



WATERPLAN 2055 EXTRA

WATER SUPPLY DEMAND STRATEGY
FOR THE TOWNS OUTSIDE THE
COLIBAN SUPPLY SYSTEM

MAY 2007

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Abbreviations used in this Report

DSE	Department of Sustainability and Environment
G-MW	Goulburn-Murray Water
GMMWater	Grampians-Wimmera Mallee Water
ML	megalitres

1. INTRODUCTION

Coliban Water provides water and wastewater services to a 16,500 square kilometre region of Central and Northern Victoria, with a population of 130,000 people. Coliban Water's service area covers 49 towns, including the towns of Bendigo, Castlemaine, Echuca, Rochester, Cohuna, Boort, Pyramid Hill, Trentham, Wedderburn and Bridgwater. Supply to these towns has occurred for up to 100 years.

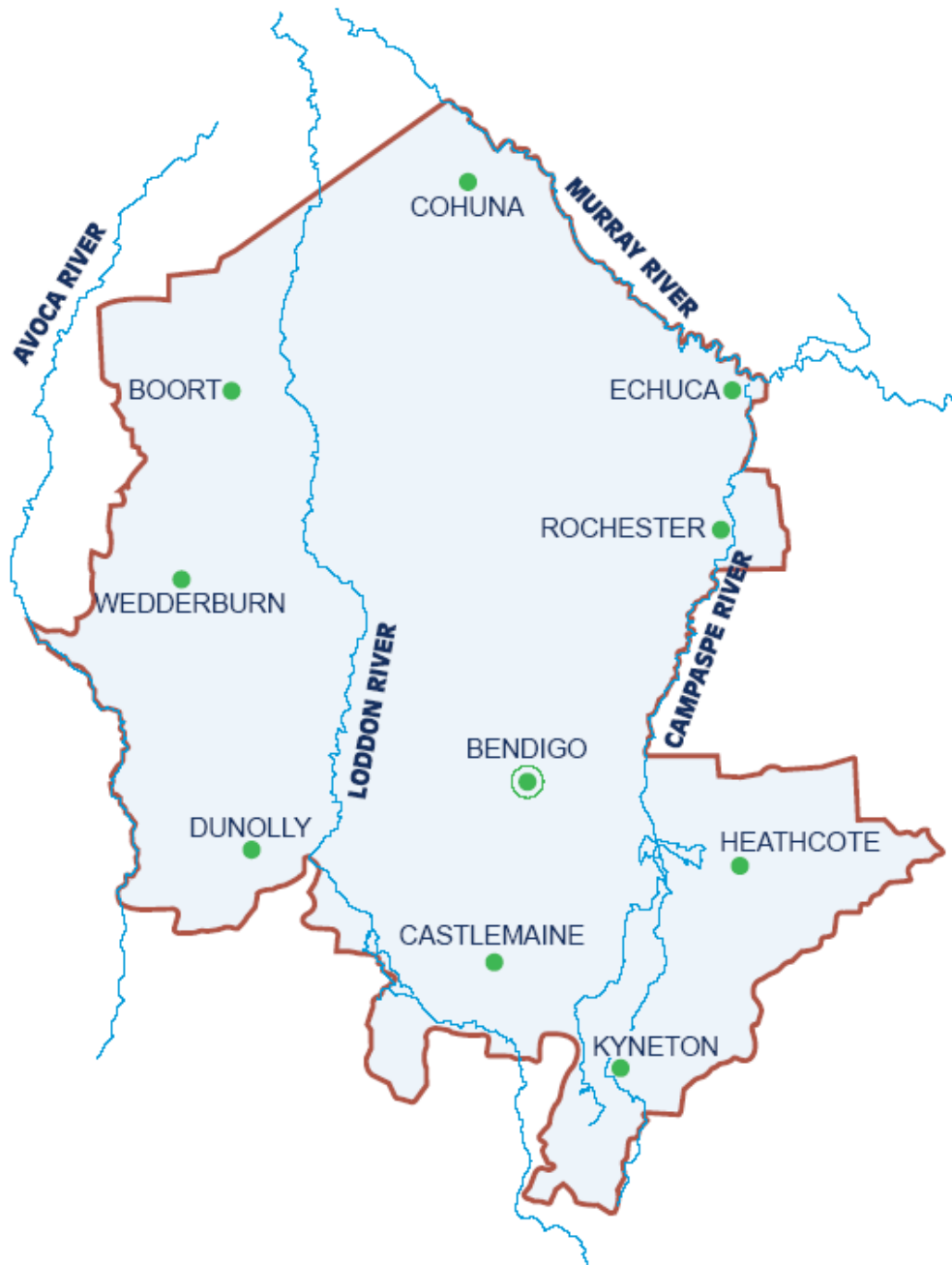


Figure 1: Map of the Coliban Water Region

Coliban Water provides the full range of wholesale and retail water supply functions, including water harvesting and storage, water treatment, urban water supply and wastewater collection, disposal and reuse, and trade waste services.

WaterPlan 2055 which was released in February 2006 covers the area served by the Coliban Water Supply System, being Bendigo, Castlemaine, Kyneton and the smaller surrounding towns.

This Strategy covers the remaining 28 towns outside the Coliban Water Supply System. The towns covered in this Strategy are supplied from six different catchment systems; Murray, Goulburn, Loddon, Wimmera, Campaspe and the Groundwater systems.

2. SECURING THE REGION'S WATER SUPPLY

New urban developments and industries can be accommodated provided water for them is obtained by improving the efficiency of our current water use, or through securing additional water supplies. By limiting the future growth of our water consumption, these measures promote the sustainable use of the entire Murray-Darling Basin's resources by:

- > preserving the existing security of supply;
- > helping maintain water and land quality; and
- > preventing further deterioration of the flow regime for the environment.

Currently, with water restrictions in place across all Coliban's supplies, the region is in a serious water supply situation. Further growth and climate change will result in the need to secure extra water. In the meantime, all water use needs to be better managed, and new sources of water must be found. We can successfully meet our future water needs in several ways, including:

- > demand management;
- > reducing water loss;
- > the increased use of recycled and alternative water supplies; and
- > exploring options to augment supplies.

This Strategy furthers the objectives and aims of the State Government's White Paper – Our Water Our Future, by outlining how Coliban Water is working with stakeholders, such as the North Central Catchment Management Authority and local Councils, to meet the challenge of securing our water future.

The Strategy aims to help increase general awareness of the region's water resources, their management and their future use. It also aims to allow individuals to make wiser water use choices and further contribute to the overall security of water for our community, businesses, industries and the natural environment.

There are a number of challenges to the region's future water security that must be met and carefully managed to safeguard the health of the region's waterways and the prosperity of the local communities.

The biggest challenges include population growth in some areas and declining populations in others, the uncertainty of global climate change, successive years of

below average rainfall, and stressed rivers. As a community, we must find the right balance between reducing water consumption and finding new sources of water.

3. SETTING THE SCENE

3.1 Our Water History

The development of the cities and towns covered in this Strategy largely commenced from the mid 1800's, as former goldminers turned to agriculture and took up settlement across Victoria's dry northern plains. They were also encouraged by the new Land Selection Act 1869.

The Port of Echuca was already a major trading centre prior to the 1850's gold rush, when steamboats took wool from the Riverina down the Murray River to Adelaide for export. This river trade quickly ebbed when the Victorian Government linked Echuca to Melbourne in 1864 via a railway line.

Many smaller northern towns along a number of railway lines also flourished, including Korong Vale, Rochester and Pyramid Hill. In addition, water supplies to some of these towns commenced during this period, largely to fuel the passing steam trains.

Prior to the development of Victoria's northern towns, the aboriginal inhabitants lived in harmony with their environment for tens of thousands of years, sourcing their water from the creeks and rivers' meagre flows.

The first European explorers, Major Mitchell and Captain Sturt followed by the squatters, renamed some of these rivers (for example the Campaspe, Loddon and Murray). Water supplies from these rivers to local towns remained extremely unreliable



Loddon United Waterworks Trust Headworks at Bridgewater on the Loddon River built 1884.

Early achievements in water supply works included the construction of Bridgewater Weir in the 1880s, and the Serpentine Weir. Though mooted as early as 1864, the eventual construction of Laanecoorie Reservoir on the Upper Loddon River in 1891 also improved water security to downstream towns.

This was a period of growth for small, local irrigation trusts across Victoria's north, such as around Durham Ox and Cohuna.



Bridgewater Weir, Loddon River, built 1880's.



Laanecoorie Reservoir, Loddon River, completed 1891

In the earlier 1900's, the Victorian State Government consolidated most of the then water and irrigation schemes under the administration of its new State Rivers & Water Supply Commission, constituted under the Water Act 1905. The SR&WSC took control of many of the towns covered by this report. At the same time, the government encouraged northern Victoria's agricultural development under various 'Closer Settlement' Acts.

From 1909, the SR&WSC also supervised the subdivision of properties into irrigation blocks, which included grading and channelling for water flow, ready for settlement. Men returning from the Great War took up these 'soldiers' blocks', using water to

make a new life on the land, and clearing the northern Victorian scrub to create 'the granary of Victoria'.

For most of the 20th century, these towns were supplied by a variety of water authorities including municipal councils, local water trusts and the SR&WSC. Some areas prospered, especially when new irrigated pastureland became productive around Rochester and Echuca in the 1930s. At Bridgewater, reliable flows down the Loddon River supplied water for the hydroelectric plant at the Bridgewater flourmill.

The completion of Cairn Curran reservoir in 1956 secured even more water downstream along the Loddon River, while the opening of Lake Eppalock in 1964 improved supply security to towns downstream along the Campaspe River.

Similarly, several new reservoirs were constructed on the Goulburn and Murray systems, notably Eildon and Hume reservoirs. These were built primarily for irrigation, but they significantly boosted the security and quality of water to the towns supplied.

In 1992, the control of some town supplies passed to the newly formed Coliban Region Water Authority, known as Coliban Water. This control was extended to include the townships of the Campaspe Region Water Authority later in the 1990s.

Coliban Water today supplies most of its northern towns with bulk raw water either sourced from Goulburn-Murray Water and drawn from rivers and channels, or sourced from Grampians-Wimmera Mallee Water and drawn from the Wimmera Mallee stock and domestic channel system.

3.2 Bulk Entitlements

Bulk entitlements are an authority's share of water from a catchment. The Victorian State Government allocates bulk entitlements to provide water for urban, environmental and agricultural uses.

Bulk entitlements are in place for all the towns that Coliban Water supplies except for the surface diversion at Trentham. Trentham currently has a 48ML groundwater licence and Coliban Water and the Department of Sustainability and Environment are negotiating a formal bulk water entitlement for the surface water supply.

Rochester has an existing bulk entitlement of 134ML from the Campaspe system to supplement its bulk entitlement of 1,400ML from the Goulburn system. However, the Campaspe bulk entitlement has not been used in recent years due to high salinity levels and water shortage and Rochester has been supplied entirely from the Goulburn system.

The combined bulk entitlement for the eight systems is 10,786ML of which nearly 60% is in the Murray system.

Table 3.1 Water Supply System Characteristics

System	Towns	Connections	Bulk Entitlement or Licence ML	Population 2005
Murray	Cohuna, Echuca, Gunbower, Leitchville	8,103	6,285	15,500
Goulburn	Boort, Dingee, Lockington, Macorna, Mitiamo, Mysia, Pyramid Hill & Rochester	2,688	2,420	4,764
Loddon	Bridgewater, Inglewood, Jarklin, Laanecoorie, Dunolly, Bealiba, Tarnagulla & Serpentine	1,500	820	2,264
Wimmera	Borong, Korong Vale, Wedderburn & Wychitella	688	450	923
Groundwater	Elmore	440	284	680
Groundwater	Trentham	450	178	730
Campaspe	Axedale, Goornong & Rochester	289	349	470
Total		14,158	10,786	25,331

3.3 System Reliability

Coliban Water has adopted a target of 95% reliability for its water supply systems.

System reliability is the statistical probability of not having water restrictions in any given year. It is calculated over an extended period, normally 100 years. A system reliability of 95% equates to a 5% probability of restrictions in any given year.

Other regional urban water authorities in Victoria have adopted performance targets typically ranging between 90% and 95% reliability, with most major centres provided with 95% system reliability.

The variability of bulk supplies or stream flows and the capacity of the systems' storages are factors that influence system reliability.

Coliban Water has no river storages for the towns considered in this report. It depends on the supply of bulk water from the storages controlled by the following authorities:

- Murray system – Goulburn-Murray Water acting on behalf of the Murray Darling Basin Commission.
- Campaspe, Goulburn and Loddon systems - Goulburn-Murray Water.
- Wimmera system – Grampians-Wimmera Mallee Water.

Coliban Water has service basins or tanks located at a number of its town supplies. The size of these is dependant on the frequency of delivery from the bulk water authorities. For example, supply from Grampians-Wimmera Mallee Water usually only occurs once per year, requiring large service basins for those towns. Other towns, such as Laanecoorie and Echuca, which get supply direct from rivers, can pump continuously from these sources.

3.4 Population Growth

Within the cities and towns covered by this Strategy, Coliban Water currently provides supply to some 14,160 water connections serving a population of approximately 25,330 people.

The largest town is Echuca with 12,600 people, while the next two largest towns are Rochester with 2,900 people and Cohuna with 2,340 people. These three towns alone comprise 70% of the total population of the 28 towns in this Strategy. Each of the other 25 towns is relatively small with populations of 760 people or less.

The DSE publication *Victoria in Future 2004 (VIF)* growth statistics formed the baseline for Coliban Water population forecasts, along with sensitivity tests against Coliban Water's water connection data, other local information and the Australian Bureau of Statistics (ABS) Census of Population and Household data.

Population forecasts for the 28 towns vary considerably from a growth of 1.5% pa to a decline of 0.8% pa.

Echuca has the fastest growing population, with an average growth rate of 2% pa for the past five years. It is forecast to continue at a rate of 1.5% pa for the time-period of this Strategy. Echuca is a major tourist destination and its population can significantly swell by tourist numbers during holiday seasons.

By 2055, the forecast total population of the 28 towns is 41,000 people with some 26,500 people, or 64%, in Echuca alone. This is an average growth rate of 1.0% pa and an overall population increase of 15,900 people over the next 50 years.

Table 3.2 Population Projections

System Towns	Population Trend					
	Nominal Forecast Growth	2001	2005	2014 7 years	2027 20 years	2055 50 years
MURRAY SYSTEM						
Cohuna	0.5%	2,236	2,340	2,420	2,580	2,970
Echuca	1.5%	11,335	12,570	14,580	17,430	26,460
Gunbower	0.1%	283	290	290	300	300
Leitchville	-0.7%	297	300	280	260	210
Total	1.3%	14,151	15,500	17,570	20,570	29,940
GOULBURN SYSTEM						
Boort	0.5%	756	760	790	840	970
Dingee	-0.8%	60	60	60	50	40
Lockington	0.1%	400	410	410	420	430
Macorna	-0.7%	23	23	20	20	15
Mitiamo	-0.8%	100	100	90	80	70
Mysia	-0.2%	21	21	20	20	20
Pyramid Hill	-0.8%	498	500	470	420	335
Rochester	0.5%	2,792	2,890	3,020	3,220	3,710
Total	0.3%	4,650	4,764	4,880	5,070	5,590
LODDON SYSTEM						
Bridgewater	0.5%	403	405	420	450	520
Inglewood	-0.2%	685	690	680	660	630
Jarklin	-0.8%	14	14	10	10	10
Laanecoorie	-0.2%	60	60	60	60	56
Dunolly	0.0%	663	670	670	670	670
Bealiba	0.0%	124	140	140	140	140
Tarnagulla	-0.2%	158	160	160	160	150
Serpentine	-0.8%	122	125	120	110	80
Total	0.0%	2,229	2,264	2,260	2,260	2,260
WIMMERA SYSTEM						
Borong	-0.2%	53	53	50	45	35
Korong Vale	0.0%	183	180	180	180	180
Wedderburn	-0.2%	656	660	650	630	600
Wychitella	-0.2%	30	30	30	30	25
Total	-0.2%	922	923	910	890	840
GROUNDWATER						
Elmore	0.5%	665	680	710	760	870
Trentham	0.6%	697	730	775	840	990
CAMPASPE SYSTEM						
Axedale	0.5%	198	210	220	230	270
Goornong	0.5%	261	260	270	290	330
Total	0.5%	459	470	490	520	600
Total – All systems	1.0%	23,773	25,331	27,600	30,910	41,090

3.5 Current Water Use

The base year for consumption is the two-year average of the years 2000/01 and 2001/02, which were the last two years of unrestricted use prior to the introduction of water restrictions (except for the Wimmera supplied towns, which have been on restrictions since 1999)

Total water use for the 28 towns in the base years averaged 9,560ML.

The distribution of water use between the domestic and commercial sectors and system losses is shown in Table 3.3.

Table 3.3 Current Water Use

System	Water Use (Base Years) ML					
	Residential	Industrial & Commercial	System Water Loss	Total BE Taken	Residential litres / person / day	Total litres / person / day
Murray	2,778	2,355	927	6,060	538	1,173
Goulburn	834	926	283	2,043	491	1,203
Loddon	290	95	220	605	356	744
Wimmera	110	20	219	349	327	1,037
Groundwater - Elmore	117	47	24	188	482	772
Groundwater - Trentham	60	27	42	129	236	507
Campaspe	90	18	78	186	537	1,107
Total	4,279	3,488	1,793	9,560	493	1,102

Figure 2 Current Water Use Split

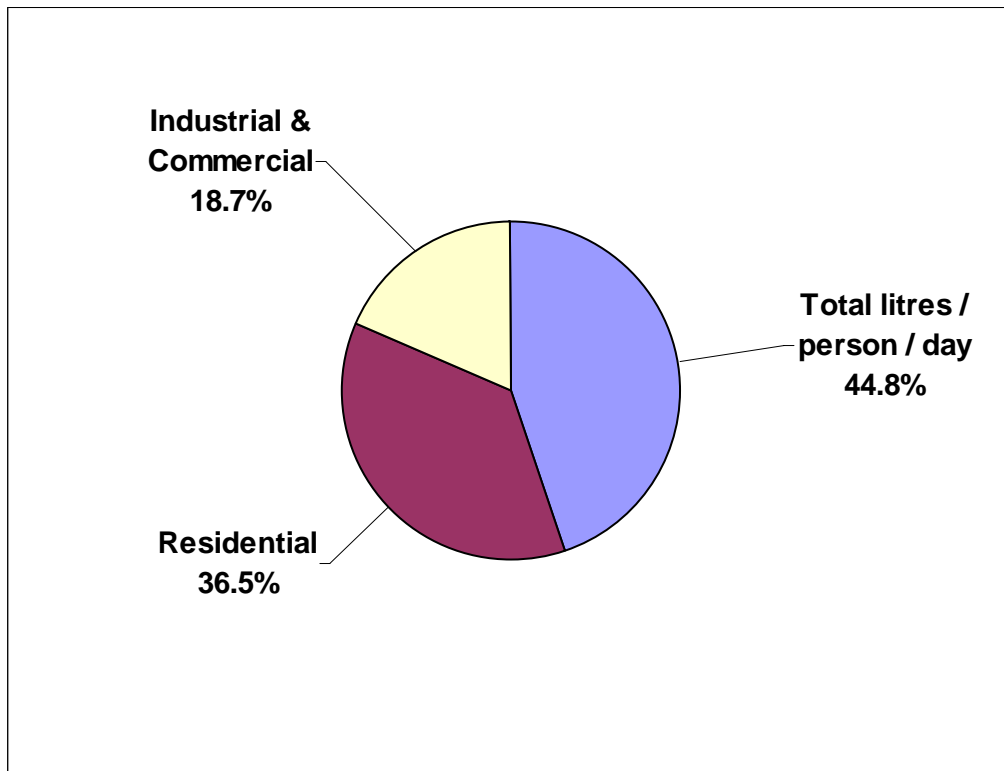
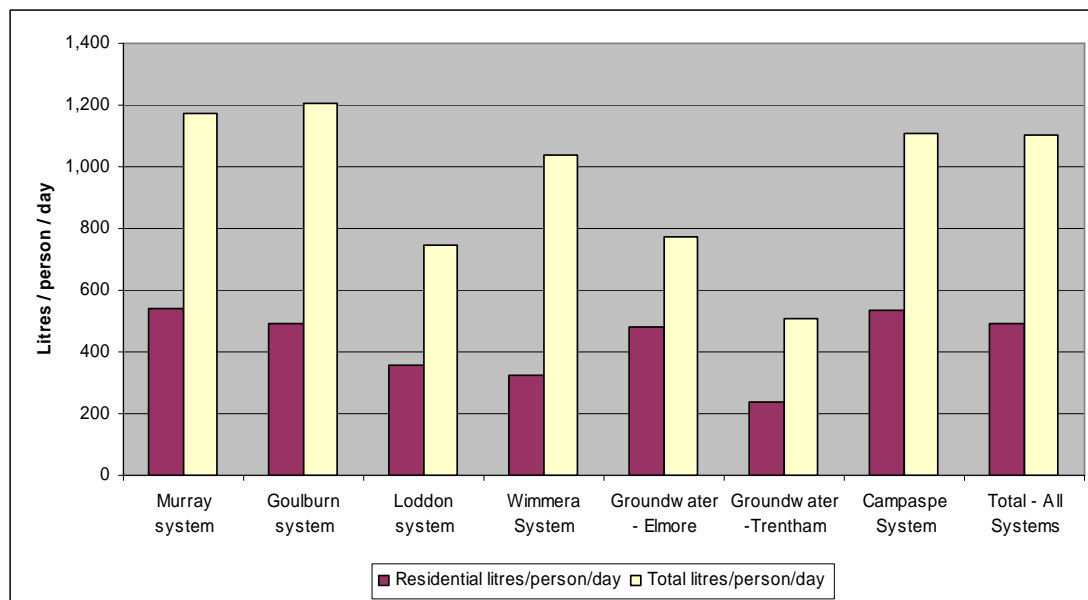


Figure 3 Per capita water use for the base years of 2000/01 and 2001/02



Industrial & commercial water use is 37% for the 28 towns, which is mainly due to the large industrial users in the Murray and Goulburn systems comprising food, pet food and milk processing industries with a total annual water use in excess of 3,000ML. The Loddon, Campaspe and Wimmera systems have low industrial & commercial water use of less than 16% in each.

The water loss per capita is extremely high in the Wimmera system due to the open earthen storages that store water between the once-a-year channel runs from the Grampian system.

3.6 Projected Water Demand

The long-term water demand projections are based on historic water use, population growth and assume no significant change in the water consumption behaviour pattern or per capita water use.

Population growth has a major impact on water demand, as does industrial and commercial use that is forecast to expand and lead to an increased demand for water. The available water is also under pressure from competing “beneficial” uses including water required for environmental sustainability.

The projected water use over the next 50 years, with unrestricted supply, is that the total demand will increase to 14,933ML.

This is an increase of 5,400ML on the base year use. Most of the increased demand will come from Echuca (Murray system), with demand increasing by some 4,540ML from 4,600ML to 9,150ML.

Table 3.4-Projected Water Demand

System	Unrestricted Annual Demand ML			
	2000-02	2014 7 years	2027 20 years	2055 50 years
Murray	6,060	6,470	7,560	10,780
Goulburn	2,043	2,214	2,323	2,562
Loddon	605	618	607	606
Wimmera	349	340	330	315
Groundwater - Elmore	188	190	205	235
Groundwater - Trentham	129	145	155	185
Campaspe	186	200	210	250
Total	9,560	10,177	11,390	14,933

3.7 Current Drought & Water Restrictions

Coliban Water introduced water restrictions in December 1999 in the Wimmera system towns and in October/November 2002 in all the other towns to reduce water use to sustainable levels during the current drought.

3.8 Rainfall and Runoff Patterns

Inflows into storages do not always result when average or typical rainfall occurs. The type, intensity and duration of rainfall, together with catchment and atmospheric conditions greatly affect the quantity of surface runoff and inflows into storages.

The greatest inflows typically occur during the wetter winter/spring months. The main reason for the drop in storage inflows over summer/autumn is the dryness of the catchment, with the warmer conditions quickly drying out the ground in between periods of rain. In contrast, the cooler winter/spring conditions keep the ground saturated for longer, thus improving the possibility of good runoff.

Unfortunately, a year of 'average' rainfall will not always result in 'average' inflows. Good catchment inflows depend not only on the amount of rain that falls over a year, but also the timing of when that rain falls and long term rainfall trends. The extended dry conditions over the last five to ten years have resulted in lower than expected runoff from rainfall events.

3.9 Climate Change

Climate change refers to the anticipated change in climate conditions due to the increase in the concentration of greenhouse gases in our atmosphere. The science behind the projection of the nature of these changes is improving. However, there are wide uncertainties associated with these projections. There are further uncertainties with the translation of climate projections into impacts on stream flow and system yield.

The research carried out by the CSIRO predicts that climate change could result in a considerable reduction in water yield from catchments and therefore reduced availability of water for urban supplies.

Coliban Water has considered the potential impact of climate change in planning for the longer-term future based on CSIRO as well as DSE research and publications.

Table 3.5 shows the projected percentage changes in annual average runoff estimated by the CSIRO.

Table 3.5 Water Yield Reductions due to Climate Change

System	Lower Impact Scenario	Medium Impact Scenario	Upper Impact Scenario
Murray	-5%	-17%	-32%
Goulburn	-7%	-23%	-43%
Loddon	-10%	-31%	-58%
Wimmera	-13%	-35%	-62%
Campaspe	-9%	-28%	-54%

Coliban Water has also considered a further scenario based on a continuation of the low inflows experienced over the past 10 years. This analysis shows significant reductions in the yield from the Murray, Campaspe and Loddon catchments and a moderate reduction in the Goulburn catchment.

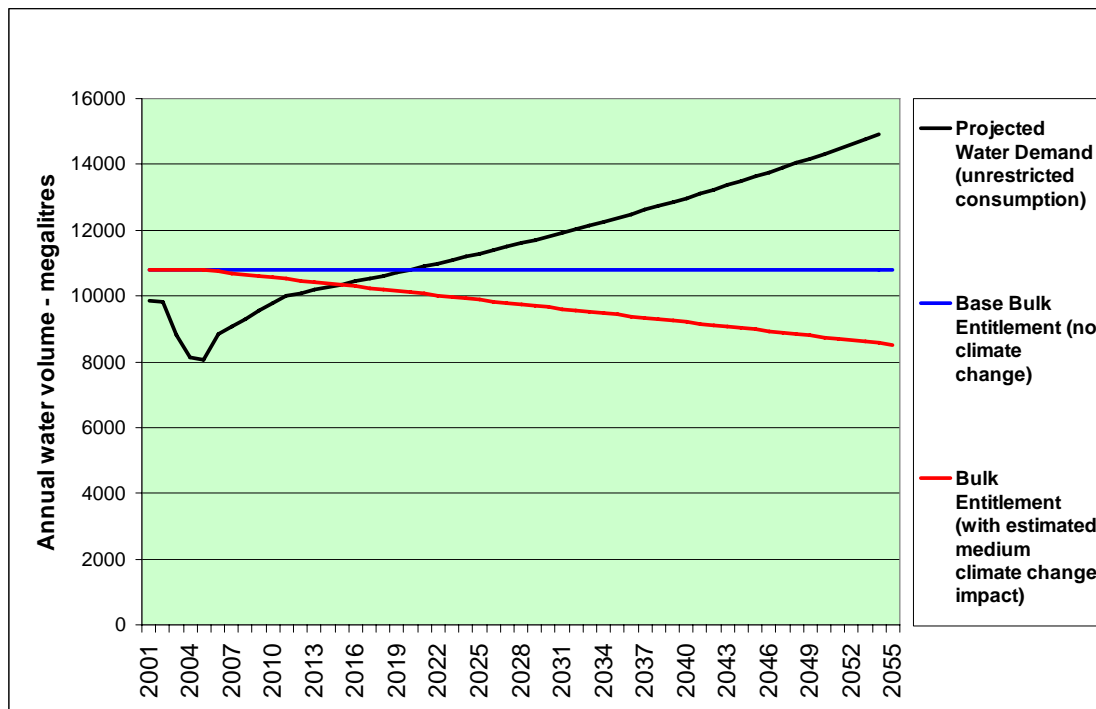
Coliban Water has adopted the Medium Climate Change scenario as the basis for this Strategy. The impact of the medium climate change scenario is that the current yield of 10,786ML will decline by approximately 2,240ML to a total of 8,545ML. This will result in a significant shortfall of 6,400ML in meeting the predicted demand of 14,930ML in the year 2055.

As shown in Table 3.6, additional water will be required within the next seven years to meet the impact of the medium climate change scenario and increasing population.

Table 3.6 Yield Projections Adjusted for Climate Change

System	Yield (Bulk Entitlement) - adjusted for Climate Change ML				Yield Deficit - Additional Water Required to meet Climate Change ML			Year that Demand Exceeds Water Yield
	2005	2014	2027	2055	2014	2027	2055	
Murray	6285	6,100	5,820	5,220	370	1,740	5,560	By 2010
Goulburn	2420	2,320	2,170	1,870	0	150	690	After 2020
Loddon	820	780	710	570	0	0	40	After 2045
Wimmera	450	420	380	290	0	0	25	After 2045
Groundwater – Elmore	284	275	250	205	0	0	30	After 2045
Groundwater – Trentham	178	170	160	130	0	0	55	After 2025
Campaspe	349	330	310	260	0	0	0	After 2055
Total	10,786	10,395	9,800	8,545	370	1,890	6,400	

Figure 4 Demand and Climate Change Impact



3.10 River Health

In meeting the water supply needs of the urban community, Coliban Water also recognises its role in assisting the North Central Catchment Management Authority to improve the health of our rivers and waterways.

The health of the rivers from which we draw our raw water from is generally in the condition range of poor to moderate and further extraction from these rivers should be minimised in the interests of river health.

Throughout this Strategy, the highest priority is on reducing our demand for water and therefore minimising the need for increase extractions from the rivers. The future projections indicate that there will be relatively small additional needs from the Loddon, Wimmera, Campaspe and Groundwater systems.

In the Goulburn and Murray systems, the growth of some towns will require additional extraction from rivers, but this water will be obtained either through investment in water savings measures or by purchasing entitlements from current users.

4. COMMUNITY CONSULTATION

In August/September 2004, Coliban Water held a series of Community Workshops to raise public awareness of the available options to improve the security of water supply in the medium to long term. These workshops were followed in February 2005 by the release of an 'Options Paper,' where direct feedback was sought via an attached 'Feedback Sheet.'

Community workshops were held in Kyneton, Castlemaine, Bendigo, Echuca and Wedderburn with more than 200 people attending the seven workshops.

At each workshop, the water resource planning role of both the Department of Sustainability and Environment (DSE), and Coliban Water was initially clarified, along with the key issues facing the region. All participants were then placed in groups of 6-12, and asked to express their views on topics such as:

- water restrictions;
- alternative water sources, including recycled water;
- reducing consumption and other methods to save water; and
- reducing losses.

These workshops provided valuable feedback to Coliban Water, and highlighted a number of key messages, as follows:

- **Water Restrictions**

Participants were in favour of the community adopting water restrictions during times of water shortage, and also generally supported permanent water conservation measures (which is consistent with the Victorian Government's White Paper 'Securing Our Water Future'). Participants also wanted water restrictions to be more transparent.

- **Recycled Water**

The increased use of recycled water was commonly seen as an important solution to maintaining parks and garden, while also providing garden water at home.

- **Water Pricing**

There was general acceptance of the need to increase the price of water, in order to discourage wastage.

- **Water Saving Measures**

There was recognition of the need to introduce a wide range of measures to save existing water, and find alternative supplies of future water. There was also considerable discussion on the use of stormwater; but alternative sources such as recycled water, grey water and rainwater were more widely supported.

Further consultation has been conducted at individual meetings with local government and meetings of community groups such as Progress Associations.

5. THE WAY FORWARD

This Strategy details the development of supply and demand side management actions that are innovative and will be achieved taking into consideration a long-term outlook; the total water cycle, social, environmental and economic costs and benefits and potential risks, such as climate change.

- Demand Side Actions – these are designed to decrease future consumption or reduce losses.
- Supply Side Actions – these are designed to increase the amount of water available to meet future demand.

5.1 Demand Side Actions

Coliban Water has set a target of a 15% reduction in total per capita water use from the base year use by 2015 for the total supply system covered by this Strategy. This equates to a reduction in demand of around 1400ML/year.

This reduction in demand will be achieved through the following measures.

5.1.1 Permanent Water Saving Rules

Coliban Water must continue to influence community attitudes in order to achieve permanent behavioural changes in public water consumption, if it is to achieve its required demand reduction targets.

The community was consulted during the development of the Permanent Water Saving Rules and these measures have been in force since 1 July 2006 for any customers not subject to stage 1 to 4 water restrictions. They are designed to form healthy water use behaviour.

Action 1

Coliban Water has introduced Permanent Water Saving Rules as policy when restrictions are not in force.

5.1.2 Reducing Losses in the Reticulation System

About 8% or 680 megalitres per annum of raw water use in the systems covered by this Strategy appears to be 'lost' in the pipe reticulation network. The loss is likely to be a combination of pipe leaks and /or inaccurate bulk metering.

The pipe leakage losses will rise over time if no action is taken to detect and rectify leaks in the system.

In addition, it appears that some of the bulk metering into and through the systems is not 100% accurate, resulting in inconsistent figures and making the assessment of system efficiencies and losses difficult.

To address these losses, Coliban Water will investigate the value of a leakage assessment and reduction program.

This program could include:

- introducing step-testing, leak-noise and leak-detection operations;
- striving for 'operational excellence' in repairs and maintenance;
- reducing 'unauthorised' water consumption; and
- improving meter accuracy, through the correct selection, installation, rehabilitation and replacement of meters.

Action 2

Coliban Water will implement, where justified, Urban Leakage Reduction Programs.

5.1.3 Reducing Service Basin Evaporation and Seepage and Water Treatment Plant Losses

A number of towns in the northern and western part of the region have earthen service basins, which are filled from channel supplies. Evaporation and seepage from these basins is estimated to lose about 300ML- 400ML/year, much of it in the service basins filled from the Wimmera supply system.

Korong Vale, Borung & Wychitella Service Basins

The Wimmera supply system towns of Korong Vale and Wedderburn are serviced with three earthen service basins of 450 megalitres total capacity situated at Korong Vale. Large service basins are required as they are normally filled annually. Investigations have been carried out into seepage and evaporation losses on the Korong Vale service basins. A detailed analysis of the years 2004 to 2006 indicated seepage losses are about 40% and evaporation losses 30% of raw water use. Groundwater interception pumps were installed in the 1990's to recover some of the seepage. They recover about 90 megalitres per annum.

Evaporation can be reduced by spraying suitable products, such as "Watersavr" onto water surfaces. Coliban Water trialled "Watersavr" on its Korong Vale service basin for four weeks in March 2006. Given the current critical water situation, it is being used in the summer of 2007 on the Korong Vale, Wychitella and Borung service basins as well as other Coliban storages. The work is costly and will be used selectively in future.

Grampians Water is currently pipelining the Wimmera-Mallee stock and domestic channel system. GMMWater plan to pipeline the channel system from the Grampians to Korong Vale, Borung and Wychitella by about 2010. Because the supply will be continuous, the size of service basins needed for each town will be much smaller than the current size. GMMWater has indicated that they require balancing service basins of one to two weeks capacity.

Depending on what is constructed to replace the existing basins this in turn will reduce the seepage and evaporation losses. Potential savings are in the order of 100

to 160 megalitres per annum. However, these will need to be confirmed with further investigations. If the size of basins is reduced as part of the Wimmera Mallee pipelining Grampians Water is likely to claim the water savings.

Action 3

Coliban Water will replace the existing large service basins at Korong Vale, Borung and Wychitella with smaller storages when those supplies are connected to the Wimmera Mallee pipeline project.

Other Service Basins

In addition to the Wimmera system service basins there are ten other earthen service basins of about 300 megalitres total capacity. These basins are filled intermittently.

Covering or lining these basins would be very costly and cannot be justified at present. Coliban Water will manage the water levels in these basins to minimise evaporation and where appropriate will apply evaporation reduction products to reduce losses.

Action 4

Coliban Water will continue to use evaporation reducing products selectively on its service basins.

Water Treatment Plant Losses

As part of an on-going program to improve drinking water quality being supplied to customers, Coliban Water is planning to either upgrade treatment plants or provide some towns with water supply from another source. As well as providing better quality drinking water this will also have the added benefit of reducing water losses, as generally around 3%-4% of raw water is lost during the treatment process.

Axedale Water Supply

A pipeline connecting Bendigo to Axedale is planned for construction in 2008 to provide a higher quality of drinking water supply to customers in Axedale. This will eliminate the water losses from evaporation and seepage from the Axedale service basin as well as losses through the water treatment process. The existing bulk entitlement for Axedale will be transferred to Coliban Water's Lake Eppalock entitlement.

Action 5

Coliban Water will connect Axedale to the Bendigo supply system.

Goornong Water Supply

Goornong is also supplied with raw water drawn from the Campaspe River and consideration is being given to connecting Goornong to the Bendigo water reticulation system.

Action 6

Coliban Water will investigate the option of connecting Goornong to the Bendigo supply system.

Bridgewater/Inglewood Water Supply

Because of the deteriorating performance of the existing water treatment plant at Bridgewater, Coliban Water plans to construct a pipeline from Bendigo to Bridgewater and therefore supply the two towns from the Coliban system.

This will eliminate seepage and evaporation losses from the Bridgewater service basins and losses from the water treatment process.

Action 7

Coliban Water will supply Bridgewater and Inglewood with treated water from the Bendigo reticulation system.

Leitchville/Gunbower Water Supply

Currently both Leitchville and Gunbower have their own separate water treatment plants drawing water from the Murray system. As part of an ongoing water quality improvement program it is planned to investigate the possibility of upgrading the Leitchville Water Treatment Plant to also supply Gunbower. This would result in the Gunbower water treatment plant being closed down with a consequential saving in the water losses associated with operating a water treatment plant.

Action 8

Coliban Water will investigate the option of supplying Gunbower from an upgraded water treatment plant at Leitchville.

5.1.4 Community Education

Water resource management is recognised by the local community as a major issue. Coliban Water is committed to cooperating with local councils to develop a sustainable water supply for the entire Coliban Region.

Coliban Water has a comprehensive and integrated communication and community engagement plan, designed to help customers better understand the issues associated with securing sustainable future water supplies. This Strategy relies on a range of different consultations and representative groups. A very positive aspect of this community involvement is that people are thinking creatively, innovatively and responsibly about future water availability; consequently, they are also modifying their water use in a favourable manner.

Coliban Water programs and campaigns designed to help its customers to use water more efficiently include:

1. Smart Gardens For a Dry Climate– this project has run for many years in partnership with the broader community and includes seminars, the introduction of gardening ‘best practice’ and drought-proof plants and materials; information leaflets and gardening training programs;
2. Schools’ Water Efficiency Program – includes a schools-based water education program to complement existing curriculum outcomes; the availability of a major water education resource for schools across the Coliban Water region (motto: ‘Water: Learn It! Live It!’), supported by a teachers’ professional development conference to launch the program and to help ensure its integration into the curriculum.
3. Free education sessions on smart water use.

Other initiatives include community consultation and presentations about specific projects; newsletters, fact sheets and on-line information detailing water conservation tips; media announcements and clips; water patrols; recycled water projects; and community information on water restrictions.

In conjunction with the North-Central Catchment Management Authority, Coliban Water supports and sponsors the annual Waterwatch Program, run by the NCCMA.

Coliban Water is committed to raising awareness and providing better information for its customers regarding individual water consumption; to this end, it began including enhanced information on all accounts sent out from 1 July 2005.

Action 9

Coliban Water will continue its education and consultation programs to support customer water efficiency and conservation efforts.

5.1.5 Water Saving Incentives

Water Saving Devices

The government support the use of water saving devices throughout Victoria. It has introduced mandatory water efficient plumbing standards for all new houses including the fitting of water conserving shower roses and taps. All new fittings in existing houses must also meet water efficiency standards. Victoria has also passed groundbreaking legislation to introduce a mandatory water efficiency labelling and standards scheme for water-using appliances such as dishwashers, toilets, washing machines and showerheads. These initiatives will support the government's water saving target of 25 % for all new developments.

Water Smart Gardens and Homes Rebates Scheme

The Water Smart Gardens and Homes Rebates Scheme is encouraging households to use water wisely.

Across Victoria, the government has committed \$10 million over four years to provide rebates to households that are 'water smart' in their gardens and homes. Water Smart rebates are available to residential on customers on reticulated water systems across Victoria, including Coliban Water customers, wanting to make their homes more water efficient through the retrofitting of approved fittings and appliances and installation of garden mulch.

Greywater Recycling and Rainwater Tanks

Coliban Water will continue to encourage and support customers who wish to install greywater reuse systems and rainwater tanks to reduce use of drinking water where appropriate.

Greywater is household water that has not been contaminated by toilet discharge and includes water from bathtubs and clothes washing machines. Substituting greywater for non-drinking uses such as outdoor use and toilet flushing reduces consumption of quality water for purposes that do not require it.

The State government recognises the role of rainwater tanks in reducing stormwater flows and providing alternative supply; it has included their installation and use in its 5-star standards for all new housing. Use of rainwater tanks will help customers to substitute rainwater for non-drinking uses such as outdoor use and toilet flushing.

Rebates are available for greywater systems, rainwater tanks, rainwater tank to toilet connections, dual flush toilets, water conservation audits, water efficient shower roses and a basket of water saving devices.

These programs have had good acceptance with \$32,500 in grants provided for the towns covered by this Strategy for \$223,000 worth of works carried out by customers.

Action 10

Coliban Water will continue to encourage schemes that produce water savings.

5.1.6 Pricing Incentives

A New Smarter Water Pricing System

Our Water Our Future requires regional urban water authorities to design pricing structures that provide incentives to customers to reduce water use while reflecting the true cost of water delivery and environmental impacts. Coliban Water introduced the smarter pricing system on 1 July 2005

What is a Stepped Tariff?

Stepped tariffs are based on a 'user-pays' system that encourages customers to save water. Stepped tariffs recognise the need to provide water for essential domestic use at an affordable price. For water use above a specified level of consumption, customers will pay a higher price. Stepped tariffs are widely regarded as the fairest and most effective way to price water to encourage conservation.

How does it Work?

Each quarter Coliban Water will continue to take a reading of a customer's water meter to determine the amount of water that has been used. The water usage component of the bill is determined by the number of kilolitres of water use. Instead of applying a flat rate to the water usage, a three stepped pricing structure will be applied, based on water consumption. The allowance in each Step is calculated on a daily basis and charged on a quarterly basis.

The stepped tariff does not apply to Non-Residential customers.

Action 11

Coliban Water will continue to implement a water pricing system that provides a financial incentive to customers to reduce water use.

5.1.7 Non-Residential Conservation

Savings in Industry

The introduction of cleaner production planning as a requirement in major trade waste agreements has decreased trade waste loadings on water reclamation plants and has provided significant improvements in efficient water use.

Coliban Water has a number of commercial customers that are significant water users. The largest consist of five significant food industries in Echuca, milk factories in Rochester and Leitchville and a pet food company at Pyramid Hill. They use about 2,700 megalitres per annum between them. Commercial use in Echuca is 39% of Echuca's total use. Commercial use in Rochester is over 57%.

Coliban Water has been working with its commercial customers to find ways of reducing water consumption. Significant decreases in water use have been achieved over the last five years and it is believed that further efficiencies can still be gained.

Working with Local Government to Reduce Water Use

Under the Victorian Government's Sustainable Water Use Plans Program, Coliban Water is working with local government to reduce water consumption by councils and develop water conservation plans.

The towns covered in this Strategy are within the Shires of Campaspe, Central Goldfields, Gannawarra, Loddon, Hepburn and the City of Greater Bendigo. Local government is often a significant water user, irrigating parks, sporting fields, public gardens and other open spaces, and using water for other council operations. As the local planning authority, local government is in a unique position to shape public attitude and behaviour regarding water conservation and to set improved standards for water conservation in new developments.

Smart Water Fund

The Smart Water Fund has been extended to include regional Victoria, with funding rounds occurring annually until June 2008.

The Smart Water Fund was established in 2002 by the metropolitan water authorities and the State Government. To date, the Fund has provided over \$7 million to support projects that demonstrate the benefits of conserving water and encourage the community and industry to adopt more efficient water management practices.

In particular, the Fund encourages innovative approaches to water and biosolids recycling and increasing water savings for future urban and environmental needs. Under Our Water Our Future, an extra \$1 million per year has been provided to extend the Fund into regional Victoria.

Schools Water Efficiency Program

A \$2 million Schools Water Efficiency Program was launched in April 2005 by the State Government to help Victorian schools conserve water across the state while saving money on their water bills. The four-year program will assist primary and secondary schools to undertake an audit of their internal water use.

Through focusing on simple measures, such as fitting flow control valves and fixing leaking taps or cisterns, the Schools Water Efficiency Program offers low cost works for potential water savings of between five and 30 per cent in each school. The Program will operate under a 'payment by savings' system, allowing schools to obtain funding up front to undertake the works, and recoup costs through water savings.

Action 12

Coliban Water will continue to work with local government, industry and schools to develop and implement water conservation, recycling and cleaner production programs.

5.1.8 Water Sensitive Urban Design

Urban growth across the Water Supply Systems is projected to continue with new developments providing opportunities to introduce innovative and more efficient water management practices.

Local government and Coliban Water have the opportunity to lead water sensitive urban development by adopting a total water cycle approach and encouraging the use of recycled or alternative water supplies where appropriate.

The State Government has recognised these opportunities by setting a 25% water saving target for new development within Victoria. Coliban Water will use its demonstration housing units being constructed in Alder Street, Bendigo, to illustrate the application of Water Sensitive Urban Design Principles.

Action 13

Coliban Water, in consultation with local government, will continue to promote, where applicable, Water Sensitive Urban Development Principles for new developments in urban areas.

5.1.9 Demand Modelling

There is a need to further improve end-use demand modelling of water consumption to enable accurate and timely reviews of strategy actions. This modelling should be done in a coordinated way by all Victorian Water Authorities.

Action 13

Coliban Water will work with other Victorian Water Authorities and the Department of Sustainability and Environment in developing a Victorian End Use Model that will improve demand modelling and forecasting capabilities by:

- **Better understanding of demand and influencing factors**
- **Disaggregating water uses i.e. residential, open space, various industry sector use) and spatial distribution of these uses**
- **Understanding the biggest water-using industry sectors and the setting of sector benchmarks**

5.2 Supply Side Management

Demand management measures alone will not be sufficient to provide the amount of water needed for the future. Additional measures will be needed to meet increased demands or to provide the agreed level of reliability to customers.

5.2.1 Additional Water Sources

Water Savings Projects

Additional water can be obtained from investing in water savings projects conducted by other water authorities or private enterprises and claim the savings.

Water savings projects require considerable investment in time and money in preliminary investigations, management and administration. In addition, there is considerable competition for water savings projects as state and federal governments pursue them for environmental allocations on major river systems.

Coliban Water has already entered into one agreement with Goulburn-Murray Water to fund the Catumnal Pipeline Project in return for the water savings and has provided the funding for the business case development for the Mitiamo Pipeline Project.

Action 14

Coliban Water will invest in water savings projects where justified by sound business case evaluation.

Water Trading

Given the small amounts of water required for most of the systems covered in this Strategy, the likely main source of additional supplies is water trading. Water trading is the purchase of permanent or temporary water entitlements from other sources such as irrigation water rights or river diversion licences.

The preferable strategy in the long term is to have adequate permanent allocations for all towns to ensure secure water allocations. However, in the short term Coliban Water will need to use a combination of temporary and permanent purchases until it achieves adequate permanent allocations.

There are concerns in some sections of the community regarding purchasing water from one type of enterprise to augment another. There are also the possible adverse effects on towns where water rights are lost from the surrounding district.

However, there is a growing acceptance in the community that authorities like Coliban Water will need to enter the water trading market in order to achieve the bulk entitlements needed for future growth. In addition, the small amount of water needed as a percentage of the trading pool means that Coliban Water's purchases on the water market is likely to have a minimal impact on prices and resources available to other users.

Action 15

Coliban Water will purchase additional water entitlements where necessary to provided increased reliability of supply.

5.2.2 Other Supply Measures

Rochester Winter Supply

Rochester is the largest of the towns in the Goulburn System, yet is the only town without any form of raw water supply storage. Historically, when the Waranga Western Channel closed for maintenance over the winter period, Rochester was supplied with raw water from the bulk entitlement from the Campaspe River. In recent years the availability of this water has been restricted and the quality of water has been very poor, leading to a temporary supply being provided from the Campaspe Weir. This supply while providing a better quality water relied on running part of the channel system out of season, which resulted in considerable water loss.

The longer-term solution is to construct a storage of sufficient capacity to provide a reliable supply of good quality raw water for Rochester over the winter period. The water for this storage will be obtained from the Goulburn System entitlements.

Action 16

Coliban Water will construct a raw water storage to provide a reliable winter supply for Rochester.

Amalgamating Goulburn System Bulk Entitlements

Currently each individual town in the Goulburn system has its own Bulk Entitlement order, which stipulates the amount of water than can be used in each town. In order to make more efficient use of the total amount of water available from the Goulburn system it is proposed to consolidate all the individual bulk entitlement orders into one order.

Action 17

Coliban Water will request approval to consolidate all existing Goulburn System Bulk Entitlement Orders into one.

Serpentine Raw Water Supply

Serpentine is currently supplied from the Loddon system via diversion from the Serpentine Creek. In recent years, the salinity of the raw water has been increasing to the extent where it is now becoming unacceptable to the customers.

One option would be to construct a desalination plant at Serpentine to treat the water, but a possible better option would be to supply Serpentine from the Waranga Western Channel on the Goulburn System. This would provide a much better quality of raw water, but would require the acquisition of additional Goulburn system water entitlement. Conversely, such a change would free up an equivalent amount of water entitlement in the Loddon system, which could be traded for other uses.

Preliminary investigations have been made into supplying Serpentine from the Waranga Western Channel as part of the East Loddon Waterworks District pipelining proposal currently being evaluated by G-MW.

Action 17

Coliban Water, in conjunction with Goulburn-Murray Water, will further investigate the option of supplying Serpentine from the Goulburn system via Waranga Western Channel.

5.2.3 Improved Measurement of Bulk Supplies

Critical to any program to improve water use efficiency is the availability of reliable monitoring data. An examination of the bulk meter readings for the various town supplies shows that some of the bulk meters do not meet current accountability and management standards. Some meters such as detheridge meters and propellers are not up to current standards and need to be replaced with more accurate magflow meters.

Some meters have been installed incorrectly and need to be reinstalled.

Action 18

Coliban Water will upgrade all bulk water meters to meet National Water Metering standards.

5.3 Other Options

A number of other possible options have been suggested and have been considered, but they have been deemed to be either lower priority or not viable for a variety of reasons.

Reclaimed Water – Recycling, Reuse & Substitution

One of Coliban Water's strategic objectives is to have 100% reuse of recycled water from its water reclamation plants, with a high priority being to use the recycled water to substitute for water that could be used for drinking water.

Coliban Water has water reclamation plants serving the towns of Axedale, Boort, Bridgewater, Cohuna, Dunolly, Echuca, Elmore, Gunbower, Inglewood, Leitchville, Lockington, Pyramid Hill, Rochester, Trentham and Wedderburn.

There is no stream discharge from any of these plants with 100% reuse currently being achieved for agricultural use under long-term contractual agreements... As such, none of the water from these plants is available for reuse as a substitute for domestic supply.

Desalination

Groundwater has been considered as an option for raw water supply to a number of towns, but the salinity levels are such that desalination would be required in order to ensure that the water met Australian Drinking Water Guidelines. While the cost of desalination has been steadily reducing, the issues associated with high-energy use and the disposal of the highly concentrated brine waste in inland areas means that such an option is difficult to justify, except in extreme circumstances.

5.4 Summary of Actions

Coliban Water may need to improve current water availability by up to 6,400ML over the next fifty years to provide sufficient supplies for future urban growth and to accommodate for the impact of climate change on the available water supply.

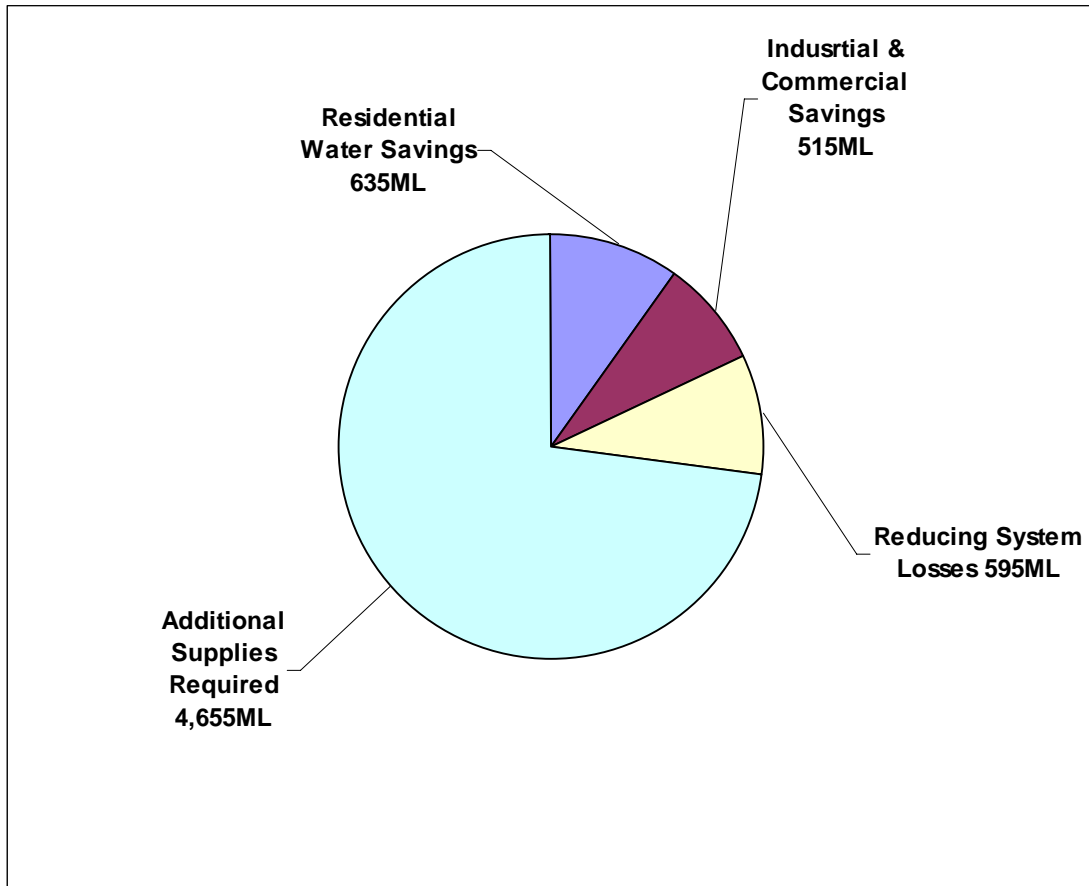
The estimated savings and additional supplies from the actions are detailed in Table 5.1 and Figure 5. They show the relative amounts of water that are likely to be achieved from the three key areas of the Water Security Plan.

Table 5.1 Actions for reducing use and securing water supplies

Option	Murray System (ML)	Goulburn System (ML)	Loddon System (ML)	Wimmera System (ML)	Campaspe System (ML)	Groundwater System (ML)	Totals
Average use (base years of 00/01 & 01/02)	6,060	2043	605	349	186	317	9,560
Water use reduction Strategies:							
Permanent Residential water savings rules, Community education, Water saving incentives, Pricing incentives, Water sensitive urban design	420	120	45	15	10	25	635
Non-residential conservation (working with industry)	350	140	15	0	0	10	515
Reducing System Losses	320	80	100	175*	50	30	755*
Total reduction in use	1,090	340	160	30	60	65	1,745
Water Shortfall predicted in 2055	5,560	690	40	25	0	85	6,400
Balance required by additional supplies.	4,470	350	-120	-5	-60	20	4,655

* 160ML of these savings are returned to Grampians-Wimmera Mallee Water.

Figure 5 Actions for reducing loss and securing water supplies



6. THE NEXT STEPS

Implementing This Strategy

This Strategy is the initial step in securing water for the future for the cities and towns outside of the Coliban Supply System. Implementation of some of these actions has already commenced, with a significant number of the measures to be undertaken over the next 5-8 years.

Community Support

Support from the community is critical in ensuring a number of actions within the Strategy are successfully undertaken. Apart from the demand management actions that require specific input from our customers to continue to minimise water consumption, a number of projects will involve considerable consultation. Over the coming few years, Coliban Water will be seeking community input (sometimes this will be solely focused on those directly affected) on some of these large water saving projects.

On-going Development

Coliban Water plans to review and upgrade the water supply demand management strategy on a 5 year rolling basis, so that impacts such as future growth and climate change can be kept up to date as much as possible. This will ensure that if works need to be undertaken on a more urgent timeframe, then this can be done prior to the need becoming critical.

Important Note

The successful implementation of this Strategy will not prevent future water shortages during times of below average rainfall. Drought is a fact of Australian life, and this Strategy is not to provide water on a never-ending basis (i.e. drought proof the region), rather it has been developed to ensure that water is available to meet future demand at 95% reliability. As such, urban restrictions are still possible in the future – in fact these are certain to occur at some stage.

Acknowledgments

Some information, photographs and text courtesy of David Thompson, DJT Consulting Pty Ltd.

APPENDIX

Murray Supply System

Overview of Supply

The Murray River supply system supplies water to the towns of Echuca, Gunbower, Leitchville and Cohuna. It provides potable water to 8,103 connections, serving a population of 15,500 people. The combined bulk entitlement for the system is 6,285ML and all water is pumped directly from waterways to treatment plants – there is no offsite storage in the system.

Echuca is a major tourist destination and has significant food processing industries. Leitchville has a major milk processing facility (Murray Goulburn) and supplies a rural supply system. There are four rural water supply schemes connected to the Cohuna supply system.

Town	Delivery System	Connections	Bulk Entitlement ML	Population 2005
Cohuna	Gunbower Creek	1,362	677	2,340
Echuca	Murray River	6,296	5,055	12,570
Gunbower	Taylor's Creek	176	131	290
Leitchville	Gunbower Creek	269	422	300
Total		8,103	6,285	15,500

Current Water Balance

The distribution of water use between the domestic and commercial sectors, and system water losses, is shown in the following table.

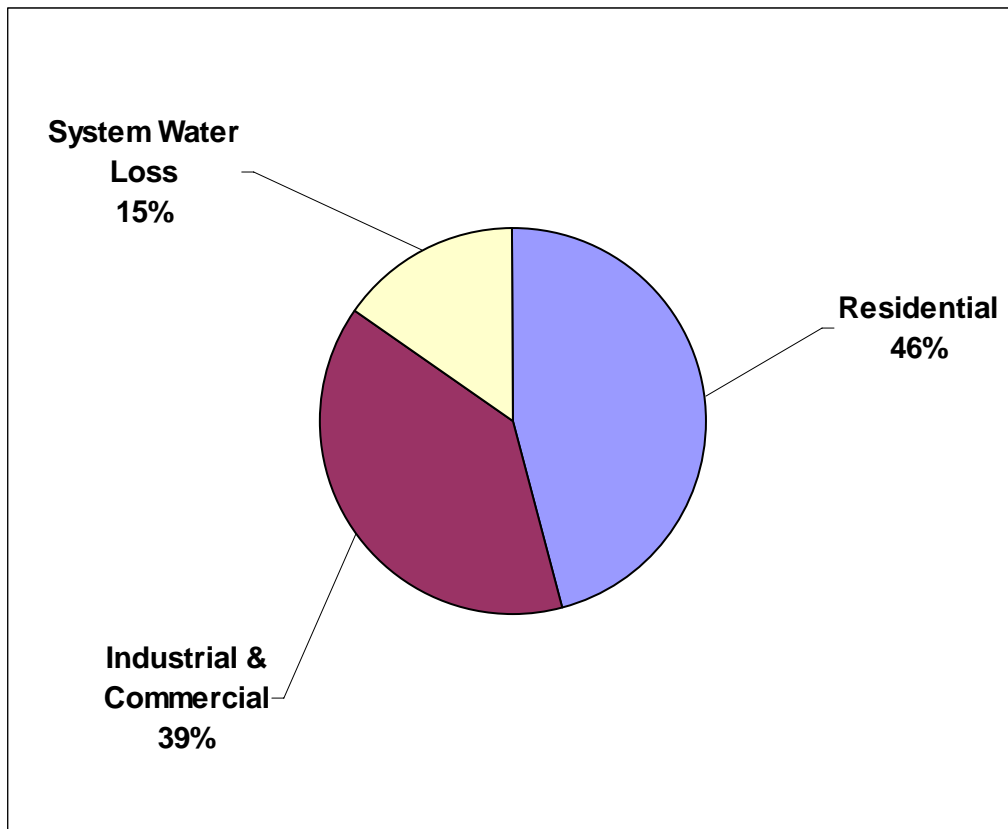
Town	Water Use (Base Years) ML					
	Residential	Industrial & Commercial	System Water Loss	Total BE Taken	Residential litres / person / day	Total litres / person / day
Cohuna	634	128	39	801	777	980
Echuca	2,028	1,785	774	4,587	490	1,110
Gunbower	51	17	37	105	494	1,020
Leitchville	65	425	77	567	600	5,230
Total	2,778	2,355	927	6,060	538	1,173
	46%	39%	15%	100%		

The total per capita water use of 1,173 litres per person per day and the residential per capita water use of 538 litres per person per day are comparable with the averages for the towns in this Strategy of 1,100 and 490 respectively.

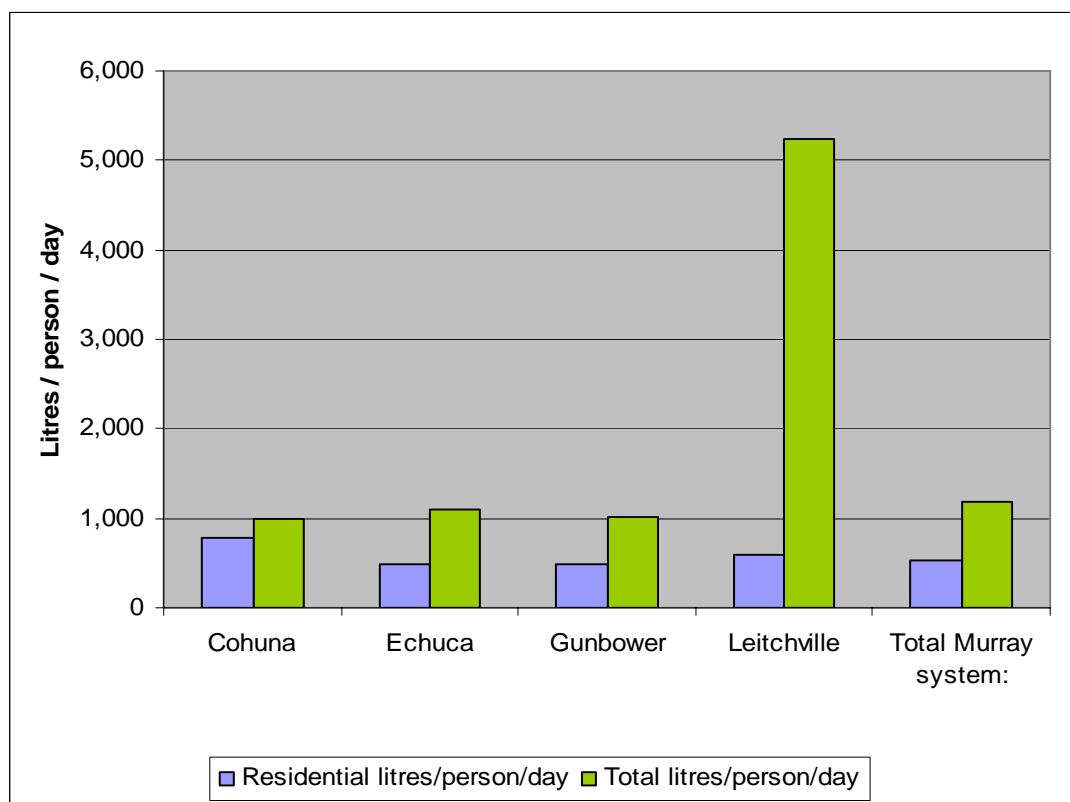
There is high industrial & commercial use, accounting for 39% of the total system demand, with large food processing industries at Echuca and Leitchville. The Murray system accounts for two-thirds of all industrial & commercial use of the systems in this Strategy.

The Murray system is one of the better performing systems in terms of losses, with total losses of 927ML or 15% of the total system use.

Murray System Use (Base Year)



Per capita water use for the Murray system supplies for the base year



The high total per capita water use for Leitchville is due to its high industrial use averaged over a very small population base.

Population Forecast

The Murray system population is forecast to increase by an average of 1.3% pa with the major growth centre at Echuca. Echuca's population is predicated to double over the next 50 years increasing from some 12,570 to 26,460.

Town	Population Forecast					
	Nominal Forecast 50 Year Growth	2001	2005	2014	2027	2055
Cohuna	0.5%	2,236	2,340	2,420	2,580	2,970
Echuca	1.5%	11,335	12,570	14,580	17,430	26,460
Gunbower	0.1%	283	290	290	300	300
Leitchville	-0.7%	297	300	280	260	210
Total	1.3%	14,151	15,500	17,570	20,570	29,940

Future Water Use

The unrestricted water use, based on water usage for the years 2001/02 and 2001/01, the per capita water use and population forecasts are set out below.

Over the next 50 years, the Murray system's unrestricted demand is forecast to increase by 4,720ML from its current base of 6,060ML to a total estimated demand of 10,780ML. Most of the increased demand will come from Echuca, with demand increasing by some 4,587ML to 9,150ML.

Town	Unrestricted Annual Demand ML			
	2000-02	2014	2027	2055
Cohuna	801	870	920	1,060
Echuca	4,587	4,970	6,030	9,150
Gunbower	105	110	110	110
Leitchville	567	520	500	460
Total	6,060	6,470	7,560	10,780

Climate Change

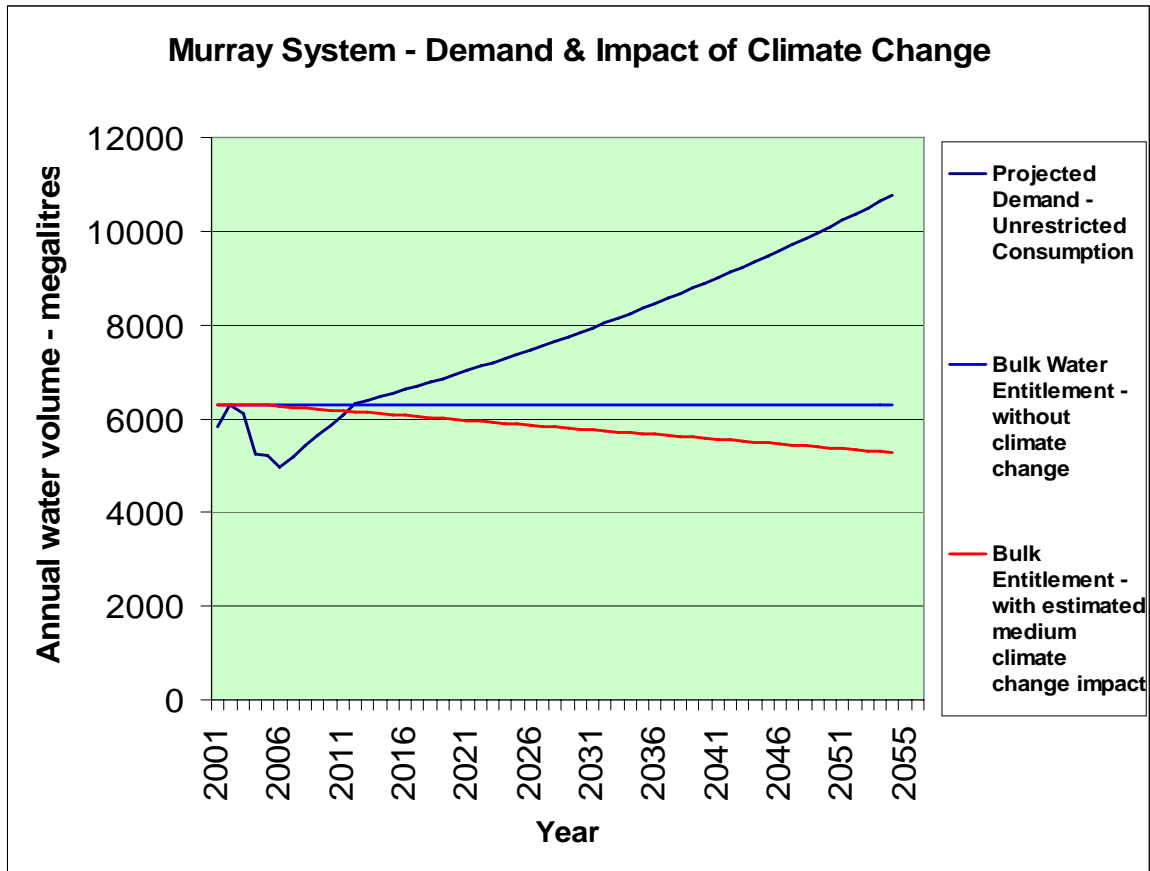
The potential impact on the Murray system yield from the lower, medium and upper climate change forecasts, based on CSIRO research, are

Lower impact	-5%
Medium impact	-17%
Upper impact	-32%

Under the medium change scenario, by 2055 the current yield of 6,285ML will reduce to 5,220ML. The continuation of the low inflows as experienced over the past 10 years would have a greater impact and reduce yield to about 3,000ML.

This reduction in yield to 5,220ML will result in a significant shortfall of 5,560ML in meeting the predicted demand of 10,780ML in the year 2055.

Additional water will be required within the next seven years to meet the impact of the medium climate change scenario.



Murray System	Yield (Bulk Entitlement) - adjusted for Climate Change ML				Yield Deficit - Additional Water Required to meet Climate Change ML			Year that Demand Exceeds Water Yield
	2005	2014	2027	2055	2014	2027	2055	
Total	6285	6,100	5,820	5,220	370	1,740	5,560	By 2010

Goulburn Supply System

Overview of Supply

The Goulburn system provides a potable water supply to the towns of Boort, Lockington, Pyramid Hill and Rochester, as well as non-potable supply to Dingee, Mitiamo, Macorna and Mysia. The system supplies water to 2,688 connections, serving a population of 4,764 people.

Raw water is delivered via the Goulburn-Murray Channel system to service basins in each town, except for Rochester, which is supplied all year round with channel supplies. Rochester has a major milk processing facility, while Pyramid Hill has a significant pet food processing facility. The total bulk entitlement for all towns is 2,420ML.

Town	Delivery System	Connections	Bulk Entitlement ML	Population 2005
Boort	Goulburn-Murray Channel system	502	425	760
Dingee		44	50	60
Lockington		231	130	410
Macorna		29	40	23
Mitiamo		61	60	100
Mysia		12	15	21
Pyramid Hill		314	300	500
Rochester		1,495	1,400	2,890
Total		2,688	2,420	4,764

Current Water Balance

The distribution of water use between the residential and commercial sectors, and system water losses, is shown in the following table.

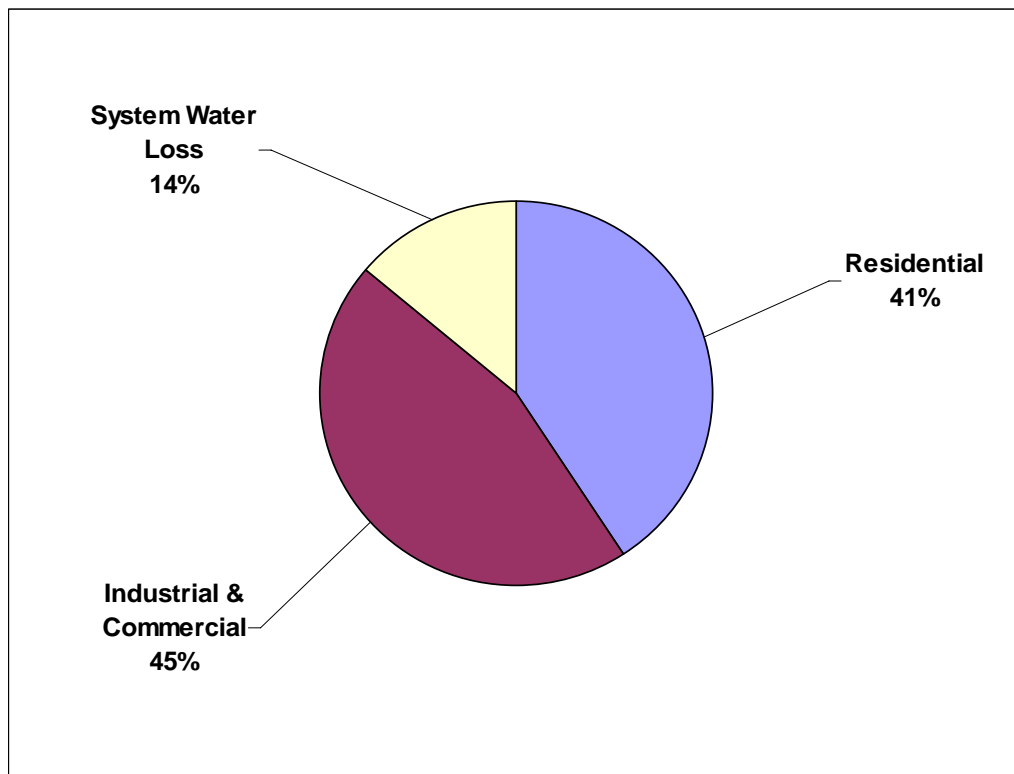
Town	Water Use (Base Years) ML					
	Residential	Industrial & Commercial	System Water Loss	Total BE Taken	Residential litres / person / day	Total litres / person / day
Boort	145	64	61	270	525	980
Dingee	8	4	2	14	373	620
Lockington	58	11	24	93	394	630
Macorna	1	0	4	5	119	600
Mitiamo	11	5	41	56	301	1,550
Mysia	2	0	6	8	196	980
Pyramid Hill	84	76	89	249	462	1,370
Rochester	525	767	57	1,349	515	1,320
Total	834	926	283	2,043	491	1,203
	41%	45%	14%	100%		

The total per capita water use of 1,203 litres per person per day and the residential per capita water use of 491 litres per person per day are comparable with the averages for all towns in this Strategy of 1,100 and 490 respectively.

Industrial & commercial use is very high and accounts for 45% of the total system water demand, mainly due to the milk factory at Rochester and other industrial use at Pyramid Hill and Boort. The Goulburn system is the only system where industrial & commercial use exceeds the residential use.

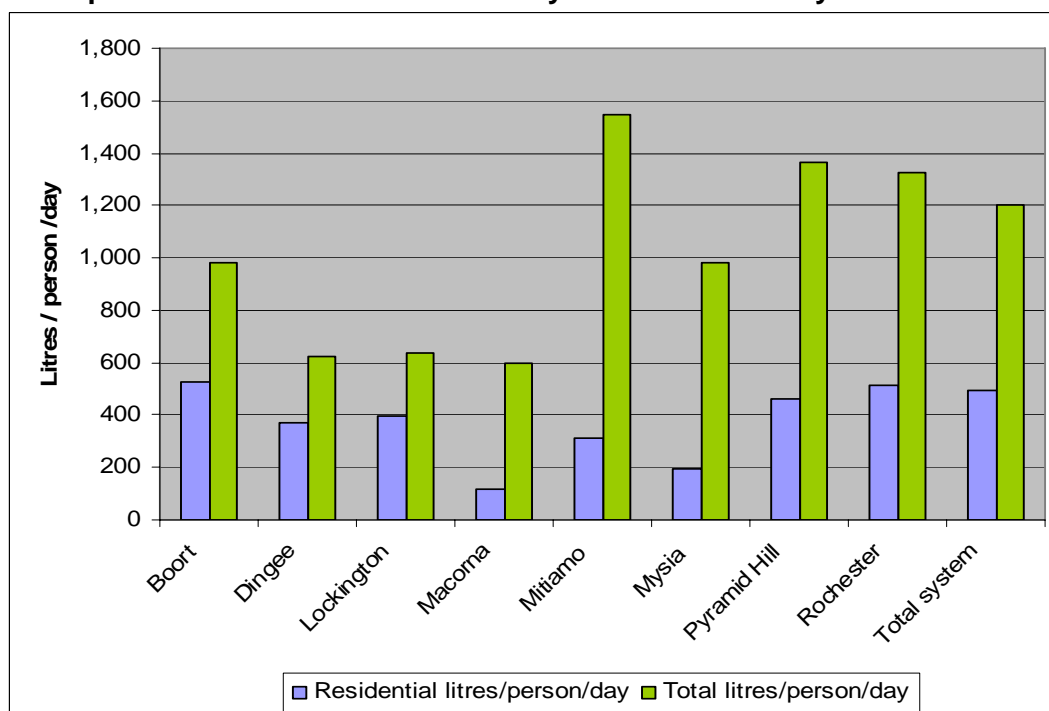
The Goulburn system is the best performing system in terms of system losses, with system losses of 283ML or 14% of its total system use. This figure is due to the performance of the Rochester system where there are no open earthen storages and losses account for only 4% of Rochester's total use. All other towns have open earthen storages and exhibit high water losses of 33% of their total water use.

Goulburn System Use (Base Year)



There is considerable variation between the towns in both the residential and total per capita water use. A number of factors cause the variations including the influence of industrial use in Rochester and Pyramid Hill, water losses in some of the service basins and possible meter inaccuracies.

Per capita water use for the Goulburn system for the base year



Population Forecast

The forecast population increase for the Goulburn system is 0.3% pa, which will increase the population by 830 persons over the next 50 years from 4,764 to 5,590 people. The major growth centre is Rochester where the population is forecast to increase at a greater rate than the Goulburn system average, increasing by 820 people. Negative growth rates are likely for all small towns of less than 400 people.

Town	Population					
	Nominal Forecast 50 Year Growth	2001	2005	2014 7 years	2027 20 years	2055 50 years
Boort	0.5%	756	760	790	840	970
Dingee	-0.8%	60	60	60	50	40
Lockington	0.1%	400	410	410	420	430
Macorna	-0.7%	23	23	20	20	15
Mitiamo	-0.8%	100	100	90	80	70
Mysia	-0.2%	21	21	20	20	20
Pyramid Hill	-0.8%	498	500	470	420	335
Rochester	0.5%	2,792	2,890	3,020	3,220	3,710
Total	0.3%	4,650	4,764	4,880	5,070	5,590

Future Water Use

The table below sets out the water use over the next 50 years based on water usage in the base years of 2001/02 and 2001/01, the current per capita water use and population forecasts.

The Goulburn system's unrestricted demand is likely to increase from the base of 2,043ML by 520ML to a total estimated demand of 2,562ML. The increased demand is from Rochester (530ML) and Boort (80ML). The water demands from all other towns are expected to remain steady or decline due to declining populations.

Town	Unrestricted Annual Demand ML			
	2000-02	2014	2027	2055
Boort	270	280	300	350
Dingee	14	10	10	10
Lockington	93	100	100	100
Macorna	5	7	6	5
Mitiamo	57	50	50	40
Mysia	8	7	7	7
Pyramid Hill	249	230	210	170
Rochester	1,349	1,530	1,640	1,880
Total system	2,043	2,214	2,323	2,562

Climate Change

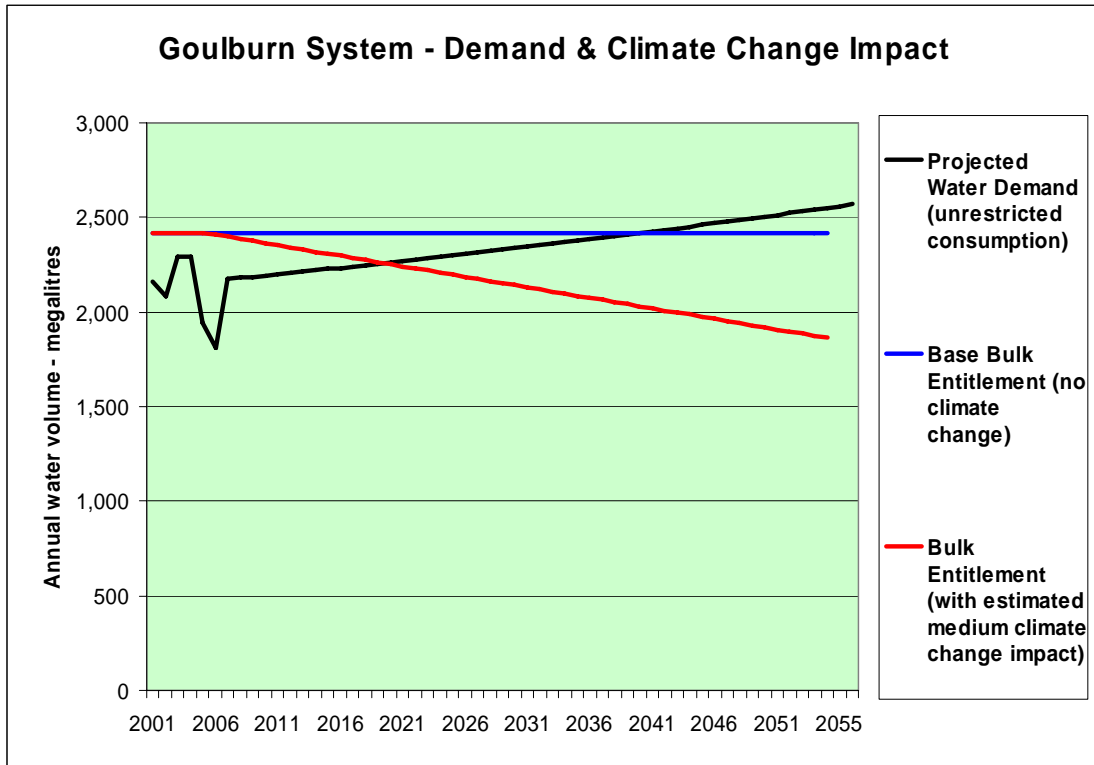
The potential impact on the Goulburn system yield from the lower, medium and upper climate change forecasts, based on CSIRO research, are

Lower impact	-7%
Medium impact	-23%
Upper impact	-43%

The Table below sets out the impact of the medium change scenario. It shows that the current yield of 2,420ML will reduce to 1,870ML over the next 50 years. The continuation of the low inflows as experienced over the past 10 years would reduce yield to about 2,000ML.

This reduction in yield to 1,870ML will result in a shortfall of 690ML in meeting the predicted demand of 2,562ML in the year 2055.

Additional water will be required for Rochester within the next seven years to meet the impact of the medium climate change scenario. However, with a re-distribution of bulk entitlements between the Goulburn towns, the additional water would not be required until after 2020.



Town	Yield (Bulk Entitlement) - adjusted for Climate Change ML				Yield Deficit - Additional Water Required to meet Climate Change ML			Year that Demand Exceeds Water Yield
	2005	2014	2027	2055	2014	2027	2055	
Boort	425	410	380	330	0	0	20	After 2055
Dingee	50	50	40	40	0	0	0	After 2055
Lockington	130	120	120	100	0	0	0	After 2055
Macorna	40	40	40	30	0	0	0	After 2055
Mitiamo	60	60	50	50	0	0	0	After 2055
Mysia	15	10	10	10	0	0	0	After 2055
Pyramid Hill	300	290	270	230	0	0	0	After 2055
Rochester	1,400	1,340	1,260	1,080	190	380	800	Now
Total system	2,420	2,320	2,170	1,870	0	150	690	

Loddon Supply System

Overview of Supply

The Loddon system provides potable water to the towns of Bridgewater, Inglewood, Laanecoorie, Dunolly, Bealiba, Tarnagulla and Serpentine and a non-potable supply to Jarklin. The system supplies water to 1,500 connections, serving a population of 2,260 people.

Raw water is drawn from the Loddon River at Bridgewater and Laanecoorie and from the Serpentine Creek, a tributary of the Loddon River, at Jarklin and Serpentine.

Water treatment plants are located at Bridgewater, Laanecoorie and Serpentine. Dunolly, Bealiba and Tarnagulla receive a pumped supply from the Laanecoorie water treatment plant.

Only the Bridgewater/Inglewood system has a small off-river earthen storage. Due to the higher than desirable salinity levels in the Bridgewater/Inglewood towns, it is proposed to connect these two towns to the Bendigo reticulation system (Coliban System).

The total bulk entitlement for the eight towns is 820ML. There are no major industries in the Loddon system.

Town	Delivery System	Connections	Bulk Entitlement ML	Population 2005
Bridgewater	Loddon River	225	820	405
Inglewood	Loddon River	451		690
Jarklin	Serpentine Creek	13		14
Laanecoorie	Loddon River	41		60
Dunolly	Loddon River	448		670
Bealiba	Loddon River	99		140
Tarnagulla	Loddon River	132		160
Serpentine	Serpentine Creek	91		125
Total		1,500	820	2,264

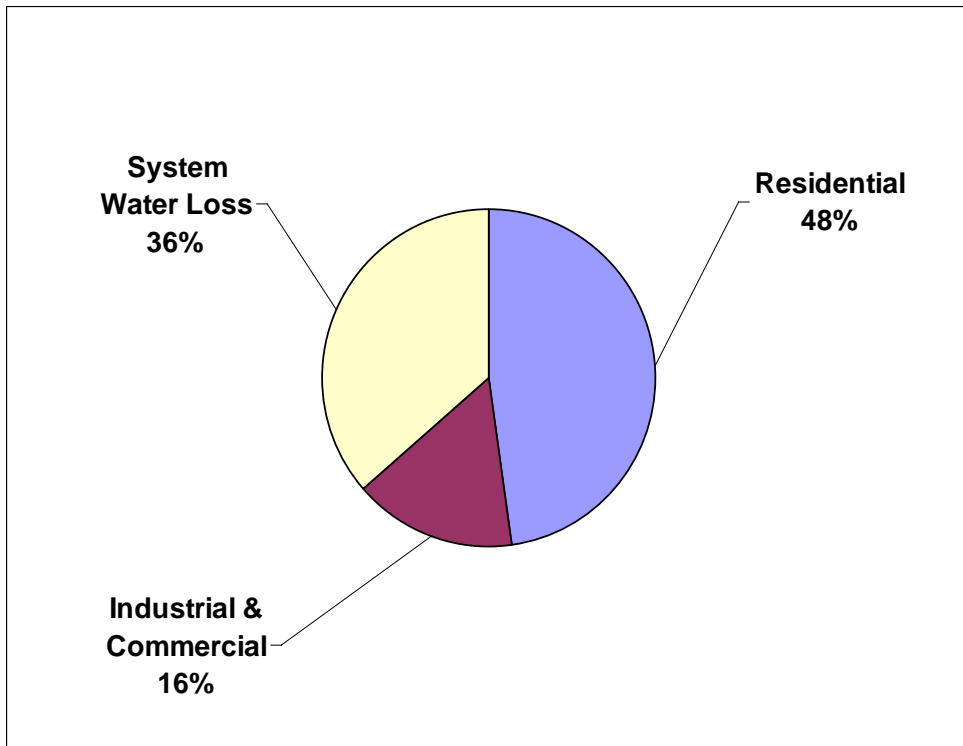
Current Water Balance

The distribution of water use between the domestic and the industrial & commercial sectors and system losses, is shown in the following table.

Town	Water Use (Base Years) ML					
	Residential	Industrial & Commercial	System Water Loss	Total BE Taken	Residential litres / person / day	Total litres / person / day
Bridgewater	54	20	136	335	360	840
Inglewood	89	36				
Jarklin	3	0	6	9	587	1,660
Laanecoorie	118	29	63	210	320	580
Dunolly						
Bealiba						
Tarnagulla						
Serpentine	26	10	15	51	573	1,150
Total	290	95	220	605	356	744
	48%	16%	36%	100%		

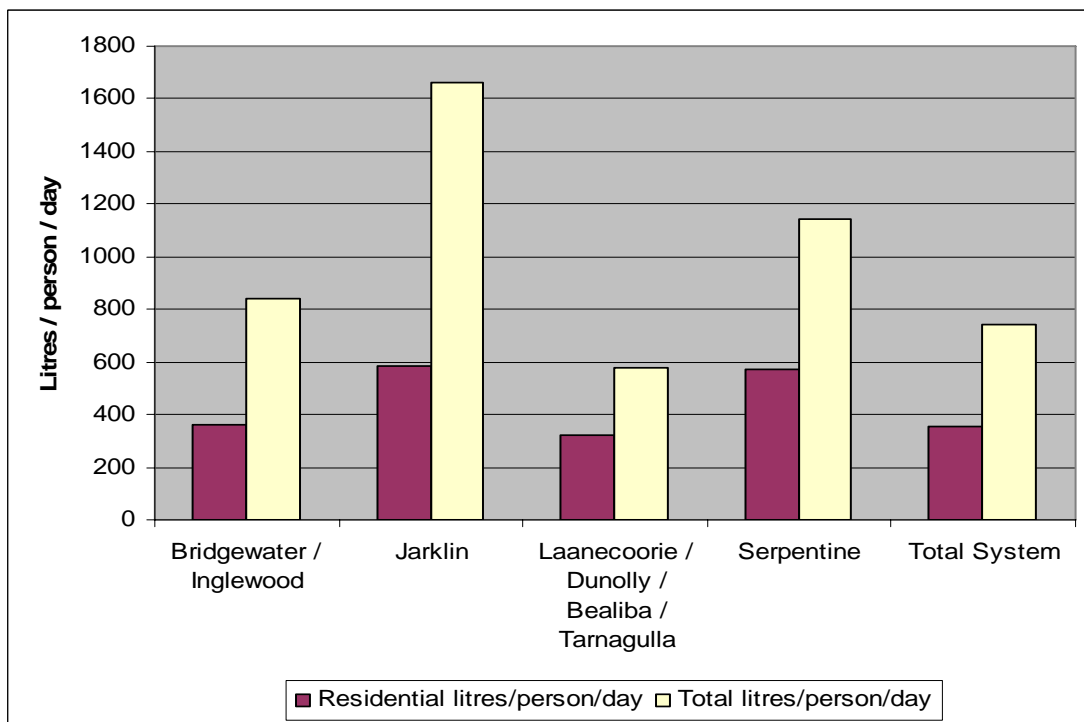
Industrial & commercial use accounts for only 16% of the total system demand. The total per capita water use of 744 litres per person per day is significantly less than the average for all towns in this Strategy of 1,100, due mainly to the absence of any major industry in these towns.

Loddon System Use (Base Year)



There is considerable variation between the eight towns in both the residential and total per capita water use as shown in the following chart. The small towns of Jarklin and Serpentine are prone to large variations in per capita use.

Per capita water use for the Loddon system for the base year



Population Forecast

The Loddon system's population of 2,260 is forecast not to increase over the next 50 years. A small population increase is predicted in Bridgewater but this is offset by negative growth rates in other towns.

Town	Population Forecast					
	Nominal Forecast 50 Year Growth	2001	2005	2014	2027	2055
Bridgewater	0.5%	403	405	420	450	520
Inglewood	-0.2%	685	690	680	660	630
Jarklin	-0.8%	14	14	10	10	10
Laanecoorie	-0.2%	60	60	60	60	56
Dunolly	0.0%	663	670	670	670	670
Bealiba	0.0%	124	140	140	140	140
Tarnagulla	-0.2%	158	160	160	160	150
Serpentine	-0.8%	122	125	120	110	80
Total	0.0%	2,229	2,264	2,260	2,260	2,260

Future Water Use

The unrestricted water use, based on years 2001/02 and 2001/01, the per capita water use and population forecasts are set out below.

The table shows that the Loddon system's unrestricted annual demand is likely to experience only marginal changes, if any, remaining relatively constant at 610ML to 620ML per year.

Town	Unrestricted Annual Demand ML			
	2000-02	2014	2027	2055
Bridgewater / Inglewood	335	340	340	350
Jarklin	9	8	7	6
Laanecoorie Dunolly Bealiba Tarnagulla	211	220	220	210
Serpentine	51	50	40	40
Total	606	618	607	606

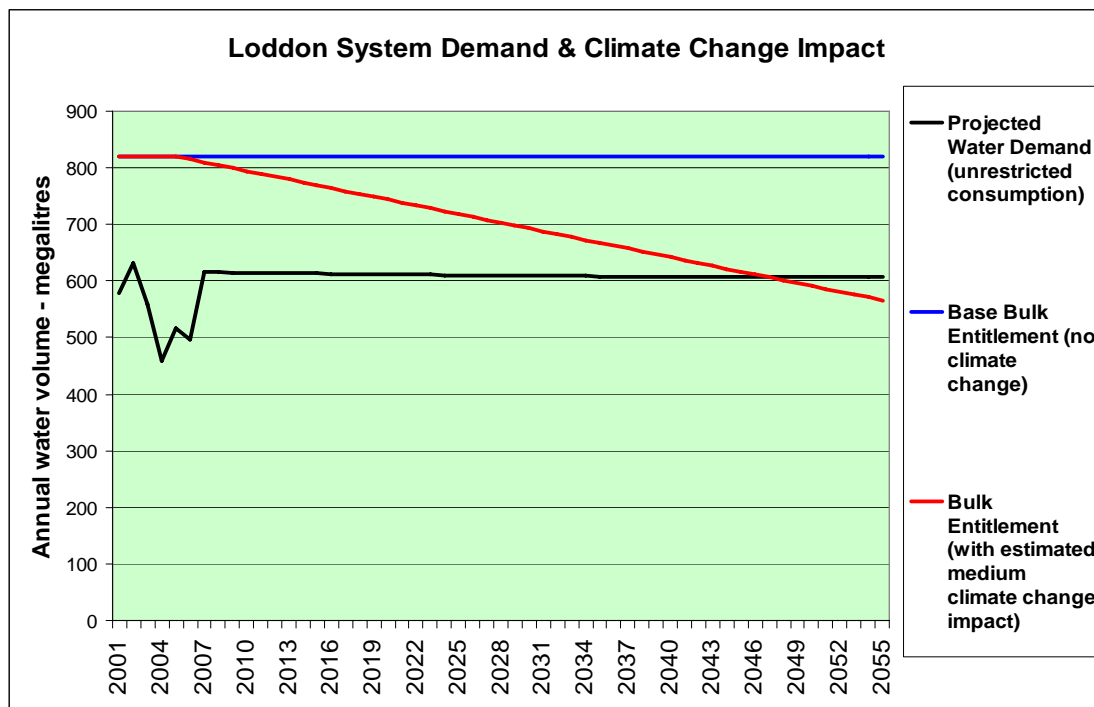
Climate Change

The potential impact on the Loddon system yield from the lower, medium and upper climate change forecasts, based on CSIRO research, are

Lower impact	-10%
Medium impact	-31%
Upper impact	-58%

The Table below sets out the impact of the medium change scenario. Under this scenario, by 2055 the current yield of 820ML will reduce to 570ML. The continuation of the low inflows as experienced over the past 10 years would have a greater impact and reduce yield to about 330ML.

This reduction in yield to 570ML will result in a shortfall of 40ML in meeting the predicted demand of 610ML. Additional water will be required after 2045 to meet the impact of the medium climate change scenario.



Loddon System	Yield (Bulk Entitlement) - adjusted for Climate Change ML				Yield Deficit - Additional Water Required to meet Climate Change ML			Year that Demand Exceeds Water Yield
	2005	2014	2027	2055	2014	2027	2055	
Total	820	780	710	570	0	0	40	After 2045

Wimmera Supply System

Overview of Supply

The Wimmera system provides potable water to the towns of Korong Vale and Wedderburn and a non-potable supply to Borung and Wychitella. The system supplies water to 690 connections, serving a population of 920 people.

Raw water is delivered via the channel system from storages in the Grampians Wimmera Mallee Water region to earthen open storages at Korong Vale, Borung and Wychitella. There are normally one or two deliveries of water each year, one at the beginning of the channel operation season and one at the end of the season.

The total bulk entitlement for the system is 450ML.

Town	Delivery System	Connections	Bulk Entitlement ML	Population 2005
Borong	Grampians Wimmera Mallee channel system	24	450	53
Korong Vale		134		180
Wedderburn		515		660
Wychitella		15		30
Total System		688	450	923

Current Water Balance

The distribution of water use between the residential and industrial & commercial sectors and system water losses is shown in the following table.

Town	Water Use (Base Years) ML					
	Residential	Industrial & Commercial	System Water Loss	Total BE Taken	Residential litres / person / day	Total litres / person / day
Borong	6	0	16	22	310	1,140
Korong Vale	22	1	195	316	330	1,030
Wedderburn	79	19				
Wychitella	3	0	8	11	270	1,000
Total	110	20	219	349	327	1,037
	32%	6%	62%	100%		

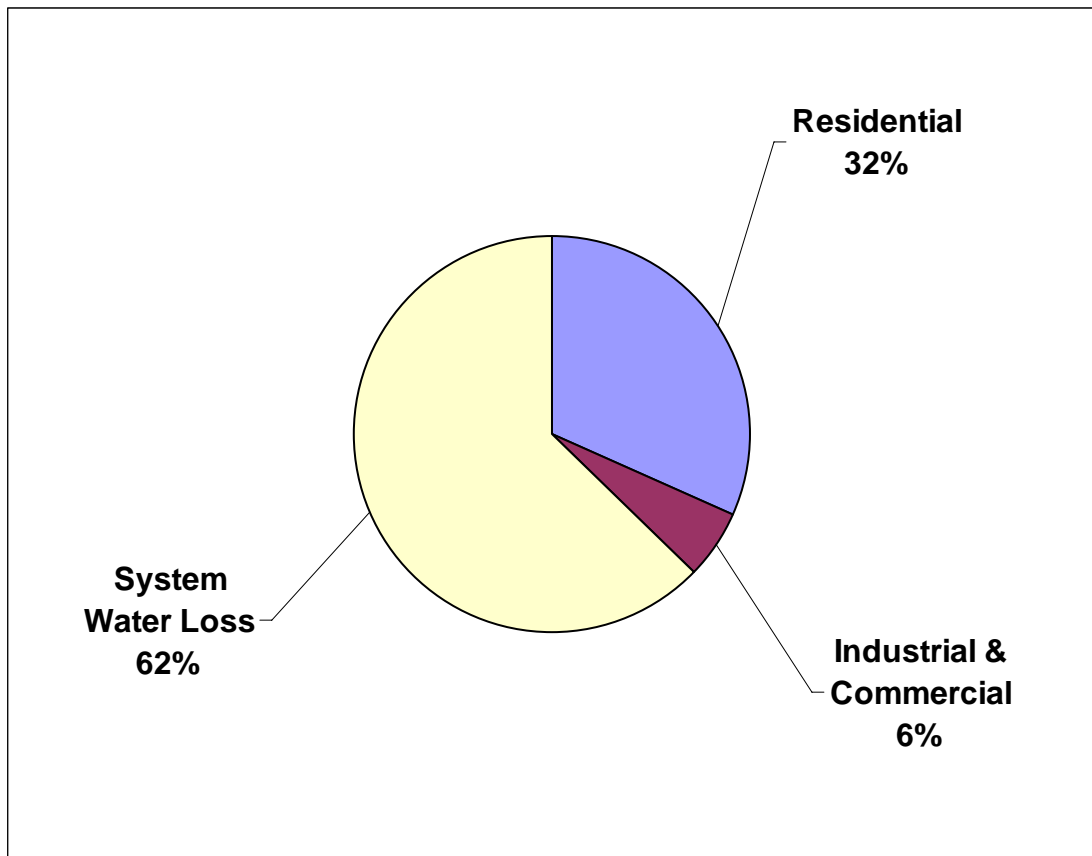
The total per capita water use of 1,037 litres per person per day is comparable to the average of all towns in this Strategy of 1,100.

Residential per capita water use of 327 litres per person per day is significantly lower than the average for all systems of 490. This is due to the Wimmera towns being on water restrictions since 1999.

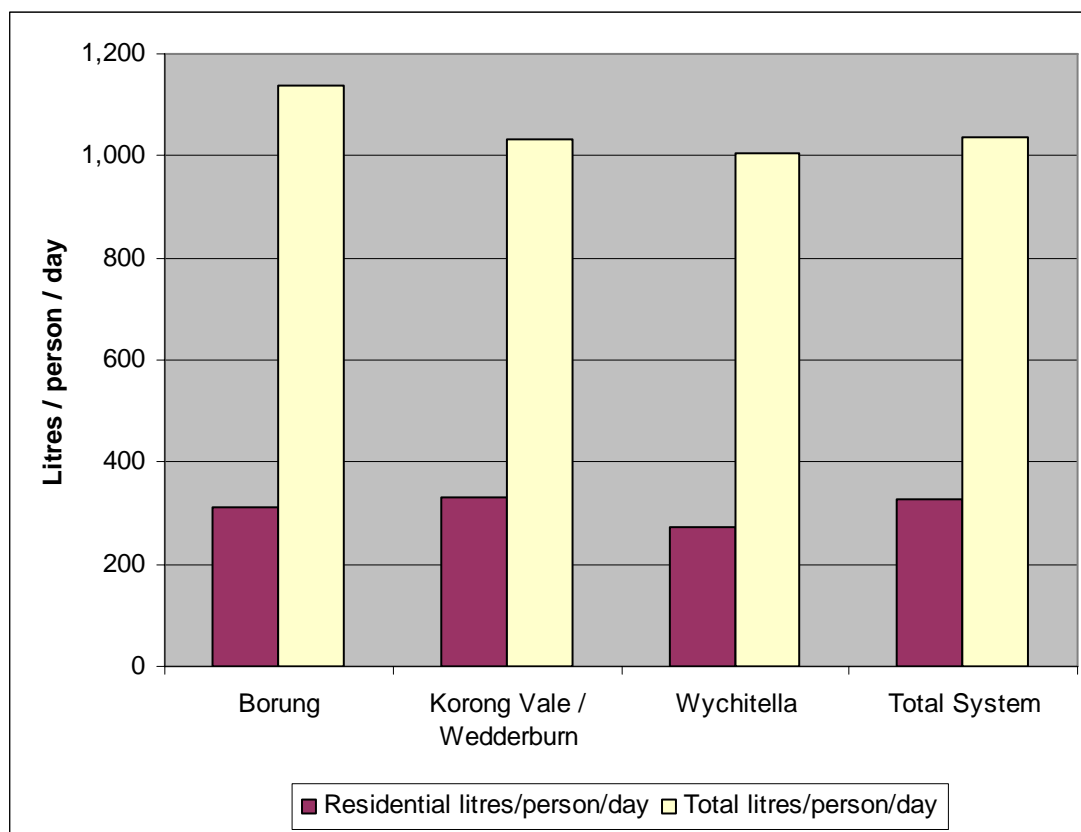
There is very little industrial & commercial water use, accounting for only 6% of the total system use.

Water losses are very high and amount to 62% of the total use. Seepage and evaporation losses from the system's open earthen storages are significant; a detailed study of the three Korong Vale storages, over a two-year period, found that seepage and evaporation losses were as much as 70%, with seepage comprising 40% of the raw water use and evaporation comprising another 30%.

Wimmera System Use (Base Year)



Per capita water use for the Wimmera system for the base year



All towns in the Wimmera system have very similar residential and total per capita water use.

Population Forecast

The Wimmera system population is forecast to decline by an average rate of 0.2% pa from 920 people to 840 people over the next 50 years. None of the towns is expected to increase in population.

Town	Population Forecast					
	Nominal Forecast 50 Year Growth	2001	2005	2014	2027	2055
Borong	-0.2%	53	53	50	45	35
Korong Vale	0.0%	183	180	180	180	180
Wedderburn	-0.2%	656	660	650	630	600
Wychitella	-0.2%	30	30	30	30	25
Total	-0.2%	922	923	910	890	840

Future Water Use

The unrestricted water use, based on water usage for the years 2001/02 and 2001/01, the per capita water use and population forecasts are set out in the following table.

Unrestricted demand is likely to decrease from 349ML to 315ML due to the declining population.

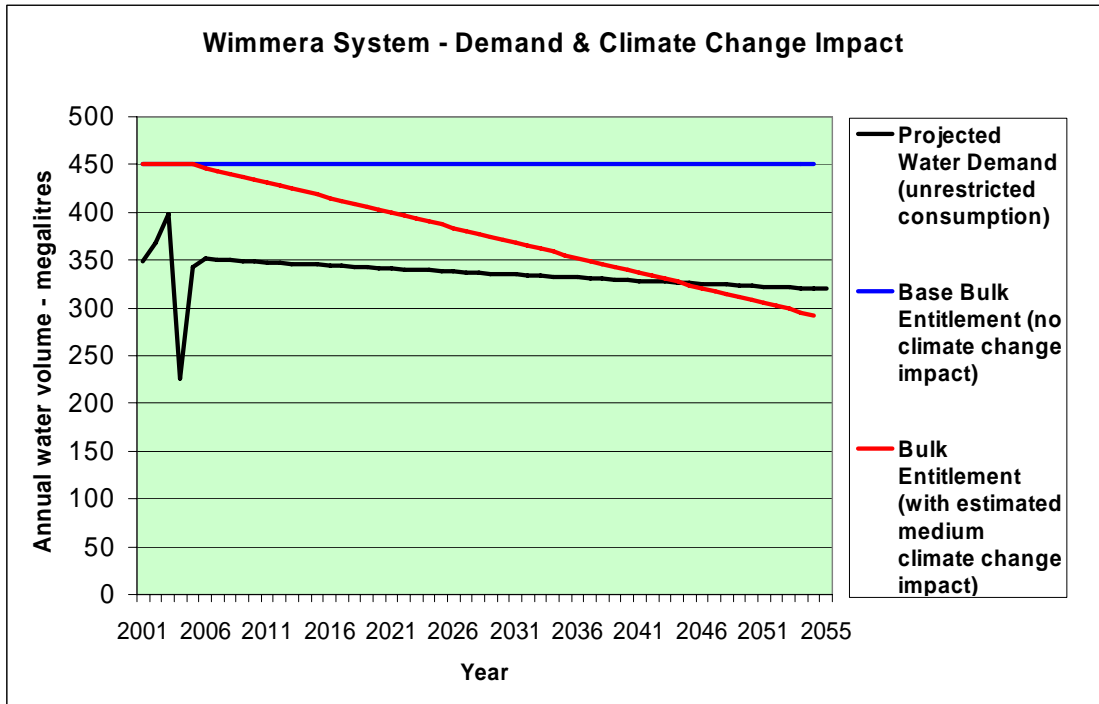
Town	Unrestricted Annual Demand ML			
	2000-02	2014	2027	2055
Borong	22	20	20	15
Korong Vale	316	310	305	290
Wedderburn				
Wychitella	11	10	10	10
Total	349	340	330	315

Climate Change

The potential impact on the Wimmera system yield from the lower, medium and upper climate change forecasts, based on CSIRO research, is the most severe of any of the systems that comprise this Strategy, and are

Lower impact	-13%
Medium impact	-35%
Upper impact	-62%

Under the medium change scenario, the current yield of 450ML will reduce to 290ML by 2055.



Wimmera System	Yield (Bulk Entitlement) - adjusted for Climate Change ML				Yield Deficit - Additional Water Required to meet Climate Change ML			Year that Demand Exceeds Water Yield
	2005	2014	2027	2055	2014	2027	2055	
Total	450	420	380	290	0	0	25	After 2045

Campaspe Supply System

Overview of Supply

The Campaspe system provides potable water to the towns of Axedale and Goornong and in the past has provided part of the supply to Rochester. The system supplies water to 289 connections, serving a population of 470 people.

Raw water is drawn directly from the Campaspe River. The bulk entitlement for Axedale and Goornong is 215ML. There is also a current bulk entitlement of 134ML for Rochester but this has not been drawn upon in recent years as Rochester has been supplied totally from the Goulburn system.

Town	Delivery System	Connections	Bulk Entitlement ML	Population 2005
Axedale	Campaspe River	117	63	210
Goornong		172	152	260
Rochester			134	
Total		289	349	470

Current Water Balance

The distribution of water use between the residential and the industrial & commercial sectors and system water losses, is shown in the following table.

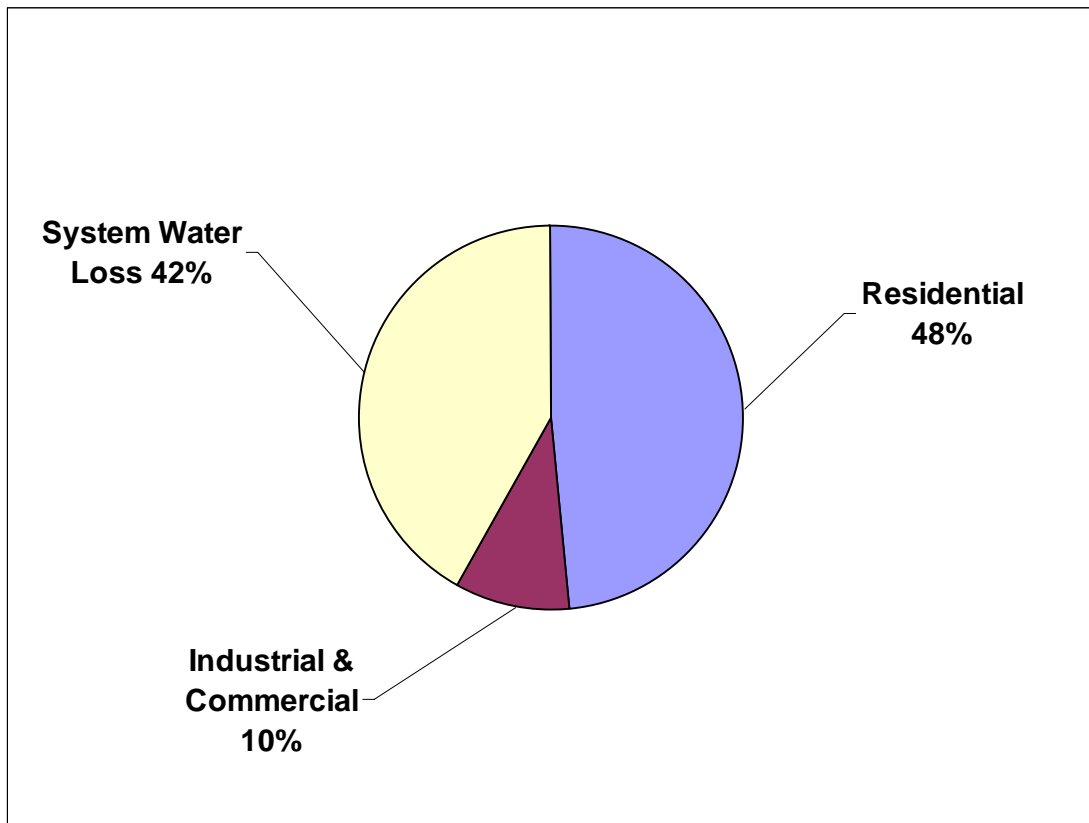
Town	Water Use (Base Years) ML					
	Residential	Industrial & Commercial	System Water Loss	Total BE Taken	Residential litres / person / day	Total litres / person / day
Axedale	32	7	31	70	443	960
Goornong	58	11	47	116	609	1,220
Total	90	18	78	186	537	1,107
	48%	10%	42%	100%		

The total per capita water use of 1,107 litres per person per day and the residential per capita water use of 537 litres per person per day are comparable to the average usage of all the towns in this Strategy of 1,100 and 490 respectively.

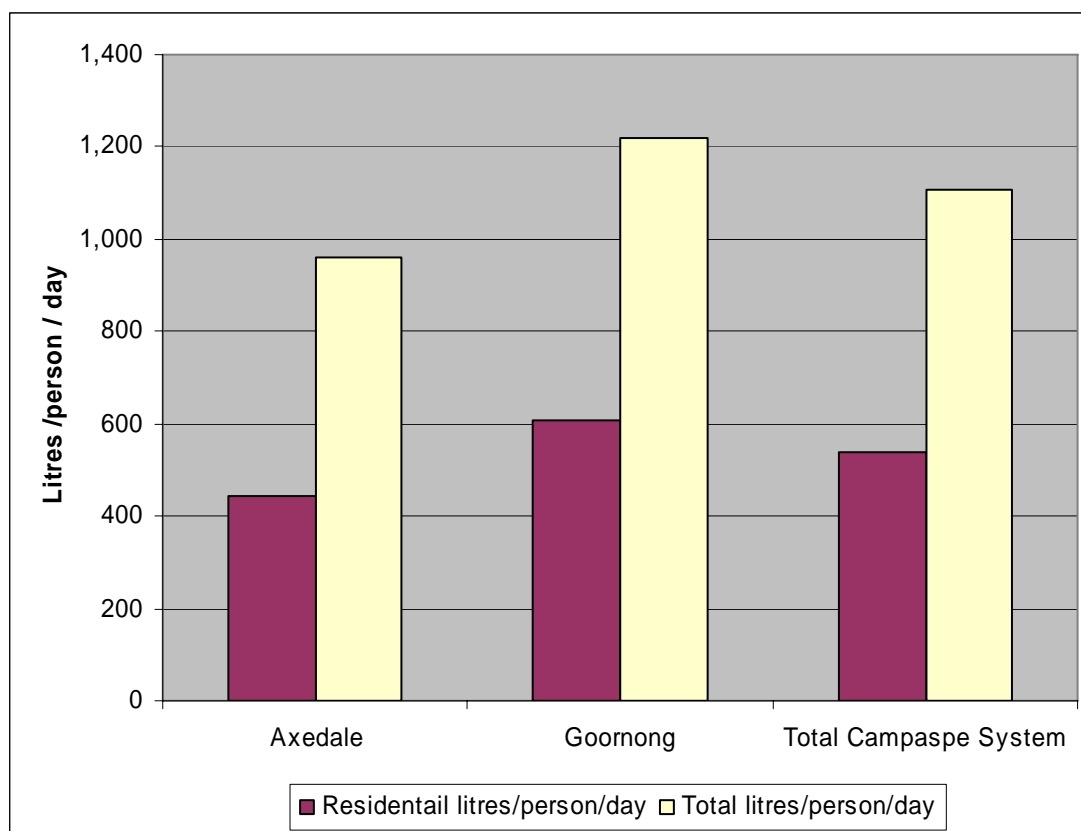
There is low industrial & commercial use, accounting for 10% of the total system demand.

The Campaspe system performs poorly in terms of system water losses comprising 42% of total use.

Campaspe System Use (Base Year)



Per capita water use for the Campaspe system for the base year



Population Forecast

The Campaspe system population is forecast to increase by an average of 0.5% pa from 460 to 600 people over the next 50 years.

Town	Population Forecast					
	Nominal Forecast 50 Year Growth	2001	2,005	2014	2027	2055
Axedale	0.5%	198	210	220	230	270
Goornong	0.5%	261	260	270	290	330
Total System	0.5%	459	470	490	520	600

Future Water Use

The unrestricted water use, based on water usage in the years 2001/02 and 2001/01, the per capita water use and population forecasts are set out in the following table.

The Campaspe system's unrestricted demand is forecast to increase from the 186ML to 250ML due to the increased population.

Town	Unrestricted Annual Demand ML			
	2000-02	2014	2027	2055
Axedale	70	80	80	100
Goornong	116	120	130	150
Total	186	200	210	250

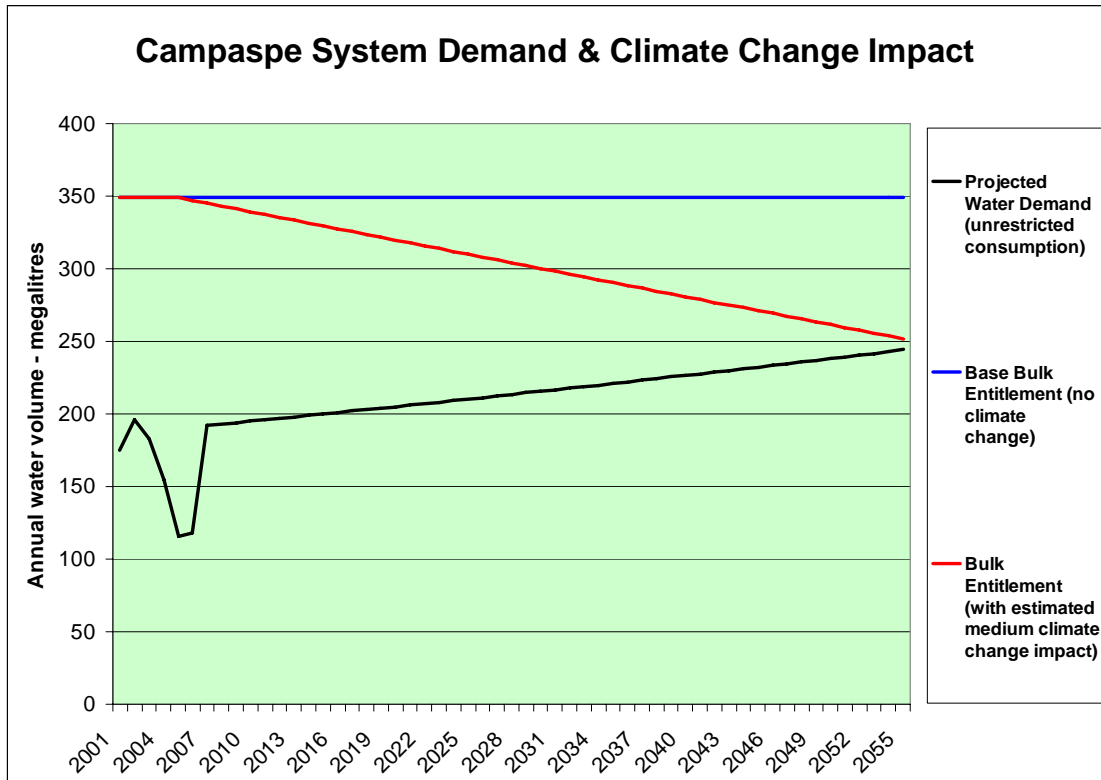
Climate Change

The potential impact on the Campaspe system yield from the lower, medium and upper climate change forecasts, based on CSIRO research, are

Lower impact	-9%
Medium impact	-28%
Upper impact	-54%

Under the medium change scenario, by 2055 the current yield of 215ML for Axedale and Goornong will reduce to 160ML. Additional water will be required after the year 2017 under the impact of this climate change scenario.

Rochester's current bulk entitlement of 134ML will reduce to 100ML by the year 2055 under the medium change scenario. The allocation of this yield for continued use by the Campaspe system towns, that is Axedale and Goornong, would be sufficient to meet future demand to the year 2055, as shown in the following table.



Campaspe System	Yield (Bulk Entitlement) - adjusted for Climate Change ML				Yield Deficit - Additional Water Required to meet Climate Change ML			Year that Demand Exceeds Water Yield
	2005	2014	2027	2055	2014	2027	2055	
Total	349	330	310	260	0	0	0	After 2055

Groundwater Supply Systems

Overview of Supply

The towns of Elmore and Trentham are supplied from different groundwater systems and accordingly are considered separately for the purposes of this Strategy.

Elmore has 440 connections and a population of 680 people and located adjacent the Campaspe River. It has a groundwater licence entitlement of 284ML.

Trentham has 450 connections and a population of 730 people and is located in the upper reaches of the Campaspe catchment. It has a groundwater licence entitlement of 48ML and a yet to be formalised entitlement to surface water, estimated to be a minimum of 130ML.

	Delivery System	Connections	Bulk Entitlement or Licence ML	Population 2005
Elmore	Groundwater	440	284	680
Trentham	Groundwater	450	178	730

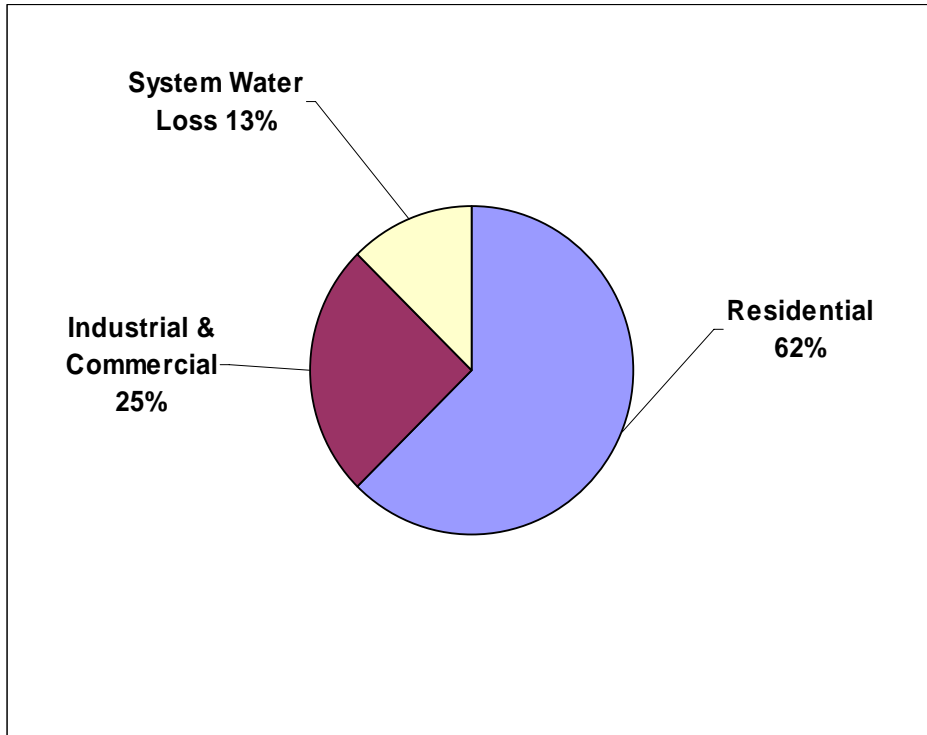
Current Water Balance

The distribution of water use between residential and industrial & commercial sectors and system water losses is shown in the following table.

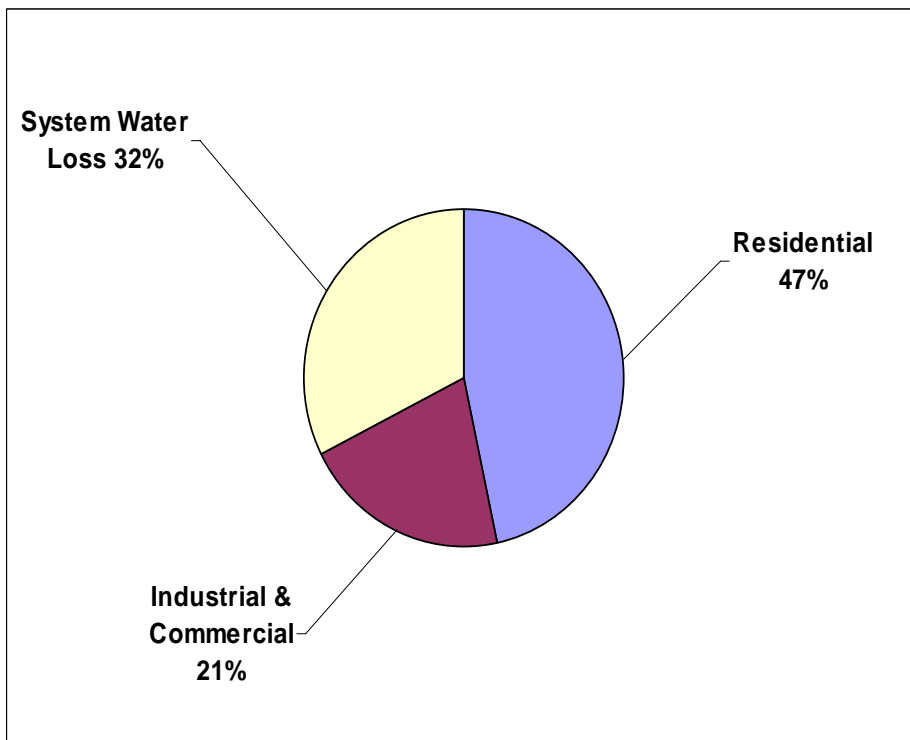
Town	Water Use (Base Years) ML					
	Residential	Industrial & Commercial	Total Water Loss	Total BE Taken	Residential litres / person / day	Total litres / person / day
Elmore	117	47	24	188	482	772
Trentham	60	27	42	129	236	507

The total per capita water use and the residential per capita water use are relatively low, particularly for Trentham, when compared to the averages for all towns in this Strategy of 1,100 and 490 litres per person per day respectively.

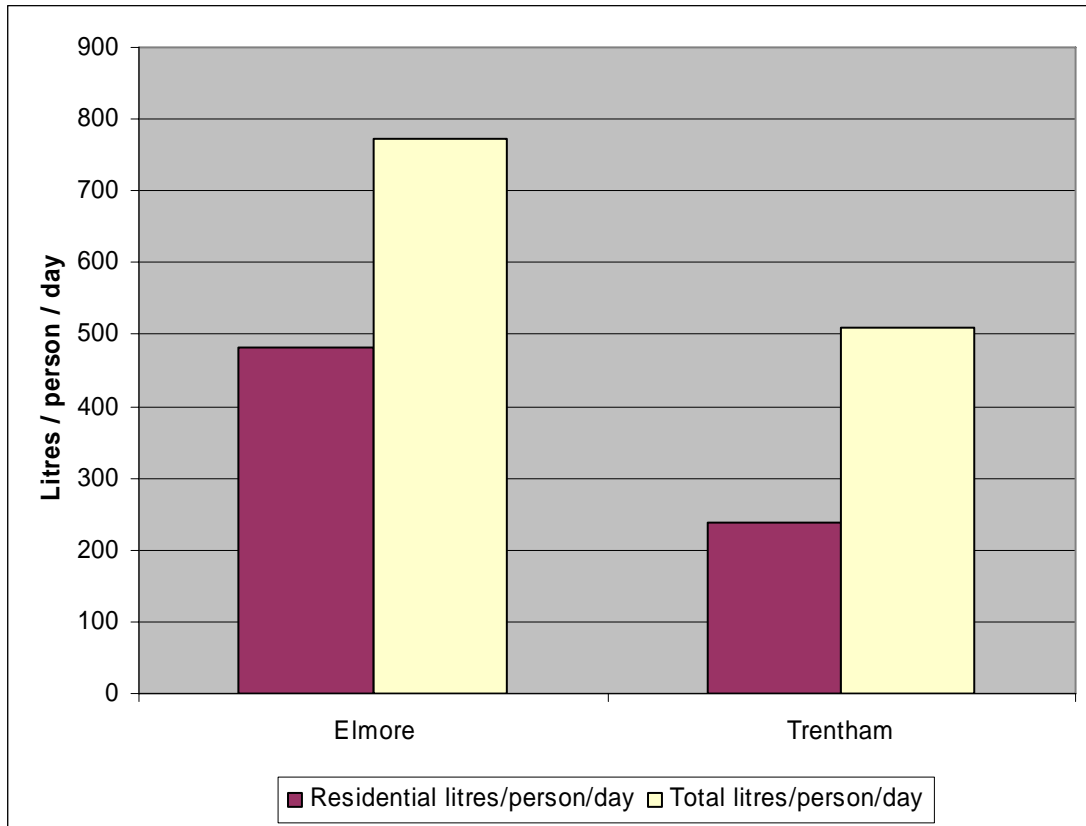
Elmore - Groundwater System Use (Base Year)



Trentham - Groundwater System Use (Base Year)



Per capita water use for the Elmore and Trentham groundwater systems for the base year



Population Forecast

Elmore’s population is predicted to increase by 0.5% pa from 680 to 870 people by the year 2055 while Trentham is forecast to increase by 0.6% pa from 730 to 990 people.

Town	Population Forecast					
	Nominal Forecast 50 Year Growth	2001	2,005	2014	2027	2055
Elmore	0.5%	665	680	710	760	870
Trentham	0.6%	697	730	775	840	990

Future Water Use

The unrestricted water use, based on the years 2001/02 and 2001/01, the per capita water use and population forecasts are set out in the following table.

Both Elmore and Trentham's demand will increase due to increasing population.

	Unrestricted Annual Demand ML			
	2000-02	2014	2027	2055
Elmore	180	190	205	235
Trentham	130	145	155	185

Climate Change

The potential impact of climate change on the yield of groundwater systems is assumed equivalent to the forecast impacts on their respective surface river systems: both towns are in the Campaspe catchment:

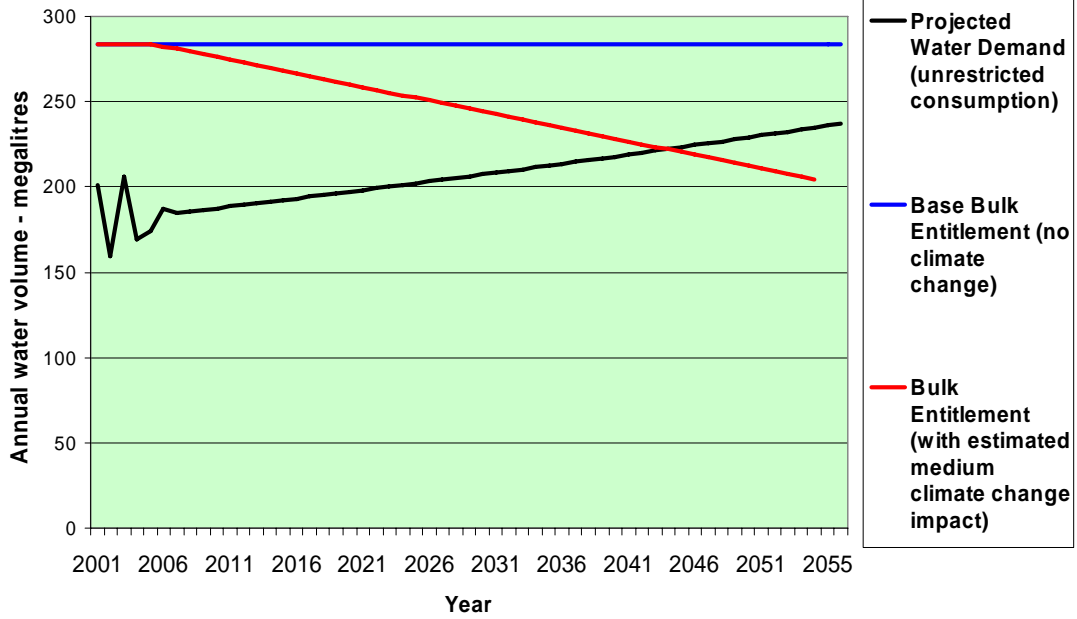
Lower impact	-9%
Medium impact	-28%
Upper impact	-54%

Under the medium change scenario, by 2055 the current yields of 284ML and 178ML for Elmore and Trentham will reduce to 205ML and 130ML respectively. The continuation of the low inflows as experienced over the past 10 years would have a greater impact and reduce yield to 113ML and 71ML respectively.

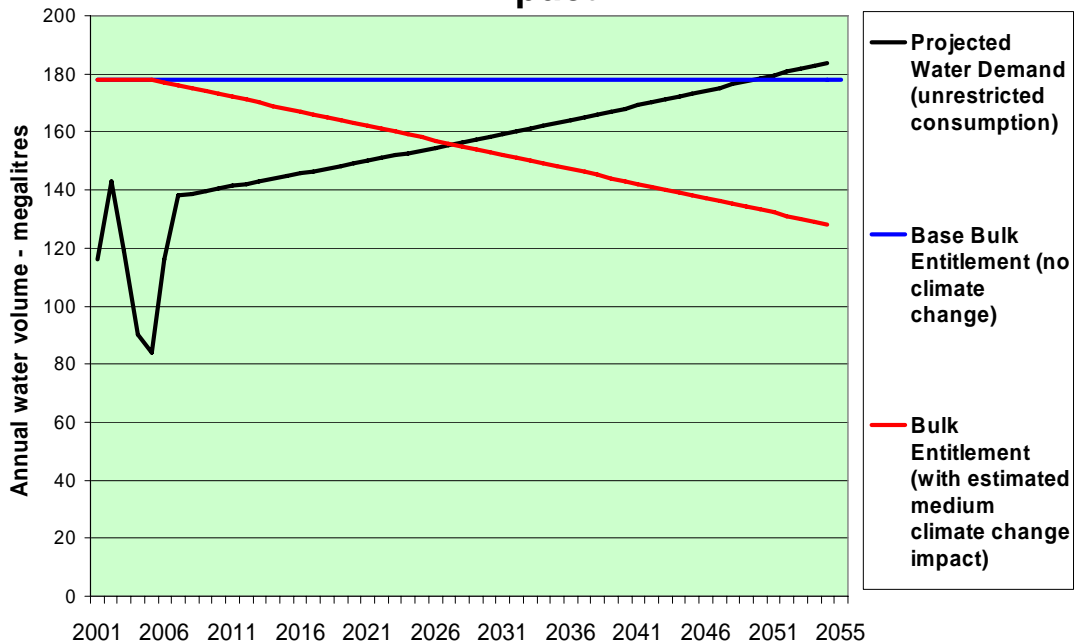
Additional water will be required after the year 2045 to meet Elmore's water demands but after the year 2025 to meet Trentham's water demand under the impact of the medium climate change scenario.

The above forecast for Trentham is based on the formalisation of a minimum entitlement of 130ML to surface water in addition to its current groundwater license of 48ML.

Elmore - Demand & Climate Change Impact



Trentham - Demand & Climate Change Impact



Town	Yield (Bulk Entitlement) - adjusted for Climate Change ML				Yield Deficit - Additional Water Required to meet Climate Change ML			Year that Demand Exceeds Water Yield
	2005	2014	2027	2055	2014	2027	2055	
Elmore	284	275	250	205	0	0	30	After 2045
Trentham	178	170	160	130	0	0	55	After 2025