Occasional Paper No. 25

July 2010

Implications of population growth in Australia on urban water resources

WATER SERVICES ASSOCIATION OF AUSTRALIA

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Overview of WSAA

The Water Services Association of Australia (WSAA) is the peak body of the Australian urban water industry.

The Association's 34 members and 26 associate members provide water and sewerage services to approximately 16 million Australians and to many of our largest industrial and commercial enterprises.

WSAA was formed in 1995 to provide a forum for debate on issues important to the urban water industry and to be a focal point for communicating the industry's views.

WSAA encourages the exchange of information and cooperation between its members so that the industry has a culture of continuous improvement and is always receptive to new ideas.

The functions of WSAA are:

- be the voice of the urban industry at the national and international level and represent the industry in the development of national water policy,
- facilitate the exchange of information and communication within the industry,
- undertake research of national importance to the Australian urban water industry and coordinate
- coordinate key national research for the industry,
- develop benchmarking and improvement activities to facilitate the development and improved productivity of the industry,
- develop national codes of practice for water and sewerage systems,
- assess new products relating to water, sewerage and trade waste systems on behalf of the water industry,
- jointly oversee the Smart Approved Watermark Scheme for products and services involved in conserving water use
- coordinate annual metric benchmarking of the industry and publish the National Performance Report with the Federal and State Governments.

Appreciation

I am grateful to the WSAA Members who have contributed to this paper.

I also appreciate the analysis of population data by Dr Bob Birrell, Director of the Centre for Population and Urban Research, Monash University.

Ross Young
Executive Director, WSAA

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Abbreviations

GL represents gigalitres.	One GL equals one billion litres.
ML represents megalitres.	One ML equals one million litres.
kL represents kilolitres.	One kL equals one thousand litres.

Data sources

Data sources in this paper where not specifically indicated have been obtained from WSAA Members and the Australian Bureau of Statistics.

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ISBN 1 920760 48 2

Foreword

Australia's major urban water utilities through the Water Services Association of Australia (WSAA) have prepared this report to better inform the community of the challenges we face to deliver sufficient urban water supplies to support an expanding population.

Water in an arid continent like Australia must be managed more effectively if we want to sustain higher levels of population – predicted to potentially be an extra 21.5 million people within the next 50 years.

Significant population growth will take place against a backdrop of climate change which is predicted to reduce the volume of water available from our dams.

One of the key findings of this report is that Australia's major urban centres will experience a significant increase in demand even on the most conservative estimates of population growth.

By 2026, on current population trends, it is predicted that major urban centres will have an additional demand of over 600 billion litres annually and by 2056 of over 1000 billion litres. However, with the recent investment in desalination and recycled water, the additional demand can, in theory, be met up to 2026 assuming rainfall does not continue to deteriorate.

With less water in our dams this additional demand will need to be met by new sources of water or we risk our cities being subject to high level water restrictions for extended periods. Going forward these new sources of water will comprise a combination of sources including recycled water, both for drinking and non-drinking purposes, desalinated water, groundwater, stormwater and rural to urban trading.

It is imperative that there are no policy blocks in place that would preclude a source of water being considered for inclusion in a diverse portfolio of water supply options.

Water conservation programs will continue to be at the core of water resource strategies for our urban areas to further improve water efficiency.

Australia in the last ten years has faced extended periods of drought and low levels of rainfall over our catchments. The drying climate presented a challenge to governments and the community to become wiser about how we use and source our water.

In all cases we have risen to these challenges, building new water sources and reducing our use of water to historically low levels. This demonstrates that when faced with challenges to our water security we have been able to innovate and use the latest technologies to overcome these challenges.

There is little doubt that our cities in 2056 will have a different water paradigm than exists today. It is imperative that all the stakeholders involved in planning our cities work together in an interdisciplinary manner to ensure cities of the future are more water sensitive, liveable, sustainable and optimise the use of all available water sources.

Indeed the lesson of the last few years is that Australia can confidently and sustainably meet our water needs even with the most ambitious population increases – we just need to start planning for it now.

Ross Young
Executive Director, WSAA

Executive summary

This Occasional Paper analyses the potential impacts on water resources resulting from future population projections in Australia's major capital cities – namely Sydney, Melbourne, Perth, Adelaide, Canberra and Brisbane (South East Queensland).

The two key drivers that influence demand for water in our cities and towns are population growth and climate change.

Although Australia has an outstanding track record in reducing per capita urban water consumption, new sources of water will be required to meet future demands.

The population projections in this paper are prepared by the Australian Bureau of Statistics (ABS). The ABS provide population projections out to 2056 using three series of data – Series A (high), Series B (medium) and Series C (low).

Using 2007 as a baseline the ABS predict that by 2056 using Series A Australia's population will be 45.5 million (a 102 percent increase), Series B projection is 35.5 million (a 69 percent increase) and Series C projection is 31 million (a 47 percent increase). Following expert advice, WSAA believes that Series B or Series C are the most plausible outcomes but Series A analysis has been included to demonstrate the impacts of an aggressive increase in population growth on urban water resources.

To calculate the impact of population growth on urban water resources it is necessary to multiply the projected population growth by the projected per capita consumption plus incorporate projected commercial and industrial demand to ascertain the total demand on urban water resources out to 2056. Water consumption habits are influenced by a range of factors which are notoriously difficult to predict in the short term let alone over the long term to 2056.

Apart from population growth the main factors that influence water consumption in our cities and towns are climate change, housing type and density, uptake of water efficient appliances, water restrictions, water saving rules, cost of water, economic growth, demographics and the design of our growing cities.

Despite the difficulty in predicting future water consumption trends over the longer term, experts in the urban water industry have used best efforts to determine per capita consumption from a base of 2009 to 2026 and then from 2026 to 2056. Due to the relaxation of harsh ongoing water restrictions, per capita consumption is predicted to rise in some of the capital cities until 2026 although overall, per capita consumption is expected to fall but by a modest amount by 2056.

The analysis shows that from 2009 to 2026, total urban water consumed is projected to increase by 49% (Series A), 42% (Series B) and 39% (Series C). The projected gap between the volume of water supplied in 2008/09 and the increased volume of water consumed is 735GL (Series A), 631GL (Series B) and 581GL (Series C). Desalination will be able to supply a significant proportion of the additional water required up to 2026.

Not surprisingly the analysis out to 2056 shows a much larger water demand.

Series A, which is considered the most aggressive and least plausible of the ABS population projections, results in additional demand of 1612GL in 2056, which is more than double the volume of water consumed by the major capital cities in 2008–09.

Series B, which is considered the most plausible population projection, results in additional demand of 1147GL in 2056, which represents a 76 percent increase in the water consumed in the major capital cities in 2008–09.

Series C, results in the lowest additional demand of 961GL in 2056, which still represents a 64 percent increase in the volume of water consumed by the major capital cities compared to 2008–09.

The reality is that new water sources will be developed but the precise mix of water supply options will be difficult to predict given the long period of time involved and the potential for technological advances to take place which will enable us to do things with water that are not possible today.

It is expected that the development of a diverse portfolio of water supply options including recycled water for non-drinking and drinking purposes, desalination, rural to urban water trading, rainwater tanks, groundwater, stormwater and dams will be required to mitigate the risks associated with population growth and climate change. There should not be any blocks to the different sources of supply. Each case should be examined on its merits.

Long term water resource plans which are reviewed on a regular basis will be the mechanism whereby Australian cities will continue to enjoy safe and reliable sources of water. Water efficiency programs will continue to be the backbone of urban water resource plans.

As we have shown in this paper, the gap between supply and demand will be large if new water sources are not developed for urban Australia. However, the urban water industry has demonstrated over the past ten years its ability to adapt to climate change and to implement significant capital intensive projects to develop new sources of water. The industry is well positioned to accommodate higher population growth through the development of a diverse portfolio of water supply sources and sophisticated water efficiency strategies.

The industry is taking a proactive role in shaping our cities of the future by ensuring climate and water resilience is incorporated into city planning at the outset. In this way we will, through collaboration with key stakeholders, be able to ensure our cities of the future are green, water sensitive and sustainable.

The task of supplying potentially 21.5 million additional people with reliable and safe water supplies by 2056 will not be easy, but it will be done provided all stakeholders work together.

Ross Young
Executive Director, WSAA

Introduction

Australia is one of the most urbanised countries in the world. Therefore, the provision of safe and reliable water supplies to urban Australia going forward is of upmost importance if we are going to enjoy ongoing prosperity and maintain our enviable quality of life.

The two dominant factors determining the sustainability and reliability of water supplies for urban Australia are population growth and the impacts of a drying climate.

Significant population increases are forecast for Australia over the next 45 years. By 2056 it is expected that Australia's population could grow by 21,495,000 people (Series A – ABS Population Projections), which represents a 102 percent increase from 2007. Population growth of this magnitude will have impacts across Australia; however, as the Australian population hugs the coast, the ramifications will be most pronounced in coastal zones.

There is no doubt that there will be significant implications for the urban water industry as most people will live in capital cities and major regional and urban centres across Australia.

Many Australians are concerned about the future of urban water systems given the rapidly changing rainfall patterns resulting from climate change. Australia has always experienced the most variable and fickle rainfall patterns of all continents but this notorious variability is expected to increase into the future and will be associated with an increased frequency of extreme weather events at both ends of the spectrum. Also, a drying climate reduces surface runoff into dams, which are our major source of water. Although by 2012 all mainland coastal capital cities (with the exception of Darwin) will have a desalination plant (Perth will have two), dams will remain the dominant source of water for our cities into the foreseeable future.

In many respects population growth combined with climate change represents a 'perfect storm' for the urban water industry. Despite this, our cities will not run out of water. The last decade has demonstrated how quickly the urban water industry has been able to adapt to a drying climate by implementing a range of measures on both the supply side and the demand side of the water resources equation.

The challenges are not insurmountable as significant efficiencies in water use will continue to be made in urban Australia.

It is often forgotten that urban water use is less than 25 percent* of the total water consumed in Australia and rural and urban water systems are increasingly becoming interconnected allowing water markets to be established.

This paper explores the implications for urban water resources of population growth over the next 40 years, focusing on three ABS Population Projections. It also discusses how the urban water industry might address the dual challenges presented by climate change and significant population growth.

*ABS, 2006, Water Account Australia 2004-05 (cat. no. 4610.0)

Trends in water consumption

Recent trends in residential water consumption[1]

The extent to which water efficiency in urban areas has been embraced is one of the great social revolutions to occur in Australian society over the last 10 to 20 years. Capital city residential water consumption continues to be very low compared with historical levels.

The following analysis of the volume of residential water supplied and per capita consumption demonstrates significant water savings despite strong population growth.

Table 1 - Volume of residential water supplied (GL)

	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Canberra	40	31	31	34	32	26	27
Sydney	388	346	330	321	317	293	321
Brisbane	95	97	102	72	61	52	55
Adelaide	124	112	109	110	112	93	93
Melbourne	242	268	264	273	249	228	223
Perth	144	161	159	158	169	165	174
Total	**1,081**	**1,016**	**995**	**968**	**939**	**857**	**893**

The following key points can be deduced from Table 1:

- The total volume of residential water supplied has decreased by 12 percent from 2003–04 to 2008–09. Over this period the population increased by 7.7 percent.
- The volume of residential water supplied has increased by 4 percent from 857 GL in 2007–08 to 893 GL in 2008–09, reflecting the relaxation of water restrictions in a number of capital cities which had reduced water consumption to unsustainably low levels.

If water consumption had remained at 2002–03 levels, an additional 224 GL would have been consumed in 2007–08 year compared to what was actually consumed. To put this volume in perspective, 224 GL is similar to the water consumed by all households in Melbourne in 2008–09.

[1] Hobart and Darwin have been excluded from the capital city water consumption comparisons due to a lack of data. South East Queensland data is used for future projections rather than Brisbane data as South East Queensland is now linked with a water grid and can be considered as a single planning entity.

Table 2 - Residential water supplied per capita (kL)

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Canberra	97	94	104	95	76	79
Sydney	83	78	75	74	68	74
Brisbane	102	104	73	60	51	53
Adelaide	105	101	101	102	84	83
Melbourne	77	74	75	68	60	57
Perth	111	107	105	110	104	106

The following key points can be deduced from Table 2:

- Of the major capital cities, Perth has clearly the highest residential water supplied per capita which reflects its very hot summers, less stringent water restrictions relative to other cities, and sandy soils.
- Brisbane has achieved almost 50 percent savings per capita since 2003–04 due to severe water restrictions but it is expected that per capita consumption will increase as restrictions are removed and consumption levels increase to more sustainable levels.

Recent trends in industrial and commercial water consumption

Even though the commercial and industrial sector only consumes 20 to 30 percent of the urban water supplied to our cities and towns, this sector generates enormous gross domestic product for the Australian economy and represents a high value use of water.

The urban water industry has worked in partnership with the commercial and industrial sector to implement business efficiency programs to enable the sector to become more water efficient. Despite buoyant economic activity, the volume of industrial and commercial water supplied decreased by 2 percent from 368 GL in 2003–04 to 357 GL in 2008–09 (excluding South East Queensland). Industrial and commercial water supplied decreased by nearly 3 percent from 2007–08 to 2008–09.

Many industrial and commercial businesses have in recent years implemented water efficiency programs in response to water scarcity. The measures adopted have included water efficiency audits, water efficient appliances and equipment, behavioural change programs, rainwater tanks, internal recycling water projects, leak detection and installation of additional water meters (refer to '*WSAA Occasional Paper No. 23 Meeting Australia's water challenges - Case studies in commercial and industrial water savings*' for examples of investment that has occurred in this sector to improve water efficiency)

Total urban water supplied

The following table outlines the total volume of water supplied to households, the commercial and industrial sectors and all other water using sectors, such as local government, in Australia's major capital cities.

Table 3 - Total urban water supplied (GL)

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Canberra	49	48	52	48	41	42
Sydney	563	526	528	510	482	492
South East Queensland*					215	223
Adelaide	166	166	151	156	139	138
Melbourne	433	431	438	402	370	360
Perth	228	225	231	240	240	250
Total					**1,486**	**1,505**

*Note total urban water supplied data is not available for South East Queensland for the period 2003-04 to 2006-07.

Population projections

Rapid population growth is the major driver underlying projected increases in total urban water consumption within Australia's major capital cities. It is, therefore, critical that the most appropriate population projections are considered.

Population projections used here have been taken from the latest ABS projections published in September 2008, which include:

- **Series A** (high growth assumptions relating to fertility, life expectancy at birth, net overseas migration and net interstate migration)
- **Series B** (current trends in these variables)
- **Series C** (low growth assumptions in these variables) have been used to project urban water supplied.

Using all three series of population projections provides the widest range of potential impacts on urban water supplies.

The Water Services Association of Australia (WSAA) engaged Dr Bob Birrell from Monash University to provide the following advice relating to Australian population projections (see Appendix 1 for more extended analysis and commentary).

"The selection of appropriate population projections is difficult for two reasons. One is that the major components, net overseas migration and fertility have varied sharply in Australia's recent history. The second is that the Commonwealth and State governments which prepare population projections invariably assume that recent trends in migration and fertility will continue throughout the projection period. They are not equipped or empowered to ask questions about whether the numbers resulting are realistic in the light of the long term economic, political or environmental outlook.

"**Series A** which has Australia reaching 39 million by 2050, and the Intergenerational Report projection which has the population reaching 35 to 36 million, are the two least plausible projections. ABS Series A, which assumes 220,000 migrants per year, is highly unlikely to be sustained.

"**Series B** is more plausible and can be regarded as representing the high end of the projection spectrum. It is considered to be at the high end because of its net migration assumption. Though reflecting the recent upsurge, its net migration assumption of 180,000 per year is still very high by comparison with every year over the past three decades.

"**Series C** is also plausible and can be regarded as a reasonable indicator of the lower end of the projection spectrum. Even though low by the standards of recent years, the 140,000 per annum net migration assumption is a reasonable one.

"In the case of the three Intergenerational Reports (IGR) prepared by the Federal Treasury, which were published in 2003, 2007 and 2010, the demographic assumptions have altered to reflect the demographic policy setting prevailing at the time the projections were prepared. As a consequence the projections have changed radically over just seven years. The annual net overseas migration assumption was 90,000 per year for the 2003 projection, 110,000 for the 2007 projection and 180,000 for the 2010 projection. The fertility assumption has also increased since 2003, from 1.6 [2] in 2003 to 1.7 in 2007 and 1.9 in 2010. The population outcome for the base case in each of these sets of projections by 2042 was 25.3 million for IRG 2003, 27.8 million for IGR 2007 and 33.2 million for IRG 2010. In the case of IRG 2010, Australia's population is projected to reach 35.9 million by 2050."

Based on this analysis by Dr Birrell, **WSAA has chosen Series B and Series C as the most likely population projections.** Series A data is used and discussed throughout this paper as a means of showing how a more aggressive population increase would further impact on urban water resources.

[2]The fertility figure used is the Total Fertility Rate (TFR). This is defined as the total number of births a woman would have over her child-bearing life if she repeated the propensity of women to give birth at each age in a particular year. It is a useful measure because it is not influenced by the age distribution of women. However it may be misleading as an indicator of long term fertility, that is the number of children a women has actually had over her child bearing life, because of variations in timing of births by age group. The TFR was low in Australia through the 1990s because during this decade many women in the twenties postponed having children. The recent increase in fertility to 1.9 is largely attributable to a 'catch-up' on the part of women who had earlier postponed having children.

Table 4: ABS population projections (000's)

	Observed 2007	Series A 2026	Series B 2026	Series C 2026	Series A 2056	Series B 2056	Series C 2056
Sydney *	4 282.0	5 487.2	5 426.3	5 358.2	7 649.0	6 976.8	6 565.2
Melbourne	3 743.0	5 272.3	5 038.1	4 861.7	7 970.7	6 789.2	6 100.9
Brisbane *	1 819.8	2 908.0	2 681.1	2 465.6	4 955.1	3 979.3	3 237.0
Adelaide	1 145.8	1 410.8	1 384.5	1 391.8	1 848.5	1 651.8	1 623.7
Perth	1 518.7	2 455.2	2 267.6	2 112.1	4 164.4	3 358.4	2 815.5
Australian Capital Territory	334.1	462.5	416.5	373	683.2	509.3	374.2
Hobart	207.4	266.8	245.3	228.2	367.2	279.7	224
Darwin	117.4	189.3	165.2	142.4	334.9	243	169.2
Total capital cities	13 373.4	18 452	17 624.7	16 933	27 973	23 787.5	21 109.6
Australia	**21 015**	**28 723**	**27 236.7**	**25 971.9**	**42 510.4**	**35 470**	**30 906.1**

3222.0 - Population Projections, Australia, 2006 to 2101

*Note: ABS Brisbane population projections have not been used to develop total urban water supplied projections. High and medium population projections for Brisbane have been sourced from the Planning Information and Forecasting Unit (PIFU), Department of Infrastructure and Planning SEQ forecasts from 2006 to 2051; Queensland's future population 2008 edition.

* Note: ABS population data is not the data for the Sydney Water area of operations, but accounts for the Sydney ABS statistical region.

***South East Queensland Population forecasts (000's)**

	Observed 2008	High Series 2026	Medium Series 2026	High Series 2056	Medium Series 2056
South East Queensland	**3,043**	**4,609**	**4,204**	**7,015**	**5,696**

Source: Planning Information and Forecasting Unit (PIFU), Department of Infrastructure and Planning SEQ forecasts from 2006 to 2051; Queensland's future population 2008 edition.

Water consumption projections

Assumptions used for projecting water consumption in the future

The water efficiency programs implemented by water utilities and governments have been very successful in reducing per capita water consumption over the last 10 to 15 years.

Although there are still many opportunities to further improve the efficiency in which water is used in our cities and towns, one must be cautious in thinking that the significant achievements of the past can be repeated in the future. In many respects the water efficiency ‘low hanging fruit’ has been harvested and future water efficiency measures are likely to be more expensive and intrusive on customers.

A major step change in improving water efficiency is only likely to occur through a significant technological development. Despite this, water utilities and governments will continue with programs to improve water efficiency.

The following consumption drivers are common to all capital cities and have been used to assist the projection of urban water consumption in the future:

Population growth

Rapid population growth is the major factor underlying projected increases in residential water supplied (see earlier commentary on population projections).

Climate change

An increase in water use is expected as the temperature impacts of climate change take effect beyond 2030, particularly the increase in the number of days above 30 degrees Celsius which might increase the amount of water required to keep gardens and parks alive; evaporative air conditioner use might also increase in response to higher temperatures.

The design of cities of the future

The planning for the future expansion of our cities is often dominated by transport infrastructure needs with the assumption that water related infrastructure can always be easily installed. This is true to a certain extent but unless water planning is undertaken at the outset along with all the other infrastructure needs, many opportunities to introduce water sensitive features into our cities will be lost.

Concepts such as using urban areas as rainwater catchments, wetlands to purify stormwater runoff, allowing stormwater to percolate into the groundwater and reducing peak flows in waterways are difficult to achieve unless they are designed into the urban form and structure at the greenfields stage. Retrofitting after development occurs is generally a more expensive option.

It is essential that the urban water industry collaborate with all the stakeholders involved in planning for the growth of our cities to ensure that water sensitive related requirements are designed in at the outset. By doing this we will be better able to reduce our reliance on traditional water sources, build resilience into systems to cope with future climate and population shocks and more importantly create greener, more attractive and liveable cities.

Housing type and density

The types of houses built in the future can influence water consumption, in particular the extent to which there are outdoor areas that require watering. In some capital cities in Australia outdoor water consumption represents nearly 50 percent of total household consumption. A denser city is likely to use less water for outdoor purposes.

Installation of water efficient appliances

The increasing efficiency of appliances (partially driven by legislation) and the increasing uptake of these appliances will reduce water consumption. The Water Efficiency Labelling Standards Scheme (WELS), administered by the Commonwealth Government, has been highly successful in directing consumers to purchase water efficient products. Proposed mandatory minimum standards for washing machines and dishwashers will also assist in reducing water consumption.

Water restrictions and permanent water saving measures

The introduction of temporary water restrictions during extreme water scarcity periods are likely to be implemented as an option in a climate as variable as Australia’s. There is no doubt that restrictions have worked to reduce water consumption but as the community continues to use water efficiently under permanent water saving rules and to use more efficient appliances, the potential impact and benefit of restrictions could be diminished. Harsh water restrictions are not the vision of the urban water industry as restrictions impose costs and inconvenience on consumers and water saving rules are preferred to ensure good practices prevail, such as not using sprinklers in the middle of a hot day.

Increasing cost of water

Traditionally water has been considered a resource that was insensitive to price but rising water prices are likely to result in stronger price signals for consumers particularly in the more discretionary outdoor use of water. The price increases proposed to pay for the new water security infrastructure are far more significant than inflation based increases of the past.

Economic growth

The rate of growth of the Australia economy is likely to influence the extent to which water consumed by the industrial and commercial sectors will increase.

Changing demographics

The fastest growing household type in Australia is single person dwellings. This is driven by a range of factors including the ageing of the baby boomers, a high divorce rate and people delaying marriage. The reason that this trend is important to the urban water industry is that with single person dwellings economies of scale are lost which can lead to higher per capita water consumption[3].Studies show that if an additional person moves into a single person dwelling, water consumption only increases by 80 percent and subsequent people only use 50 percent of the amount of water consumed by one person. This is because clothes washing and dishwashing is done more efficiently with larger loads and garden watering remains the same.

[3] 'WSAA Occasional Paper No.15 - Impact of Demographic Change and Urban Consolidation on Domestic Water Use', Page 10, Table 5 'Projected number of persons, number of households by lone person and other households and average household size and change 2001 to 2031 Melbourne'

Projected residential water consumption per capita for 2026 and 2056

Taking into account all of the drivers that influence urban water consumption, expert water resource planners from the major capital city water utilities have undertaken an assessment of how consumption levels may change between now and 2026, and from 2026 to 2056. Given that water consumption trends are subject to many social, technological and environmental and town planning factors, projecting water consumption so far into the future is more an art than a science.

Selecting a base year for comparison with future years is also very difficult given varying levels of restrictions. For example, in 2009 Melbourne had much more severe water restrictions than many other capital cities.

Nevertheless, best endeavours have been applied to predicting per capita demand into the future so that population increase impacts can be fully assessed.

Table 5: Residential water consumption kL per capita

	Actual **2009**	Projected **2026**	Projected **2056**
Sydney	74	70	63
Melbourne	57	63	59
Brisbane*	53	73/84	73/84
Adelaide	83	85	71
Perth	106	87	76
Canberra	79	93	78

* For SEQ (including Brisbane) as part of the 2009 SEQ Water Strategy there is a maximum residential per capita consumption daily planning target of 230 litres per person per day. This is the target that underpins the SEQ Water Strategy planning scenarios and would result in projections of 84 kL per capita. However, should consumption not increase above 200 litres per person, this would result in projections of 73 kL per capita consumption representing a saving of 11kL per year.

Per capita consumption for most capital cities is projected to increase or remain stable from 2009 to 2026. Capital cities such as Brisbane, Melbourne and Canberra have reduced their current per capita consumption to such exceptionally low levels as a result of the imposition of water restrictions and water consumption targets (under 60kL per capita per annum/165 litres per capita per day) that per capita consumption is projected to increase as restrictions are lifted.

Only Perth shows a significant projected decrease in per capita consumption from 2009 to 2026. This is due to the proposals in the 50 year plan recently released by Water Corporation for Perth and surrounds 'Water Forever towards Climate Resilience' which contains a range of water efficiency measures to reduce per capita water consumption by 25 percent by 2060.

From 2026 to 2056, all capital cities are projected to decrease per capita consumption or maintain 2026 levels due particularly to efficiency gains made through water efficient appliances and the expected trend to increased density living.

Projected total urban water consumption for 2026 and 2056

Total urban water consumption comprises the sum of residential water, commercial, municipal and industrial water and other water consumed (includes estimated non-metered water supplied).

The following projections clearly identify how significant increases in population will place additional demand on available sources of water supply (see Appendix 2 for the methodology used to create 2026 and 2056 projections).

From 2009 to 2026, total urban water consumed is projected to increase by 49% (Series A), 42% (Series B) and 39% (Series C). The projected gap between the volume of water supplied in 2008/09 and the increased volume of water consumed is 737GL (Series A), 631GL (Series B) and 581GL (Series C).

Table 6: **2026** Projected total urban water consumption (GL)

2026	Actual 2009 GL	Series A GL	Series A % change from 2009	Series B GL	Series B % change from 2009	Series C GL	Series C % change from 2009
Sydney	492	620	26%	613	25%	605	23%
Melbourne	360	535	48%	511	42%	494	37%
South East Queensland	223	536	141%	494	122%	494	122%
Adelaide	138	178	29%	174	26%	175	27%
Perth	250	308	23%	284	14%	265	6%
Canberra	42	66	57%	59	41%	53	27%
Total	**1,505**	**2,242**	**49%**	**2,136**	**42%**	**2,086**	**39%**

Note: South East Queensland 2026 projections have been sourced from the 2009 South East Queensland Water Strategy. No low growth population projection has been formulated within the 2009 South East Queensland Water Strategy. Therefore, the medium series (equivalent to Series B) has also been used for Series C in the table above.

73kL per capita consumption has been used to develop 2026 South East Queensland projections.
If 84kL per capita consumption had been used, the following projected volumes for 2026 would be:
Series A 591GL, Series B 545GL and Series C 545GL.

Table 7: **2056** Projected total urban water consumption (GL)

2056	Actual 2009 GL	Series A GL	Series A % change from 2009	Series B GL	Series B % change from 2009	Series C GL	Series C % change from 2009
Sydney	492	778	58%	709	44%	668	36%
Melbourne	360	760	111%	647	80%	582	61%
South East Queensland	223	848	281%	693	211%	693	211%
Adelaide	138	194	41%	174	26%	171	24%
Perth	250	456	83%	368	47%	308	23%
Canberra	42	81	95%	61	45%	45	7%
Total	**1,505**	**3,117**	**107%**	**2,652**	**76%**	**2,466**	**64%**

Note: South East Queensland 2056 projections have been sourced from the 2009 South East Queensland Water Strategy. No low growth population projection has been formulated within the 2009 South East Queensland Water Strategy. Therefore, the medium series (equivalent to Series B) has also been used for Series C in the table above.

73kL per capita consumption has been used to develop 2056 South East Queensland projections.
If 84kL per capita consumption had been used, the following projected volumes for 2056 would be:
Series A 933GL, Series B 762GL and Series C 762GL.

Discussion

Not surprisingly, all three scenarios result in significant additional water demand and water supply for urban Australia by 2026 and, in particular, 2056 if no investment is undertaken to develop new sources of water and water efficiency programs fail to deliver further per capita reductions.

Series A, which is considered the most aggressive and least plausible of the ABS population projections, results in additional demand of 1612GL in 2056, which is more than double the volume of water consumed by the major capital cities in 2008–09.

Series B, which is considered the most plausible population projection, results in additional demand of 1147GL in 2056, which represents a 76 percent increase in the water consumed in the major capital cities in 2008–09.

Series C, of course results in the lowest additional demand of 961GL in 2056, which still represents a 64 percent increase in the volume of water consumed by the major capital cities compared to 2008–09.

The reality is investment will be undertaken over the next 40 to 50 years on both the demand and supply sides to ensure that our cities do not run out of water. The last 10 years demonstrates the capability of the urban water industry to rapidly adapt and invest in new water sources to mitigate the significant risks now posed by a drying climate and population growth.

The response to date

At the start of this century urban Australia was almost completely dependent on surface runoff into the dams as the sole source of water. This is a very high risk option in an era of climate change. When the signals became pronounced that climate change would result in a drying climate, the industry began to invest in new sources of water that were not reliant on rainfall, such as desalination. Perth was the first State to invest in a desalination plant at Kwinana (which was completed in November 2006) and by 2012 five more desalination plants will be operational across Australia, resulting in a potential capacity of 674GL per annum if these plants are upgraded to their potential full capacity. This volume of water would almost alone meet the additional demand at 2026 even using the most aggressive population growth projections contained in Series A. This assumes there are no further significant reductions in rainfall. Other sources of water, such as recycled water, groundwater and rural to urban water trading, have also been developed to create more resilient and robust urban water supply systems.

When anyone makes a prediction into the future they become 'a hostage to fortune' and invariably these predictions prove to be incorrect. Therefore, it is not possible to accurately predict what water supply options and water efficiency measures will be adopted over the next 40 years to ensure that urban Australia can cater for the projected increases in population. This highlights the need to be adaptable to changing circumstances in the design, the resilience, and operation of our water systems.

Permanent water restrictions are not the solution

As previously stated, the two most difficult areas to predict are climate change and per capita consumption of water. The analysis undertaken by the water utilities shows that between 2008–09 and 2026 per capita consumption generally rises, with Sydney remaining relatively stable. Perth is expecting a significant reduction which will make its water use per capita more comparable with other Australian cities.

Some people might call on governments to implement permanent water restrictions in an effort to reduce the demand for water out to 2056. There is little doubt that temporary restrictions are useful to address extended dry spells and can defer significant expenditure. However they have an economic impact on water using businesses and effect social amenity and should not be used as a permanent solution. If permanent water restrictions are in place when you enter a severe dry period you have no emergency options to implement as they are part of the normal demand management program. The very low water per capita water consumption now experienced in a number of capital cities is artificially low due to restrictions.

In the long term lower level water saving rules are a low cost sensible way to promote ongoing water efficient behaviour.

Modest increases in per capita consumption should not be viewed as a negative as the prudent use of water in our cities and towns creates wealth (e.g. the nursery and garden industry) and adds greatly to the ability of householders to enjoy gardening and, at the same time, improves the livability of our cities and towns by keeping sports fields and public open spaces adequately irrigated. Recent experiences in cities where water restrictions have been removed and replaced with water saving rules indicate that the subsequent increase in per capita consumption is quite modest and is nowhere near the level of consumption that was experienced four to five years ago, let alone several decades ago.

Water prices rising
Water consumers across Australia are now experiencing quite significant increases in water prices to pay for the new infrastructure that is being constructed to mitigate the risks associated with climate change. It is too early to make a call on whether water demand will become more elastic to price as the price of water increases. Outdoor use of water has always been more elastic to price than indoor use and the strongest price signals will probably apply to the outdoor use of water. High water prices by themselves are unlikely to be the key to reducing per capita water consumption due to the largely inelastic nature of internal water use for essential needs such as clothes washing and hygiene. Also, the power of price as a signal is reduced for tenants and householders who either don't receive a water bill or are able to obtain a concession from their State Government. The introduction of intelligent networks in the future may include 'smart meters'. This could lead to more innovative tariffs providing choices to customers. Smart meters may also enable time of use tariffs which potentially could shift some water consumption to off peak periods.

Technological advancement
Over recent decades there has been tremendous advancement in urban water management through the use of technology, which has delivered the modern and efficient wastewater and water systems that exist today. In the past 40 years enormous technological advances have been made in water supply and wastewater systems. For instance, 40 years ago, membranes, microfiltration and reverse osmosis were not known, SCADA systems did not exist or at the very best were rudimentary, water and wastewater treatment was elementary, and most customers were not metered and paid for water on the basis of the value of their property.

The extent of past change indicates what we might experience over the next 40 years. It is highly likely that we will witness significant technological developments that will enable water engineers to implement systems, processes and solutions that current day water engineers can only dream about.

One of the certainties of the next 40 years is that climate change will remain the 'X' factor for water resources planners. The extent to which climate change increases evaporation, the climate becomes more variable and extreme weather events becoming more common, all adds up to a planning environment that is both complex and uncertain.

Technology advancements are also likely on the demand side with the potential for a number of current household water uses to become waterless. The design of new suburbs and the renovation of existing suburbs must take into account the concept of integrated water management at the outset. Our cities of the future will require us to capture as much water as possible to enable them to continue to be green and attractive places to live, work and play.

The implications of a low carbon economy are also likely to present opportunities and challenges for water resource planners. For instance, the urban water industry has the ability to generate renewable sources of energy such as using biogas produced at wastewater treatment plants to generate electricity. Likewise, mini hydro electricity generators are being installed in water distribution systems.

On the other hand, the new sources of water being developed such as desalination and recycled water are far more energy intensive than traditional water supply systems which comprised water flowing by gravity from dams into the water distribution systems.

Key principles of water resource planning
Water resource plans for capital cities and major urban centres have been developed over the last decade to ensure reliable and safe water supplies in the context of a drying climate and population growth.

Some of these plans already have a horizon of 40 to 50 years into the future.

Although it is inevitable that these plans will need to be amended to take into account myriad changes in context, such as population growth, nevertheless they provide a sound basis for planning in uncertain times.

History shows that major investment in new infrastructure is triggered by sudden low inflow events and low storages. Future planning and investment should have a long term horizon so that an extreme event does not result in the need to introduce severe water restrictions.

The water resource plans for the major capital cities and the planning horizons are as follows:
Adelaide: 'Water for Good' - 50 years,
Perth and surrounds: 'Water Forever' - 50 years,
Sydney: 'Metropolitan Water Plan' - to be updated in 2010 with a 50 year horizon,
South East Queensland: 'South East Queensland Water Strategy' - 2050,
Melbourne: 'Our water, our future',
Canberra: 'Think water, Act water' - 2050.

Given the great uncertainty that now exists and the extent of uncertainty is likely to increase in the future, there are a number of important principles that must be adopted when planning for the future water requirements for urban Australia. They are as follows:

1. Robust water resource planning processes – it is essential that robust water resource plans exist for each of Australia's capital cities and major regional centres. Given uncertainty, these plans must be reviewed on a regular basis to take into account the changing contexts –whether it be climate, social values or technological developments. These planning processes must also ensure that the health of our river systems is protected.
2. The continued development of a diverse portfolio of water supply options to mitigate the impacts of climate change – even though it is not possible to predict precisely what sources of water will be included in any given portfolio, the principle of spreading water resources risks over multiple sources of water is immutable.
3. It is almost certain that water will remain the quintessential environmental, social and political resource. Because of this, robust stakeholder and community engagement will need to be conducted on all water resource planning processes.
4. The design of our homes, suburbs and commercial developments will need to factor in water elements at the outset rather than having to 'bolt on' water sensitive solutions as an afterthought.
5. Innovation and adaptation will be essential so that the benefits of new technology and new research outcomes can be implemented quickly and efficiently.

Case study:
How desalination and recycled water are increasingly important sources of water

Six desalination plants will be operational in Australian capital cities within three years. As the diagram below clearly shows, these newly constructed desalination plants have the capacity to supply up to 674 GL of water.

From the earlier analysis, the projected increase in urban water demand from 2009 to 2026 is 736GL (Series A), 630GL (Series B) and 580GL (Series C).

Therefore, desalination will be able to provide a significant proportion of the additional for water up to 2026. It must be stressed that desalination will be an important source of water going forward, but it is unlikely to be the panacea. For instance, desalination is generally only an option for coastal cities. A diversified portfolio of water supply sources will provide the greatest protection against climate change risks and ensure a reliable and sustainable water supply into the future.

City	Location	Capacity (ML/annum)	Ability to increase capacity (ML/annum)	Completion date
Sydney	Kurnell	90,000	180,000	Completed
Melbourne	Wonthaggi	150,000	Up to 200,000	2011
South East Qld	Tugan	49,000		Completed
Perth	Kwinana	45,000		Completed
	Binninyup	50,000	100,000	2011
Adelaide	Port Stanvac	100,000		Dec 2012
	Total	**484,000**	**674,000**	
		This represents 35% of capital city water consumption in 2007-08	**This represents 49% of capital city water consumption in 2007-08**	

Case study continued on next page

Case study (continued from previous page)
Recycled water in Australia

Recycled water is becoming an increasingly important source of water for urban Australia. Since 2002 the volume of water recycled by the urban water industry has increased by over 120 percent. The 173 gigalitres of recycled water produced in 2008/09 by the major urban water utilities is equivalent to the total water supplied to all households in Perth in 2008/09. Major capital cities have increased the volume of water recycled by a staggering 52 percent in the three years between 2005/06 and 2008/09.

To date recycled water schemes have only supplied water for non-drinking purposes such as irrigation of sports fields and parks, commercial and industrial uses and for third pipe systems supplying households with recycled water for garden watering and toilet flushing. Recycled water is also being used to provide environmental flows to stressed river systems.

As explained in WSAA Position Paper No. 2 'Refilling the Glass – exploring the issues surrounding water recycling in Australia', the position of our major capital cities on the coast can be a significant impediment to the wholesale production of recycled water. As the wastewater treatment plants where recycled water is produced are generally at the lowest point in the catchment to take advantage of gravity, recycled water often has to be pumped significant distances uphill to areas where it can be used. This can result in recycled water being a very expensive and energy intensive source of water.

Inland regional cities and towns have many more options available for using large volumes of recycled water for purposes such as horticultural and agricultural irrigation. For instance, Western Water in Victoria recycles 77 percent of the total wastewater treated.

Up to this point, none of the water recycling schemes supplies water to potable water systems even though systems have been built in South East Queensland that would allow this to happen.

It is essential that data from all the existing water recycling plants is collated so that industry can point to a solid track record of treatment plant performance which will assist in building community confidence in recycled water.

Water security will become an increasingly important issue in the future and, as technology advances and new recycled water schemes prove safe and viable, the use of recycled water for indirect potable reuse will be inevitable.

While significant amounts of recycled water are being used across Australia, in order to make full use of this resource over the coming decades we will need to address blending this water with traditional drinking water sources. If this is to happen, the urban water industry will need to begin working closely with the community and key stakeholders to build trust in recycled water systems and assure the community that risks can be managed. Indirect potable recycling will not always be the optimal or preferred water supply choice and, for many utilities, using recycled water for purposes other than replenishing drinking water supplies may remain a preference. However, with innovation, leadership and commitment to maintaining public health and safety, indirect potable recycling will come to be considered a legitimate source water option to be included in a diverse portfolio of water sources.

Conclusion

As we have shown in this paper, the gap between supply and demand will be large if new water sources are not developed for urban Australia. However, the urban water industry has demonstrated over the past ten years its ability to adapt to climate change and to implement significant capital intensive projects to develop new sources of water. The industry is well positioned to adapt to higher population growth through the development of a diverse portfolio of water supply sources and sophisticated water efficiency strategies.

The urban water industry is well placed to implement programs and capital investments that will be necessary to meet increasing demand for water as the Australian population grows and climate change makes rainfall supply less reliable.

A long term planning horizon exists for water utilities to continue to proactively respond to the key drivers of consumption and climate change. The urban water industry needs to consider and plan for all population growth scenarios to ensure future water security.

High quality water resource plans, reviewed on a regular basis involving all stakeholders is likely to be the only approach that will ensure reliable and sustainable supplies of urban water going forward, regardless of the magnitude of population growth that Australia experiences. The backbone of these water resource plans will always be water efficiency measures supported by the development of new water sources including recycled water, desalination, rural to urban water trading, groundwater, stormwater, rainwater tanks and dams.

The urban water industry must collaborate with all stakeholders involved in the planning for the growth of our cities to ensure that water sensitive aspects are designed into the city form at the outset. In this way we will be able to create greener, more attractive and sustainable cities of the future.

The task of supplying potentially 21.5 million additional people with reliable and safe water supplies by 2056 will not be easy, but it will be done provided all stakeholders work together.

Appendix 1- Population projections analysis and commentary

The Water Services Association of Australia engaged Dr Bob Birrell from Monash University to provide the following advice relating to Australian population projections.

The selection of appropriate population projections is difficult for two reasons.

One is that the major components, net overseas migration and fertility, have varied sharply in Australia's recent history.

The second is that the demographic professionals within the Commonwealth and State governments who prepare population projections invariably assume that recent trends in migration and fertility will continue throughout the projection period. They are not equipped or empowered to ask questions about whether the numbers resulting are realistic in the light of the long-term economic, political or environmental outlook.

In the case of the three Intergenerational Reports (IGR) prepared by the Federal Treasury, which were published in 2003, 2007 and 2010, the demographic assumptions have altered to reflect the demographic policy setting prevailing at the time the projections were prepared. As a consequence the projections have changed radically over just seven years. The annual net overseas migration assumption was 90,000 per year for the 2003 projection, 110,000 for the 2007 projection and 180,000 for the 2010 projection. The fertility assumption has also increased since 2003, from 1.6 [4] in 2003 to 1.7 in 2007 and 1.9 in 2010. The population outcome for the base case in each of these sets of projections by 2042 was 25.3 million for IRG 2003, 27.8 million for IGR 2007 and 33.2 million for IRG 2010. In the case of IRG 2010, Australia's population is projected to reach 35.9 million by 2050.

There is a similar pattern for the most recent Australian Bureau of Statistics (ABS) projections published in 2003 and 2008. In the ABS 2003 publication, Australia's population was projected to reach 26.4 million by 2050 under the base case projection (Series B). The assumptions were that net migration would stabilise at 100,000 per year and fertility at 1.6. Migration was moving up sharply by 2003, but the ABS decided that this was an aberration, relative to the long period of much lower levels of migration since the early 1990s. Fertility had been around the 1.7 level for several years.

Table 4: ABS population projections (000's)

	Observed 2007	Series A 2026	Series B 2026	Series C 2026	Series A 2056	Series B 2056	Series C 2056
Sydney	4 282.0	5 487.2	5 426.3	5 358.2	7 649.0	6 976.8	6 565.2
Melbourne	3 743.0	5 272.3	5 038.1	4 861.7	7 970.7	6 789.2	6 100.9
Brisbane *	1 819.8	2 908.0	2 681.1	2 465.6	4 955.1	3 979.3	3 237.0
Adelaide	1 145.8	1 410.8	1 384.5	1 391.8	1 848.5	1 651.8	1 623.7
Perth	1 518.7	2 455.2	2 267.6	2 112.1	4 164.4	3 358.4	2 815.5
Australian Capital Territory	334.1	462.5	416.5	373	683.2	509.3	374.2
Hobart	207.4	266.8	245.3	228.2	367.2	279.7	224
Darwin	117.4	189.3	165.2	142.4	334.9	243	169.2
Total capital cities	13 373.4	18 452	17 624.7	16 933	27 973	23 787.5	21 109.6
Australia	**21 015**	**28 723**	**27 236.7**	**25 971.9**	**42 510.4**	**35 470**	**30 906.1**

3222.0 - Population Projections, Australia, 2006 to 2101

*Note: ABS Brisbane population projections have not been used to develop total urban water supplied projections. High and medium population projections for Brisbane have been sourced from the Planning Information and Forecasting Unit (PIFU), Department of Infrastructure and Planning SEQ forecasts from 2006 to 2051; Queensland's future population 2008 edition

***South East Queensland Population forecasts (000's)**

	Observed 2008	High Series 2026	Medium Series 2026	High Series 2056	Medium Series 2056
South East Queensland	**3,043**	**4,609**	**4,204**	**7,015**	**5,696**

Source : Planning Information and Forecasting Unit (PIFU), Department of Infrastructure and Planning SEQ forecasts from 2006 to 2051; Queensland's future population 2008 edition.

By the time the 2008 ABS projection series was published, its three main scenarios (Series A, B and C in the preceding table) all embodied higher fertility and net migration assumptions than was the case for the 2003 publication. These higher assumptions reflected a surge in the TFR to 1.9 in 2007 and a rapid increase in net migration to 177,617 in 2007.

Series A in the 2008 publication assumes that net migration will continue at 220,000 per year and fertility at 1.9, Series B assumes that net migration will continue at 180,000 per year and fertility at 1.8 and Series 3, the lowest of the group, assumes net migration of 140,000 per year and fertility at 1.6. Australia's population by 2050 is projected to be 39.6 million in Series A, 33.9 million in Series B and 30.2 million in Series C.

The scale of the projected increase in just five years is dramatic. As noted, under Series B in 2003, Australia's population was projected to reach 26.4 million. By contrast, Series B in 2008 produces a population of 33.9 million or 7.5 million more. It is worth noting in passing that changes in fertility have a significant long term effect on population numbers. Every increase of .1 in the TFR adds an additional million to Australia's population by 2050.

The dilemma for the user of these projections is whether a sudden recent change in the demographic setting should be taken as an indicator of long-term trends.

The Commonwealth Treasury thinks so. Under the 2010 IGR base case, as noted, it is assumed that annual net overseas migration will fall from the current level (over 250,000) to 180,000 per year by 2012, then stabilise at this number for the remainder of the projection period. For fertility, the assumption is that this will fall a little to 1.9 by 2013 then stay at this level. This projection also assumes a significant improvement in life expectancy, especially for males, relative to the assumptions used in the 2003 and 2007 projections. Under these assumptions, Australia's population will reach 35.9 million by 2050.

The 2010 IGR also prepared an additional low and high projection. The low projection assumed net overseas migration of 150,000 and fertility of 1.7. Australia reaches 30.2 million on these assumptions. The high projection assumes an annual net overseas migration figure of 210,000 and fertility of 2.1. The resultant population by 2050 is not provided in the published IGR 2010 document.

Deciding on the most appropriate projections

As noted, the 2008 median ABS projection (series B) assumes that the current record-high net migration intake and high fertility will continue. According to the Rudd Government, there is a continuing economic imperative to sustain a high migration program. This includes the impending retirement of the baby boomers (those born in the 1950s and early 1960s) and the certainty that, as a consequence, the rate of labour force growth in Australia will slow sharply over the next couple of decades (even with continuing high migration). The government is also concerned about the long term decline in the ratio of the working aged population to those aged 65 plus. This too, is inevitable, regardless of the size of the migration program. However the proportion of the population aged 65 plus under the base IRG 2010 projection by 2050 is 22.7 per cent compared with 26.0 per cent under the low projection. As of 2010 the proportion of Australia's population aged 65 plus was 13.5 per cent. As long as migration policy is driven by such concerns, the Series A and B 2008 ABS projections, and the IGR 2010 base projection, which are all predicated on continued high net migration, must be taken seriously.

The ABS 2008 high projection (Series A), which has Australia reaching 39 million by 2050, is the least plausible of these projections. The 220,000 net-migration assumption in ABS Series A is unlikely to eventuate. Though this figure is below the recent net-migration level (currently estimated at 285,000 for 2008–09), this recent level is a product of unusual population movements, mainly of students (discussed below). It is also well above current Labor Government policy. The government's long-term planning target is to achieve a net overseas migration intake in a range between 150,000 and 230,000 per year.

The 2010 IGR base projection incorporates the Labor government's current net overseas migration policy assumption of around 180,000 per year. This should be regarded as the upper limit for migration. The main reason for this argument has to do with the difficulties of coping with an additional 14 million between 2010 and 2050, as would be the case under the base case IRG 2010 projection.

[4] The fertility figure used is the Total Fertility Rate (TFR). This is defined as the total number of births a woman would have over her child-bearing life if she repeated the propensity of women to give birth at each age in a particular year. It is a useful measure because it is not influenced by the age distribution of women. However it may be misleading as an indicator of long term fertility, that is the number of children a women has actually had over her child bearing life, because of variations in timing of births by age group. The TFR was low in Australia through the 1990s because during this decade many women in the twenties postponed having children. The recent increase in fertility to 1.9 is largely attributable to a 'catch-up' on the part of women who had earlier postponed having children.

Net overseas migration has only rarely reached this level for more than a few years, even when it was government policy to maximise immigration. Net overseas migration averaged 98,361 over the 31 years 1977 to 2007.[5]

There are also doubts about the high-fertility assumption. A net migration intake of 180,000 per year would impact on fertility. The recent increase in fertility to just over 1.9 is mainly a consequence of timing of births. It reflects a catch-up for women in their thirties who postponed births while in their twenties. However, fertility could fall again, especially if competition for housing from migrants helps keep house prices high. The ability to purchase a house is an important determinant of couples' decisions to start a family.

The ABS Series B projection, which is based on similar assumptions to the 2010 IGR base projection, that is net overseas migration of 180,000 per year and fertility of 1.8, should be regarded as representing a plausible high end of the projection spectrum. This produces a population of 33.9 million by 2050. The slightly lower outcome compared with the IGR 2010 projection of 35.9 million is largely caused by the difference in the fertility assumption. Another contributor is that the ABS Series B projection assumes a lower life expectancy outcome than is the case for the IGR projection.

The ABS low scenario (Series C), which leads to a population of 30.2 million by 2050 is also plausible and can be regarded as a reasonable indicator of the lower end of the projection spectrum. The outcome for this projection by 2050 is the same as for the 2010 IGR low projection. Both assume net overseas migration of 140,000 to 150,000 per annum. Though low by the standards of recent years, this migration assumption is reasonable. For most of the past decade, Australia has lost around 60,000 permanent departures each year. Thus, the permanent migration program has to be around 200,000 to achieve a net figure of 140,000. The permanent program (including the humanitarian component) only reached this level once in the past thirty years and that was in 2008–09. The very high level of recent net overseas migration (285,000 in 2008–09) was mainly a product of a huge influx of overseas students, most of whom are yet to return home. This will change with current reforms in the rules governing permanent residence applications from former overseas students. The new rules will largely decouple education in Australia from access to a skilled permanent residence visa. As a consequence there is likely to be a stabilisation of the influx of overseas students and a significant increase in the numbers returning to their home country.

[5] Department of Immigration and Citizenship, Population Flows, Immigration aspects, 2006-07 edition, p. 146

Appendix 2- Entities which provided data

Sydney - Sydney Water,

Melbourne - City West Water, Yarra Valley Water, South East Water, Melbourne Water,

Brisbane/South East Queensland - Queensland Water Commission,

Adelaide - Office for Water Security and SA Water,

Perth - Water Corporation,

Canberra - ACTEW.

Appendix 3 - Terminology

Volume of water supplied - Residential

Total metered and estimated non-metered, potable and non-potable water supplied to residential properties for the reporting period (estimated volumes are noted on the data).

Total urban water supplied

The total metered volume of water (potable or non-potable, including recycled) supplied to customers over the reporting period plus estimated non-metered water supplied. This comprises the sum of residential water supplied, commercial, municipal and industrial water supplied and other water supplied (includes estimated non-metered water supplied).

Data

- 1 kilolitre (kL) = 1,000 litres
- 1 megalitre (ML) = 1,000,000 litres
- 1 gigalitre (GL) = 1,000,000,000 litres

Calculation of projected total urban water supplied

Projected total urban water supplied for each capital city has been calculated by using projected per capita consumption multiplied by Series A, B and C (ABS 3222.0 - Population Projections, Australia, 2006 to 2101 population projections) to generate three scenarios of residential water supplied.

The average ratio of water supplied as a percentage of total urban water supplied from 2002–03 to 2008–09 for each capital city was then applied to each residential water supplied scenario.

ABS Brisbane population projections have not been used to develop total urban water supplied projections. High and medium population projections for Brisbane have been sourced from the Planning Information and Forecasting Unit (PIFU), Department of Infrastructure and Planning, SEQ forecasts from 2006 to 2051; Queensland's future population 2008 edition

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