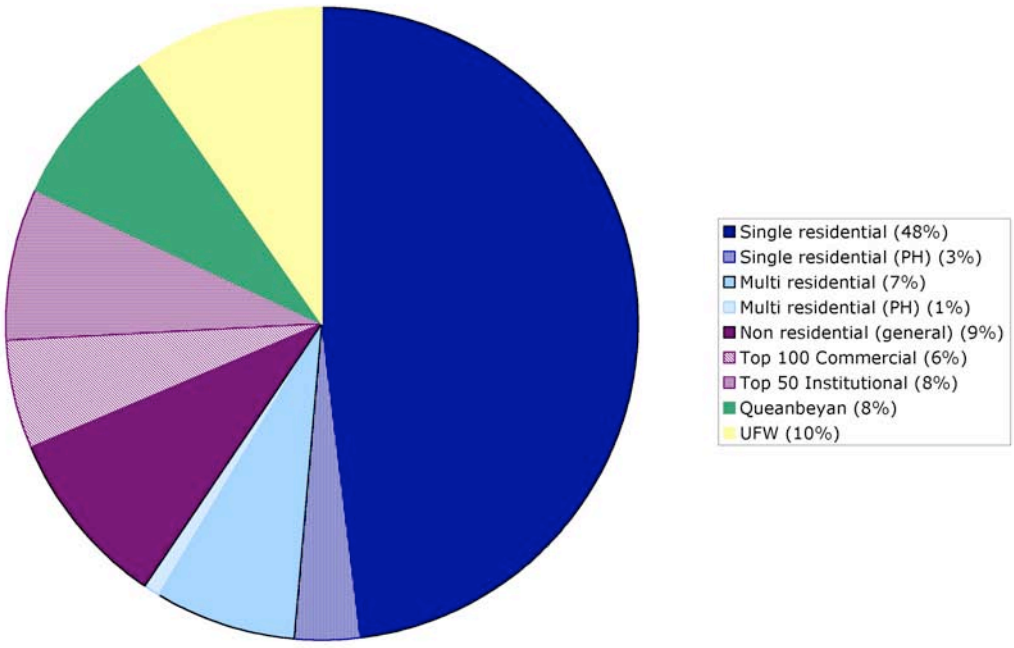
[2] End use analysis is the disaggregation of water demand into customer sectors (e.g. single and multi residential dwellings, commercial/industrial properties, institutional properties and unaccounted for water/leakage) and then into individual end uses (e.g. toilets, showers, baths, taps and washing machines which constitute indoor demand (going to sewer) and garden irrigation and pools which constitute the outdoor component of demand).

[3] Unaccounted for water is water lost or used within the system before it reaches the customer meters and attributable to slow running customer meters.

[4] Demand projection (determination of the reference case) by utilities is often calculated by dividing total potable demand by the current population to obtain the overall demand per person (kL/person/annum), which is then multiplied by the projected population to obtain the total anticipated demand. This form of demand projection does not allow for the significant changes in water demand that can occur from a shift in housing type, occupancy ratios, commercial sector growth and other issues that are considered by end use analysis such as toilet and showerhead stock.

- multi residential housing associated with public housing;
- non residential properties[5] (e.g. commercial and industrial properties such as office blocks, laundries, golf courses and hotels and institutional properties such as schools, departmental office blocks, hospitals and airports);
- non residential properties associated with the top 150 users;
- Queanbeyan; and
- unaccounted for water.

Figure 2-2 Current Water Demand by Sector (2001/2002)



Source – ACTEW
Notes – PH – public housing, UFW – unaccounted for water

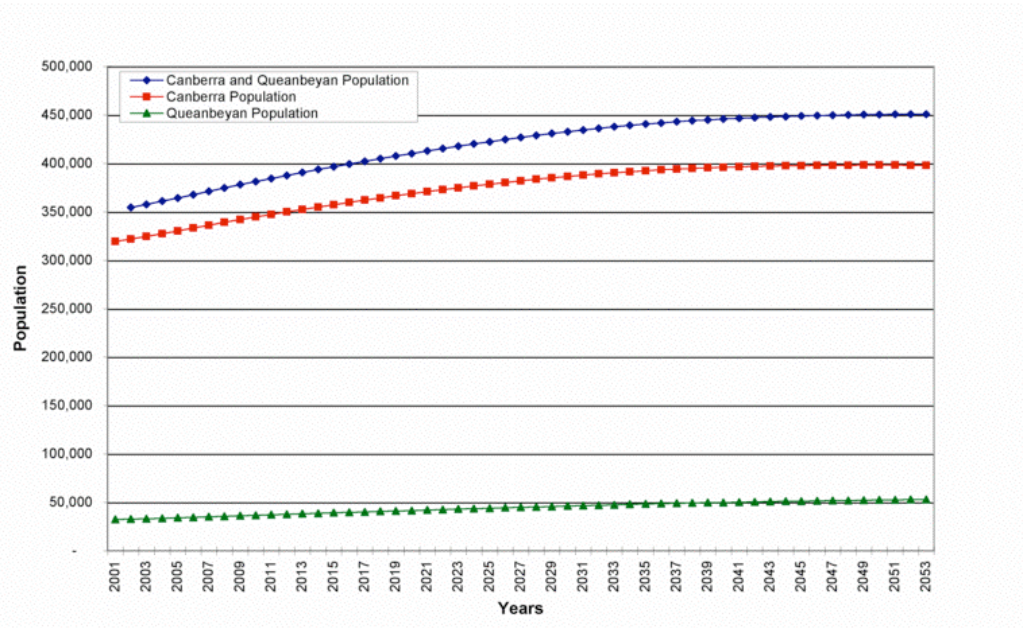
[5] For analysis the demand for water would normally be split into commercial/industrial customers and institutional customers and then be further disaggregated into individual customer types. However, the current ACTEW database does not define customers specifically under these classifications and the available database query used for analysis under this Study did not have additional fields identified to further disaggregate customers.

Single residential dwellings dominate water demand in Canberra and represent 48% of total demand or 86% of residential demand. According to ACTEW and Environment ACT investigations these customers use a considerable proportion of water (approximately 43%[6]) for outdoor end uses such as gardens, lawns, washing cars and pools (ACT Government, 2003). Another large customer group are the top 150 commercial/industrial and institutional customers, which represent 14% of total demand or 60% of non residential demand. Considering these two groups use just under two thirds of the current potable water demand, demand management and source substitution initiatives that focus on single residential customers and the top 150 commercial/industrial and institutional customers are likely to provide significant savings.

2.3 Demographics

Figure 2.3 shows the current and projected population for Canberra and Queanbeyan based on data received from the Chief Ministers Department (Carlton e-mail 24/09/03) and subsequent discussions with staff (pers comm. Tim Carlton). As indicated the Queanbeyan population is currently approximately 9.2% of the total population served. However, this is expected to increase to 11.7% by 2053 due to a higher growth rate in Queanbeyan compared to Canberra, which is primarily associated with a higher expected rate of migration.

Figure 2-3 Population

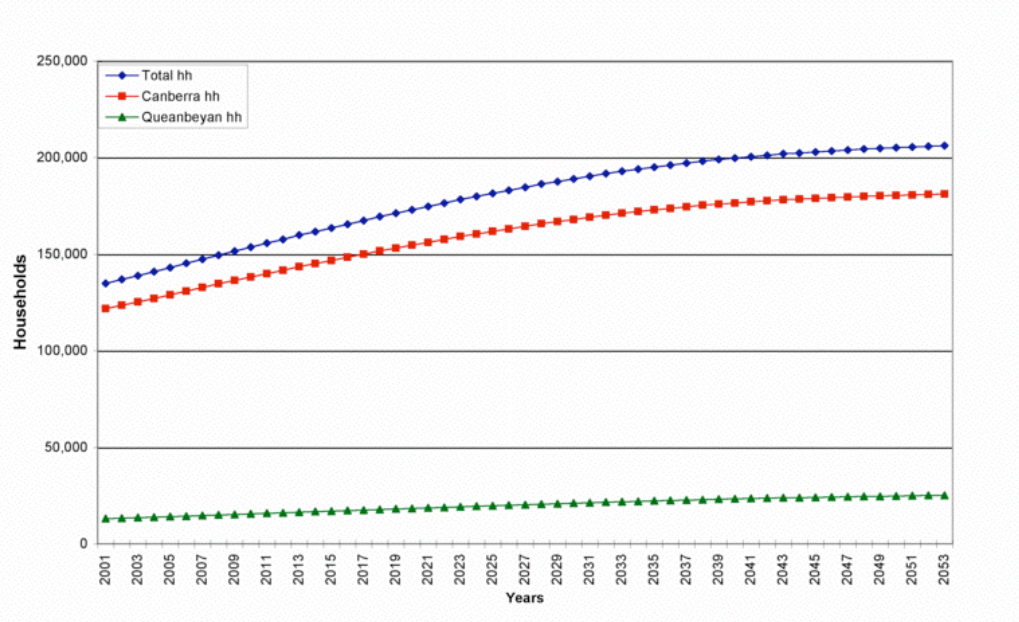


Source – CMD data (Carlton e-mail 24/09/03) and ISF calculations

Figure 2.4 shows the growth in the number of households in Canberra and Queanbeyan and illustrates that the proportion of total households in Queanbeyan relative to Canberra is expected to almost double to cater for the growing population.

[6] The outdoor water use figure appears to be in the correct order of magnitude for the climate associated with Canberra but has not been verified and needs further investigation through the use of analysis of seasonal variation of customer meter readings.

Figure 2-4 Housing Stock



Source – CMD data (Carlton e-mail 24/09/03) and ISF calculations

In Canberra single residential properties currently dominate the housing sector (77%). However, in Queanbeyan the proportion of single residential properties is less significant at only 65%. It is anticipated that the proportion of multi residential properties in Canberra is expected to increase slightly in future but little is known about how housing stock will change in Queanbeyan at this time (pers comm. Tim Carlton). Appendix A provides figures of the current and future anticipated single and multi residential housing stock and population within these houses for Canberra and Queanbeyan based on Chief Ministers Department data.

The population and housing stock both now and in the future help to identify the likely occupancy ratio within single and multi residential properties. The current occupancy ratios in Canberra and Queanbeyan and in 2053 are summarised in Table 2.1.

Table 2-1 Occupancy Ratios

Area	Current (2003)			Future (2053)		
	Single Residential	Multi Residential	Overall	Single Residential	Multi Residential	Overall
Canberra	2.86	1.76	2.6	2.43	1.53	2.2
Queanbeyan	2.9	1.67	2.47	2.45	1.44	2.11

Note – Queanbeyan occupancy ratio is based on the assumption that the proportion of population in single and multi residential properties does not change and that the occupancy ratio drops at the same rate as that of Canberra. These assumptions have assisted in calculating the number of single and multi residential households in Queanbeyan in the future as this data was unavailable at the time the analysis required for this Study was carried out.

As the number of single and multi residential properties changes and the number of people living within in each household decreases (occupancy ratios reduce) the demand for water per person will change. Considering single residential properties dominate the housing stock and that the level of outdoor water usage associated with each single residential household will remain at approximately the same level (currently 43%), the demand per person is likely to rise. The population increase, household numbers and occupancy ratios within single and multi residential properties have been used to build the residential sector proportion of the reference case (see Section 2.4).

It is anticipated that in the long run lot sizes for single residential properties are likely to reduce, that there is a potential for fixed irrigation systems to increase[7] and that the stock of appliances such as dishwashers may increase. All these factors will also affect per capita demand. However, little is known about these factors currently or how they are therefore likely to change in the future and thus ultimately affect demand.

2.4 Reference Case Demand

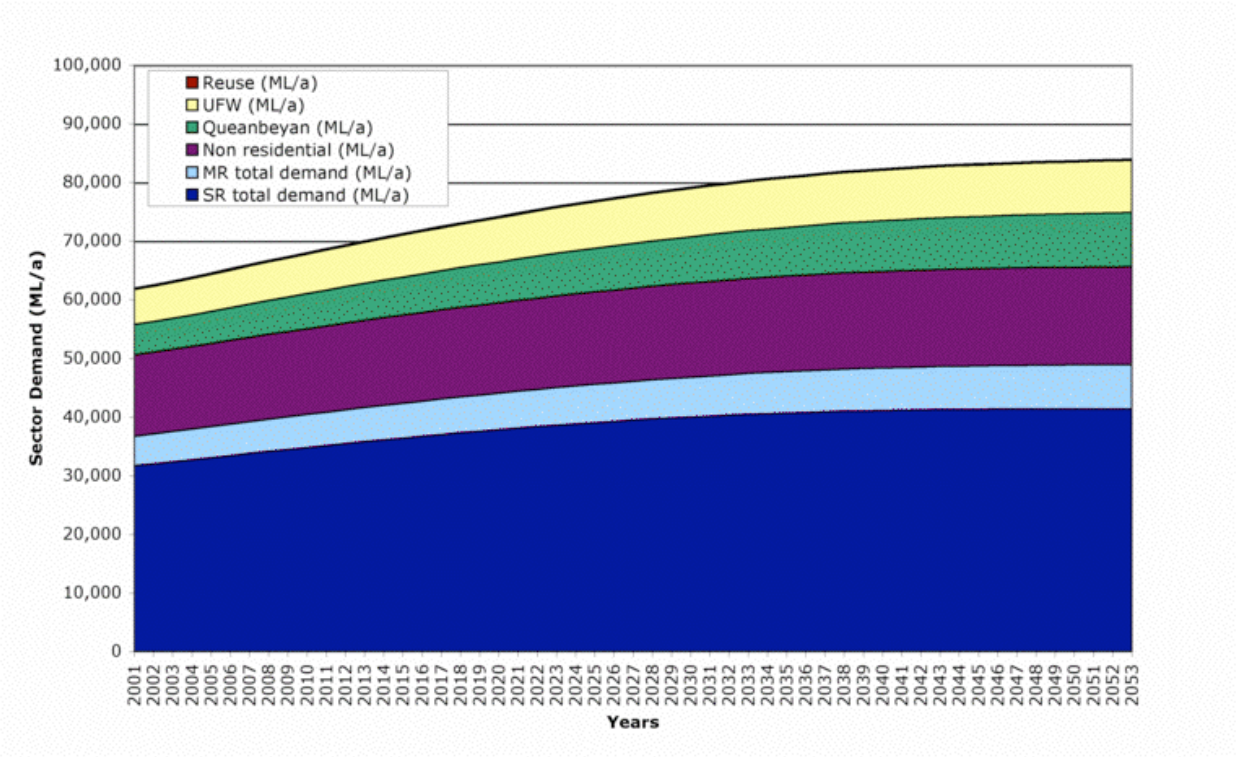
The reference case demand has been determined based on the current water demand (discussed in Section 2.2) and demographic information available (discussed in Section 2.3). Figure 2.5 shows the reference case demand and how the demand of the major sectors will change over the next 50 years. The major sectors are:

- single residential;
- multi residential;
- non residential;
- Queanbeyan;
- Unaccounted for water (UFW); and
- reuse.

Potable demand is currently at approximately 63,000 ML/a. In the next 50 years potable water demand is expected to increase by approximately one third and reach nearly 84,000 ML/a.

[7] Investigations into fixed irrigation systems in Perth have indicated the proportion of households with fixed irrigation systems is increasing and that these fixed irrigation systems are actually leading to an increase in outdoor demand (Loh & Coghlan, 2003)

Figure 2-5 Reference Case Demand



The single residential and multi residential demand projections have been based on:

- the average demand of a single residential household being 339 kL/household/annum (323 litres per capita per day) with 43% being outdoor demand; and
- the average demand of a multi residential household being 178 kL/household/annum (276 litres per capita per day) with 25% being outdoor demand.

These per household and per capita figures were based on 2001 data. As the occupancy ratios decline over the next 50 years the per household indoor demand is set to decline and the per capita total demand is expected to increase marginally due primarily to the outdoor component of demand.

For the non residential sector, according to a 2001/2002 ACTEW customer database query, there were 3,944 non residential properties which equates to approximately one non residential property servicing 31 households. Removing the top 150 customers (top 100 commercial/industrial customers and top 50 institutional customers use 34,950 and 95,135 kL/property/annum respectively) the remaining non residential customers have an average demand of 1,474 kL/property/annum. To create the non residential proportion of the reference case, the demand of the top 150 customers has been kept as a constant and the remaining non residential customers increased at a rate of one non residential property per 31 households to cater for the growing number of households. The top 150 customers are primarily associated with large government office blocks and federal government facilities. It is unlikely that these large government facilities will grow in line with the Canberra population increase and thus have been kept constant for demand projection purposes.

Unaccounted for water (UFW) in Canberra is relatively low compared with other utilities around Australia, at 47 kL/connection/annum (5.4 L/connection/hour). It has been assumed that UFW will remain at this low per connection level and that it will therefore grow at a rate of 47 kL/connection/annum.[8]

Of the current 5,200 ML/a used by Queanbeyan very little is known about the current Queanbeyan disaggregated demand. Hence Canberra data has been used to assist in building the current sector demand split, which has then been used to project demand. Using Canberra per household and per capita demand it has been assumed that single and multi residential demand in Queanbeyan represent 56% and 15% of total potable demand respectively. Removing UFW at the current Canberra proportion of 10.53%[9] leaves 19% for non residential customer demand. From WSAA data (WSAA, 2001) there are approximately 973 non residential properties which equates to approximately 995 kL/property/annum and one non residential property per 13.5 households. Using this information the residential, non residential and UFW for Queanbeyan have been projected based on the Canberra methodology.

According to the ACTEW database a small number of customers have already signed contracts for reuse which will enable them to switch to the reuse supply when it comes on line around January 2004 (213 ML/a). These customers have been classified under the reuse sector in Figure 2.5. ACTEW is currently in negotiation with several other potential reuse customers, which could potentially bring the reuse demand up to approximately 450 ML/a by irrigating over 60 hectares (pers comm. Leigh Crocker). As negotiations with these customers are still underway they have not been included in the reuse sector demand at this stage.

2.5 Data Limitations

The demand projections developed as part of this Study are the most accurate to date for the Canberra area. However, the analysis has relied on limited available data. Further investigation and the collection of additional data could significantly improve the accuracy of the demand projections. The key areas in need of further investigation and/or additional data gathering are listed below:

- Currently only one snap shot year of customer meter data has been available. It is often better to take an average of the last 5 to 10 years of demand for each sector and customer type to reduce errors associated with climate influences and meter errors. It is recommended that collection and analysis of 10 years of bulk and disaggregated customer metered data is undertaken to improve the understanding of current and historical water demand.

- Further disaggregation of sectors into customer types such as schools, tourist accommodation, hospitals etc. is required to assist in better understanding the demand of specific customer types and benchmarking against current best practice to determine whether these specific customer types could benefit from a targeted demand management initiative. In particular the non residential sector relating to government properties should be further investigated due to the water efficiency opportunities available through government management and policies.

- Investigation of the seasonal variation in customer metered demand is needed to assist in better defining the indoor and outdoor components of demand.

[8] UFW comprises of: current annual real losses (CARL) which are those losses associated with joint weeps, breaks and apparent water losses averaged over the total number of service connections; and unavoidable annual real losses (UARL) which are those losses that are unavoidable considering the network, supply pressures and number of connections. The UARL component of UFW and the exact number of connections could not be determined at the time the analysis was carried out (e.g. for multi residential properties units of occupancy were used instead of property connections). Further investigation of these details will assist in improving the accuracy of this component of demand.

[9] UFW on average over the last four year has been 10.53% (Leigh Crocker e-mail 19/09/03).

- Investigation into Canberra and Queanbeyan demographics is required to ensure consistent assumptions are being used.

- Further investigation into Queanbeyan bulk and customer metered demand should be undertaken as very little data is currently available.

- More detailed analysis of historic and current UFW should be undertaken and recalibration of bulk meters undertaken to resolve meter error issues.

- End use analysis specifically for the Canberra area should be considered especially relating to outdoor water demand, lot size and evaporative air conditioners. In addition investigation into end use analysis should be undertaken to determine how demand management initiatives in Queanbeyan have and will affect demand in the future.

Recommendation

It is recommended that further data gathering and analysis is undertaken to assist in improving the accuracy of the reference case demand. For example more detailed historical disaggregation of customer metered demand, bulk water demand and seasonal demand, Canberra and Queanbeyan demographics, Queanbeyan disaggregated water demand and unaccounted for water. In particular it is recommended that investigation into end use analysis specifically for the Canberra area is undertaken and the development of an end use model.

3 OPTIONS

3.1 Introduction

Demand management and source substitution are two key ways of providing water services to a community that can enable supply side options to be deferred by several years and in some cases indefinitely. A whole range of demand management and source substitution options are available to choose from, each with varying costs and associated environmental and social benefits. These costs and benefits are different depending on how, when and where these options are implemented.

It is therefore essential that the costs and benefits of a whole range of demand management and source substitution options are assessed and compared alongside options for new supply sources. If the costs and benefits for all supply, demand management and source substitution options are considered, then the most economically, environmentally and socially appropriate solution can be taken forward for implementation.

A whole suite of demand management and source substitution options have been investigated for the Canberra area and then analysed using the principles of Least Cost Planning (LCP) or Integrated Resource Management[10] to allow 'fair' comparison with the major supply and reuse options being investigated by ACTEW. This Section concentrates on describing the options considered and Section 4.0 details the savings and costs identified for each option (part of the LCP process) to facilitate comparison with the ACTEW supply and reuse options.

3.2 Targets

To assist in deferring the need for a supply side option in the Canberra area, targets have been set which will rely on demand management and source substitution options. These targets are:

Targets (based on the base year of 2003)

- by 2013 reduce per capita potable demand by 12%
- by 2023 reduce per capita potable demand by 25%
- by 2013 increase effluent reuse from 5% to 20%
- limit stormwater flow in new developed areas to the same amount that flowed before development

Source – ACT Government, 2003b

When using demand management and source substitution options no one single option is expected to achieve targets or defer augmentation of supply. Generally a suite of demand management and source substitution options are combined to achieve these objectives. This approach has been used in this Study.

[10] Least Cost Planning is a process whereby, for example, a water service provider determines a range of options that at lowest cost provide their customers with the water related services they require rather than the water itself. This process recognises that customers do not necessarily want more water, rather they want the services that water provides such as aesthetically pleasing landscapes, sanitation and clean clothes. The process aims to investigate the whole of society costs and benefits to highlight the most economically, environmentally and socially appropriate solution.

3.3 Menu of options

A range of demand management and source substitution options have been considered in this Study, which cover various sectors of the community such as residential, commercial/industrial and institutional sectors and where possible various customer types within the community such as single residential (detached houses), multi residential (duplexes and flats) and large commercial/industrial customers (high potable water demand customers).

For each demand management and source substitution option considered, a water efficiency measure and some regulatory, educational or economic instrument have been combined to maximise their success. For example, a measure (the fitting of a AAA rated water efficient showerhead) has been combined with an economic instrument (a rebate from government which reduces the cost for the showerhead). In another option the same measure (a AAA rated showerhead) has been combined with a regulatory instrument so that it becomes mandatory for all new houses to be fitted with a water efficient showerhead. This comparison of options including comparison of the instrument (economic, educational, regulatory) assists in clarifying which options are the lowest cost to society, determined by considering the levelised cost[11] ($/kL) of each option. The levelised costs attempt to capture both costs and benefits. Levelised costs for the options considered are discussed further in Section 4.0.

The options considered have been categorised as follows:

- Demand management - residential sector (existing houses)
- Demand management - residential sector (new houses and appliances)
- Demand management - non residential sector (existing)
- Demand management - non residential sector (new)
- Demand management – unaccounted for water
- Source substitution - residential
- Source substitution – smart growth
- Queanbeyan

3.3.1 Demand Management - residential sector (existing houses)

The existing houses in the residential sector are responsible for over half of the current demand and therefore provide considerable opportunity to assist in achieving the targets.

Pricing & information/awareness

The price of water can be used as a useful means of increasing water efficiency. Adjusting the price of water in various tiers or bands can assist in ensuring basic water requirements are provided at a reasonable cost to the customer yet those customers that use considerably more than average household demand are expected to pay more per kL above a specified limit. For example a typical single residential household in the Canberra area currently uses approximately 339 kL/household/annum. A price could be set for the indoor component of demand (non discretionary water use), another higher price for the outdoor component of demand (discretionary water use) and an additional significantly higher price per kL for water that is used above average total demand. This form of pricing schedule would effectively send an economic incentive to higher water use customers to keep water demand within or below average demand levels. Whilst changing the pricing schedule a number of the proposed demand management programs could be implemented, which would effectively assist customers to reduce water demand. The Independent Competition and Regulatory Commission is currently reviewing ACTEW's pricing for water and has stated that it will take the fact

[11] Levelised cost is used as a measure of the present value unit cost of water saved or supplied. It is defined as the present value of the stream of costs over a set period divided by the present value of the stream of water demand saved or supplied over the same period.

that pricing can be used as a water efficiency measure into account when determining the prices for water for the ACT.

Information and awareness is a fundamental foundation to any demand management and source substitution program. With the recent drought and water restrictions water efficiency has become a significant issue in the Canberra area and the community has demonstrated a high level of community willingness/commitment to change water use behaviour/practices. An information and awareness program would aim to maintain the current water efficiency momentum and assist the community to further reduce demand in all sectors. The program would ensure the community has access to reliable, accurate and practical information about water resources, supply/demand issues, water sensitive urban design and how as individuals the community can reduce demand. Program elements could include: television, radio and newspaper advertising/advice; interactive websites with 'tips' for various sectors on how to save water and the provision of information packs; practical 'hands-on' workshops; a telephone advice line; and set up of demonstration sites and stalls at convenient public locations. The program would need to be on going to assist in maintaining savings.

The option developed for this Study has combined pricing and information/awareness and assumes a 5% reduction in total demand could be obtained from 75% of single residential households. This is a simplified yet conservative assumption. More detailed analysis of the current and planned pricing structure, top water users demand and development of the information and awareness program will assist in improving the accuracy of the savings associated with this option which will be separated during more detailed investigations.

AAA rated showerhead rebate

This option is similar to the showerhead program that was run for five weeks in Canberra from December 2002 to January 2003 and would involve offering AAA rated showerheads to customers at a reduced cost. This option would rely on the customers installing the showerheads themselves. A similar program implemented in Sydney found that average savings were approximately 16.5 ± 6.6 kL/household/year[12].

Dual flush toilet program

This program involves the replacement of existing single flush toilets or early model dual flush toilets with new 6/3 litre dual flush toilets at low or zero cost to the customer. The average savings achievable from switching from an 11 litre single flush toilet to a 6/3 litre dual flush toilet (based on current Canberra occupancy rates) are 37 and 23 kL/household/annum for single and multi residential households respectively and thus represent significant potential savings. However, the cost of changing such a toilet can be approximately $300 per toilet (ACT Government, 2003b). Such high costs often equate to a relatively high levelised cost unless benefits associated with deferring the augmentation of a sewage treatment plant can be incorporated (e.g. the current situation in Queanbeyan). Since the proportion of efficient dual flush toilets in households is growing each year due to new developments only installing 6/3 litre dual flush models and the fact that existing single flush toilets are gradually being replaced with 6/3 litre models due to refurbishment this option should only be pursued if it is deemed necessary to achieve the required targets within a set timeframe, as allowing natural uptake of 6/3 litre toilets would be a lower cost option.

[12] The Smart Showerhead Program took place in the greater Sydney region between July 1998 and October 1999. Evaluation of the participants of the program found average savings of 16.5 ± 6.6 kL/household/year (Sarac et al, 2002). It should be noted that theoretical savings from showerhead replacement are often reported to be higher (Cordell et al, 2003). The evaluation identified above used customer meter readings from participants of the program and compared them against a control group and thus found actual savings rather than theoretical savings attributable to the program.

Residential indoor audit/tune up

This option is similar to the program implemented by Sydney Water Corporation on 200,000 houses to date and which has been evaluated for single residential households and found to save on average 21 kL/household/annum[13]. The audit/tune up would involve offering residential customers a reduced cost or free water efficiency assessment by an experienced plumber. During the assessment the plumber would replace inefficient showerheads with AAA rated showerheads, install tap flow regulators on kitchen and bathroom basin taps, install a toilet displacement device or cistern weight device on single flush toilets (to reduce single flush volume) and check and repair leaks where possible. The plumber would also discuss and provide leaflets to the customer on water efficiency around the home.

Washing machine rebate

In this option a rebate is offered to customers at point of sale on the purchase of a new AAAA rated water efficient washing machine. The rebate program would aim to increase the sales of AAAA rated machines, typically front loading models, which can provide on average a 50% reduction in water demand compared with top loading models[14]. The rebate would be similar to other offers that have been provided around Australia at $100 to $150, which effectively pays for the difference between efficient and inefficient models. To ensure the inefficient models are removed from stock and to restrict the rebate program to customers supplied by ACTEW, customers would need to turn in their old washing machines and provide proof of address.

Residential outdoor assessment (single residential households)

Outdoor water use in single residential households in the Canberra area is estimated to be approximately 43%. In most cities across Australia average lot sizes for new houses are becoming smaller, and houses larger, which could potentially mean that overall outdoor water demand will reduce in future. However, in some cities, such as Perth, the use of fixed watering systems is becoming more common. These systems, if used correctly, can reduce outdoor water demand, however, due to a lack of available advice, householders often end up increasing water demand with these systems. Hence outdoor water demand provides considerable opportunities for improvements in water efficiency.

This option would involve helping householders to understand how to reduce outdoor water demand yet still maintain an aesthetically pleasing lawn and garden. Householders would be offered a visit by an experienced assessor at a reduced or zero cost. The assessor would complete an inspection of the lawn and garden with the householder and advise on the maintenance and use of the watering system in place, the seasonal watering regime of the plants in the garden, the use of mulch and discuss and provide leaflets on other water saving tips. The specialist would also provide where appropriate tap timers and other water saving devices and vouchers to the householder to a specified value. In similar programs undertaken these devices and vouchers have amounted to about $50 per household. To maintain these savings the program would need to provide additional vouchers and advice after the initial visit. Similar programs have been estimated to save approximately 20% of outdoor demand.

[13] An evaluation of the Sydney Water Corporation 'Every Drop Counts' program, carried out on 200,000 houses, is currently being undertaken by ISF. Results of the program show on average a 21 ± 2.5 kL/household/annum saving for single residential houses. These savings take into consideration the fact that some houses have minimal fittings modified while others have all fittings modified and is therefore a conservative estimation of the potential savings available. .

[14] Similar programs have assumed an 18 kL/household/year saving can be achieved from moving from an inefficient model to an AAAA rated water efficient washing machine (Turner et al, 2003).

Public housing indoor audit/tune up

In Canberra alone (not including neighbouring Queanbeyan housing) public housing represents 9% of the housing stock and uses approximately 4% of total water demand (2,600 ML in 2001/02). Currently as these properties are constructed and refurbished or existing showerheads become unserviceable, AAA rated showerheads are fitted. In addition where practicable flow regulating tap aerators are also fitted.

As such a large number of properties are currently owned and maintained by government and the water used is not currently paid for by the tenants[15] this provides a significant opportunity to be able to approach these tenant and assist them to save water.

In this option an indoor audit/tune up, similar to those already identified for the general residential sector, would be implemented specifically for public housing. It is anticipated the program could be implemented for virtually all properties within a 9 year time frame to tie in with the 2013 target.

Public housing outdoor assessment

Similar to the public housing indoor/audit tune up and general residential outdoor assessment this option would target the outdoor component of demand in public housing properties. Again, because government already owns and maintains these properties it is assumed that all households would be visited over a 9 year time frame to tie in with the 2013 target. Assessments and savings have been limited to single residential households at this time. However, with further investigation it may be found that multi residential properties associated with duplex style housing could potentially provide significant savings and could also be targeted thus providing an increase in potential savings.

As noted in the Section '*Pricing and information/awareness*' significant savings from this group could also be obtained if tenants were required to pay for water over a set limit related to average single and multi residential household demand. This would assist tenants to 'value' the water they use and provide an economic incentive to keep water demand within or below average demand levels.

General regulations

Water efficiency savings can be obtained from the introduction and compliance inspection of various regulations. The government has identified that it is considering/intends to introduce a number of regulations that will affect existing and new properties:

- Ban the use of sprinklers between 10.00 am and 5.00 pm except during the non daylight saving period (end March to end October).
- Ban sprinklers on total fire ban days or days above 30 deg C.
- Ban hosing down of driveways, footpaths and other impervious surfaces.
- Introduce compulsory use of trigger hoses for car washing.
- Revise building regulations to ensure hot water services are located close to showers and sink areas to reduce water and energy wasted while waiting for hot water.
- Require the separation of the water supply to toilets and cold outlets for washing machines from the edge of the house slab to enable future rainwater use.

No specific savings or costs have been assessed for these regulatory modifications. To maximise the effectiveness of the regulations it will be essential to enforce compliance. The regulations associated with outdoor water use will effectively act as a foundation program and assist in obtaining the outdoor water savings identified under the '*residential outdoor assessment*' program.

[15] Since 1995, public housing tenants have not paid for water.

3.3.2 Demand management - residential sector (new houses and appliances)

The population growth in Canberra is expected to grow at less than 1% each year. Even with this small growth rate over the next 30 years an average of over 1,500 households each year will need to be built to cater for the growing population (less will be required after 2033 as the population growth rate slows). It will therefore be essential to use regulations to ensure that new houses and those existing houses that are refurbished assist in achieving the targets by being as water efficient as possible.

Various types of regulation can be used to achieve water efficiency in new and refurbished houses. A selection of options have been identified to assess the relative savings and costs associated with the various types of regulation.

Residential development control plans (DCPs)

In this option all new houses would be required to install water efficient fixtures such as 6/3 litre dual flush toilets, flow regulators in taps and AAA rated showerheads. In addition the gardens would need to be designed around the principles of Xeriscape which include planning and design, soil analysis, appropriate plant selection, practical turf areas, efficient irrigation, use of mulches and appropriate maintenance. Using development control plans ensures a local solution and control and for a relatively low cost, means that savings of over 50 kL/household/year[16] could be obtained.

Certification at time of sale

Another option that could be linked to the current Canberra energy efficiency scheme, would be to certify properties for water efficiency prior to sale. This option aims to capture all properties rather than only those built as new developments. In Sydney, housing stock changes hands approximately once every seven years. The changeover in stock in Canberra needs further investigation, however, it is likely that only a limited number of properties in the Canberra area would not change hands over the next 30 to 50 year period being assessed and thus this option would assist in capturing all housing stock.

As the changeover in stock for Canberra is currently unknown this option has not been modelled in the analysis undertaken for this Study but does provide additional potential savings at a potentially low levelised cost.

Minimum water efficiency performance standards

Minimum water efficiency performance standards (MWEPS) for appliances are by far the most comprehensive, far reaching and cost effective means of securing appliance water efficiency. MWEPS ensure that all appliances and plumbing products purchased and installed in new and refurbished households are water efficient and that no appliances below a specified water efficiency level can be bought or installed. These standards can be used for example for showerheads, tap regulators, toilets, washing machines, dishwashers and garden irrigation systems. Currently, there is agreement of the states, territories and Commonwealth Government to introduce mandatory labelling of some water using appliances and fixtures. This will need to be extended to mandatory standards to have the required effect. The ACT Government could take a key role in pursuing this objective.

This option assumes that MWEPS are in place for showerheads, tap regulators, toilets and washing machines by 2010 and thus capture all new houses constructed after this date, as well as all those houses that are refurbished. For modelling purposes and to ensure no double counting of savings is

[16] This assumes a saving of 21 kL/hh/a for indoor demand (similar to the savings available from current retrofits) and 20% of 146 kL/hh/a which is the outdoor component of demand (29 kL/hh/a). These assumptions are conservative as both indoor and outdoor demand can be reduced further with best practice design and well designed development control plans.

included, the MWEPS option currently only includes the savings associated with washing machines. All other savings associated with showers, taps and toilets are included in individual options such as the residential indoor audit/tune up. This means that as replacement of individual showerheads and taps fitted as part of the audit/tune up are required in the future (approximately 10 to 14 years time) these fixtures and fittings can only be replaced with efficient models due to MWEPS being in place.

3.3.3 Demand management – non residential sector (existing)

The non residential sector includes the commercial/industrial and institutional sectors. Examples of commercial/industrial customers are hotels/motels, office blocks, bakeries, laundries and private golf and sports clubs. Institutional customers include customers such as churches, hospitals, government department office blocks, airports and public recreational facilities such as swimming pools and sports grounds.

The non residential sector uses approximately 22% of current potable water demand in just over 4,000 properties in Canberra. Even though the government has already achieved water efficiency savings in some of these properties, this sector still has the potential to provide significant additional savings to assist in meeting the targets.

A large number of commercial/industrial and institutional audits and retrofits have been carried out for specific industries in the United States and more locally in Australia with savings of approximately 20% being considered achievable. The types of properties vary considerably and hence modifications to increase water efficiency vary substantially from property to property. In many cases these savings are achieved through the fitting of water efficient fixtures and fittings similar to those in the residential audit/tune up (AAA rated showerheads, tap regulators, dual flush toilets) but also include other assessments and modifications such as the checking of leaks and cooling tower systems which are often responsible for significant water usage in such properties. As an example, in the case of hotels/motels water efficient appliances can be fitted in each room, the kitchen areas can be fitted with water efficient trigger devices and the laundry areas can be fitted with water efficient washing machines or retrofit devices to recycle water. In addition staff can be trained to detect leaks, use minimal water during cleaning routines, ensure full washing machine loads and the use of less water for irrigation of the grounds.

At this stage only limited information has been gathered on the non residential sector and hence the savings and costs are generic. These options will be considered in more detail once additional information on specific customer types in the non residential sector have been gathered.

Non residential general commercial/industrial and institutional audits/retrofits

This option considers existing commercial/industrial and institutional customers and aims to allow for an audit/retrofit for individual properties, which will result in an overall saving of 20% for program participants. As indicated the modifications and training required will be specific to each industry and property audited.

Non residential targeted commercial/industrial audits/retrofit

This option is more focused on large water users and aims to reduce costs by targeting the top 100 high commercial/industrial water users. The existing customer database indicates that the top 100 high water users currently use approximately 3,500 ML/year (an average of 35,000 kL/property/year). Much of this demand is associated with outdoor water use, hotels/motels, office blocks and shopping centres. Each of the types of customers in the top 100 can be assisted to reduce water by an audit followed by retrofits and training of personnel as required. With targeted visits and investment in water saving devices a saving of 25% can generally be achieved.

Non residential targeted institutional audits/retrofits

This option is specifically focused on the top 50 large institutional water users. The existing customer database indicates that the top 50 properties in this sector use 4,800 ML/year (on average 95,000 kL/property/year). Again, similar to the top commercial/industrial customers much of this demand is associated with outdoor water use such as sports grounds and irrigation of open areas. By targeted auditing followed by retrofitting, management modifications and training of staff these top water users can be expected to reduce demand by 25%.

3.3.4 Demand management – non residential sector (new)

Non residential development control plans

New commercial/industrial and institutional properties constructed and those existing properties, which are refurbished provide significant potential for water savings in the future. In a similar way to the residential sector, non residential development control plans can be used to ensure that all future properties are as water efficient as possible and move towards best practice water management.

In this option all new and refurbished properties would be required to install water efficient fixtures and fittings (e.g. 6/3 litre dual flush toilets, tap flow regulators, AAA rated showerheads, water efficient watering systems). A points system could be adopted which requires all new properties to prove that they have incorporated water efficiency measures saving at least 25% relative to current standard practice. Compliance with this control could be secured using a bonds system, submitted at the time of application for development. The bond would only be returned after completion of the building, following inspection of the property and sign off of the required water efficiency levels.

3.3.5 Demand management – unaccounted for water

Active unaccounted for water program

According to recent ACTEW records unaccounted for water in Canberra, which is the difference between bulk water supplied and metered demand by the customers, is approximately 10.5%[17] of total demand. This represents approximately 5 litres/connection/hour, which is relatively low compared to other cities around Australia. This is partially due to the relatively new network in Canberra and some of the current system management practices implemented such as customer meter replacement programs[18] which help to ensure customer meter reading accuracy and lower unaccounted for water associated with inaccurate customer meter readings.

Although Canberra currently has one of the lowest unaccounted for water connection figures in Australia it is essential that an active unaccounted for water program is used to maintain and even increase water savings through the use of initiatives such as pressure reduction, active leakage detection and control, bulk meter calibration and customer meter replacement.

ACTEW have recently evaluated a potential unaccounted for water and leakage detection program, which would involve installing meters throughout the whole of Canberra to detect leakage, would take approximately 7 years to set up and could potentially save between 1,000 and 1,500 ML/a (Crocker e-mail 19/09/03). This option requires further investigation to incorporate pressure reduction, meter calibration and meter replacement initiatives. However, for analysis purposes the cost of this option

[17] UFW 98/99 – 9.7%, 99/00 – 8.8%, 00/01 – 10.1%, 01/02 – 13.5%, 02/03 – 6.9%. The average of 98/99, 99/00, 00/01 and 01/02 is 10. 53%. In the past 2 financial years a significant proportion of water has been supplied from Googong which is known to have some issues with measurement of treated water supplied. Hence only 98/99, 99/00, 00/01 and 01/02 figures have been used as they are thought to be more representative (pers comm. Leigh Crocker).

[18] Since 1999 a meter replacement program has resulted in 41% of all small meters and 30% of all meters being replaced (Crocker e-mail 19/09/03).

has been used to allow comparison with the other options. In addition the total savings attributed to unaccounted for water have been taken to be 50% of 1,500 ML/a to ensure double counting of savings associated with other options does not occur, as options such as the non residential targeted options would also aim to find leakage in specific buildings.

3.3.6 Source substitution – residential

Source substitution in the residential sector utilises other sources of water such as rainwater tanks and greywater reuse within the home to effectively offset the demand for potable water. These alternative sources of water can be used for various end uses depending on the level of quality required and the size of tank or system fitted. End uses can include toilet flushing, washing machines use and outdoor watering on the lawn or garden. Several options using these alternative sources have been considered for both existing and new residential properties.

Rainwater tank rebates (existing)

This option involves the provision of a rebate to existing customers to encourage them to buy a rainwater tank and capture the runoff from their available roof area. Rainfall in Canberra is relatively low (approximately 600 mm per annum) therefore to maximise potential yield and security of supply rainwater tanks should be at least 10 kL and be connected to indoor end uses such as toilet flushing and washing machine usage (as well as outdoor end uses) to provide a constant demand and maximise the available stormwater storage capacity of the rainwater tank installed.

This option assumes that only 5 kL tanks are likely to be installed in existing single residential households due to space limitations and that the yield from such a tank is 35 kL/household/annum (a 10 kL tank is anticipated to yield approximately 55 kL/household/annum)[19].

Rainwater tank rebates new developments

This option assumes that larger 10 kL tanks will be installed in new single residential developments which will be able to improve security of supply and yield 55 kL/household/annum. Again these tanks would be connected to indoor end uses as well as outdoor end uses. As the tanks can be incorporated at time of construction it is assumed that a capital cost saving can be obtained.

Greywater system rebates (existing)

This option involves providing a rebate to customers for retrofitting greywater systems in existing single residential households to enable greywater from the house to be captured, treated and reused in end uses such as toilets and gardens. In this option it has been assumed that a greywater system would be able to supply 50% of outdoor demand.

Greywater new developments

This option is similar to that for existing households in that it provides a rebate for installing a greywater system but assumes that the greywater system would be incorporated at the time of construction, which will simplify piping arrangements and reduce construction costs.

[19] The 35 and 55 kL/household/annum figures have been provided by Environment ACT (pers comm. Gary Croston), which have been evaluated through modelling. Further investigation of the potential supply available from various tank sizes needs to be undertaken to take into consideration factors such as indoor and outdoor end use connection, top up from mains supply and storm buffer capacity etc. which can significantly affect the yield from such tanks.

3.3.7 Source substitution – smart growth

Residential smart growth

Residential smart growth, often called water sensitive urban design (WSUD), is where water efficiency is combined with source substitution to minimise the volume of potable water required by a household and maximise reuse and stormwater capture. Residential smart growth aims to capture a proportion of new development areas, generally in greenfield sites. The option assumes that all new houses will be fitted with water efficient fixtures and fittings, rainwater tanks to capture stormwater collected on roof areas and greywater systems to enable reuse of water within the home and on the garden/lawn area, which will use the principles of Xeriscape. Similar options analysed for other areas have been found to reduce potable demand by 70% and 80% and dry weather flows to sewer by 40% (e.g. Edmondson Park, Mitchell et al, 2002) at only marginal extra cost at the time of construction because augmentation of the water and sewage networks is not required. These smart growth areas and associated rainwater and greywater storage and treatment facilities can be built at various scales (e.g. household, street and estate scale) to reduce costs and increase reliability of supply. As the rainfall in Canberra is less than that found in locations such as Sydney (e.g. Edmondson Park, Mitchell et al, 2002) it has been assumed that potable supply could be reduced by 60%.

This option requires more detailed water balance investigation but assist in highlighting that significant savings in water demand and sewage effluent production, can be obtained by incorporating demand management and source substitution principles into the design of new households.

Non residential smart growth

As with the residential properties, non residential properties can be designed to incorporate water efficient fixtures and fittings (including AAA rated showerheads, tap regulators water efficient washing machines, efficient watering systems, leakage detection systems etc. but also more innovative appliances such as waterless urinals, 5/2 L flush toilets and the use of passive design to reduce the need for cooling tower systems). When these water efficiency measures are combined with rainwater capture, greywater and even blackwater treatment and reuse, potable demand can be reduced by as much as 80% and sewage effluent production reduced by as much as 90% (e.g. the proposed Sydney Water Headquarters building). Further details of examples of such buildings are provided in Appendix B.

Again, as the rainfall in Canberra is less than that found in locations such as Sydney, potable water demand savings of 60% have been assumed for this option which targets a proportion of all new commercial/industrial and institutional properties. As for the residential smart growth option, this option requires more detailed water balance investigation but assists in highlighting that significant savings in potable water demand and sewage effluent production can be obtained by incorporating water efficiency and source substitution into the design of new commercial/industrial and institutional properties.

Considering the large number of government buildings required in Canberra, Canberra is uniquely placed to incorporate innovative design that can be used to show case best practice design for other areas around Australia.

3.3.8 Queanbeyan

Queanbeyan is supplied from the existing ACT supply sources and currently uses approximately 8% of demand (5,200 ML/a). As indicated in Section 2.3, although Queanbeyan currently represents less than 10% of the population size of Canberra it is expected to grow more rapidly than Canberra and thus will require additional potable water supplies over the next 50 years as the population increases.

To achieve the required demand management targets, Queanbeyan will also need to reduce demand per capita in line with that of Canberra. As Queanbeyan is not controlled by the ACT Government and the water customers within Queanbeyan are actually customers of Queanbeyan City Council, a mutually beneficial cross border arrangement will need to be set up between the ACT Government and Queanbeyan City Council to ensure the required targets are obtained.

Queanbeyan Water Conservation Credits

This option would involve the ACT Government and Queanbeyan City Council setting demand management targets that if achieved and maintained entitle Queanbeyan City Council to receive incentive payments from the ACT Government. These incentive payments or 'water conservation credits' will assist Queanbeyan City Council to pay for the initiatives required to reduce demand to the agreed levels. It is assumed that the types of options would be very similar to the demand management and sources substitution options identified for Canberra and would cost approximately one tenth of the cost of the Canberra combined program to achieve the same savings considering the population is approximately one tenth of the size of Canberra.

This option will require further investigation as the demographics and non residential component of demand in Queanbeyan are different to that of Canberra. In addition Queanbeyan has already implemented a number of water conservation initiatives recently which need to be taken into consideration, although these have primarily concentrated on reducing sewage effluent rather than potable water demand. As the number of new properties in Queanbeyan is expected to rise significantly over the next 50 years there is considerable opportunity to ensure that more cost effective options associated with making new properties more water efficient can be utilised. This may actually provide Queanbeyan with more scope to reduce potable water demand at a lower levelised cost than Canberra.

Regional Water Supplier

Various ACT documents have identified that the existing supply resources may be required to not only supply the current and future populations of Canberra and Queanbeyan but also other communities such the outskirts of Queanbeyan, Yass and even Goulburn. If the current water supplies are required to supply other communities in the future, these communities would need to achieve similar demand management targets as Canberra.

An option has not been developed for this scenario as the feasibility/requirement has not been determined at this point in time. The logistics of whether Canberra would take over management of each of the communities water and sewage supplies as a regional water service provider would need to be considered or whether the current arrangement with Queanbeyan as a bulk water supplier would be maintained.

3.4 Other Options Considered

ACTEW have been evaluating a number of reuse and supply options. A selection of these options have been used to compare levelised costs with those of demand management and source substitution options. A brief description of the reuse and supply options used for this comparison are provided below.

3.4.1 Reuse Option

Extension of the North Canberra Effluent Reuse Scheme (NCERS)

This option (stages 3 and 4) is an extension of the existing scheme (stages 1 and 2) which supplies treated effluent from the Fyshwick Sewage Treatment Plant to large ovals, open space and irrigation areas. Stages 1 and 2, which will become operational next year, can provide irrigation for 80 hectares. A number of customers have already signed contracts to transfer to reuse supplies when they become available and ACTEW are currently in negotiation with a number of other large customers who are expected to sign contracts shortly. Stages 3 and 4 which involve the extension of the existing pipework systems, upgrade of the tertiary treatment plant etc. will enable an additional 70 hectares to be irrigated and could be operational in January 2005. Investigations are currently underway to identify suitable customers for these additional reuse supplies.

As no specific customers have been identified for stages 3 and 4 at this time it has been assumed that a proportion of the top 150 high water users in close proximity to the pipeline network will be able to transfer to this non potable supply for outdoor watering end uses. After the top 150 water users have obtained a 25% reduction in demand, due to the targeted demand management options, it has been assumed that a further 40% of demand for those customers in close proximity to the network could transfer to this non potable supply. This results in a demand of just over 500 ML/a. This is a conservative estimate as it is anticipated that over time this demand could be doubled. The total scheme will be able to provide approximately 1,100 ML/a, which could be increased to 1,500 ML/a with minimal additional capital/operating expenditure.

3.4.2 Supply Options

Enlarged Cotter Dam

This option involves raising the existing Cotter Dam by means of an earthfill embankment, which would enable storage to be increased significantly from 4,700 ML to 75,000 ML. Water would be held in storage until a drought and then used until the drought eased. The Enlarged Cotter Dam water would be used as the third choice supply, after Bendora and Googong Dams.

Tennent

This option involves building a new dam on the Naas River, downstream of its junction with the Gudgenby River. The site is already formally identified in the National Capital Plan (NCP) as the site for a future water supply dam for Canberra. The NCP states that the Tennent dam would be open for recreational activities, similar to Googong.

Tennent Dam would have a capacity of 150,000 ML, and hence would become the largest dam in the Canberra area (Googong Dam has capacity of 125,000 ML). In addition to the dam itself, this option would require a large pump station, large water pipelines and possibly a water treatment plant. Water from Tennent would most likely be fed into Tuggeranong for most of the year, and hence would be used in conjunction with both Googong and Corin/Bendora water.

Tantangarra

Preliminary investigations have been carried out on many options including transferring water from the Snowy Mountains, Burrinjuck and Blowering Dams. The most promising option is to transfer water from Tantangara Dam to the Cotter system. The Tantangara option envisages taking water from Tantangara Dam by tunnel and/or pipeline to the Cotter catchment. Since the ACT does not currently hold rights or entitlements to water in Tantangara's catchment, it would be necessary to purchase entitlements held by water users in NSW, Victoria or South Australia.

This option involves establishing a diversion point at the outlet of the reservoir and pumping the water through a pipeline to discharge into the Cotter River upstream of Corin Dam, or extending the pipeline right to the dam. A range of volumes of water could be obtained from this option depending on the entitlement purchased from interstate and the capacity of tunnel/pipes and pumps installed.

3.5 Summary of options

A summary of the options considered is listed in Table 3.1. The uptake of each option and the associated costs are discussed in Section 4.0.

Table 3-1 Summary of Options

Option
Demand Management Options
Pricing & information/awareness
AAA rated showerhead rebate
Dual flush toilet program
Residential indoor audit/tune up
Washing machine rebate
Residential outdoor assessment (single residential)
Public housing indoor audit/tune up
Public housing outdoor assessment
Residential development control plans
Certification at time of sale
Minimum Water Efficiency Performance Standards
Non residential general commercial/industrial & institutional audits/retrofits
Non residential targeted commercial/industrial audits/retrofits
Non residential targeted institutional audits/retrofits
Non residential development control plans
Active unaccounted for water control program
Source Substitution Options
Rainwater tank rebates (existing)
Rainwater tank rebates new developments
Greywater rebates (existing)
Greywater rebates new developments
Residential smart growth
Non residential smart growth
Queanbeyan Option
Queanbeyan Water Conservation Credits
Reuse Option
Extension of NCERS
Supply Options
Enlarged Cotter Dam
Tennent
Tantangara

3.6 Further Investigations

A number of issues need to be investigated before these options can be implemented. Some of these issues include:

- Development of a detailed implementation plan for those demand management and source substitution options to be taken forward which includes consideration of the project management and project team skills required as well as timing and interaction between various options, to maximise uptake, effectiveness and savings. For example, for maximum effectiveness the introduction of the showerhead rebate program should only be offered to those households which already have a 6/3 litre dual flush toilet and other water efficient

appliances or low occupancy rate. If the program is offered more widely then this will reduce the savings available from other options such as the residential indoor audit/tune up. Similarly when implementing options such as the indoor audit/tune up the residential outdoor assessment, toilet rebate and washing machine rebate could be offered after inspection of the household to maximise potential savings and reduce advertising costs. This would mean that various options 'hang off' other options and are implemented according to a systematic and planned program/timeframe.

- Options such as the rainwater tank rebates, greywater system rebates and smart growth need to be investigated further to understand their potential specifically for the Canberra climate. In addition investigation into the bulk buying of items such as rainwater tanks should be considered to reduce the costs associated with such an option.

- More investigation is required into the non residential customers to assess how tailored programs such as a schools, tourist accommodation and outdoor irrigators programs could potentially reduce demand compared to the more general non residential program. In addition the top 150 non residential customers need further investigation to assess their potential to be supplied from non potable sources.

- Further investigation is required to understand how unaccounted for water can be maintained and even reduced.

- More detailed assessment of pricing options and the potential to reduce high water users demand needs to be undertaken. Only a very preliminary savings estimate has been made for this Study. Once a more detailed pricing structure has been determined more accurate water savings can be calculated.

- Further investigations are required into the initiatives already undertaken in Queanbeyan to assist in future water projections and to assess how future programs should be designed to increase uptake further and focus on potable water savings rather than wastewater discharge. In addition more detailed option development for Queanbeyan is required which focuses on new developments.

- Investigation is required into the potential constraints and barriers associated with the use of greywater systems, MWEPS and development controls plans and identification of ways forward to assist implementation.

- Further analysis on house turnover is required in the Canberra area and how certification at time of sale can be used to assist in increased uptake of water efficient fixtures and fittings.

- Further investigation is required into what initiatives have already been implemented in Canberra (e.g. non residential sector and the showerhead program), evaluation of the participants customer metered data and unpacking of what has worked and where improvements could be made. In addition further investigation into outdoor demand in the residential and non residential sectors to more accurately determine potential savings specifically for the Canberra climate.

Recommendation

It is recommended that further investigation is undertaken into implementation, how specific customers could potentially reduce potable demand and how low cost options such as pricing and MWEPs can be utilised to reduce demand. In addition several options developed as part of this preliminary investigation should be refined in terms of potential savings/supply.

4 SAVINGS & COSTS

4.1 Potential Savings

The options discussed in Section 3.0 have been developed further by considering the potential savings (associated with uptake of each program) and capital and operating costs. Each of the demand management, source substitution, Queanbeyan and reuse options have been used to assist in achieving the identified targets and are assumed to be implemented gradually from 2005. Figures 4.1 and 4.2 show the cumulative potential savings in potable water demand in terms of ML/a and litres per capita per day (LCD) for each of the options considered and how a combination of the options can be used to reduce demand to such an extent that the short and long term targets in 2013 and 2023 respectively can be achieved.

The associated present value costs for achieving these targets and the level of uptake required are summarised in Table 4.1 together with the present value savings achieved in specific years, the levelised costs and average annual costs.

Figure 4-1 Savings (ML/a)

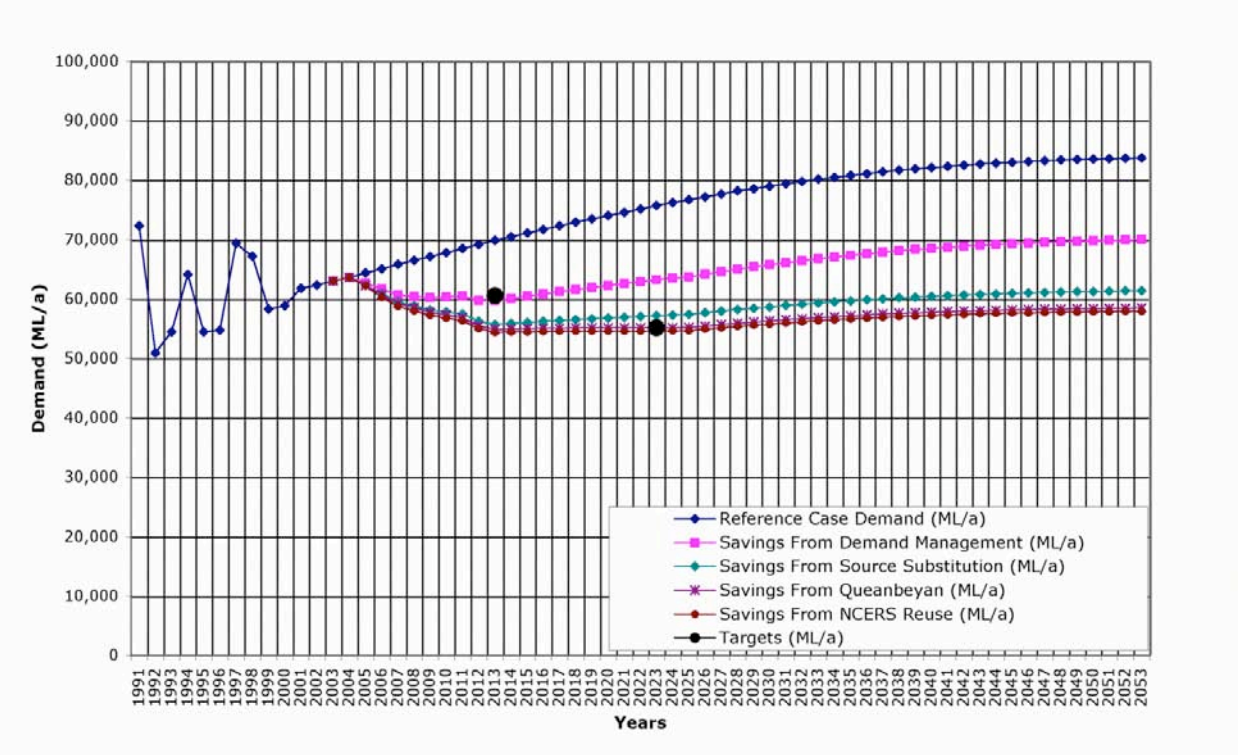
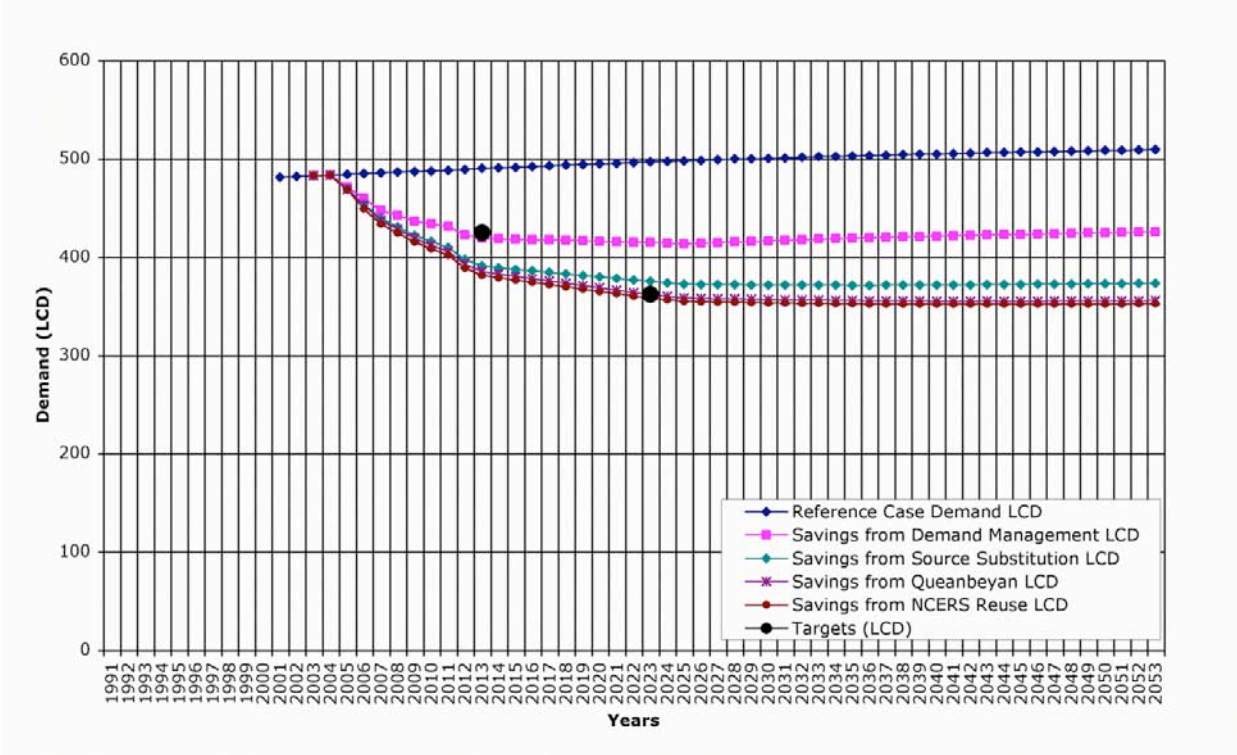


Figure 4-2 Savings (LCD)



As can be seen in Figures 4.1 and 4.2 significant savings can be achieved through a suite of demand management options alone. These savings, which can effectively cap average demand at 70,000 ML/a in 2053 (instead of the projected 83,700 ML/a). This would effectively mean that demand management could reduce average demand in 2053 to similar levels required in historical high demand years such as 1991 and 1997 (refer to Figure 4.1), although, it should be noted that Figure 4.1 shows average projected demand and not peak historic demand which is illustrated by the blue line between 1991 and 2002. It is anticipated that under the current reference case demand, additional supply options will be required to augment the existing supply by around 2017 (when demand will be above 70,000 ML/a). The demand management options alone and achievement of the 2013 target could defer this requirement by many years. The actual number of years needs further investigation as other factors such as peak demand, drought security, the effects of climate change and catchment regeneration also need to be considered.

4.2 Costs

The suite of demand management options would cost only approximately $45.2 M in present value terms when considering whole of society costs[20]. These costs, which do not include any benefits at this stage, have been discounted at a rate of 6% per annum, which has been used for all the options to provide consistency. The demand management options would achieve the 2013 target and assist in achieving the 2023 target for a very low average levelised cost of only $0.30 /kL. By 2023 demand management options would be providing a combined saving of 12,500 ML/a (equivalent to a 16.5% reduction in potable demand rather than the current proposed 25% reduction target associated with LCD).

[20] Whole of society costs have been considered for all options. These include all capital and operating costs and in the case of demand management options etc. also include those costs associated with marketing, project management and evaluation of individual options.

Table 4-1 Option Summary Table

Summary Tables								
Options	**Program participants assumptions**	**PV Costs* ($M)**	**PV Levelised Unit Cost ($/kL)**	**Average Annual Cost ($M/a)**	**Savings in 2008 (ML/a)**	**Savings in 2013 (ML/a)**	**Savings in 2023 (ML/a)**	**Savings in 2053 (ML/a)**
Demand Management Options								
Pricing & information/awareness**	75% of existing SR hh affected from 2005	1.33	0.08	0.22	937	1,171	1,171	1,171
AAA rated showerhead rebate	15% all existing SR & MR hh (- PH hh) over 3 years	1.00	0.22	0.28	304	304	304	304
Dual flush toilet program	15% all existing SR & MR hh (-PH hh) over 9 years	4.38	0.59	0.52	267	600	600	600
Residential indoor audit/tune up	40% of all existing SR & MR hh (- PH hh) over 9 years	5.33	0.42	0.64	456	1,027	1,027	1,027
Washing machine rebate	30% of existing hh with top loaders needing replacement over 5 years	0.63	1.02	0.11	35	44	44	44
Residential outdoor assessment (SR)	75% of all existing SR hh (- PH hh) over 9 years	11.33	0.46	0.50	886	1,993	1,993	1,993
Public housing indoor audit/tune up	100% of all existing SR & MR PH hh over 9 years	1.21	0.42	0.16	103	233	233	233
Public housing outdoor assessment	100% of all existing SR PH over 9 years	1.19	0.50	0.05	86	193	193	193
Residential development control plans	75% of all new SR & MR hh from 2005 to 2009 & then 50% from 2010	0.90	0.09	0.03	253	472	820	1,277
Certification at time of sale		0.00	0.00	0.00	0	0	0	0
Minimum Water Efficiency Performance Standards	100% of washing machines from 2010***	0.54	0.03	0.19	0	313	1,999	2,363
Non residential general commercial/industrial & institutional audits/retrofits	50% of existing properties in 5 years	3.14	0.37	0.62	493	616	616	616
Non residential targeted commercial/industrial audits/retrofits	Top 100 high users in 3 years	2.80	0.22	0.79	874	874	874	874
Non residential targeted institutional audits/retrofits	Top 50 high users in 3 years	3.64	0.21	1.02	1,189	1,189	1,189	1,189
Non residential development control plans	75% of all new properties from 2005	0.27	0.03	0.01	160	349	684	1,152
Active unaccounted for water control program		7.51	0.99	0.36	0	750	750	750
Sub Total		**45.19**		**5.50**	**6,044**	**10,129**	**12,498**	**13,787**
Source Substitution Options								
Rainwater tank rebates (existing)	25% of existing SR hh (- PH hh) over 9 years	102.91	10.62	5.47	347	782	782	782
Rainwater tank rebates new developments	25% of all new SR hh from 2005	16.08	4.45	0.94	77	169	325	502
Greywater rebates (existing)	25% of existing SR hh (-PH hh) over 9 years	102.85	5.13	5.47	719	1,617	1,617	1,617
Greywater rebates new developments	25% of all new SR hh from 2005	23.21	4.87	1.71	102	223	428	661
Residential smart growth****	25% of all new SR and MR hh from 2006 to 2009 & then 50% from 2010	56.35	2.27	5.05	252	966	2,344	4,126
Non residential smart growth****	25% of all new properties from 2006	7.14	1.25	0.48	96	248	515	890
Sub Total		**308.54**		**19.13**	**1,593**	**4,005**	**6,012**	**8,577**
Queanbeyan Options								
Queanbeyan Water Conservation Credits	Equivalent demand management & source substituion options*****	29.59	1.48	1.56	319	810	2,093	2,913
Sub Total		**29.59**		**1.56**	**319**	**810**	**2,093**	**2,913**
Reuse Options								
Extension of NCERS	Potential identified customers only	26.03	3.42	0.76	515	515	515	515
Sub Total		**26.03**		**0.76**	**515**	**515**	**515**	**515**
Total Savings		**409.36**		**26.95**	**8,471**	**15,458**	**21,119**	**25,792**
Supply Options								
Enlarged Cotter Dam		55.57	1.34	3.43	0	0	3,695	11,744
Tennent		77.39	1.87	4.22	0	0	3,695	11,744
Tantangara		47.01	1.14	3.94	0	0	3,695	11,744
Sub Total		**179.97**		**11.60**	**0**	**0**	**11,085**	**35,233**

Notes
* Costs for utility + government + customer (Total Resorce Cost (TRC))
** Pricing & information/awareness modelled together at this time
*** MWEPS would also capture taps and showers and effectively maintain the savings in other indoor demand management options
**** Similar concept to water sensitive urban design (WSUD)
***** Equivalent demand management & source substituion options scaled down (10%) to achieve 25% target in 2023
hh - households
SR - single residential, MR - multi residential
PH - public housing
L - Low, M - medium, H - high, Y - Yes
Areas in grey not included yet

To achieve the 2023 target a combination of source substitution, Queanbeyan and reuse options would need to be considered. Source substitution could contribute significantly to the required savings in 2023 by providing a combined saving of 6,000 ML/a (half that of the demand management options) but at a very high present value cost of $308.5 M which equates to a levelised cost of $4.50 /kL. By using the smart growth options alone (which are contained within the source substitution suite of options) almost half these savings can be obtained (2,800 ML/a in 2023) for a significantly lower present value cost of $63.8 M (levelised cost of $2.08 /kL). The Queanbeyan option provides a saving of 2,100 ML/a in 2023 at a present value cost of $29.6 M (levelised cost of $1.48 /kL) and the NCERS reuse option provides a potential saving of over 500 ML/a in 2023 at a present value cost of $26 M (levelised cost of $3.42 /kL).

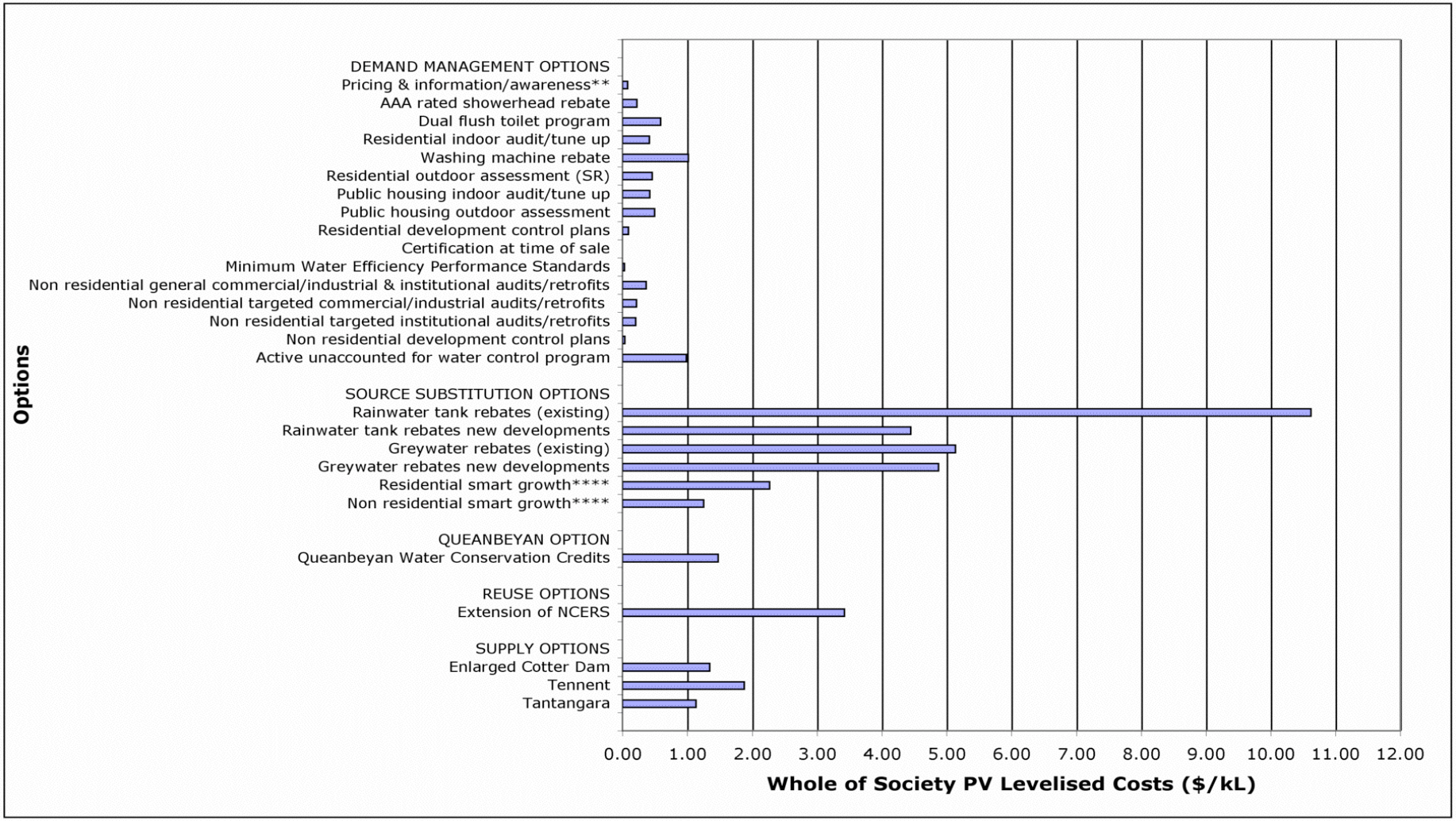
The individual levelised costs for each option are shown graphically in Figure 4.3 and illustrate the very low levelised costs of the demand management options compared to all other options. Figure 4.3 also illustrates the significantly higher levelised costs of the source substitution options. It should be noted that all these costs are whole of society costs and do not include benefits at this stage. By incorporating the benefits of reduced energy associated with treating potable water, pumping potable water to customers, pumping sewage from customers and treating the sewage and reduced energy bills associated with AAA rated showerheads etc., the costs of each of the demand management and some of the suite of Queanbeyan options could be further reduced. For source substitution options, although the costs appear high they do not include the benefits of assisting in achieving the reuse targets, assistance in achieving the stormwater targets or any benefits associated with deferring water, sewage and stormwater constraints or augmentation requirements in particular geographical locations of the Canberra area.

It should also be noted that although the NCERS reuse scheme has a relatively high levelised cost and low potential savings when compared to the other options, the savings identified are from current identified potential customers. There is significant scope to increase the number of customers drawing from the NCERS scheme, which could effectively double the potential customer base and virtually halve the levelised costs. However, these customers have not been confirmed and have therefore not been included at this stage.

In addition it should be noted that none of the demand management, source substitution, reuse or Queanbeyan options take into consideration the significant cost benefits of deferring the need for a supply option at this time.

Table 4.1 and Figure 4.3 also show details of the three key supply options currently being considered to provide a comparison. These options are assumed to become fully operational in 2018 and to be gradually utilised as the existing supplies come under strain from the growing population (the reference case). The three supply options provide relatively low levelised cost options when compared to source substitution and the NCERS scheme, are on a par with the Queanbeyan option but have significantly higher levelised costs when compared with the demand management options. These supply options cannot take advantage of the benefits associated with reducing energy unless the operating regime associated with the existing supply from Googong is incorporated, which would provide a benefit but also mean that the Googong resource is under utilised.

Figure 4-3 Whole of Society Levelised Costs ($/kL)



Notes - **Pricing & information/awareness have been modelled as one at this stage, ****Smart growth is a similar concept to water sensitive urban design (WSUD)

4.3 Timing

The supply side options will not be fully utilised until after 2053 even though the costs for construction, ($100 M, $140 M and $80 M for the Enlarged Cotter Dam, Tennent and Tantangara options respectively) would be incurred before 2018 when such supplies would be expected to be operational. In contrast the demand management, source substitution, NCERS reuse and Queanbeyan options can all be tailored to reduce demand as required (although it should be noted that for new developments and appliances these would need to be considered earlier to ensure capture of all new properties). Thus options such as demand management, source substitution, reuse and the Queanbeyan options reduce the risk of investing large amounts of capital on one specific project such as those associated with supply augmentation. Taking the savings, costs and timing issues into consideration a potential strategy is described below.

Potential Strategy

A strategy could be developed where a suite of lower levelised cost demand management options of the type identified in this report could be implemented slowly over the next 10 years. During this time the reference case demand could be projected with greater certainty and allow for the complex issues associated with peak demand, drought security, the effects of climate change and catchment regeneration to be considered. Over this 10 year period the demand management options alone could achieve the 2013 target and the other reuse and source substitution options could be further investigated and where found to be cost effective, implemented, ultimately assisting in achieving the longer term 2023 target.

By 2013 or earlier, if required, the supply options could then be re-evaluated together with any available flows that can be contributed from environmental flows[21]. If it was found at this time that:

- the reference case was growing faster than originally anticipated (due to higher than expected population growth);
- additional communities such as Yass and Goulburn were requesting to be supplied by ACT water supplies;
- climate change was reducing the security of supply more than anticipated; and/or
- the catchment regeneration was reducing catchment inflows to the dams by more than originally anticipated

then one of the supply side options could be implemented to augment supplies. This would be done with the knowledge that the Canberra area would be using all existing and new potable water supplies with the maximum efficiency because demand management initiatives would have already been implemented.

To implement the demand management options identified and allow for the 10 year plan within the strategy described, Canberra would need to invest an average of $4.9 M every year in capital and operating costs between 2004 and 2013 as identified in Table 4.2.

Table 4-2 Ten Year Whole of Society Cost Profile for Demand Management Options

Years	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total capital and operating cost each year ($M)	0.7	8.2	8.1	7.6	5.0	4.9	3.9	3.8	3.3	3.3

[21] It is understood that an evaluation of the environmental flows policy will take place in 2004 (pers comm. Gary Bickford). The current environmental flows regime was implemented in 1999. It may be found that from more recent research that the environmental flows are set too high or do not replicate natural flows and thus a proportion of these flows could potentially be used by the community without detriment to the environment.

These cost are whole of society costs and thus do not include benefits or address the question of 'who pays' for the programs. The $4.9 M and indeed all the costs discussed assume that the government or ACTEW pays the whole cost and customers participating in the programs effectively receive options such as the residential indoor audits/tune ups, residential outdoor assessments and non residential general audits/retrofits at no cost. In many other urban centres around Australia where such programs have been implemented the customer generally provides a contribution to the cost of the program[22]. This form of contribution provides a sense of 'value' to the program, a level of equity within the community and allows for those who will be receiving some of the benefits (e.g. reduced hot water bills) to contribute to the total cost of the programs.

The level of customer contribution needs to be carefully considered. As the customer contribution increases the level of participation generally decreases and thus the anticipated level of savings from a program may not be obtained due to low participation rate. To maintain the participation rate but increase the cost contribution by participants other more innovative approaches can often be used, especially for the non residential sector. These include concepts such as revolving loan funds or reduced loan schemes where the customer contribution is higher but is spread over a period of time. Hence, in the case of reduced loans the customer will be paying for a proportion of the program but will be able to recoup, for example the energy savings, in sufficient time to pay off the loan offered by government. The trade off of customer contribution versus program participation and the use of loan schemes need to be considered during development of the implementation plan.

Assuming the program participation rates identified in Table 4.1 can be achieved (e.g. government pays for the majority of the costs of each program) and the relatively conservative savings (identified for each of the options in Section 3.0) can be achieved, Figures 4.4 to 4.9 help to illustrate (in the form of supply curves) how each individual option and combination of options can save/supply potable water in 2023 and 2053. These supply curves also show the relative levelised costs for each option.

Figures 4.4 and 4.5 show a detailed breakdown of all the options excluding supply options. As indicated, in 2023 a combination of the lowest cost options MWEPS, non residential DCPs, pricing and residential DCPs will supply just less than 5,000 ML/a of savings (Figure 4.4) which will increase to approximately 6,000 ML/a by 2053 (Figure 4.5) due to additional new properties being captured by the initiatives. In comparison an option such as rainwater tank rebates for existing households will supply a fraction of the savings at over 100 times the levelised cost.

Figures 4.6 to 4.7 show a simplified breakdown of the options considered including the supply side options. In these graphs the smart growth has been separated from the core group of source substitution options due to their relatively lower levelised costs compared to rainwater tank and greywater options. These supply curves help to illustrate the significant combined savings that can be provided by the demand management options which in 2023 will be higher than any other option for a significantly lower levelised cost and in 2053 provide savings which are comparable to the supply side options (because these supply resources will not be fully utilised). Figures 4.6 and 4.7 also indicate that the Queanbeyan and smart growth options can provide a significant contribution to savings in 2053 at levelised costs which are comparable with the supply side options.

[22] For example the Sydney Water Corporation 'Every Drop Counts' indoor retrofit program where participants pay $22 towards the cost of the retrofits (full cost $130) unless they can prove low income status which entitles participants to receive the retrofit at zero cost.

Finally Figures 4.8 and 4.9 show a simplified breakdown of the options considered excluding the supply side options. This assists in illustrating how, if it was deemed inappropriate to invest in supply side options in the near future (or it was decided that a number of other options would be relied upon in the short term with supply side options being introduced in the longer term), how demand management, source substitution, reuse and Queanbeyan options can be used to provide savings in 2053 of over 25,000 ML/a with combined suites of options that range in levelised cost between $0.30 /kL to $6.43 /kL.

Figure 4-4 Supply Curve in 2023 (excluding Supply Options)

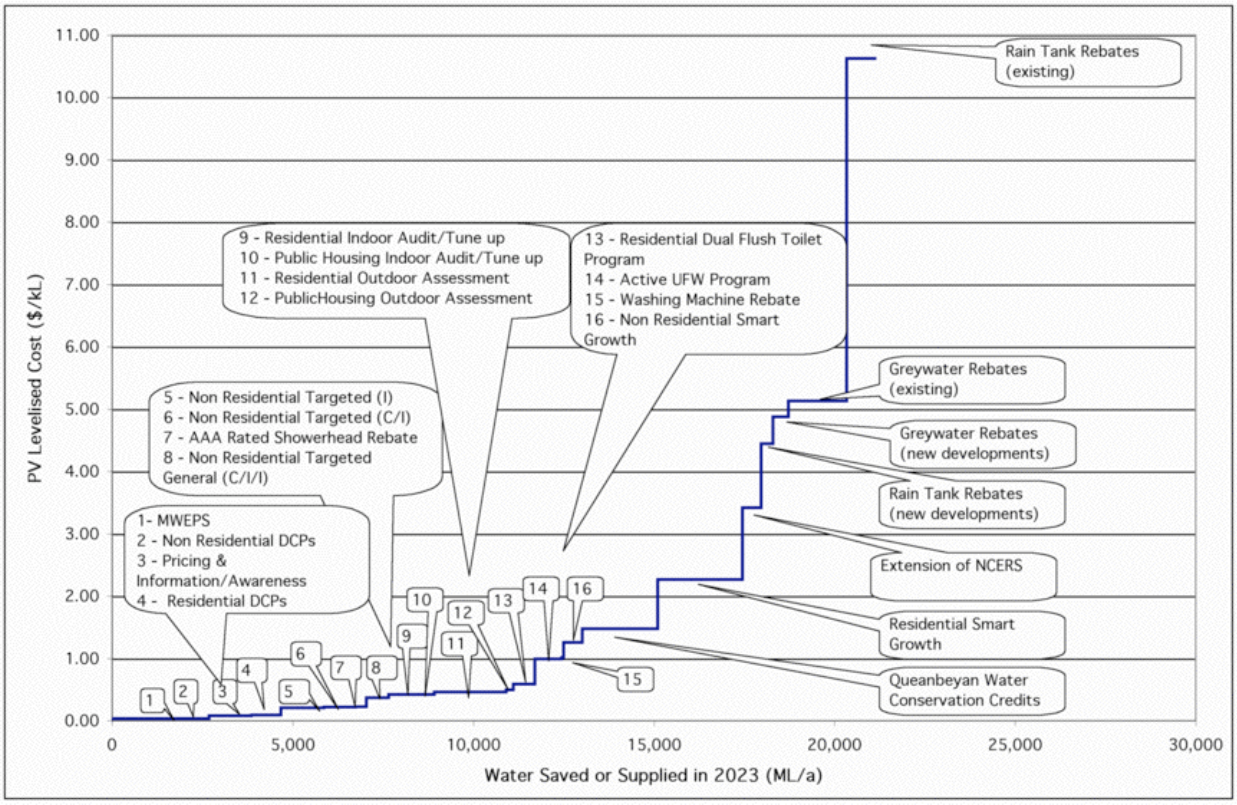


Figure 4-5 Supply Curve in 2053 (excluding Supply Options)

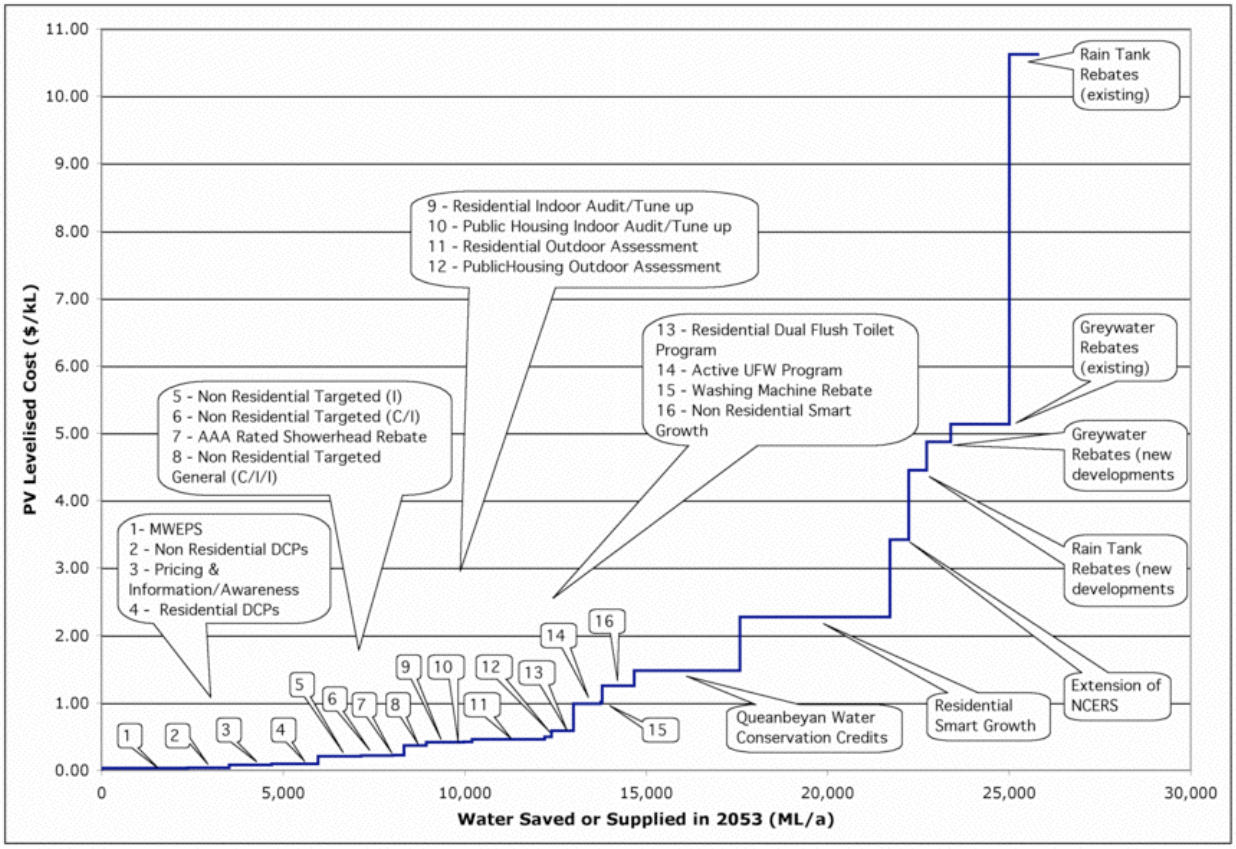


Figure 4-6 Simplified Supply Curve in 2023 (including Supply Options)

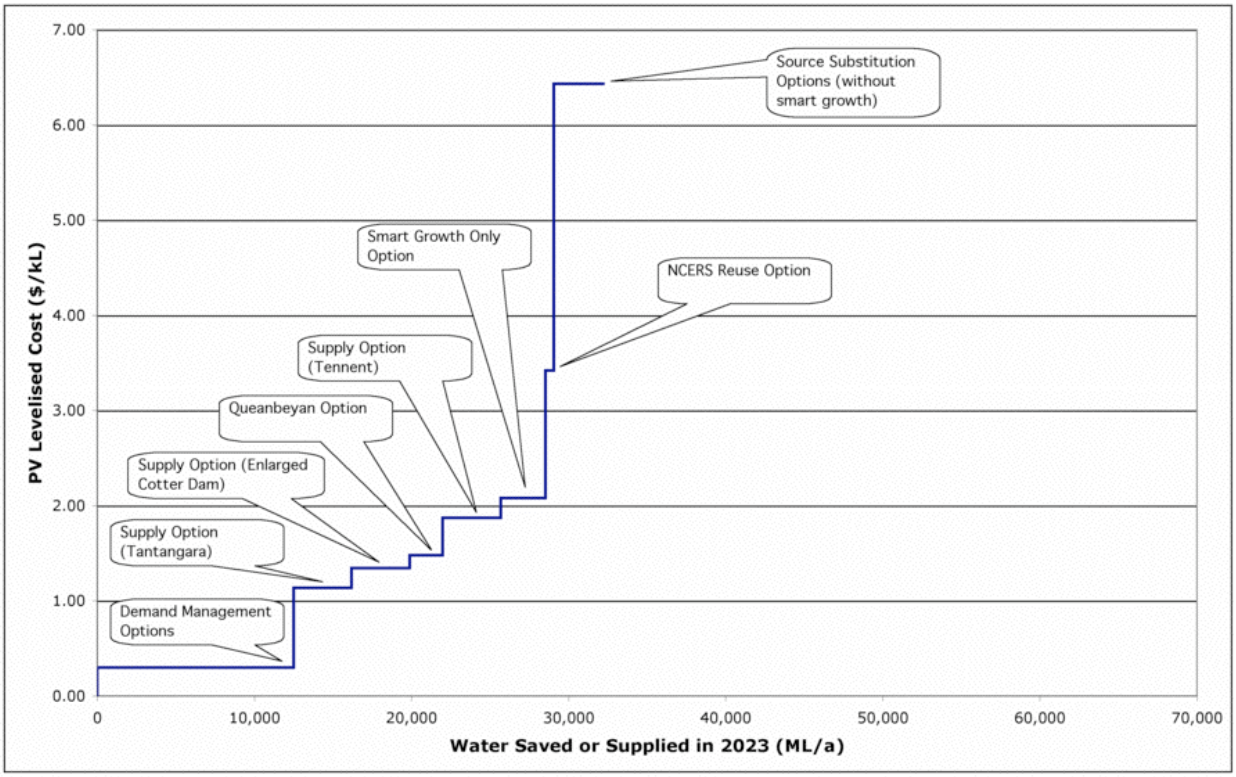


Figure 4-7 Simplified Supply Curve in 2053 (including Supply Options)

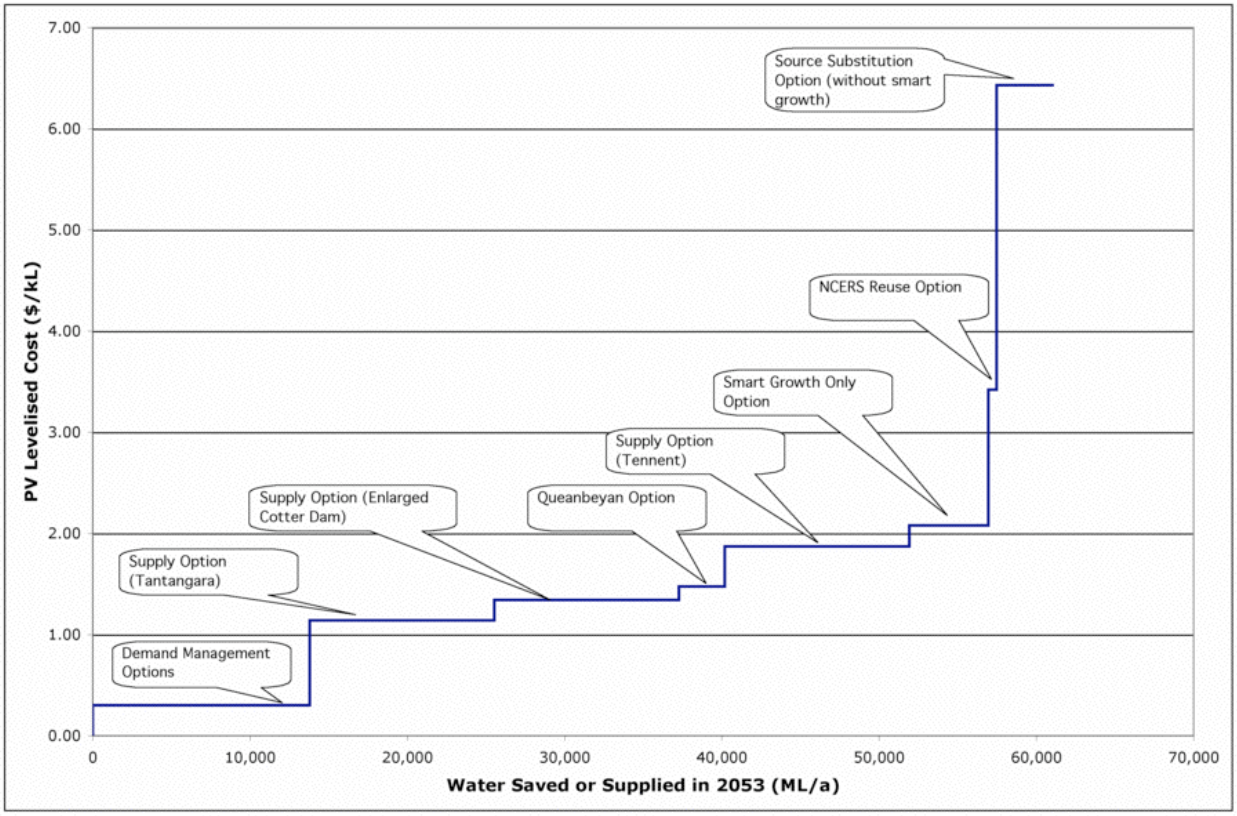


Figure 4-8 Simplified Supply Curve in 2023 (excluding Supply Options)

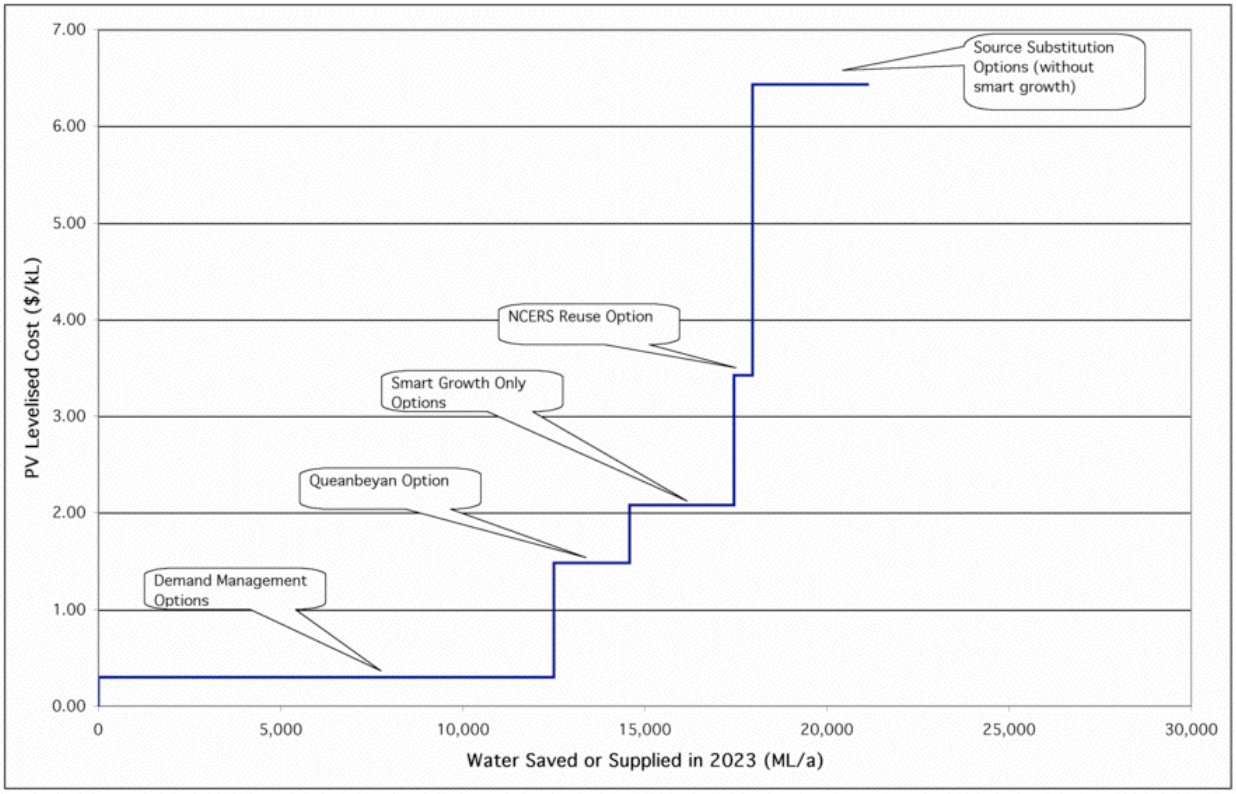
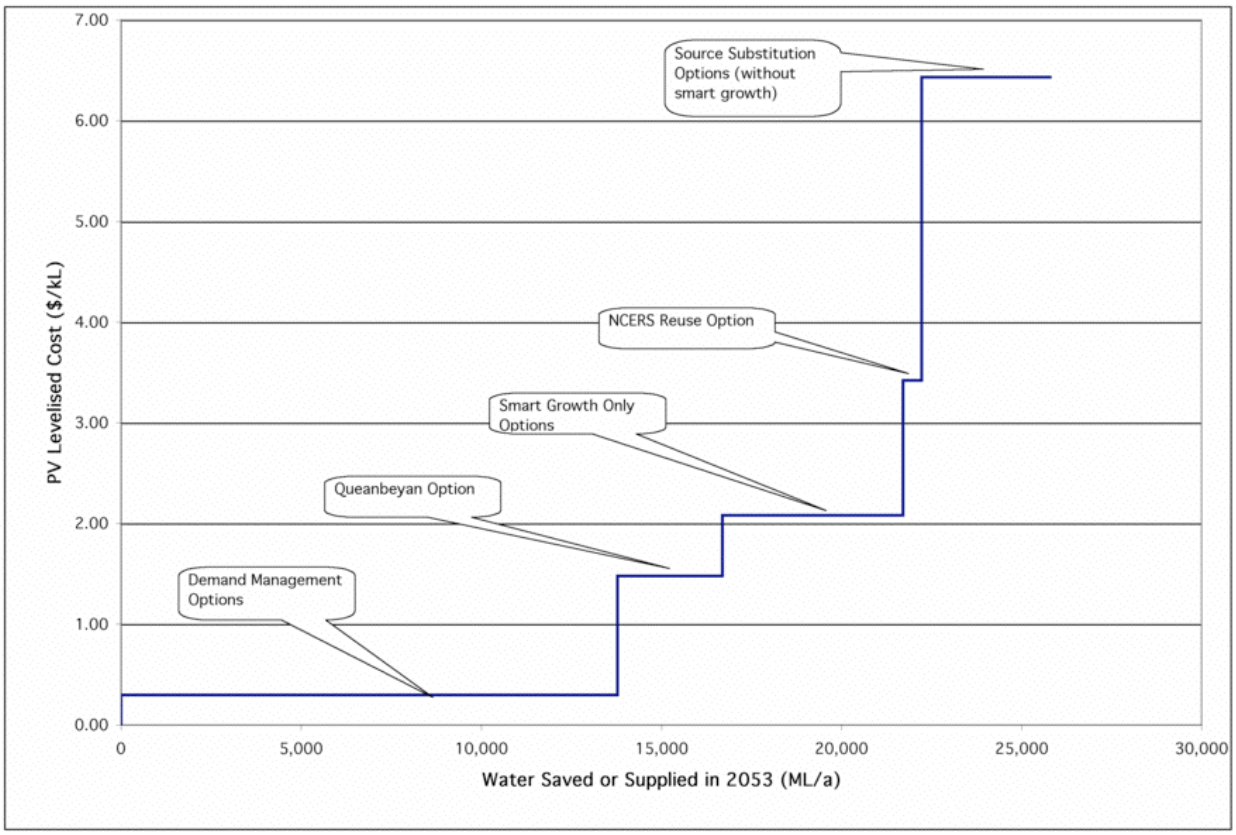


Figure 4-9 Simplified Supply Curve in 2053 (excluding Supply Options)



The supply curves and the levelised costs can assist water service providers to decide which options should be taken forward for implementation. The options currently being considered do not include benefits. Hence before a final decision is made on which options are taken forward each of the options should be considered in more detail and the net levelised costs (the cost minus the benefits) should be used to assess the lowest cost options. In addition those benefits that cannot be attributed a cost (e.g. externalities such as social equity, environmental benefits and community value) should also be considered and used with other defined criteria to determine the most economically, socially and environmentally appropriate solutions for the future.

4.4 Further investigation

A number of issues need further investigation/consideration as indicated below:

- The options identified including the supply options require more detailed analysis including investigation into benefits and externalities to assist in decision making. In addition investigation into the benefits of reducing water and energy demand to the local energy supplier ACTEW AGL should be investigated and incorporated into the options considered. In some cases options could be further developed (e.g. the residential audit/tune up) to include the provision of efficient light bulbs, other residential energy saving equipment or incentives and energy reduction education packs. This could also include combined billing systems which could be modified to provide a scoring and feedback system for householders that identifies water and energy/greenhouse gas reductions.

- The question of 'who pays' needs to be carefully considered as this may affect program participation and ultimate savings. In addition loan schemes and other funding methods need to be investigated.

- The reference case demand model developed as part of this Study, ACTEW yield model which allows for climate variations and LCP model developed as part of this Study to determine the present value costs and savings and levelised costs, as well as several other investigations into climate variability etc., need to be combined to assist in future option investigations. In addition the development of a climate correction model should be consider as a tool to assist in evaluation of programs implemented.

- To reduce costs associated with demand management and source substitution options, investigation of bulk buying of equipment (e.g. washing machines, 6/3 litre dual flush toilets and rainwater tanks) needs to be considered and decisions on whether to contract work out to plumbers and garden specialists etc. or set up in house auditing teams.

Recommendations

It is recommended that the potential strategy identified, including a 10 year plan which implements a suite of demand management options to achieve the 2013 target and allows time for further investigation of the reference case and options considered, is taken forward for further consideration.

It is also recommended that Canberra takes advantage of the opportunities available due to combined water and electricity service provision and extensive government ownership/management of properties to produce innovative sustainable solutions for service provision that can show case best practice sustainable design for the rest of Australia.

5 CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

Preliminary investigations indicate that demand management options alone can achieve the 2013 demand management target of a 12% reduction in per capita demand (based on 2003 levels) and are estimated to have a present value cost of $45.2 M and levelised cost of $0.30 /kL.

This effectively caps average demand at 70,000 ML/a in 2053, which is similar to the peak historic demands in 1991 and 1997. The suite of demand management options developed could potentially defer supply augmentation requirements for many years (reference case demand indicates augmentation required in 2017 when demand is greater than 70,000 ML/a). The actual number of years needs further investigation as other factors such as peak demand, drought security, the effects of climate change and catchment regeneration also need to be considered.

To achieve the 2023 target of a 25% reduction in demand a combination of source substitution, Queanbeyan and reuse options will also be required which have higher levelised costs than the suite of demand management options developed. These options include:

- Demand management – saving of 12,500 ML/a in 2023 at a present value cost of $45.2 M and levelised cost of $0.30 /kL.
- Source substitution – saving of 6,000 ML/a in 2023 at a present value cost of $308.5 M and levelised cost of $4.50 /kL.
- Smart growth (which is a lower cost subset of the suite of source substitution options) – saving of 2,800 ML/a in 2023 at a present value cost of $63.8 M and levelised cost of $2.08 /kL.
- Queanbeyan – saving of 2,100 ML/a in 2023 at a present value cost of $29.6 M and levelised cost of $1.48 /kL.
- NCERS reuse – saving of 500 ML/a in 2023 at a present value cost of $26 M and levelised cost of $3.42 /kL.

For comparison the supply options considered are identified below:

- New Cotter Dam – supply of 3,700 ML/a in 2023 at present value cost of $55.6 M and levelised cost of $1.34 /kL.
- Tennent - supply of 3,700 ML/a in 2023 at present value cost of $77.4 M and levelised cost of $1.87 /kL.
- Tantangara - supply of 3,700 ML/a in 2023 at present value cost of $47 M and levelised cost of $1.14 /kL.

It should be noted that in 2023 each of the supply resources would be under utilised even though the capital costs of $100 M, $140 M and $80 M would be incurred before 2018 when such supplies would be expected to be operational. By 2053 each option could supply 11,750 ML/a and would be able to provide even higher volumes after 2053.

None of the options developed take into consideration benefits associated with reduced system and property energy demand, reduced green house gas emissions, contribution to the reuse and stormwater targets, deferring specific geographical system constraints or deferring supply options. The present value costs of demand management, source substitution, Queanbeyan and reuse options can be

significantly reduced by incorporating these benefits. In addition when externalities associated with environmental and social benefits are also considered and the issues associated with the risk of investing in large water supply schemes that are not utilised for many years, these options become even more economically, socially and environmentally attractive.

The complex issue of 'who pays' have not been investigated in this Study. The costs currently assume that the government pays for the whole cost of each option as would be assumed if a supply side option (a dam) was being constructed. This allows high levels of participation in the programs to be assumed to gain maximum savings. It should be noted that the less government contributes to each option the lower the participation rate and ultimate savings are likely to be, unless innovative loan systems can be offered which allow customers to contribute to the cost of the programs with the benefits they accrue.

5.2 Recommendations

At the end of each Section within this report data limitations and recommendations for further investigation have been provided to assist in identifying necessary next steps following this preliminary assessment. Key recommendations are as follows:

- It is recommended that further data gathering and analysis is undertaken to assist in improving the accuracy of the reference case demand. For example more detailed historical disaggregation of customer metered demand, bulk water demand and seasonal demand, Canberra and Queanbeyan demographics, Queanbeyan disaggregated water demand and unaccounted for water. In particular it is recommended that investigation into end use analysis specifically for the Canberra area is undertaken and the development of an end use model.

- It is recommended that further investigation is undertaken into implementation, how specific customers could potentially reduce potable demand and how low cost options such as pricing and MWEPs can be utilised to reduce demand. In addition several options developed as part of this preliminary investigation should be refined in terms of potential savings/supply.

- It is recommended that the potential strategy identified, including a 10 year plan which implements a suite of demand management options to achieve the 2013 target and allows time for further investigation of the reference case and options considered, is taken forward for further consideration.

- It is also recommended that Canberra takes advantage of the opportunities available due to combined water and electricity service provision and extensive government ownership/ management of properties to produce innovative sustainable solutions for service provision that can show case best practice sustainable design for the rest of Australia.

6 REFERENCES

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APPENDICES

APPENDIX A – ADDITIONAL DEMOGRAPHIC DATA

APPENDIX B – EXAMPLES OF NON RESIDENTIAL SMART GROWTH

APPENDIX A - ADDITIONAL DEMOGRAPHIC DATA

Figure A-1 Canberra Population

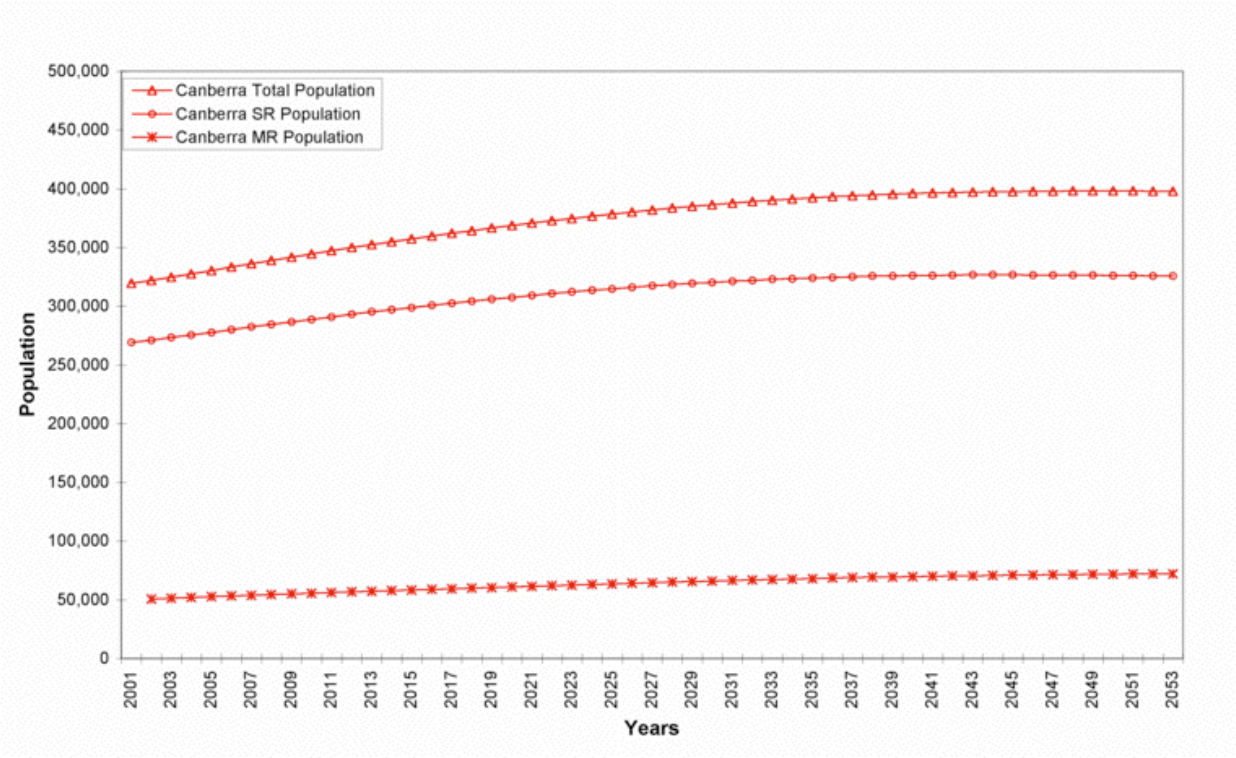


Figure A-2 Canberra Housing Stock

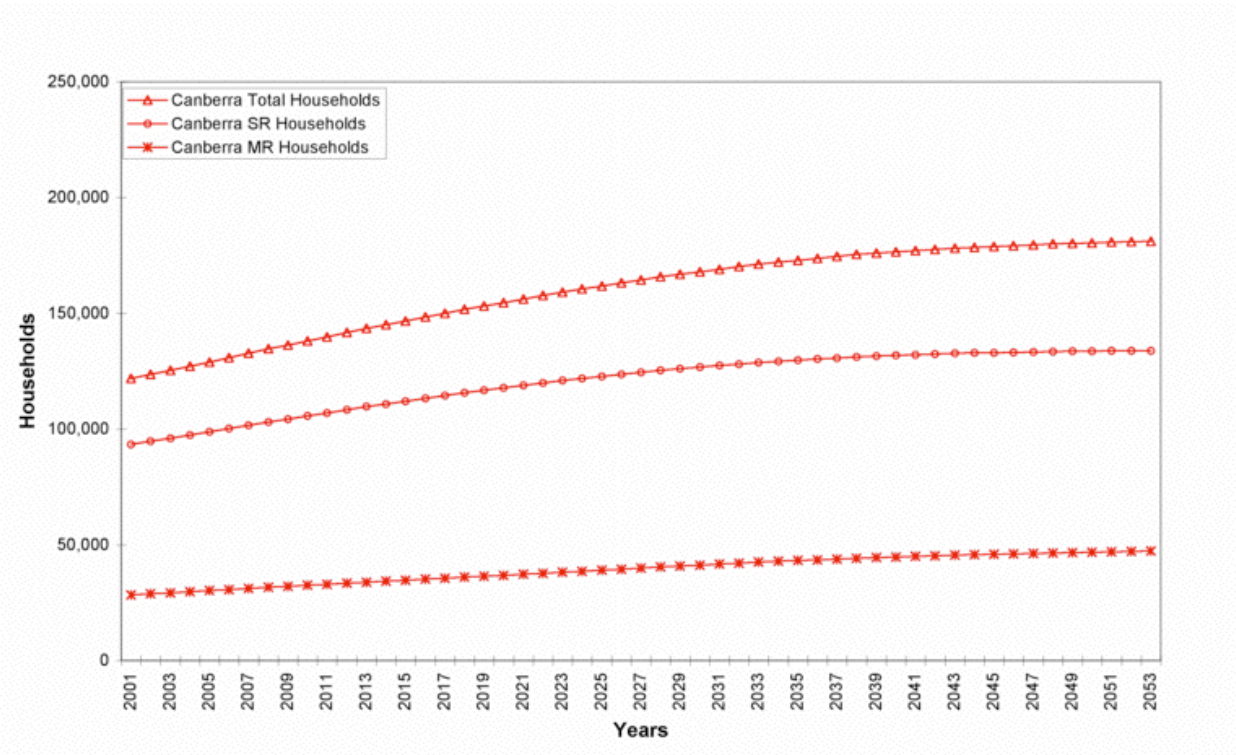


Figure A-3 Queanbeyan Population

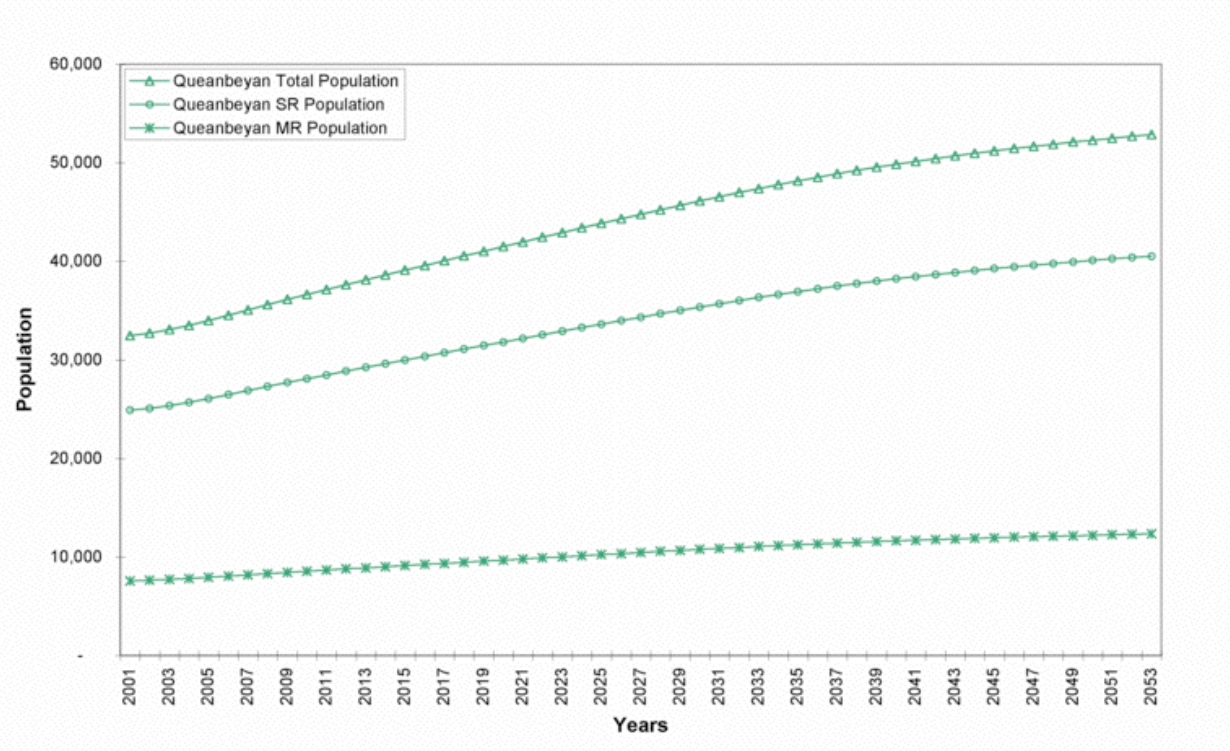


Figure A-4 Queanbeyan Housing Stock

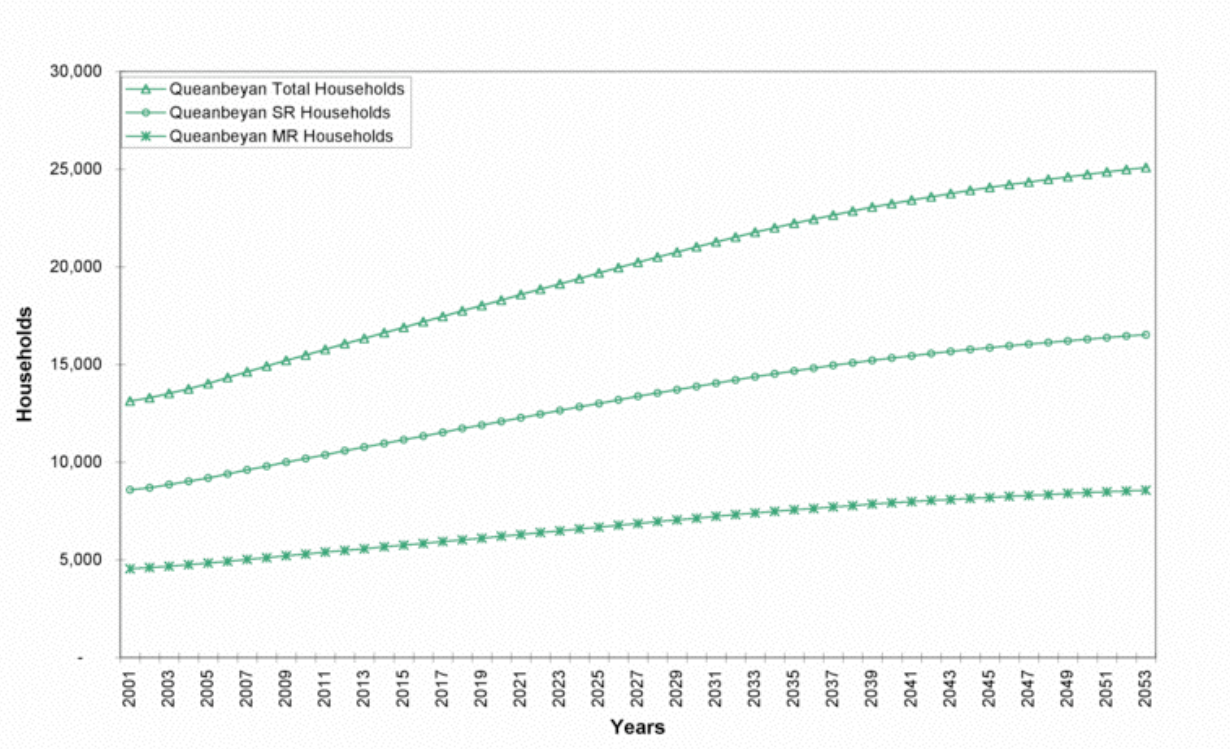


Figure A-5 Canberra Occupancy Ratios

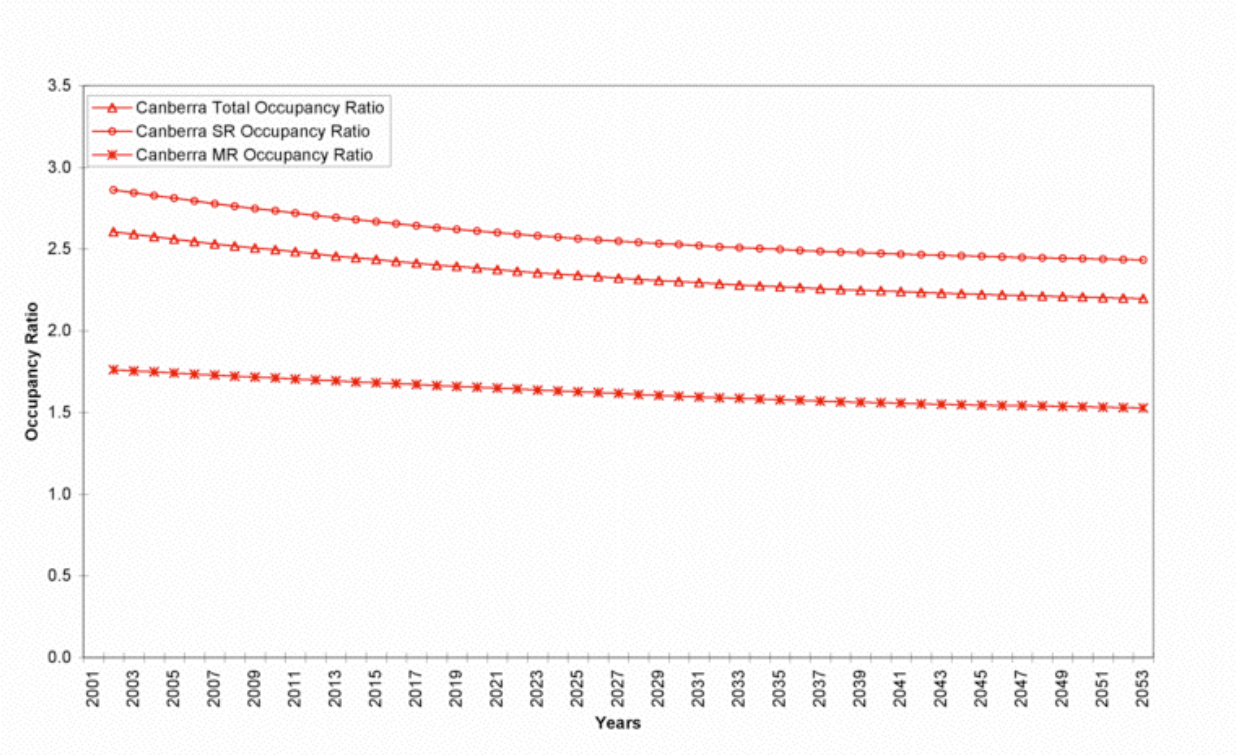
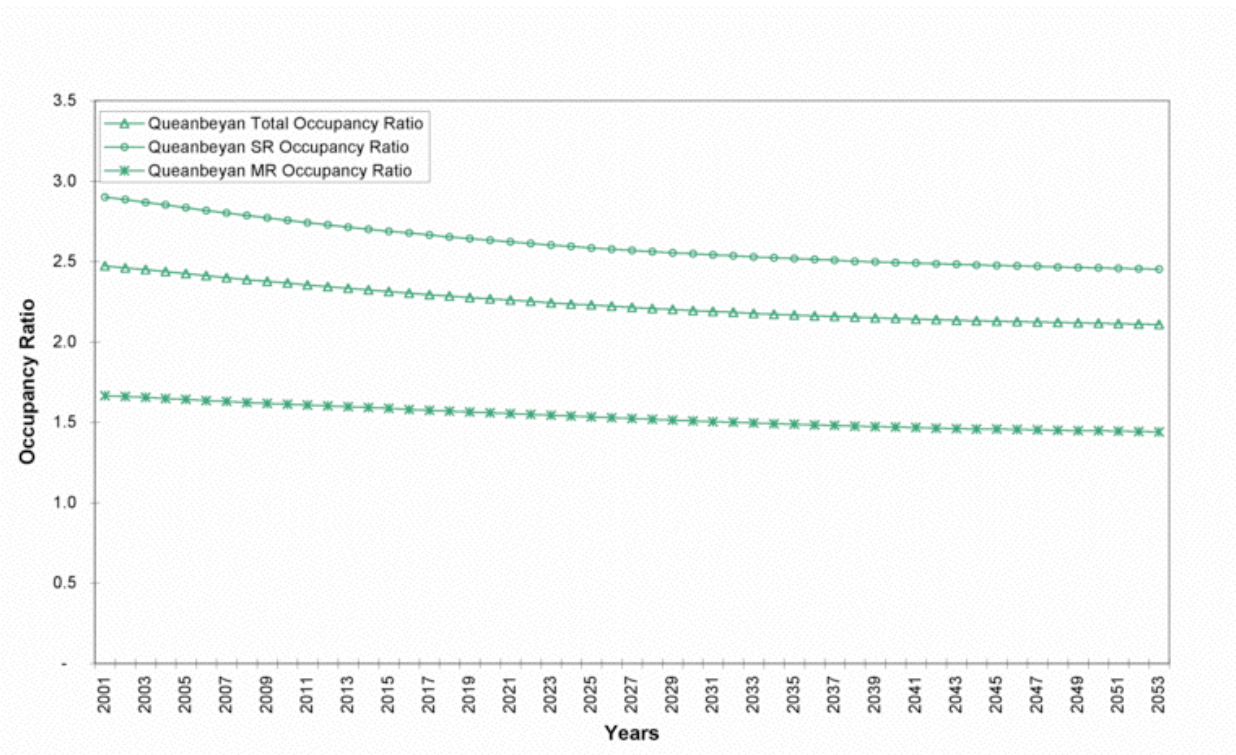


Figure A-6 Queanbeyan Occupancy Ratios



APPENDIX B – EXAMPLES OF NON RESIDENTIAL SMART GROWTH

Example – Sustainable Management in Commercial Office Buildings

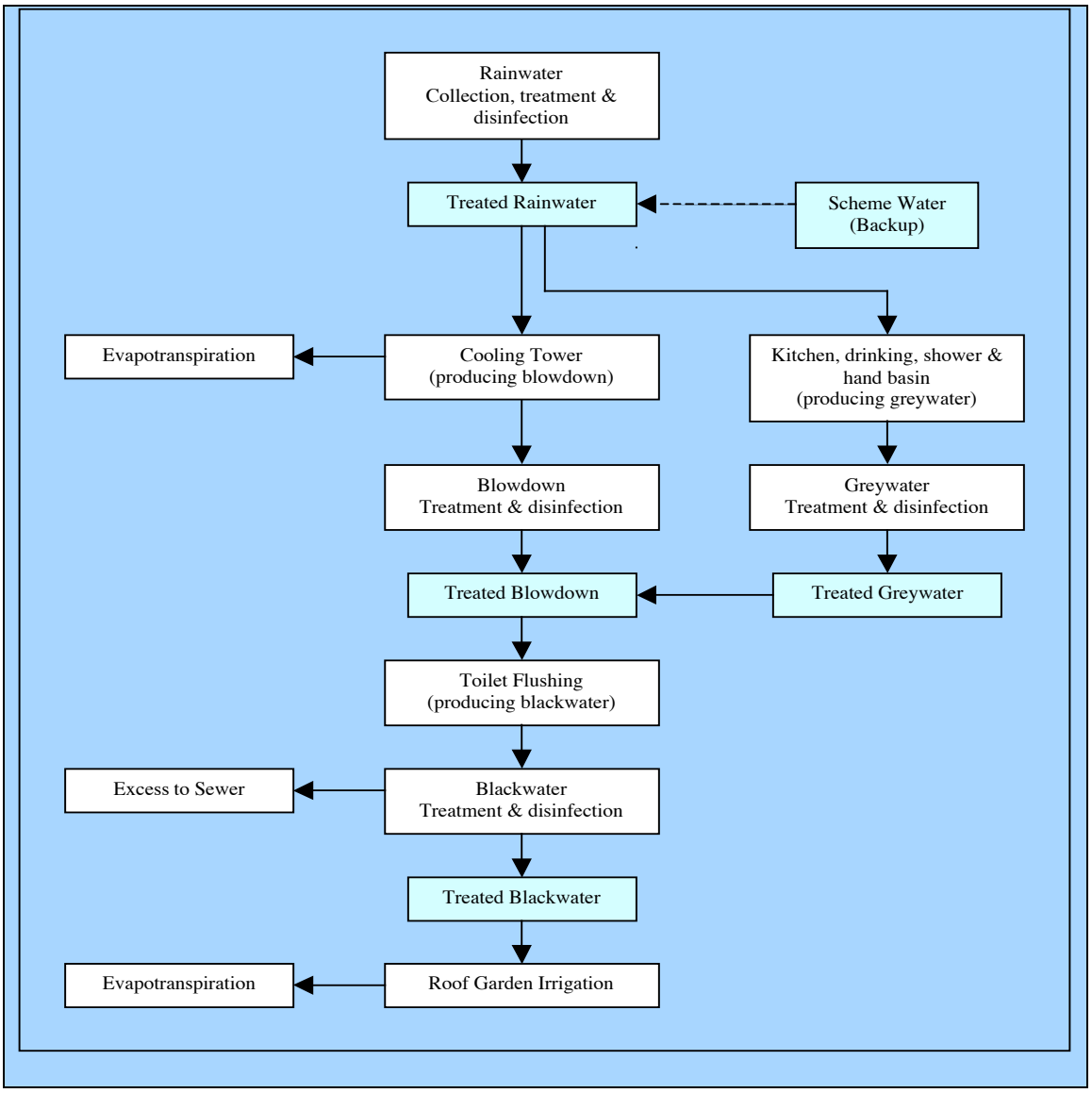
There is considerable potential to use the principles of water quality cascade & source substitution in commercial buildings to reduce their dependence on existing water, wastewater and stormwater services. Recent studies have identified that the commercial sector typically comprises of 10 – 20% of total water demand in an urban setting & that reductions of approximately 80% of scheme water demand & 90% of sewage discharge can be achieved through sustainable water management on a site specific scale compared to a conventional building. These reductions can be achieved through innovative water efficiency measures, rainfall capture & use, treated effluent reuse & the use of roof gardens for evapotranspiration (Chanan et al 2003).

Water efficient measures can include: 5/2 L or lower toilets; waterless urinals; flow regulated taps and/or infra-red tap controllers; AAA rated shower heads; well managed cooling towers or alternative systems (passive design & use of improved energy efficiency in building to reduce ambient temperatures, in-ground heat source pumps & use of decentralised systems depending on the scale of building). Cooling towers are often responsible for approximately 40% of water demand in a commercial building. Hence by finding an alternative cooling system or by using rainwater as an alternative source of water, considerable savings can be made.

Other measures used in commercial buildings being studied include: capture of rainfall for cooling towers & indoor potable water uses such as drinking, showering & hand basins; treatment of greywater & reuse for toilet flushing; treatment of blackwater & discharge to roof gardens for irrigation/evapotranspiration; & if necessary discharge of surplus effluent to sewer depending on the water balance. Potable water is often used as a back up supply or for fireflow regulations.

A number of buildings are currently operating or are being designed using these concepts to varying degrees including: the Millennium Dome in London, Olympic Park at Homebush Bay, the Water Garden in Santa Monica, 60 L Green Building in Melbourne & the planned Sydney Headquarters Building in Parramatta. The level of dependence on existing systems is dependent on a number of factors including: local regulations, designers knowledge of the water cycle & the water balance of the building with respect to surface areas & occupants being served.

A typical flow diagram highlighting the end uses and cascade effects that could be applied to a typical commercial building are identified in the following diagram.



(Source – Turner et al, 2003b)