Review of Water Consumption Forecasts

REVIEW OF WATER CONSUMPTION FORECAST IN HUNTER WATER CORPORATION'S 2008 SUBMISSION TO IPART ON PRICES TO APPLY FROM 1 JULY 2009

- Final
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1. Executive Summary

The Independent Pricing and Regulatory Tribunal of NSW (IPART) is conducting a price path review for water consumption to assist in setting prices for water, sewerage, drainage and recycled water charges for Hunter Water Corporation (HWC), which will apply from 1st July 2009 for a period of up to five years.

As part of the pricing process, HWC provided IPART with their forecast of water consumption along with background data and assumptions. IPART engaged Sinclair Knight Merz (SKM) to undertake an independent review of HWC's water consumption forecasts over the next five years, comment on the suitability and robustness of the data and information as well as approach used to develop these forecasts and provide a report on the adequacy of the data and assumptions utilised.

This report contains SKM's views on HWC's forecasting methodology and the feasibility of estimated water savings from demand management and water conservation programs as well as water recycling and reuses schemes on future water demand.

This report provides qualitative comment on the:

- suitability and adequacy of the approach adopted in water consumption forecasting
- suitability and adequacy of the background data and information used as inputs
- suitability of the assumptions used
- application of the methodology
- the balance between the use of historical trends and key drivers in generating the forecasts

1.1. Forecasting Methodology

SKM found that the methodology used by HWC to forecast consumption was generally robust.

HWC uses a spreadsheet model to project future consumption, which is based on trends in consumption for residential groupings, based on the housing construction date[1]. Analysis of consumption trends for other customer groups is also undertaken. It takes into consideration factors such as the growth in customer connections, demand management programs and the impact of recycling schemes (for both residential and industrial groups) to determine the total supply requirement.

[1] The consumption is lower for older houses, partly because they are smaller, have fewer showers, are less likely to have swimming pools etc.

Other approaches which could have been used by HWC include regression based techniques for trend analysis, which is a statistical approach, or end-use modelling, which is a "bottom-up" approach. Whichever modelling approach is used, the reliability of the forecast will mainly depend upon on the quality and adequacy of input data and reasonableness of assumptions used in modelling. Trend analysis and end-use modelling can produce more reliable forecasts, but only if high quality input data is available for the necessary inputs and model calibration. Also, all methodologies have advantages and limitations, and these should be understood prior to nominating an approach and in interpreting the modelling output.

The strengths of HWC's spreadsheet based model lies in its simplicity and transparency, with all calculations easily interrogated and altered as required. Its current weakness lies in its heavy reliance upon quantitative estimates of future customer behaviour by the utility, rather than statistical analysis. HWC's modelling methodology was also not supported by any comprehensive reporting on the model development and calibration, historical consumption analysis or on the assumptions made in consumption forecasting.

1.2. Input Data and Assumptions

The HWC forecasting methodology is based on population projections from the NSW Department of Planning (DoP) Regional Strategy, which stated that there will be an additional 160,000 people and 115,000 new dwellings in the region by 2031 (NSW DoP 2006, p.1). SKM assume the DoP's population projection is a reasonable input to the forecast.

Assumptions used in the forecast:

- Supply of water to Gosford-Wyong Councils will be 500ML/annum (a)
- The split of future residential developments will be 35% units and 65% houses
- No water restrictions will be in place
- A population growth rate of 1% per annum applies
- Reduced consumption in response to the proposed price increase only applies to outdoor residential consumption
- The Kooragang Industrial Water Recycling Scheme will commence in 2011/12
- Demand management and water recycling initiatives reduce consumption by 7%
- A constant unmetered consumption of 10.3GL/a applies

These assumptions are generally reasonable. HWC may be underestimating the influence of the proposed price increase, as some reduction in consumption may apply to other sectors. Transfers to Gosford Wyong in next 5 years may be higher than 500ML/annum, although this is highly

dependent on climate, which is difficult to anticipate. The unmetered consumption of 10.3GL/a may be an overestimate if HWC increase the number of properties under pressure reduction, or if metering of individual units is introduced.

1.3. Consumption Patterns

Residential potable water consumption in the Hunter Region has been increasing due to a population growth in the order of 1% per annum. Non-residential water consumption by high water users (>2ML/a) has been decreasing due to the closure of some major industries (namely BHP Steel Works, National Textiles and Pasminco Sulphide) as well as the uptake of recycled water by Eraring Energy and water efficient practices being implemented by a number of industries and businesses. Non-residential water consumption by other water users is predicted by HWC to increase in line with population growth.

The growth in non-residential consumption since 2004/05 is due mostly to bulk supply transfers to Gosford/Wyong ranging from 1,000 to 4,000 ML/a (HWC 2008b, p.42). Bulk transfers to the Central Coast commenced in 2003. The volume transferred is dependent on relative storage levels in the two water supply systems. HWC are predicting transfers to be 500ML/a over the determination period.

The observed water consumption over the last fifteen years shows that 2007/08 had below average consumption for the period. HWC's assert that the low consumption in 2007/08 was due to a cooler summer and above average rainfall.

1.4. Demand Management

SKM noted that HWC have included demand management initiatives in their forecast, indicating a decrease in water consumption over the next few years in both residential and non-residential sectors. The demand management initiatives include residential retrofit, leakage reduction and pressure management (HWC 2008b, p.45).

SKM found HWC may be underestimating the reduction in consumption that will occur through new demand management programs. According to HWC, there is scope to save an additional 1,400ML/a through future programs, but the impact of these programs was not included in the forecast. The main savings would be through pressure reduction, a business water efficiency program and promotion of water saving products. The volume of reduced consumption will depend on which projects are implemented, and the effectiveness of these projects.

Similarly, SKM believe HWC may be underestimating the potential reduction in consumption through the proposed pricing increase, since they do not apply any reduction to internal residential

or non-residential consumption. A price increase is expected to provide incentive for installation of water efficient appliances, as well as for more connections of toilets to rainwater tanks.

1.5. Water Recycling

In their 2008 Submission HWC quantified the expected savings through existing and proposed water recycling schemes, as part of future green-field development. Assumptions were made regarding the recycled water consumption in Chisholm, Fairly South and North Cooranbong. Estimates included potable water top-up. There is no breakdown given between potable water top-up and recycled water consumption in these three development sites, therefore there is a potential for error, but this is expected to be minor. Water balance modelling would be required for an accurate assessment of recycled water demand and potable water top-up.

1.6. Water Pricing

HWC applied a response to its proposed price increase only for existing residential detached house outdoor water demand. It was also based on the previous price increase of 26% (to $1.53), rather than the current proposed price increase of 64% by 2013.

HWC estimated a 0.5% reduction in overall water demand. SKM consider that it would be appropriate to apply a price response across all customer groups, and to update the model for the current proposed price increase. SKM conclude that the proposed price increase is likely to produce a greater reduction in consumption that the 0.5% assessed by HWC.

1.7. Bulk transfers

The bulk supply to the Central Coast is climate dependent and can occur in either direction in response to dam storage levels in the two water supply systems. The current maximum transfer is 12,800 ML/a. Stochastic modelling undertaken by Afton Water Solutions for the Gosford Wyong Councils Water Supply Authority estimated that the average annual transfers to the Central Coast during the determination period may be as high as 2,000ML/a to 3,000ML/a. However, recent behaviour suggests that the lower figure adopted by HWC is reasonable.

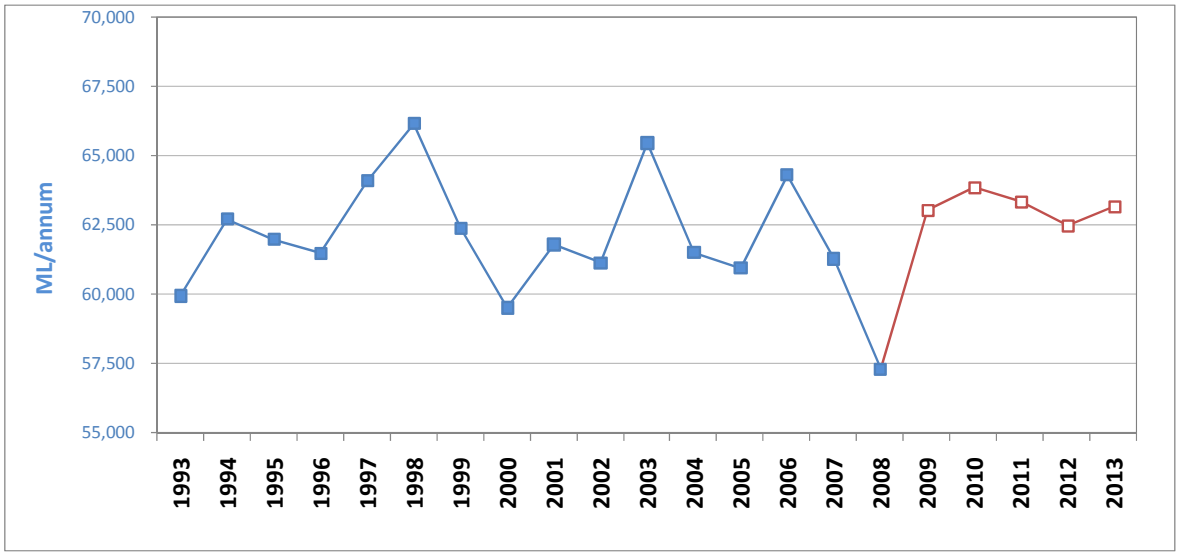
1.8. Application of Forecasting Methodology

Through an interrogation of HWC's spreadsheet based forecasting model, SKM determined that HWC's methodology was applied appropriately. The figures have been correctly calculated and all factors included in the methodology were taken into account in the forecast.

A possible improvement would be to include a statistically based climate correction in HWC's historical consumption analysis.

1.9. Forecasted Consumption

Figure 1 shows the metered and forecast water consumption patterns from 1993 to 2013. The predicted mean water consumption during this price determination period is 63.2GL/a.



- **Figure 1. Historic and forecast water consumption**

1.10. Summary

HWC have used a sound methodology to estimate future consumption, which includes analysis of historical consumption and trends in use, population growth and the impact of demand management and water recycling initiatives.

HWC have estimated that the water consumption over the approaching determination period of 2009-13 will range from 62,480 to 63,840 ML/a. The estimate during the determination period includes the effect of growth in domestic and non-domestic consumption, the effect of various

water saving initiatives and water recycling schemes and a return to average climatic conditions. The step change in estimated consumption for the year 2009, due to climate adjustment, is considered to be reasonable. The implementation of additional demand management measures, not accounted in the estimates, may reduce consumption during the determination period. However, these differences are small and within the margin of error of the estimate. In conclusion SKM have assessed that the consumption estimates prepared by HWC are within 1 or 2% of the expected climate adjusted consumption. We therefore recommend that the HWC estimates be adopted.

2. List of Abbreviations

ABS	Australian Bureau of Statistics
AIR	Annual information return
BASIX	Building Sustainability Index
CPI	Consumer Price Index
DM	Demand management
DoP	Department of Planning
GL	Gigalitres
GWCWA	Gosford-Wyong Councils' Water Authority
HWC	Hunter Water Corporation
IPART	Independent Pricing and Regulatory Tribunal
LGA	Local Government Area
L/c/d	Litres per capita per day
ML	Megalitres
SKM	Sinclair Knight Merz
UFW	Unaccounted for Water
WELS	Water Efficiency Labelling and Standards

3. Introduction

3.1. Purpose of Report

The NSW Independent Pricing and Regulatory Tribunal (IPART) engaged Sinclair Knight Merz (SKM) to undertake a review of Hunter Water Corporation's (HWC's) water consumption forecasts for the next five years, 2009 to 2013. This report provides qualitative review on the:

- suitability and adequacy of the approach to develop the water consumption forecasts
- suitability and adequacy of the data and information used
- suitability of the assumptions, particularly for water savings from water restrictions, and demand management and water conservation programs
- application of the methodology
- the balance between the use of historical trends and key drivers in generating the forecasts

It should be noted that the intention of this draft report is not to provide an alternative water consumption forecast to HWC, but rather comment on the reasonableness of their forecast, and advise if a revised forecast is necessary.

3.2. Background

HWC's forecast of metered water sales have a direct influence on the future revenue that the corporation will receive. Specifically, revenue from water sales is a product of usage charges and metered water sales. If the forecast of metered water sales is not reasonable, then the price determination by IPART will result in HWC over or under recovering its required revenue. Furthermore, water consumption has an impact on HWC's capital and operating expenditure. In the pricing review, IPART is concerned with consumption (metered consumption) which will be billed to the customers. SKM has therefore concentrated mainly on reviewing forecasts of billed consumption.

Prudent forecasting requires appropriate data on historical water consumption patterns, the development and calibration of a specific and rigorous methodology, the documentation of assumptions, the implementation of a calibrated model, and understanding of the sensitivity of the issues and of the proposed use of the outcomes.

3.3. Report Structure

This report is structured to assist with the efficient review of the data, information and approach used by HWC. The structure of the report is as follows:

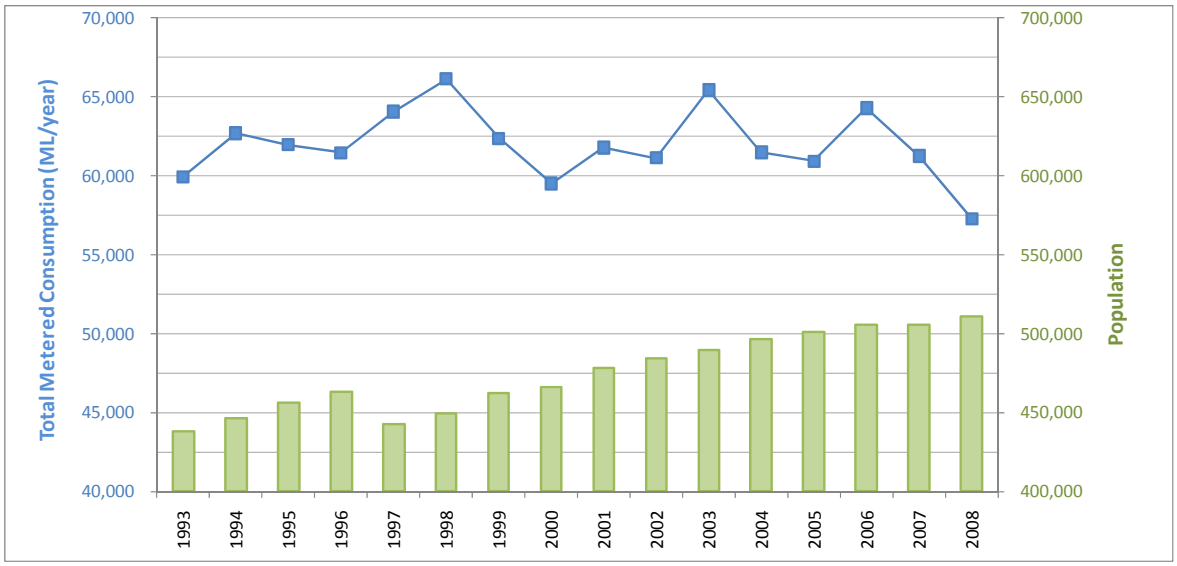
- Section 2 contains an overview of the water consumption for the next 5 years, 2009 to 2013 (the price determination period)
- Section 3 contains a breakdown of the methodology to develop the forecast
- Section 4 is an assessment of forecasting methodology and significant aspects
- Section 5 is a summary of findings

4. Water Consumption

4.1. Consumption to date

As part of the price review, IPART requested water consumption forecasts from HWC through an "annual information return" (AIR). This was made available to SKM to undertake the review. According to HWC's AIR, in the financial year 2007/08, HWC supplied approximately 57 GL of water to a residential population of around 510,000 (HWC 2008d). HWC calculate consumption based on their customer meter reading or billing records. The operating areas include the six local government areas of Newcastle, Lake Macquarie, Maitland, Cessnock, Dungog and Port Stephens. It is expected that the population served will increase by approximately 160,000 by 2031 (NSW DoP 2006, p.1).

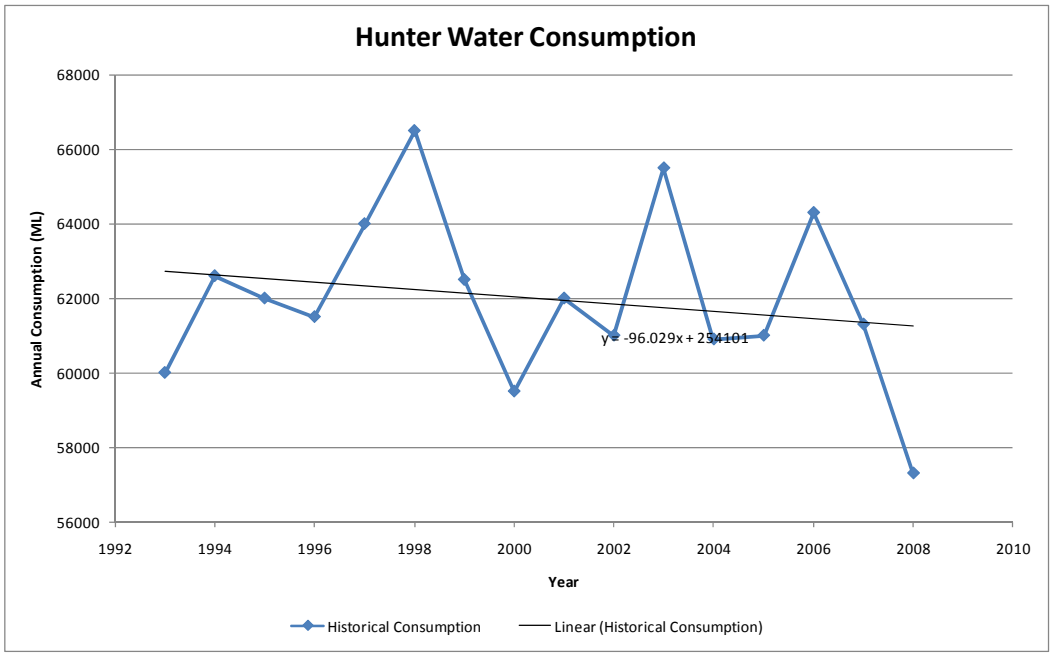
HWC's 2008 AIR and submission to IPART indicate that despite an increase in population served with reticulated potable water, annual consumption for water in the Hunter has been relatively constant, at around 62GL/a for the last 16 years, as shown in **Figure 2**, although there is a slight downward trend particularly in the last 5 years.



- **Figure 2: Historical metered water consumption and population served with reticulated water (HWC 2008c)**

Notably, 2007/08 had the lowest metered consumption in the last 16 years, at 57,300 ML. HWC claim that this was largely due to climatic influences including high rainfall and low temperatures and estimated that the equivalent climate adjusted consumption for 2007/08 was 61,100 ml, representing a difference of 3,800 ML/a. **Figure 3** shows the historical metered consumption for

HWC customers with a trend line fitted. It can be seen that there are significant variations in annual consumption due to climatic influences, with the trend line an average climate adjusted consumption. This indicates that the climate adjusted consumption for 2007/08 was approximately 61,500 ML/year, which confirms the climate adjustment by HWC.

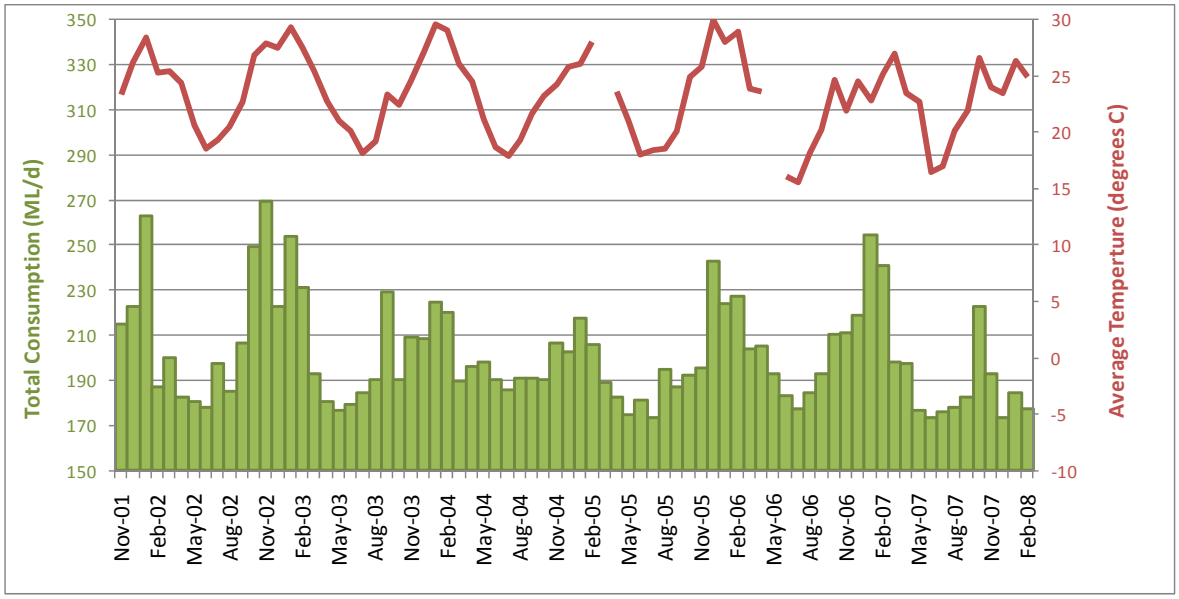


- **Figure 3: Historical metered water consumption for HWC customers (excluding transfers to Gosford Wyong) with trend line**

Since the introduction of the 'user pays' pricing in 1982, the total volume of water supplied per year has been relatively constant in the range of 70GL/a to 80GL/a, averaging about 74GL/a. Metered consumption has also remained relatively constant, in the range 60GL/a to 65GL/a , but with a slightly lower consumption in 2007/08.

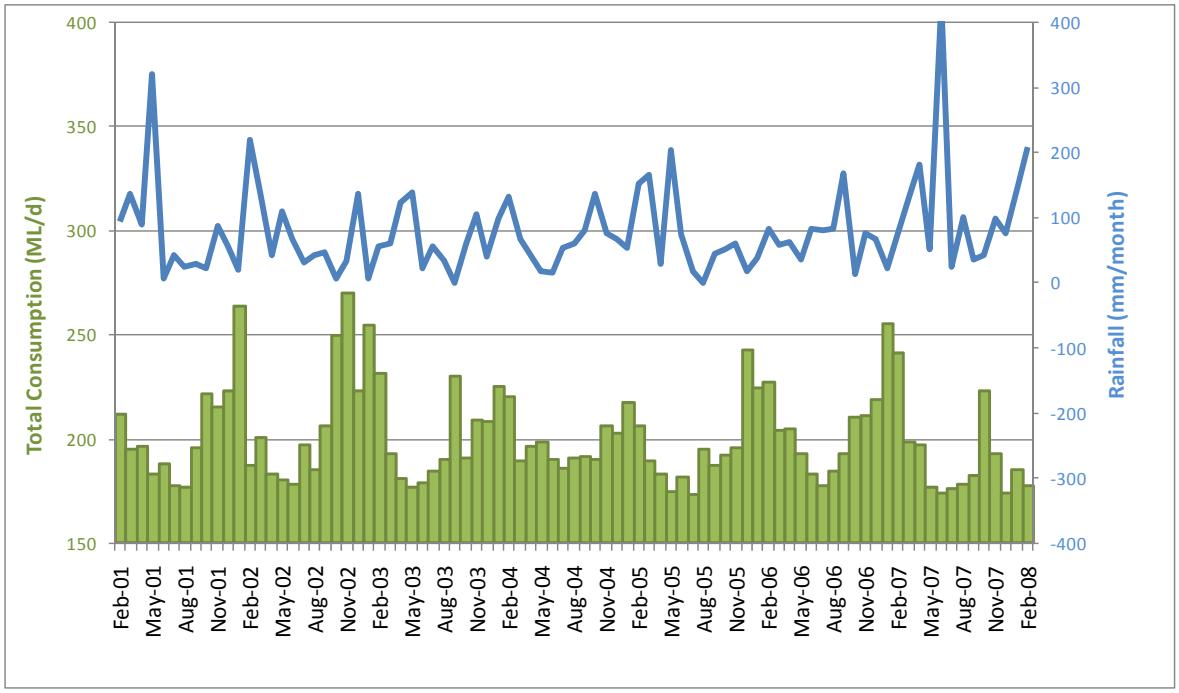
HWC's explanation for the stability in water consumption patterns over the last 20 years, despite of an increase in the population served, is both the decline in non-residential consumption, due to the closure of a number of its highest water users, and water conservation initiatives, such as BASIX, rainwater tank rebates, residential "refits", leak reduction, education and water recycling.

HWC suggest that the consumption rate is at its lower bound in 2008 due to higher rainfall and a cooler summer (HWC 2008e). **Figure** shows the seasonality in monthly average temperature and water consumption. It somewhat supports HWC's assertion that 2007/08 was cooler than average, and that this correlated with lower water consumption. The bulk transfer of 10 – 25 ML/d of water to the Central Coast over the summer of 2006/07 may explain the higher consumption despite lower average temperatures.



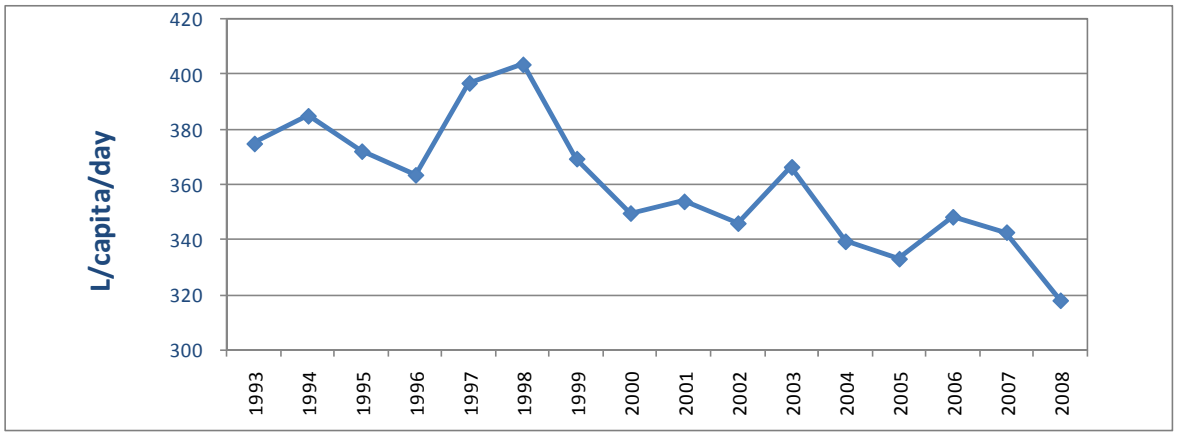
- **Figure 4. Monthly average temperature and total water consumption (HWC 2008e)**

Figure shows the monthly rainfall average and water consumption data from HWC. It further supports HWC's assertion that 2007/08 had higher than average rainfall, which is correlated with lower water consumption.



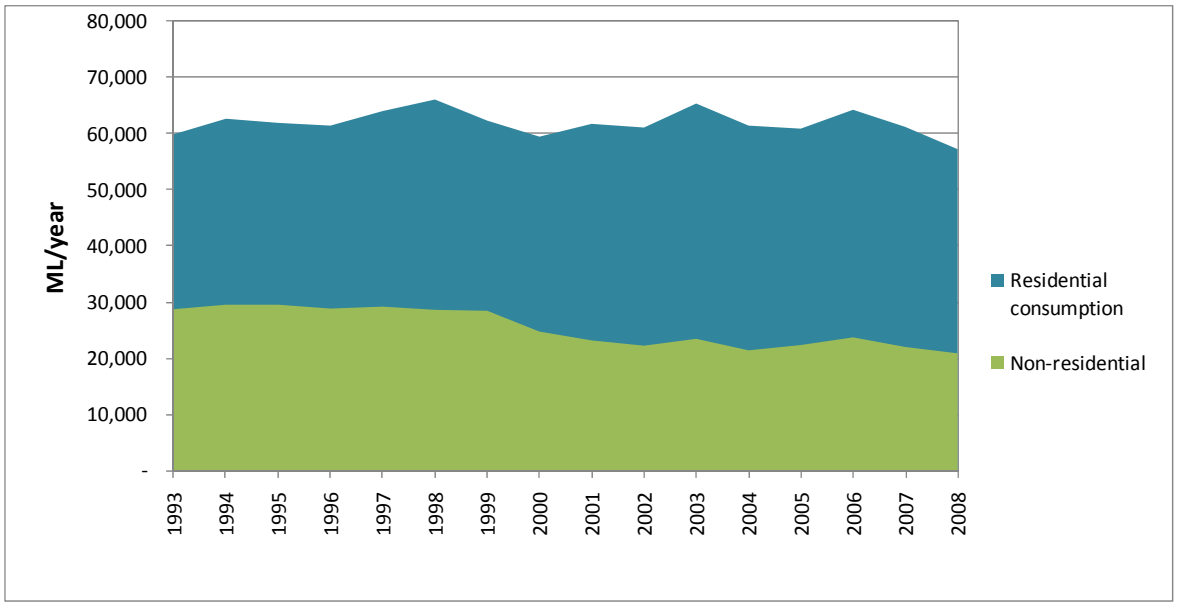
- **Figure 5. Three monthly average rainfall and total water consumption (HWC 2008e)**

Figure shows the trend in per capita metered consumption since 1993. It indicates a slight downward trend in per capita metered consumption or billing records. This is attributable to the closure of industrial customers who were high water users, as well as efficiency improvements across all of its customers.



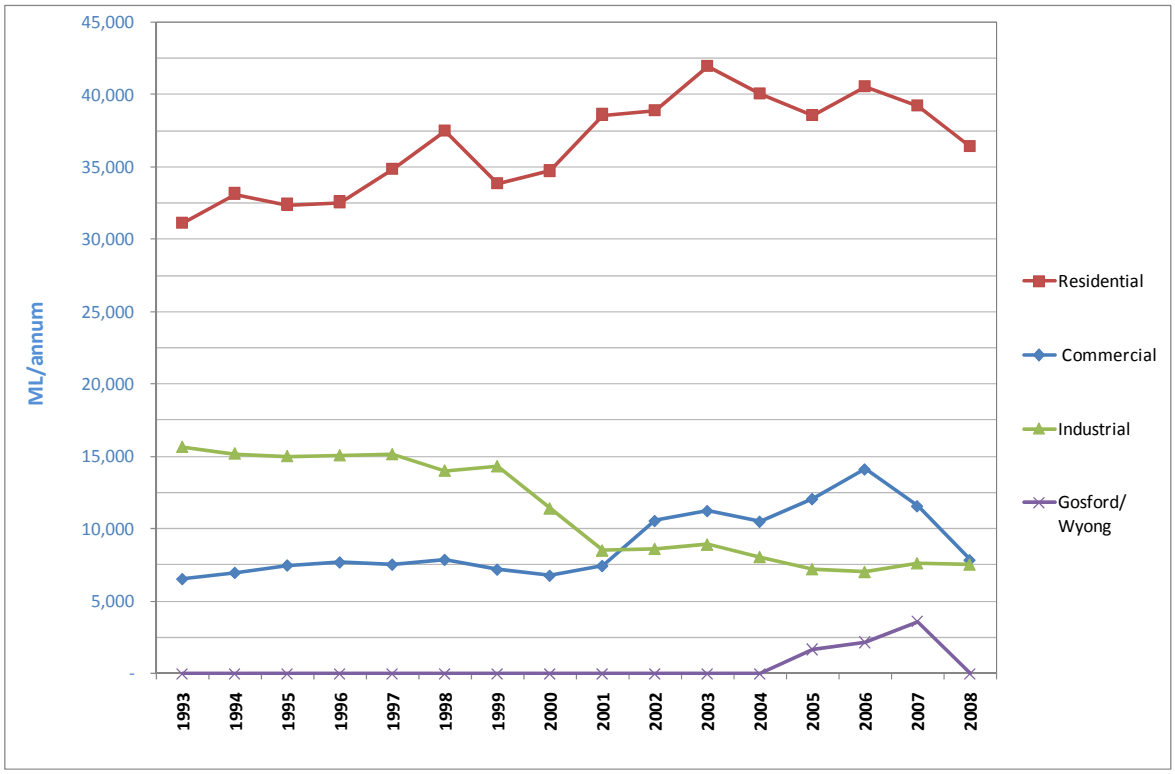
- **Figure 6. Per capita average consumption for HWC (HWC 2008c)**

Figure 7 shows HWC's breakdown of water consumption patterns by user category. According to HWC, residential consumption is the largest user group as a proportion of total supply, having increased from 39% to 54% since 1989 (HWC 2008c).



- **Figure 7. Metered water consumption by market segment (HWC 2008c)**

Figure 8 shows the annual residential consumption has gradually increased from 31,000 ML/a in 1993 to 36,500 ML/a. This relates to an average increase of approximately 370 ML (1.2% per annum). **Figure 8** also shows the volume of bulk transfers to the Central Coast, which peaked at 3,560ML/a in 2007, but fell to zero in 2008 due to increased rainfall.



- **Figure 8. Hunter Water Corporation consumption allocation between customer type (HWC 2008c)**

Figure 8 shows how the upward trend in residential consumption has been offset by significant drops in industrial consumption following closure of some customers (such as BHP Steelworks, Pasminco Sulphide and National Textiles), who used to be the highest users of potable water. The water consumption has also dropped further following the recent closure of Delta EDM. It is understood that the implementation of a water management plan at Eraring Power Station by substituting the potable water with alternative water sources (such as recycled water) has also reduced the consumption of potable water to some extent (HWC 2008a, p.27).

Sectoral water consumption rates or demands were calculated using data from HWC's customer accounts database. The quality and adequacy of this data was not assessed by SKM. However, it is assumed that the historical and archived data should be adequate and of reasonable quality.

Major Industrial Users and Customers: HWC has identified 40 customers who are the major users of potable water in the Hunter region (HWC 2006). It is understood based on the information provided by HWC that most of these industries have developed water cycle management plans in order to achieve water conservation through efficiency gains and substitution of potable water for non-potable usages with alternative water sources.

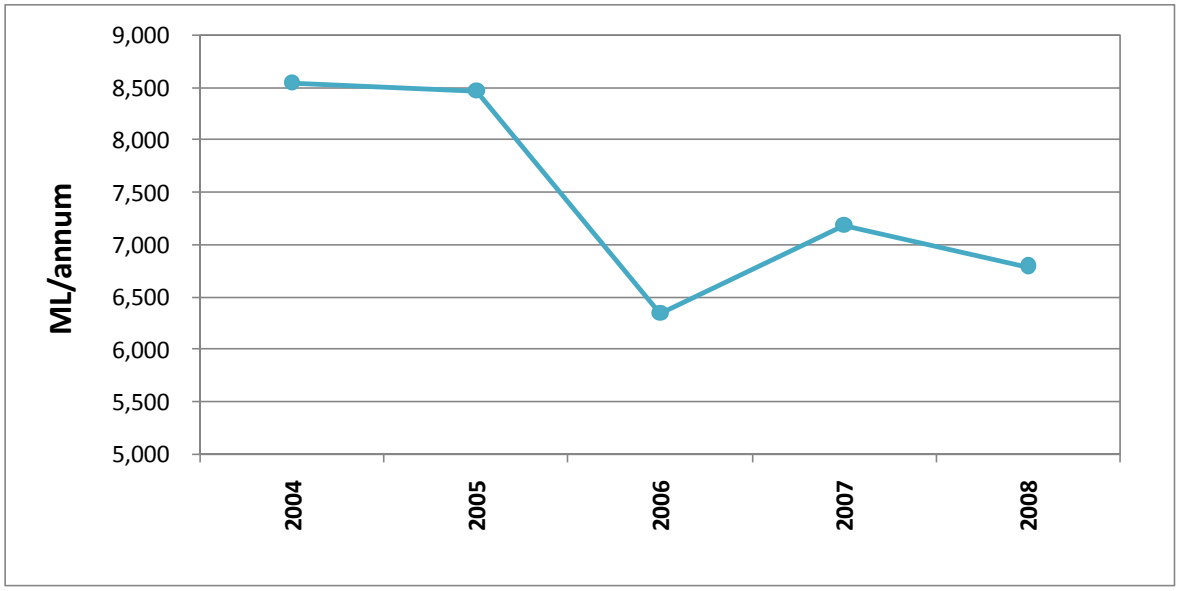
Bulk Water Supply: Bulk water transfers occur between HWC and the Gosford-Wyong Councils' Water Authority (GWCWA). Most of the supply for the Central Coast and Hunter is sourced from local catchments, but since 2003 the two systems have been connected. The rate of transfer between the two systems is determined through consideration of relative storage or supply levels in both systems. Since 2003 the transfer rate has varied from 1,000 to 4,000 ML/a from HWC to the Central Coast. Future transfer rates, since they are a function of storage level, will depend on weather conditions, as well as commissioning of the Mardi-Mangrove link main in the GWCWA system. The purpose of the link is to increase supply to the Mangrove Dam, and so should reduce the bulk water transfers from HWC to the Central Coast. It is understood that the link main is at design and construction stage and is targeted to be commissioned by 2011 (HWC 2008b, p.45-46).

It is difficult to reliably predict the required future volume of bulk water transfers to GWCWA, due to the weather dependent nature of the transfer.

A HWC- Singleton Council working party has been established to develop a Memorandum of Understanding as a basis of developing a long-term strategic link between the two supply systems (HWC 2008e p.31). HWC have suggested that the most likely supply arrangement would be to transfer 5ML/d in non-peak demand periods (300 days/annum). The total estimated supply of 1.5GL/a could commence around 2014/2015. HWC have therefore indicated that this will be a matter for consideration in the next IPART price review (HWC 2008b p.46).

Water Restrictions: HWC have a water restriction policy, but storage levels have not fallen to a level to trigger the implementation of water restrictions.

Unaccounted For Water (UFW): The UFW (unmetered consumption) since 1999 varies from 10GL/a to 15GL/a, even though the extent of the water supply system has grown substantially. As shown in **Figure 93**, a declining trend in the volume of UFW is noted since 2004.



- **Figure 93. HWC's water system losses (HWC 2008d)**

The corporation is actively involved in implementing leakage reduction, pressure management and water mains renewal programs as part of its water conservation initiatives and reliability improvement of its supply system (HWC 2008b). The outcome of these programs is believed to be the contributing factor in reduction of UFW since 2004. Possibilities also exist that the uncertainties in meter reading may provide a misleading interpretation of UFW. However, it is understood that the corporation has an active program for replacement and calibration of flow meters of its bulk supply line.

5. Forecasting Methodology

5.1. Background

Key drivers of residential consumption include:

- **Population growth.** HWC has forecast population growth of 1.0% for the determination period.
- **Economic growth rates**, which affect water usage in several ways. High economic growth accelerates trends such as the purchase of more efficient appliances. Conversely, experience shows that higher real incomes brought about by favourable economic conditions result in increased water use through the purchase of more water consuming fittings and appliances.
- **Trends in appliance purchases and usage.** There has been a move towards the installation of larger appliances in residences, such as spa baths, which can increase water usage. The installation of automatic sprinkler systems is also likely to increase water usage. Countering this has been the trend towards more water efficient appliances, such as dual-flush toilets, low-flow showerheads and front-loading washing machines.
- **Demand management and water conservation programs.** There have been efforts by HWC to undertake community education, promote the installation of water efficient devices and develop other programs that will reduce demand.
- **Pricing structure and level.** The price structures and levels that IPART determines will have some effect on water consumption. A customers water usage charge is proportional to metered consumption, and so the price increase may have a reducing influence on the volume of water consumed.
- **Current and proposed water restrictions.** External water usage is strongly influenced by water restrictions, while internal water usage is affected to a lesser degree. Water restriction policies affect consumption while the restrictions are in place, and have a residual effect for a period after the restrictions are lifted. The state of storages at the start of the forecasting period provides an understanding of the likelihood and level of water restrictions to be imposed.
- **Government policies** which have a bearing on water use, for example, the implementation of the BASIX program.
- **Household formation patterns**, such as number of dwellings, dwelling density and occupancy rates, in particular, the shift towards multi-unit dwellings and flats. The proportion of multi-unit dwellings is increasing through urban consolidation and renewal. In addition, the trend towards a lower occupancy rate increases internal water usage on a per capita basis.

Apart from these long-term factors, there are other factors that may result in short-term variations in consumption. The most important variable is climate, particularly temperature and rainfall, which can have an impact on outdoor water use. Temperature may also impact on water use through evaporative air-conditioning. Tourist numbers will also impact on both short-term and long-term trends in water usage.

Non-residential users include commercial, institutional, industrial and rural potable users. These users have different water consumption drivers to residential users.

Some of the key drivers of non-residential water consumption include:

- Business type
- Economic growth
- Irrigation needs
- Process and plant efficiency

Customers in this group are also affected by water restrictions and the increasing awareness of water conservation, and in some cases have been implementing measures to conserve potable water.

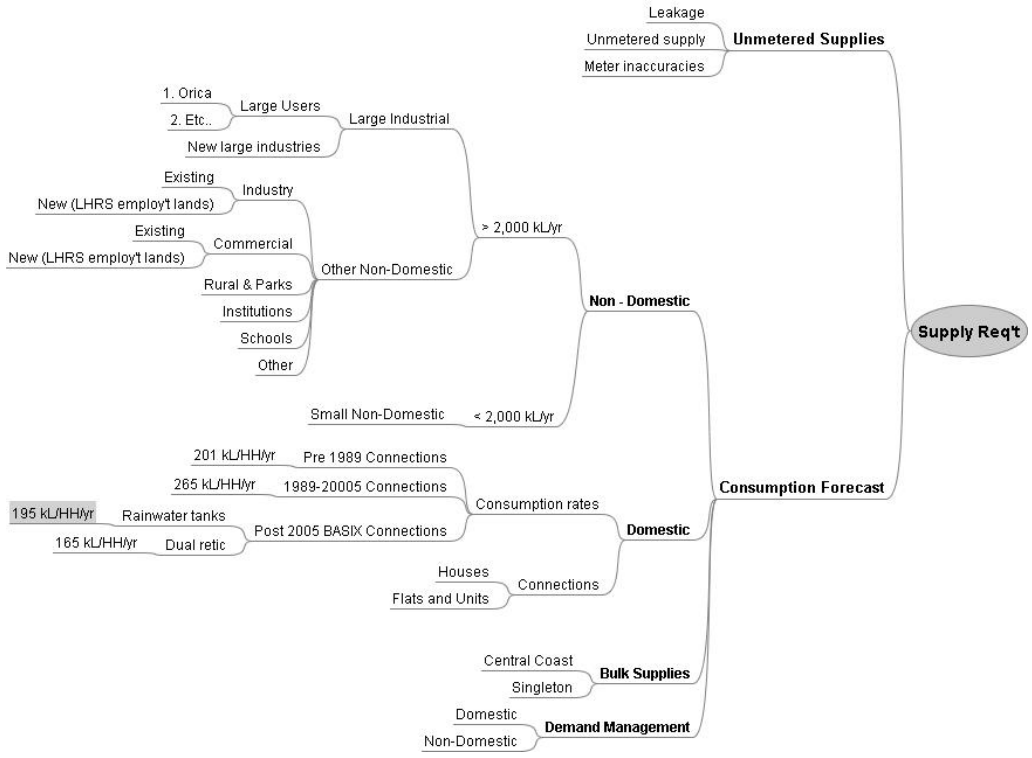
It is expected that the selection of variables for inclusion in a forecasting model is accomplished using a progressive selection process, where there is a systematic and incremental integration of variables into the forecasting model, with statistical analysis of the resulting improvement in the prediction against observed data at each step.

5.2. Method and assumptions

Multi-variable regression is currently the most common tool utilised when trying to understand the influence of demand management and other factors on water consumption (DEUS 2006, p.3). Models can relate annual, monthly and daily water consumption to climate variation and other demographic and socio-economic trends. Modelling first requires model calibration against a period of observed data.

HWC did not use a regression-type modelling approach for water consumption forecasting for their 2008 IPART submission. Instead, HWC used a deterministic type spreadsheet model, in which the forecast is determined through measurement (historical data), estimation and calculation of values for various inputs.

HWC analysis of consumption trends includes analysis of consumption by various customer groups to project future consumption. An overview of HWC's forecasting approach is shown in **Figure 10**.



- **Figure 10: HWC's categorisation of customers in forecasting (HWC 2008c)**

The customer groups include residential, non-residential (commercial, industrial and special) and bulk water supply (GWWSA) customers. The non-residential customers are separated into two sub-categories based on their usage. HWC projects consumption of the major large non-residential customers by conducting a detailed review of individual customer's intentions. Forty major industries have been targeted as the major users of water and the details of existing and projected water usage rates of these users were used by HWC in developing the forecast. Further breakdown of the water consumption patterns of residential dwellings, based on date of construction, was carried out, as shown in **Figure 10**. Other factors have also been considered to forecast total supply requirements which include the growth in customer connections, water usage patterns, demand management and water conservation programs, and the impact of recycling and re-use schemes in both residential and industrial contexts.

The HWC consumption forecasting model is not an "end-use" type model. The HWC forecasting model does not attempt to model changes in volumes of water used in specific end uses by the consumer, but rather looks for overall trends for the various customer groups. HWC attempt to

account for changes in behaviour and technology through bulk volumes saved via individual demand management initiatives.

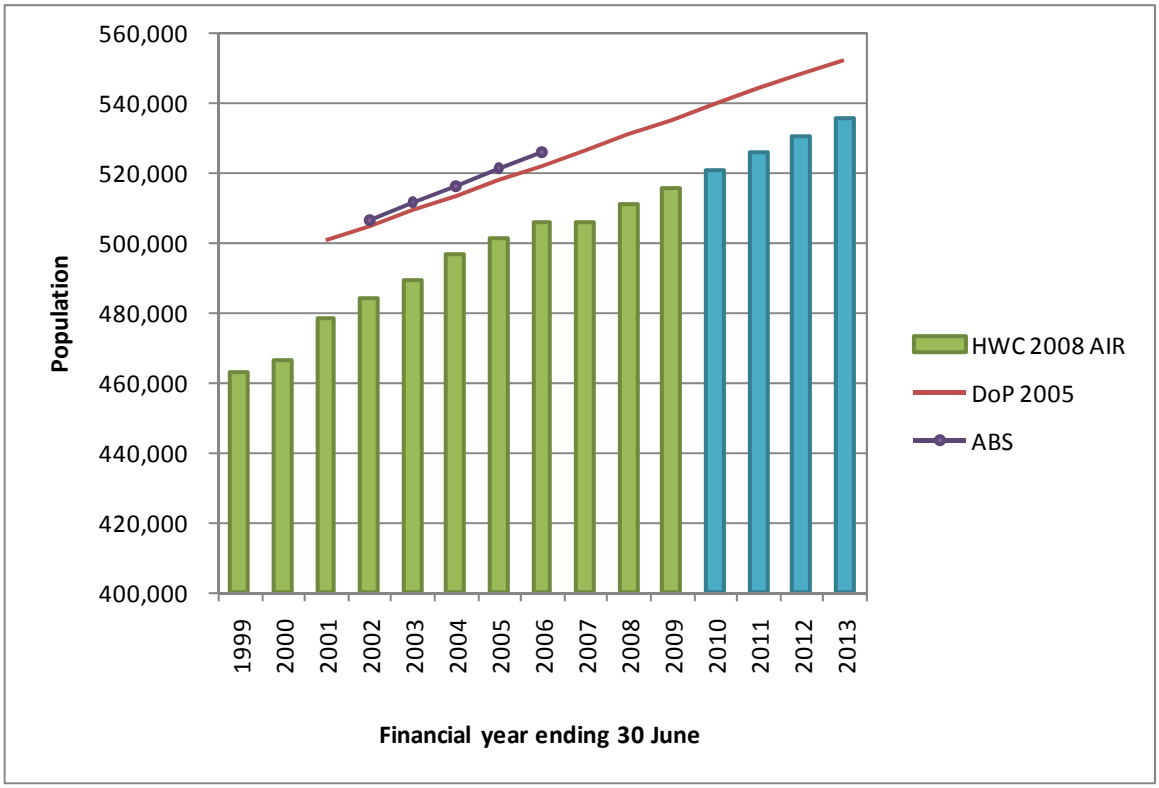
5.2.1. Input data

The forecasting methodology includes the use of projected population and dwelling data provided in the NSW Department of Planning (DoP) 2006 Regional Strategy, which stated that there will be an additional 160,000 people in the Lower Hunter region by 2031 which requires 115,000 new dwellings. The assumption for the future likely split between single density dwellings and units was made by HWC based on the approval information of residential developments in the last 10 years (HWC 2008c).

5.2.2. Review of historical and forecast population

Figure 4 shows HWC's historic and forecast population as indicated in the HWC's 2008 AIR and submission to the Tribunal. It also shows the combined population projection for the Newcastle, Lake Macquarie, Maitland, Cessnock, Dungog and Port Stephens Local Government Areas (LGAs) from the DoP and census data from the Australian Bureau of Statistics (ABS). Note that the population estimates from the DoP and ABS do not subtract the population within the LGAs not served with reticulated water.

The difference between the DoP and HWC estimates ranges from a 20,800 higher population in 2007 (DoP 4% higher) down to a 16,400 higher population in 2013 (DoP 3% higher). Both estimates have a similar growth rate for the determination period, with the DoP predicting 0.8% per annum, and HWC adopting 1.0% per annum.



- **Figure 4. Population served with potable water (HWC 2008c; DoP 2005)**

Figure 4 shows the actual population, as measured by the ABS, was close to the 0.8% predicted by the DoP.

5.2.3. Demand management programs

HWC has taken into consideration the reduction in consumption through demand management programs in their forecast. The demand management programs in **Table 1** are already in place in the region, and the estimated savings volumes shown in the table have been accounted for in HWC's model.

- **Table 1: Demand management programs in place before 5 year price path (HWC 2008c)**

		ML/a saved over the 5 year price path					
Component	**Demand Category**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**
BASIX	Residential	599	781	963	1145	1327	1509
Rainwater tank Rebate	Residential	10	10	10	10	10	10

		ML/a saved over the 5 year price path					
Component	**Demand Category**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**
Residential REFIT	Residential	165	165	165	165	165	165
Active Leak Detection (10%)	Unmetered Supplies	160	160	160	160	160	160
Water Main replacement	Unmetered Supplies	20	27	27	27	27	27
Water service replacement	Unmetered Supplies	110	130	150	170	190	210
Pressure Reduction	Unmetered Supplies	4	4	4	4	4	4
Leak Detection (25%)	Unmetered Supplies		191	191	191	191	191
BASIX Dual Reticulation	Residential		50	100	150	200	250
Total	**All**	**459**	**727**	**797**	**867**	**937**	**1007**

The demand management programs in **Table 2** have been newly introduced, and the volumes shown were also factored into the projected demand.

- **Table 2: Demand management programs in this 5 year price path (HWC 2008c)**

		ML saved over the 5 year price path					
Component	**Demand Category**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**
WELS	Residential	198	246	295	343	391	439
Smart Approved Water Mark	Residential	112	159	205	251	298	344
Department of Housing REFIT	Residential	207	207	207	207	207	207
Rainwater Tank Rebate	Residential	20	40	60	80	100	120
School Water Efficiency	Non-Residential		34	68	101	135	135
School Leakage Program	Non-Residential		30	60	90	120	150
Residential REFIT (envirosaver)	Residential	255	450	525	525	525	525
Total	**All**	**792**	**1166**	**1420**	**1597**	**1776**	**1920**

The rainwater tank rebate volume estimates are based on the uptake of the rebate increasing from 2,000 tanks to 3,000 tanks by the end of price path. The residential REFIT volume is based on projected residential (envirosaver) refits of 17,000 in 07/08 and 12,000 in 08/09 and 5,000 in 09/10.

HWC indicates that it has an annual community awareness campaign run in local media to encourage water conservation which is supported by ongoing promotional activities (HWC 2008b p.53). Hunter Water also participates in a number of community events, with displays and involvement at these events used to promote water efficiency (HWC 2008b p.53). No explicit allowance was made for this community education in their demand management estimates.

There are a number of other potential new programs that may be implemented by HWC within the determination period that are identified in the $H_2$50 Draft Plan proposed program summary, but were not included in the forecasting model (p. 112-113). According to HWC, if all the projects were to proceed, they could save over 1,400ML/a. The main savings are through pressure reduction, a business water efficiency program and promotion of water saving products. HWC may therefore be overestimating future water consumption by up to 1,400ML/a.

There are about 10,000 properties, or 5.5% of customers, in pressure reduced zones (implemented pressure management schemes) of HWC's distribution network (HWC 2008b, p.69). This figure was to be reviewed in the 2007/08 financial year via a Pressure Management Assessment Review. It is noted that HWC are assuming no increase in savings through pressure management (or targeted commercial demand management programs), despite their claim that "Hunter Water is always looking for new, innovative and cost-effective ways of improving the operation and management of the water distribution network" (HWC 2008b, p.66).

The introduction of users pays pricing for houses reduced water consumption by 10%-20%. It is understood that flats and units are currently charged according to the reading of a single water meter that measures total consumption. It is suggested a 10-20% reduction in water consumption for flats and units could be obtained if individual metering of units in multi-unit developments is introduced, since it makes tenant accountable for their individual water use. It is also more equitable and would encourage the conservation of water by all residential users, regardless of their accommodation. The expected reductions in water consumption warrant metering individual apartments, including retrofits, wherever possible. Despite this, individual metering is unlikely to be introduced to any significant extent within the current determination period, and so will not influence the consumption forecast.

5.2.4. High Water Users

HWC projects consumption of the major large non-residential customers by conducting a detailed review of individual customer's intentions and using historical water consumption trends. These large users are periodically reviewed as a group, and individual adjustments are made as information becomes available.

The main items of interest relating to the consumption forecast are:

- Delta EMD announced that closure of their Mayfield plant is to occur at the end of March 2008. The reduced demand of approximately 0.5GL/a has been incorporated into the forecast. No other major users are expected to close their operations over the next 5 years.

- The following major users are expected to start operating in the Hunter and have been included in the Top 40 Users;
  - Intertrade Industrial Park (formerly RLMC - Mayfield) is expected to start attracting businesses in 2011/12
  - The Newcastle Coal Infrastructure Group (NCIG) Coal Loading facility on Kooragang is expected to increase consumption
  - New employment lands in HWC area of operations totalling 825Ha is expected to gradually increase water consumption
- Other Non-Domestic Demand is expected to increase by 1,200 ML/a from 2007/08 to 2030/2031 as a result of growth in institutions, clubs, schools and other small non-domestic users.
- In June 2008, Hunter Water's area of operations was extended to include Dungog Shire. According to HWC, the additional billable retail water consumption as a result of this transfer is expected to be approximately 503 ML/a in 2009/10 growing to around 508 ML/a in 2012/13. However, this is offset by the equal loss of wholesale sale of water to Dungog Shire Council. HWC expects growth in connections in the Dungog LGA to be moderate (1% per annum), consisting mainly of infill connections in the townships supplied with water and a small rural residential subdivision at Paterson. A growth of about 30 meter equivalents is expected over the price period from around 2,415 meter equivalents in 2008/09 to around 2,445 in 2012/13.

5.2.5. Recycled Water Schemes

Recycled water schemes reduce potable water consumption but have a biased pricing arrangement. Recycled water charges are lower than potable in order to encourage usage, although recycled water is generally more expensive for the utility to produce.

Nevertheless, these schemes are supported because they:

- Defer water supply augmentation
- Reduce effluent discharge to waterways
- Have higher supply reliability than rainwater or stormwater harvesting
- Contains nutrients, reducing the needs for fertilizers in agricultural applications.

During 2006/2007, approximately 4,060 ML of recycled water was used in HWC's areas of operations, representing 8.3% of the dry weather wastewater flow loading entering HWC's wastewater treatment plants (HWC 2008b, p.74).

Currently, HWC have implemented the following recycled water schemes across the region (HWC 2008a):

- Kooragang Industrial Water Scheme (will be implemented by 2010, saving 3,000 ML/a of potable water)
- "Third Pipe" Dual Reticulation Systems in New Residential Developments (ultimate water savings in excess of 1,000 ML/a)
- Highly Treated Recycled Water to Industrial Customers
- Municipal and Rural Irrigation Using Recycled Water
- Wastewater Treatment Plants Internal Reuse
- Large Scale Regional Recycling Schemes

Details of each recycling scheme can be found in **Appendix B**.

The recycling schemes in **Table 3** are already in place in the region, and the estimated savings volumes shown in the table have been accounted for in HWC's model.

- **Table 3: Recycling schemes in place before 5 year price path (HWC 2008c)**

		ML/a saved over the 5 year price path					
Component	**Demand Category**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**
Wastewater Treatment Plant Reuse	Non-Residential	180	180	180	180	180	180
Golf Courses, bowling green and TAFE	Non-Residential	482	482	482	482	482	482
Industrial Reuse	Non-Residential	1393	1393	1393	1393	1393	1393
All	**All**	**2055**	**2055**	**2055**	**2055**	**2055**	**2055**

The recycling scheme shown in Table 4 will be introduced during the determination period, and the volumes shown were also factored into the projected demand. SKM note that the Koorangang Industrial Scheme will be save a considerable amount of water from 2010 onwards.

- **Table 4: Recycling schemes in this 5 year price path (HWC 2008c)**

		ML/a saved over the 5 year price path					
Component	**Demand Category**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**
Kooragang Industrial Scheme	Non-Residential				1497	2993	2993

The majority of reuse in 2006/07 was in agricultural applications (49%) for irrigation, which does not offset potable demand, and so is not included in the forecast model. This agricultural reuse volume is variable on a yearly basis due to climatic conditions. The next main reuse application was industrial reuse (34%) mainly for power generation at Eraring Power Station and coal washing. Other uses include process water within the wastewater treatment process and municipal reuse. Municipal reuse included reuse at golf courses, bowling greens, and a TAFE campus (HWC 2008b, p.74).

HWC's recycled water programs are constrained by the proximity of users to the sewage treatment works since the cost of pipelines to transport the effluent is often prohibitive.

5.2.6. Unaccounted for water (UFW)

The UFW (non-metered usage) is the difference between total supply and total metered consumption (including non-revenue metered consumption), which can be separated into the following:

- Meter inaccuracy (bulk supply and customer meters),
- Leakage, breaks, overflows and water loss
- Authorised and unauthorised non-metered usage

Growth in non-metered usage will occur as a result of increasing number of connections and length of watermains in the water supply system, as well as normal system deterioration.

HWC did not provide a forecast of real losses, such as leakage. Rather they assumed a constant unmetered volume of 10.3GL/a for the determination period.

HWC indicates that it has been carrying out other specific programs for water loss minimisation for many years. Details of the system water loss strategies that are currently being used by HWC to control losses from the water distribution system can be found in the Appendix A.

As shown in **Table 1,** HWC assumed that each year leakage reduction through water service replacement will save an additional 20ML/a. It did not assume increases in savings for any of its other water loss minimisation programs. SKM assume HWC may be underestimating the volume of water it will save through leakage reduction, since it states in its H250 report (p.65) that "Hunter Water is always looking for new, innovative and cost-effective ways of improving the operation and management of the water distribution network". Pressure management can also reduce customer leakage, and so could slightly reduce the pressure related leakage and metered

consumption if the areas under pressure management are increased. Despite this, the effect of this underestimation on overall consumption is likely to be small (less than 0.1% per annum).

5.2.7. Climatic conditions and trends

Temperature has an important influence on year-to-year variations in water consumption, but this factor has not been explicitly taken into account in HWC's forecasting methodology. Evaporation has a significant impact on water use in detached houses through garden irrigation. Temperature also has an impact on water use in commercial and industrial buildings through the use of evaporative air conditioners and some outdoor water usage.

SKM believes that the inclusion of climate correction based on past consumption against rainfall, evaporation and temperature records in HWC's forecasting methodology would improve the robustness of their forecast in predicting consumption under "average" climatic conditions. This involves separating the climate independent component of water consumption from the climate induced water consumption component in the historical data. This would allow a more robust prediction of the climate independent component for the price determination period.

There is no allowance for climate change in the water consumption forecast for the next 5 years. This is reasonable, since the impact of climate change will be negligible. Natural variability in weather is expected to be the dominate climate driver over the next 5 years.

5.2.8. Water Pricing

The recent water consumption for the Hunter is under a volumetric, user pays pricing system. The introduction of users pays pricing by HWC reduced water consumption by 10%-20%. It also resulted in a reduction in the price elasticity of consumption for water, particularly for indoor water use, which is less discretionary. This means that further increases in price will have less of an impact on water consumption.

The proposed volumetric prices in HWC's 2008 IPART submission are shown in **Table 5**. This price increase will result in an increase of $162 in real terms for the water usage charge over the period of the determination for a typical customer who consumes 200kL/a.

- **Table 5: Proposed pricing ($08/09) (HWC 2008a, p.93).**

	2008/09	2009/10	2010/11	2011/12	2012/13
Base price ($/kL)	1.27	1.63	1.77	1.94	2.08

HWC's water consumption forecast included an adjustment to take into account the proposed increase in the price charged for water over the next determination period. HWC have assumed this 64% increase in price will result in a 0.5% reduction in overall water consumption (HWC 2008, Demfor Model). This relatively small reduction occurs since HWC only applied the price response to residential customer's outdoor usage. SKM suggest that it would be appropriate to extend the price response across other customer groups.

5.2.9. Restrictions

HWC's water consumption forecast has not been adjusted to take into account of expected restrictions and seasonal influences on water consumption. This is not significant, since SKM's assessment of yield and storage levels indicate that the probability of entering restrictions over the next 5 years is less than 1%.

5.2.10. Economic Indicators

Economic indicators such as per capita income have not been considered in HWC's water consumption forecast, although it is known that higher water usage occurs in larger households with higher income levels.

5.2.11. Bulk Water Supplies

Transfers between HWC and the Central Coast

HWC has been supplying water to the Central Coast since 2004/05 due to very low levels in the Gosford/Wyong's dam storages. In December 2006, the link between HWC and the Central Coast was augmented to increase the transfer capacity to 27 ML per day and again in March 2008 to provide transfer capacity of 35 ML per day (12,700ML/annum). The amount of water transferred each day to the Central Coast is determined by the relative storage levels in the two systems (HWC 2008b, p.45).

There are no hard rules for transfers between the Hunter and the Central Coast, but preliminary guidelines are:

- Water is transferred from the Hunter to the Central Coast if the GWCWA storages are lower than the HWC storages. Opportunistic transfers south occur if the GWCWA storages are less than 70% and more than 2.5% below the HWC storages. More water is transferred south if the GWCWA storages are less than 60% and more than 7.5% below the Hunter storages and Mardi Dam is less than 80%.
- Transfers north occur if the HWC storages are below the GWCWA storages. Opportunistic transfers north are made if water is spilling at Lower Wyong and HWC storages are below 70% in order to delay the onset of HWC restrictions. Water is transferred north if the Hunter region is under restrictions and GWCWA storages are more than 7.5% higher than the Hunter storages.
- There is a 5% no transfer gap when the HWC and GWCWA storages are close to, or equal to one another, in order to avoid frequent transfers.

HWC estimates that there will be an average transfer to Gosford/Wyong of 500 ML/a for the period 2009-2013 (HWC 2008a, p.30). However, stochastic modelling undertaken by Afton Water Solutions for Gosford Wyong Council Water Authority indicates that the average transfer to the Central Coast over the next 5 years is likely to be 2,000 ML/a to 3,000ML/a. and therefore suggest HWC is underestimating the volume of bulk transfers to the Central Coast.

The Gosford/Wyong Water Plan 2050 indicates that the Gosford/Wyong water supply system will be upgraded to provide for growth, but will still rely on supply from HWC for drought security. Gosford/Wyong's dependence for drought security has been factored into the calculation of the reliable system yield. A working party comprising representatives from Gosford and Wyong Councils and Hunter Water has been established to further consider long term drought security requirements (HWC 2008b, p.45-46).

Transfers between HWC and the Singleton

Opportunities are being investigated for a strategic water supply link with Singleton. According to HWC, the most likely supply arrangement would be to transfer 5ML/d in non-peak demand periods (300 days/annum) (HWC 2008). The total estimated supply of 1.5GL/a could commence around 2014/2015.

5.2.12. Residential Consumption Forecast and Assumptions

HWC breaks down the residential dwellings into "houses" and "units" categories with different consumption patterns due to differences in dwelling demographics and external water usages.

Water consumption per dwelling is predicted to decline in the approaching price period. The implementation of BASIX water efficiency improvements (such as water efficient shower heads, toilets and tap fittings) and installation of rainwater tanks in new development will have the effect of reducing the per-dwelling consumption in the 5 year period (HWC 2008c).

HWC have determined that new house connections since 1989 have had a typical consumption of 265 kL/a and flats/units have had a consumption of 130 kL/a. No explanation was provided on how these values were derived. The meter reading data or billing records of HWC corporate database can be analysed to determine water consumption rate for houses and units built post 1989. It is assumed HWC used such an approach to determine these consumption rates. SKM did not assess the accuracy of these values, or review the method by which HWC determined them.

HWC uses the following water consumption values for the new developments under BASIX requirements (post 2005):

- Houses with Rainwater Tanks = 195 kL/a (26% reduction)
- Houses with Dual Reticulation = 165 kL/a (38% reduction)
- Flats/Units = 95 kL/a (27% reduction)

Under BASIX, new single density dwellings should reduce their water consumption rate by 40% from the baseline level. This results in a requirement of a maximum potable water consumption of 148L/p/d. With an occupancy rate of 2.5 persons /dwelling, the consumption for new dwellings would be below 135kL/dwelling/a. With an occupancy rate of 3persons/dwelling, the consumption for new dwellings would be below 162kL/dwelling/a. The reason HWC provided for using estimated consumptions per dwelling that are higher than BASIX requirements was that they believe 6% savings attributed to the use of water efficient toilets is not appropriate, since dual flush toilets were already present within the BASIX baseline figure (Geoffrey Dyce, HWC, personal communication, November 2008). HWC stated they are monitoring the water consumption of properties under BASIX to obtain a best estimate of savings, and this is reflected in the values used. No details of this analysis were documented to support this claim. Despite this, this assumption is only applicable to growth of approximately 4,000 dwellings per annum. Overall, this discrepancy is not significant.

The third pipes or dual reticulation networks for recycled water will be provided in three major development sites with an estimated ultimate 12,000 dwellings (HWC 2008b, p.45). The major development sites include:

- Thornton North (ultimate 5,000 dwellings)
- Gillieston Heights / Cliftleigh (ultimate 4,000 dwellings)
- North Cooranbong (ultimate 3,000 dwellings)

HWC's assumptions for connection to dual reticulation at these sites are shown in **Table 6**.

Table 6. Dual reticulation connection (HWC 2008c)

Year	Dual reticulation connections
2009	50
2010	534
2011	1,018
2012	1,502
2013	2,081

Table 7 shows HWC's breakdown of the residential consumption forecast over the next 5 years. It shows how house construction date, dual reticulation, rainwater tanks and other demand management has been factored into the total residential consumption forecast.

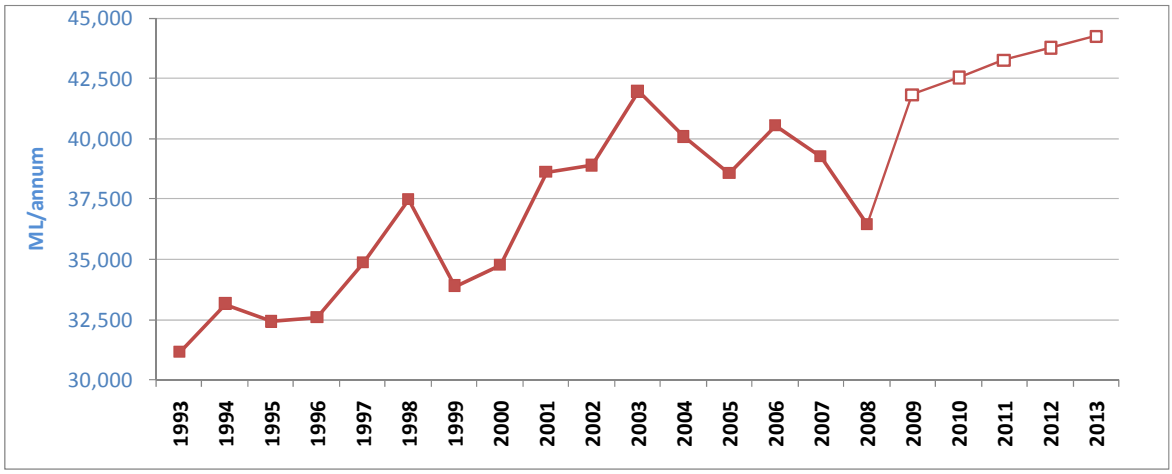
- **Table 7: Residential Consumption Forecast Breakdown and Assumptions (HWC 2008c)**

		2008*	2009	2010	2011	2012	2013
Pre 1989 house annual consumption	kL/a	201	201	201	201	201	201
Pre 1989 houses	No.	130664	132829	132829	132829	132829	132829
1989 - 2005 house annual consumption	kL/a	265	265	265	265	265	265
1989-2005 houses	No.	33544	33544	33544	33544	33544	33544
Post 2005 annual consumption - rainwater	kL/a	195	195	195	195	195	195
Post 2005 houses with rainwater tanks	No.	5533	7961	10002	12089	14224	16312
Post 2005 annual consumption - dual reticulation	kL/a	165	165	165	165	165	165
Post 2005 houses with dual reticulation	No.	50	534	1018	1502	2081	2660
Pre 2005 Flats and units annual consumption	kL/a	130	130	130	130	130	130
Pre 2005 Flats and units	No.	31813	31813	31813	31813	31813	31813
Post 2005 Flats and units annual consumption	kL/a	95	95	95	95	95	95
Post 2005 Flats and units	No.	3908	5243	6602	7986	9396	10833
Demand Management savings		-792	-1102	-1291	-1406	-1520	-1635
Total Residential Consumption	ML	39949	40786	40994	41560	42041	42522

*Estimated figures based on average climate conditions – not recorded

The upward trend in residential water consumption over the last 20 years is predicted to continue as the population increases at about 1% p.a. With the increasing population expected in the Hunter Region over the next 25 years, HWC is forecasting a continuation in the growth of residential consumption, partially moderated by BASIX, residential reticulated recycling schemes and other efficiency measures (HWC 2008c). This is reflected in **Figure 5**. The step change in consumption between the year 2008 and 2009 is based on an assumed return to average climate conditions.

Figure 5 also shows the predicted increase in consumption between 2007/08 and 2008/09 due to the assumption of return to average climate.

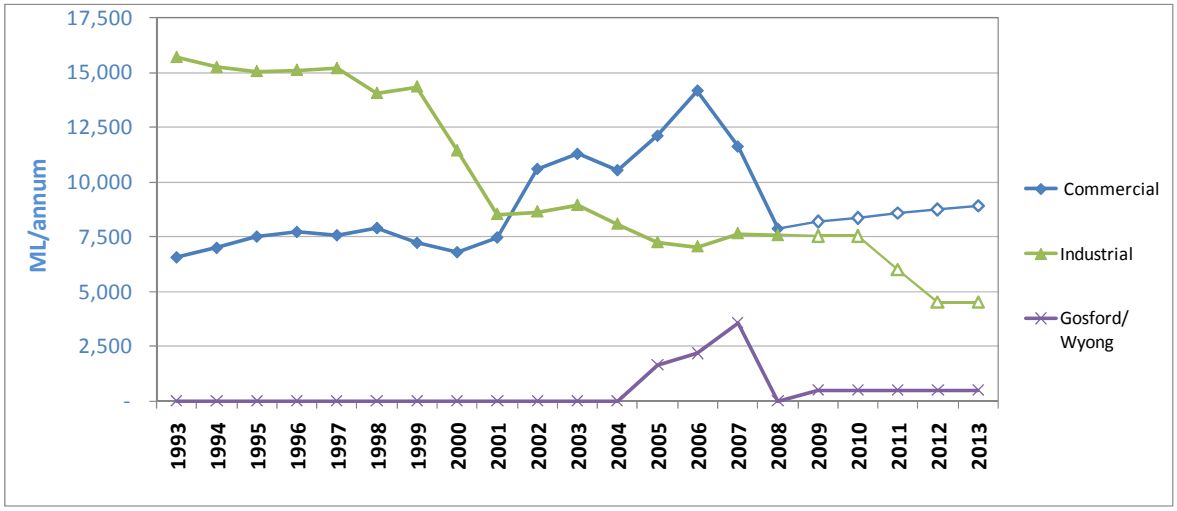


- **Figure 5: Historic and Forecasted residential consumption (HWC 2008d)**

5.2.13. Non-residential consumption forecast

HWC separates non-residential customers into 2 sub-categories, a customer group requiring greater than 2,000 kL/a and a group requiring less than 2,000 kL/a. HWC projects the demand of the major large non-residential customers by conducting a detailed consultation and review of individual customer's intentions. Historical trends, recycling schemes and demand management programs are taken into consideration during this review. HWC expects non-residential demand to remain relatively stable or declined to some extent, as shown in **Figure 6**. This is mainly due to the Kooragang industrial recycled water scheme, which is predicted to recycle 3,000ML/a in 2012 and 2013, and additional water efficiency gains which are included in HWC's forecast model. These schemes, when completed, are expected to keep non-residential demand at or below the current demand for the next 20 years (HWC 2008).

HWC's non-residential demand assumes growth for the sub-2,000kL/a group demand will match the population growth rate of 1.0% per annum.



- **Figure 6: Historic and forecast non-residential consumption (HWC 2008c)**

5.2.14. Summary of factors affecting water consumption

HWC's consumption forecasts take into account an estimate of future dwelling statistics, long term trend in residential use, demand management programs and government policy. **Table 8** shows which of the factors that affect water demand were included in HWC's forecast methodology.

- **Table 8: Factors that affect water demand used in HWC's forecast**

Potential Driver	Considered in forecast
Population	Yes
Housing Occupancy Rates	Yes
Measures of commercial and industrial development	Yes
Consumption trends for high water users	Yes
Long-term trends in water consumption	Yes
Demand Management Programs	Yes
Government Policy (BASIX)	Yes
Water recycling	Yes
Climatic conditions and trends	No
Water pricing	Yes
Restrictions	No
Economic indicators, such as per capita income	No

5.2.15. Assumptions

The following are key assumptions made by HWC:

1. The size of HWC's customer base was calculated based on the number of potable water billing accounts. HWC's forecasting model uses the "household" as the unit for calculation of residential consumption.
2. Assumed that houses built pre 1989 have an average water consumption of 201kL/annum.
3. Assumed that houses built 1989-2005 have an average water consumption of 265kL/annum.
4. Assumed that houses built post-BASIX (2005), and with a rainwater tank, have an average water consumption of 195kL/annum.
5. Assumed that houses built post 2005, and with a dual reticulation connection, have an average water consumption of 165 kL/annum.
6. Assumed that flats and units built pre 2005 have an average water consumption of 130kL/annum.
7. Assumed that flats and units built post 2005 have an average water consumption of 95kL/annum.
8. Assumed annual growth in population of 1.0%.
9. Assumed 65% of residential properties are houses and 35% are flats and units.
10. A spreadsheet model was used to predict consumption using housing categories as variables
11. Non-domestic consumption is expected to increase by 200 ML/annum as a result of growth in institutions, clubs, schools and other small non-domestic users. This is equivalent to a non-domestic growth rate of 1.0% per annum, in-line with the population growth rate.
12. The number of future dual reticulation customers at Thornton North, Gillieston Heights / Cliftleigh and North Cooranbong will total 2,000 connections by 2013.
13. The supply of recycled water to industrial customers in the Kooragang industrial Water Recycling Scheme is expected to result in offsetting potable water consumption commencing in 2011/12. The reductions in potable consumption are expected to by approximately 3,000 ML/a.
14. Additional pressure reduction, business water efficiency programs and water saving products promotional programs will not proceed.
15. Assumed transfers to Gosford/Wyong of 500ML/a, until 2012/13.
16. Increased uptake of rainwater tanks based on increases to government rebates.
17. Inclusion of savings from external water efficiency programs (envirosaver showerhead refits)
18. Inclusion of price elasticity consumption response for external water use of existing customers. A price elasticity coefficient of -0.10 has been assumed. Under this factor a 10% increase in

price results in a 1% decrease in consumption. The response to increase in price was assumed to only apply to the discretionary outdoor usage of residential customers.

19. Recent decline in residential consumption is a result of short-term climatic conditions, specifically a cooler and wetter summer in 2007/08. A permanent shift in usage behaviour is not observable (either small or non-existent).
20. Constant 10,300 ML/a unmetered supply over the determination period.
21. Supply of 1,500 ML/a to Singleton will not commence until 2014/2015, hence not within the determination period under review.
22. Demand management programs targeting domestic and non-domestic users (excluding BASIX) are expected to result in savings of up to 6,100 ML/a.
23. No demographic or socio-economic variables were included in the forecast model.
24. Change in income level among HWC's residential customer base have not been explicitly considered.
25. Natural variability in weather is expected to dominate any variation in rainfall and evaporation due to climate change within the determination period. Hence, there is no allowance for climate change in the water consumption forecast.
26. Estimated savings through demand management are subtracted from the "un-managed" metered consumption forecast in order to arrive at the final estimate of future metered consumption.
27. Changes in annual number of tourists are not explicitly considered. Potentially contained within the "commercial" demand forecast.
28. The trend towards increasing appliance efficiency is anticipated to continue into the future and will result in changes in household water use.
29. Pressure reduction and leak repair will result in a 20ML/a reduction in leakage.
30. Since HWC has not imposed water restrictions in the past, water meter data from a period without water restriction was the used to calculate a per capita potable water consumption (L/p/d).

5.3. Summary

HWC's approach to water consumption forecasting takes a top-down approach and is based on a spreadsheet model. Input data includes:

- Historical water meter data
- Population growth projections
- Consultation with high water users

- Estimates of future savings through demand management
- Predicted volumes of recycled water
- Predicted volumes of bulk water transfers

HWC's forecasting method involves splitting historical consumption into user categories and analysing each separately. This is a reasonable methodology and appears to use the best available data.

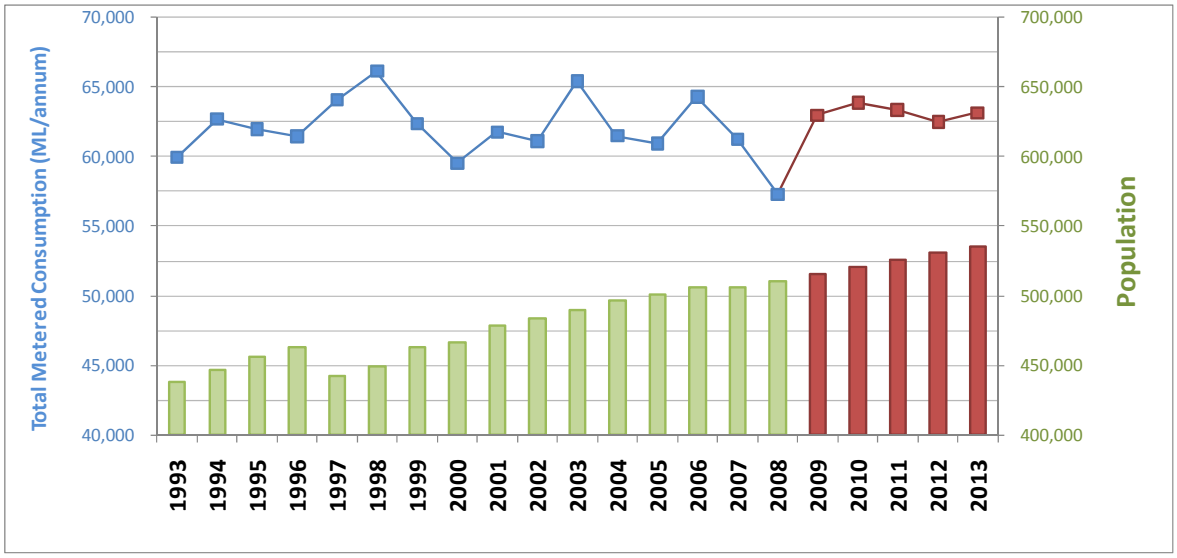
The main deficiency of their analysis is that it does not account for the effect that climatic conditions have on annual or seasonal consumption, which is known to be significant. A climate correction of the historical consumption record could improve the reliability of the forecast.

Other potential deficiencies in HWC's methodology include: underestimating the response to the proposed price increase, and underestimating of the volumes saved through leakage reduction. The HWC method did not include economic indicators (which can be key drivers of consumption trends) in their water consumption forecast, but this is not expected to have significant effect.

6. Forecasted Water Consumption

6.1. Water Consumption Forecast

HWC have estimated that the water consumption over the approaching determination period of 2009-13 will range from 62,480 ML/a to 63,840 ML/a, as shown in **Figure 7** (HWC 2008c). The step change in consumption for the year 2009 is largely due to an assumed return to average climatic conditions. The increase also includes a provision for growth in domestic and non-domestic consumption.



- **Figure 7. Historical and forecast water consumption (HWC 2008c)**

Table 9 shows that HWC attribute the stability in their water consumption forecast to the increase in water consumption through the increase in population being offset by a decline in non-residential consumption. It is agreed that with increasing number of dwellings, there will be an increase in residential water consumption over the next 5 years.

Table 9. Breakdown of the current forecast by customer type

		Financial Year Ending 30 June (ML)							
Source	**Units**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
HWC Submission 2010-13 [c]	ML/a					63,843	63,340	62,479	63,178
Residential Consumption [c]	ML/a	40,554	39,239	36,428	41,860	42,515	43,268	43,761	44,284
Non Residential Consumption [c]	ML/a	23,739	22,026	20,866	21,169	21,328	20,072	18,718	18,894
Total [c]	ML/a	64,293	61,265	57,294	63,029	63,843	63,340	62,479	63,178
Population [c]		505,719	505,712	510,703	515,695	520,687	525,678	530,670	535,662
Residential Connections [c]		208,022	212,394	215,819	219,620	223,503	227,458	231,487	235,590
Non Residential Connections [c]		12,668	12,048	12,493	12,500	12,500	12,500	12,500	12,500
Total Connections [c]		220,690	224,442	228,312	232,120	236,003	239,958	243,987	248,090
Household consumption [c]	kL/property/a	195	185	169	191	190	190	189	188
Per capita Residential Consumption [c]	L/c/d	220	213	195	222	224	226	226	226
Per capita Total Consumption [c]	L/c/d	348	343	318	345	346	350	350	351
Non Res Consumption per property [c]	kL/property/a	1,874	1,994	1,830	1,854	1,866	1,910	1,921	1,936

a. Hunter Water Corporation

b. Hunter Water Corporation, Submission to IPART on prices to apply from 1 July 2009, October 2008, Appendix A1.

c. Hunter Water Corporation, 2008d, Annual Information Return

6.2. Assessment of forecast

SKM has undertaken an assessment of HWC's water consumption forecast with the following aim:

- suitability and validity of data for the intended purpose
- adequacy and completeness of data
- data collection methodology and sources
- quality and reliability of data
- methodology for data analysis

The following sections will outline the comments made on the robustness of the assumptions used in the consumption forecasts, based on a desktop review of available information.

6.2.1. Dwelling statistics

The HWC forecasting methodology is based on DoP's projected population over the price determination period. The information is considered to be the best available and reliable for projection of water consumption.

Past trends indicate the proportion of single density dwellings in the Hunter region is declining and the proportion of units is increasing. This upward trend is expected to continue which will reduce per capita consumption and subsequently, the consumption forecast. HWC assumed 65% of the growth will be in houses and 35% in units. This is reasonable, and within the long-term average ratio.

6.2.2. Review demand management programs

SKM carried out a qualitative evaluation of demand management programs, initiated by either HWC or state or federal governments, which would have potential to affect the consumption over the forecasted period. We qualitatively considered the implications of the demand management program on consumption forecasts, and checked an allowance for reduction in consumption had been included in the HWC's forecast.

There are a number of other potential programs that may be implemented by HWC within the determination period, but were not included in the forecasting model (HWC 2008b, p.112-113). According to HWC, if all the projects were to proceed, they could save over 1,400ML/a. The main savings are through pressure reduction, a business water efficiency program and promotion of

water saving products. HWC may therefore be overestimating future water consumption by up to 1,400ML/a.

HWC states in its $H_2$50 Plan that HWC are always looking for opportunities for further leakage reduction, but no increase in savings was assumed in the forecast.

The estimate of volume of potable water saved through residential water recycling and demand management initiatives is shown below in **Figure 8**. Considering the total forecasted water consumption is about 62,000 ML/a, the savings make up on average 7% per annum, and so small inaccuracies in predicted volumes will not significantly influence the overall water consumption forecast.

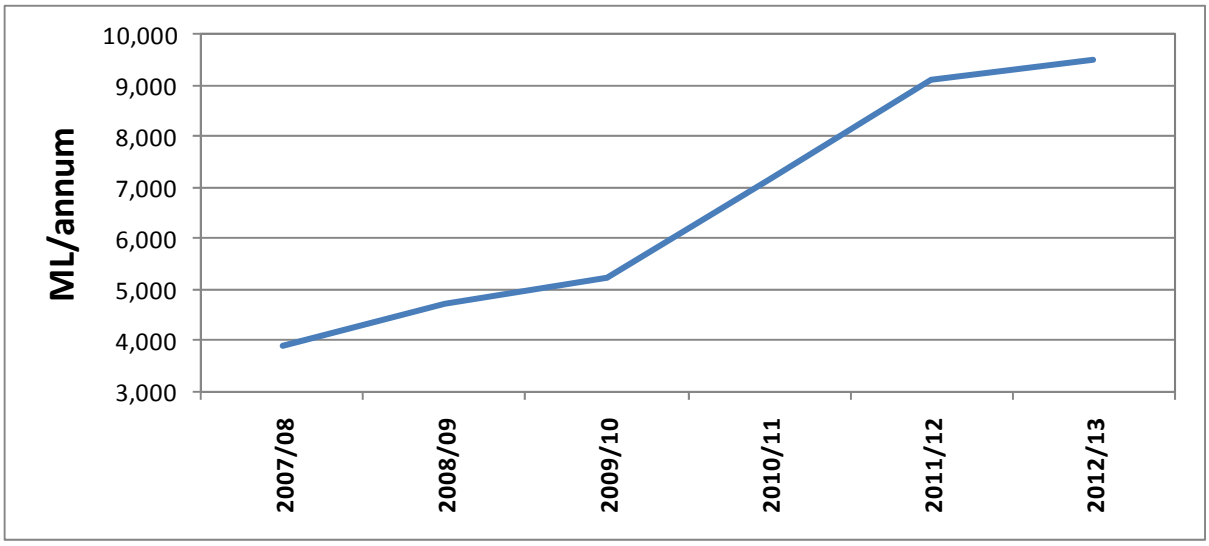


Figure 8. Savings attributed to demand management programs (HWC 2008c)

The reductions achieved through demand management will depend upon the level of commitment from residents, businesses, local government, community groups, HWC and the state government, but the level of commitment is not predicted to change significantly during the determination period, and so will have little influence on the consumption forecasts.

6.2.3. Prediction of future water recycling initiatives

SKM reviewed the influence of HWC's recycled water programs on consumption forecasts, which are provided in Table 10. These details have been checked to evaluate this volume of water was appropriately accounted for in the consumption forecast.

SKM consider there is increasing public acceptance and even encouragement for water recycling schemes, and so the extent of recycling schemes is likely to increase over time.

SKM consider it likely that existing schemes will continue, regardless of dam storage levels, and so will continue to reduce the demand per dwelling.

The only new water recycling saving is obtained through the Kooragang Industrial Reuse Scheme. This industrial reuse scheme has yet to be implemented. Once implemented, it will reuse approximately 3,000ML/a, and so it will, as intended, significantly reduce potable water consumption. The forecast may therefore be sensitive to delays in connection to some of the larger customers. It is anticipated that that the scheme will be commissioned by early 2011.

- **Table 10: Savings from Recycling Initiatives in the 5 Year Price Period (HWC 2008c)**

	2008	2009	2010	2011	2012	2013
Savings (ML/a)	6	60	114	1665	3226	3291

6.2.4. Impact of Bulk Supply to Gosford/Wyong

The volume of water transferred between the Hunter and Central Coast is dependent upon the relative storage levels in the two water supply systems, which is dependent upon climate. Allowing for the current storage levels, average demand and average rainfall and runoff conditions HWC estimate a net transfer of 500 ML/a to Gosford/Wyong for the determination period of 2009-2013 (HWC 2008a, p.30).

Stochastic modelling undertaken by Afton Water Solutions for the Gosford Wyong Councils Water Supply Authority estimated that the average annual transfers to the Central Coast during the determination period may be as high as 2,000ML/a to 3,000ML/a. However, recent behaviour suggests that the lower figure adopted by HWC is reasonable.

6.2.5. Non-metered supply

SKM finds that existing water loss minimisation initiatives play a significant role in reducing non-metered supplies in the Hunter region. A slight growth in non-metered usage was observed as a result of the growth in connections and water mains in the water supply system. SKM agrees with HWC's assumption that the natural growth in non-metered usage will be offset by water loss minimisation programs such as active leakage detection, pressure reduction, and mains replacement.

6.2.6. Prediction of impact of future pricing changes

HWC included a small reduction (0.5%) in their consumption forecast for the expected impact of their proposed price structure. Since they used a small price elasticity factor (-0.1), and only applied it to outdoor residential usage, they may be under-estimating the impact of price increases.

6.2.7. Prediction of future water restrictions

With such low probability of restrictions within the determination period it is reasonable for HWC to not include any effect of restrictions in their water consumption forecast, even though restrictions can have a significant impact on discretionary use of water and in non-residential uses.

6.2.8. Summary of Discrepancies

Table 11 summarises the differences in HWC's and SKM's input assumptions.

- **Table 11.**

Factor	HWC	SKM
Existing Community Education	Possible underestimate	
Additional Demand management (ML/a)	Nil	1,400
Bulk water transfer (ML/a)	500	Difficult to anticipate
Future water pricing	Possible underestimate	

7. Summary and Conclusions

7.1. Summary

SKM has found that the general water consumption forecast was reasonable and within historical bounds. Key findings are:

- The data and information used by HWC in developing its water consumption forecast included: HWC's historic water meter data; customer billing data; and the DoP's forecasted population and dwelling data for the lower Hunter Region. SKM believe these are reasonable inputs to water consumption forecast.
- The methodology employed by HWC to develop the water consumption forecasts was to split historic consumption based on customer type and construction date of residential dwellings. In this way HWC could incorporate the various trends for each customer group, including benefits from demand management and water loss minimisation programs into the water consumption forecast. Overall, it was a suitable approach for the region's water consumption forecast.
- The step change in estimated consumption for the year 2009 due to a return to average climate conditions is considered to be reasonable.
- The bulk transfers between HWC and the Central Coast is climate dependent and can range from 0 to 12,800 ML/a. HWC forecast an annual transfer to the Central Coast of 500ML/a during the determination period. Stochastic modelling undertaken by Afton Water Solutions for the Gosford Wyong Councils Water Supply Authority estimated that the average annual transfers to the Central Coast during the determination period may be as high as 2,000ML/a to 3,000ML/a. However, recent behaviour suggests that the lower figure adopted by HWC is reasonable.
- The current method does not account for the impact of climate on annual consumption. Inclusion of a quantitative allowance for climate impacts would improve the robustness of the estimates.
- 2007/08 had lower than average temperatures and above average rainfall, and SKM agree with HWC's assertion that this contributed to a lower water consumption.
- HWC may be underestimating the reduction in consumption that will occur through the proposed price increases, since they do not apply any reduction to internal residential or non-residential consumption.
- HWC may be underestimating the reduction in consumption that will occur through new demand management programs. According to HWC, there is scope for additional water savings which increase up to 1,400ML/a by 2013/14. The main savings are through pressure reduction, a business water efficiency program and promotion of water saving products, but it

will depend on which projects are implemented, when they are implemented, and their effectiveness.

- HWC may be underestimating the reduction in consumption that may occur through pressure management, since it will reduce both non-metered and metered consumption. HWC states in its $H_2$50 Plan that HWC are always looking for opportunities for further leakage reduction, but no increase in savings was assumed. Despite this underestimation of potential savings through pressure management, the effect of this on overall consumption is likely to be small (less than 0.1% per annum).
- Water restrictions were not included in the water consumption forecast as they are unlikely to be applied during the determination period. Although restrictions can have a significant impact on discretionary use of given the current storage levels. Stochastic modelling by SKM indicate a 99.1% probability that there will be no restrictions in the next 5 years.
- Assumptions for water savings from demand management and water conservation programs have been forecasted to increase over the 5 year period. This is found to be appropriate as the number of households participating in these programs is expected to increase.
- Through an interrogation of HWC's calculation spreadsheet, SKM determined that HWC's forecasting methodology was applied appropriately. The figures have been correctly calculated and all factors included in the methodology were taken into account in the forecast.
- There was a suitable balance between historical trends and key drivers in generating the forecasts. HWC used a proper balance of their historical consumption data along with key drivers such as savings from demand management, population growth, increase in dwellings and savings from demand management programs to generate the forecast.

7.2. Conclusions

HWC have estimated that the water consumption over the approaching determination period of 2009-13 will range from 62,480 to 63,840 ML/a. The estimate during the determination period includes the effect of growth in domestic and non-domestic consumption, the effect of various water saving initiatives and water recycling schemes and a return to average climatic conditions. The step change in estimated consumption for the year 2009, due to climate adjustment, is considered to be reasonable. The implementation of additional demand management measures, not accounted in the estimates, may reduce consumption during the determination period. However, these differences are small and within the margin of error of the estimate. In conclusion SKM have assessed that the consumption estimates prepared by HWC are within 1 or 2% of the true climate adjusted consumption. We therefore recommend that the HWC estimates be adopted.

8. References

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Hunter Water Corporation, 2008c, Demfor model, v7. The spreadsheet model used by HWC for demand forecasting.

Hunter Water Corporation, 2008d, Annual Information Return

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Appendix A Existing Water Loss Minimisation Initiatives

The following sections detail the different programs in place to minimise water losses in the Hunter Water region.

Pressure Management

The main objective of pressure management is to reduce water loss from leaks that are difficult to locate and usually are very small by optimising system pressure. It also assists in reducing the number of water main breaks and can extend the life of piping. The Windale PRV zone was selected for a pressure management trial in 2004-05 as it had a considerable level of night flow and a significant history of breaks. As a result of pressure reduction, a reduction in night flow of about 16% was observed, representing a recovery of 4 ML/a . The reduction in pressure has directly resulted in a reduction of leakage in the Windale zone (HWC 2008b).

Water Service Replacement Program

In the past, small diameter galvanised iron pipe was used to connect the water main to the customer's water meter. This part of the water service is owned by customers. Many of these pipes have currently reached the end of their serviceable life and are deteriorating to the point where they have become a source of leakage. HWC undertakes this work as a direct leak minimisation initiative even though these services are the responsibility of the property owner. This program resulted in savings of about 110 ML over 2007-08 and has been found to be relatively cost effective (HWC 2008b)..

Water Main Replacement Program

This program is intended for water mains that have a history of breaks and leaks. In this financial year (2007-08), 13.3km of pipes were replaced. The replacement have been undertaken in accordance to an economic evaluation model based on the economic trade off between continuing maintenance versus replacement of main lengths with a history of breaks or leaks. This model also takes into consideration other factors such as disruption to customers caused by main failure and repair and the cost of water losses. The estimated savings from this program is about 20 ML/a (HWC 2008b).

Active Leakage Control

This initiative aims to assess the level of leakage though flow monitoring which will result in the development of targeted approach for a leak detection survey. The program is considered as an 'early intervention' of leakages and aims to identify leaks before they would normally be reported (HWC 2008b).

Leak Detection

Leak detection technology has developed extensively in recent years with the application of acoustic loggers, which has permitted a considerable reduction in the time and cost of leak detection. This has been done by focusing skilled operators (ie. using acoustic listening devices) into areas of known leakage. Over the past three financial years, large studies have been performed in Newcastle (2005-06), the western side of Lake Macquarie (2006-07) and the Coalfields areas of Kurri Kurri and Cessnock (2007-08). The 2007-08 study identified and repaired 102 leaks in 500km of water mains saving about 183 ML/a of water (HWC 2008b).

Appendix B Water Recycling Schemes

Kooragang Industrial Water Scheme

The first scheme to gain approval in the Recycled Water Strategy was the Kooragang Industrial Water Scheme. This scheme is for industrial customers in North Mayfield and Kooragang Industrial precincts, replacing 3,000 ML/a of potable water use. Design for the scheme has commenced and Hunter Water has been liaising with a number of potential customers. Initial enquiries have demonstrated a significant demand for the recycled water product.

The scheme will involve provision of an advanced treatment plant, utilising a dual membrane process, to produce a high quality, low salt, recycled water product suitable for use in various industrial processes as well as pipelines and pumping stations for the distribution of the product. The recycled water plant will utilise all of the dry weather effluent produced from the Shortland Wastewater Treatment Plant in the production of high quality recycled water. It is anticipated that the concept design and environmental impact assessment will be completed by late 2008 and that the scheme will be commissioned by early 2011(HWC 2008b).

"Third Pipe" Dual Reticulation Systems in New Residential Developments

Hunter Water will develop residential dual reticulation schemes in green field sites where supported by developers and/or local government. This is in response to the NSW Government's Building Sustainability Index (BASIX) requirements. Dual reticulation schemes are currently being pursued in Thornton North, Gillieston Heights, Cliffleigh, and North Cooranbong. At full development, these schemes could deliver annual potable water savings in excess of 1,000 ML/a (HWC 2008b).

Highly Treated Recycled Water to Industrial Customers

The key elements of the strategy for industrial recycling are:

- Implementation of Kooragang Industrial Water Scheme for potential customers in North Mayfield;
- Kooragang Island industrial precincts;
- The maintenance of the existing industrial supply agreements; and
- Watching brief on possible demands such as proposed industrial developments at the Hunter Economic Zone and at Tomago (HWC 2008b).

In addition, prior to starting the Recycled Water Strategy Study, Hunter Water has discussed supplying up to an additional 360 ML/a of recycled water to Eraring Power Station as effluent flows become available from growth in the Dora Creek Wastewater Treatment Plant catchment (HWC 2008b).

Municipal and Rural Irrigation Using Recycled Water

The strategy for the use of treated effluent in municipal and other irrigation applications is to:

- Expand supply when cost effective to do so;
- Assist proponents with the development of new proposals on a case by case basis; and
- Develop a sewer mining framework (HWC 2008b).

Wastewater Treatment Plants In-plant Reuse

Hunter Water considers the use of recycled water at wastewater treatment plants during the course of major facility upgrades. The use of recycled effluent in these applications will:

- Substitute for potable water currently used in the treatment plant operations (e.g. screenings washing, grit washing); and
- Reduce treated effluent discharges to receiving waters (HWC 2008b).

Large Scale Regional Recycling Schemes

These large scale schemes are possible long term options for alternative climate independent water sources.

They involve the collection of treated effluent from a number of wastewater treatment plants and further processing. One potential large scale regional scheme is indirect potable supply for Grahamstown Dam or Tomago Sandbeds. Indirect potable supply was evaluated against Tillegra Dam as a supply alternative (HWC 2008b).

Communications and Education

Hunter Water is currently developing programs to improve recycled water use and general community understanding of this product. Activities identified include:

- Development of an active two-way communication program to inform users of recycled water;
- promote awareness of recycled water quality issues;
- Provision of information on the impacts of unauthorised use; and
- Provision of information on the benefits of recycled water use (HWC 2008b).