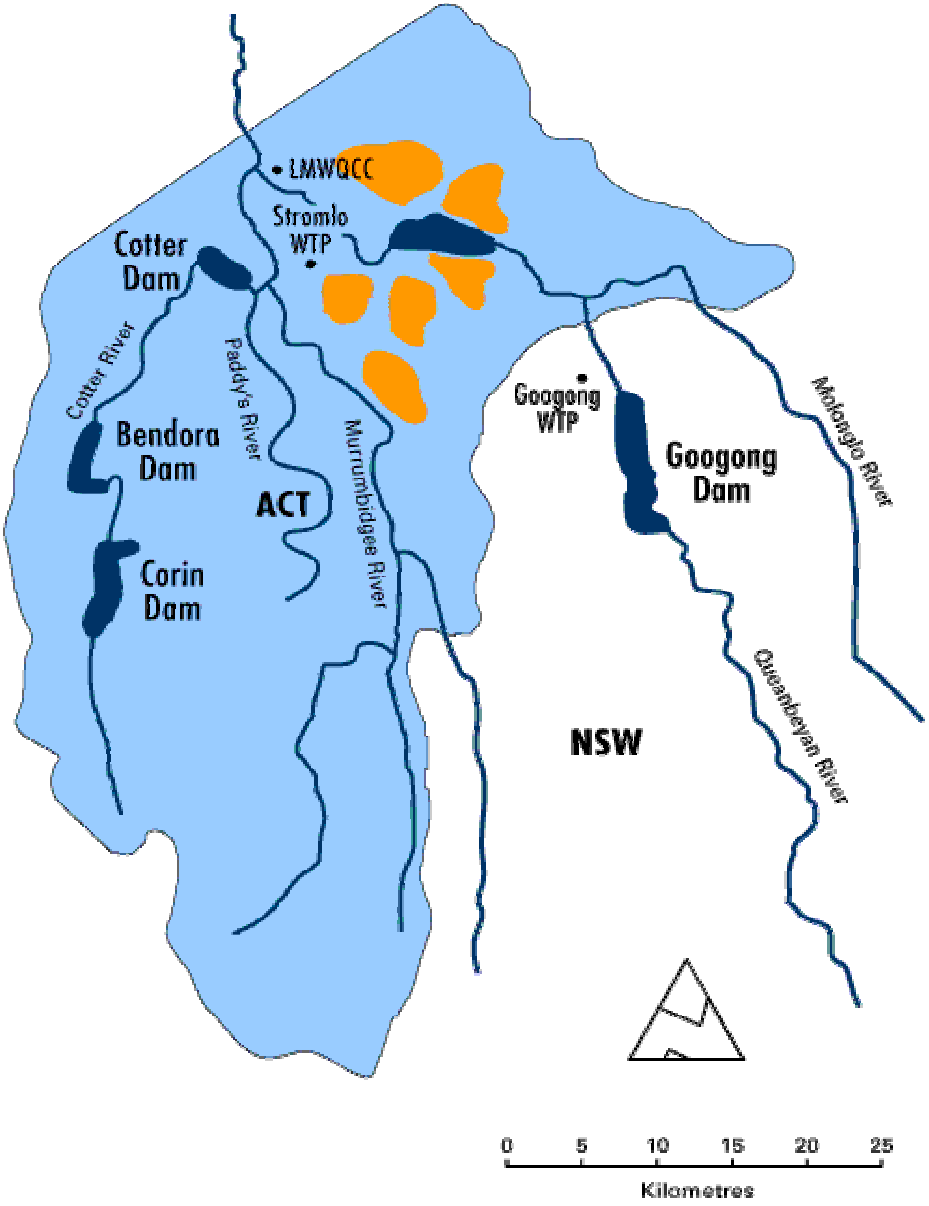
futurewateroptions

FOR THE ACT REGION IN THE 21ST CENTURY

ACTEW CORPORATION

An Assessment of the Need to Increase the ACT's Water Storage

December 2004



ACT Water Supply

ABN 86 069 381 960

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Executive Summary

The ACT Government's *Think water, act water* strategy released in April 2004 identified a major objective "To provide a long term, secure water supply for the ACT and region". At the request of the ACT Government this report addresses the question of whether, and if so when, there is a need to provide additional water storage for the ACT and region. This report is based on a substantial amount of technical and supporting research, details are provided in Chapter 8.

There will also be a second report by ACTEW to the ACT Government in March 2005 that outlines the strengths and weaknesses of options for additional water storage for the ACT.

Is the ACT water poor?

The average amount of water available for use by the ACT is 494 GL/yr. More than half that total (272 GL/yr) is allocated to the environment and the remainder (222 GL/yr) is available for human use. ACTEW extracts 65 GL/yr (less than 1/3 of the human use allocation) and about half of this is returned to the Molonglo River after treatment at the Lower Molonglo Water Quality Control Centre. The Molonglo River flows into the Murrumbidgee River and eventually into Burrinjuck reservoir from where the water provides environmental benefits and is allocated to downstream users. The ACT uses relatively little of the water available to it (only 6%).

In addition, all the water that enters the ACT through the Murrumbidgee River from NSW (about 386 GL/yr) flows through the ACT and back into NSW. On average, about 839 GL/yr flows into NSW. Even during periods of drought, the ACT is still a net exporter of water to NSW. Indeed that remains the case, even if the Queanbeyan and Molonglo rivers flows into the ACT were not counted as part of the ACT runoff (which they have been since 1909), but as NSW inflows.

The ACT is therefore water rich relative to its population. It has enough water under ACT control to meet the environmental requirements and to supply more than a million people, but storage is currently limited.

Is the existing ACT's water storage sufficient?

This report focuses on the question of whether the ACT and region needs to increase the existing water storage. ACTEW has previously determined that additional water storages were not needed until about 2017 and planning for this need would have commenced in about 2007. However, more recent scientific information on climate variations, climate change and natural disaster events, notably the bushfires of January 2003 and the worst drought in our climatic records, have required the previous position to be reviewed. A sophisticated computer model has been developed by ActewAGL to allow the assessment of key variables and to predict when the next storage is required. These key variables are:

- Natural Environmental Risk Factors

  New scientific information has been obtained on the impacts of climate variability, climate change and the recent bushfires on the amount of water that is likely to runoff into the Googong and the Cotter reservoirs. Due to the risks and uncertainties of this information, a conservative approach has been taken:

  1. climate variability and climate change,
  2. the impact of bushfires on storage inflows in the ACT.

- Government Planning Parameters

  The ACT Government has outlined population projections in the Spatial Plan and water efficiency targets in *Think water, act water*. These projections are also adopted in this report:

3. population growth to 500,000 in 2032 and servicing growth in the surrounding region,

4. meeting the water use efficiency targets (reduction in water consumption of 12% per capita by 2013 and 25% by 2023) set in *Think water, act water*.

- Factors within Government/Community Control

  The ACT Government and the community could agree to alter the existing Environmental Flow Guidelines. They could also agree to accept a modified level of water restrictions:

5. environmental flows of water between and from our reservoirs at Googong, Corin, Bendora and Cotter required to maintain the health of the river ecosystems. This report is based on the current environmental flows. These flows are under review by Environment ACT with the initial analysis to be completed in March 2005 and finalised in August 2005,

6. the duration, frequency and severity of water restrictions.

Conclusions

New scientific knowledge of the potential combined effects of climate change and bushfire impacts has meant that additional water storage will be needed sooner than previously expected.

The predictions of future conditions using the six variables listed above show that reservoir storage levels would become low to very low in periods of drought. The ACT will not run out of water, but only if severe and onerous water restrictions are applied, or unless some unforeseen event occurs.

The predictions assume that over the next 20 years, water use per person will be reduced by 25%, at an estimated cost to the ACT Government and the community of about $400 million.

Water restrictions are predicted to apply for a high proportion of the time. Stage 1 restrictions or greater are predicted to occur one year in three. Stage 3 and Stage 4 restrictions could occur for perhaps two successive summers each decade. Of this, Stage 4 restrictions (which bans all outdoor watering) would occur for 10 months once every 25 years. Such frequent and severe water restrictions are significantly more onerous than those that have been previously planned in Canberra or anywhere else in Australia.

Furthermore, over the coming years these restrictions will bring increasingly more pain to the community and at the same time be less effective. This is because restrictions would come on top of a substantial reduction in per capita water use through meeting the water efficiency targets, which within themselves will require permanent water restrictions.

Unless the ACT is willing to accept the regular recurrence of water restrictions of a severity and frequency unprecedented in planning elsewhere in Australia, then additional water storage will be needed in the ACT.

ACTEW's second report to the Government in March 2005 will set out options for a program to provide a long term, secure water supply for the ACT and region. Such a program might well be implemented in stages, but would need to begin now. The second report will examine opportunities to implement this program in stages which will allow time to assess whether or not the assumptions underpinning this work, for example population growth, come to fruition.

1 Introduction

It took from 1898 until 1908 to agree on the site for Australia's national capital, Canberra. In assessing the site climate, landform for the building of a garden city and adequate water supply were key aspects. In fact there is plenty of water available in the ACT. The *Seat of Government Acceptance Act 1909* allocated to the Australian Capital Territory (ACT) all the waters in the rivers and streams of the ACT plus the waters of the Queanbeyan and Molonglo river catchments to ensure water availability for future growth.

The ACT is in the midst of the worst drought on record. Below average rainfall for the last three years has seen ACT water storage reach its lowest level on record and the need to introduce water restrictions for the first time in over thirty years.

The current drought has highlighted how vulnerable the existing water supply can be during long periods of low rainfall. The past two summers have seen the introduction of Stage 3 water restrictions. While there is a significant amount of water available in the ACT, it appears that there is currently inadequate storage to deal with what is now the worst drought in the climate records. Increasing population, the effects of climate change and the recent bushfires will put additional pressure on the ACT's water storage capability into the future.

In April 2004 the ACT Government released its comprehensive long-term water strategy, *Think water, act water* to provide guidance for the sustainable management of the ACT's water resources. The major objectives of the strategy relevant to this report are:

- Provide a long-term, reliable source of water for the ACT and region;
- Increase the efficiency of water usage; and
- Promote development and implementation of an integrated regional approach to ACT/New South Wales cross-border water supply and management.

This report and the overall *Future Water Options Project*, specifically respond to the first objective[1] above from *Think water, act water* and provides:

- an assessment of the adequacy of ACT's water resources for future water supply purposes,
- actions for more efficient use of the existing water supply infrastructure including the use of Cotter Reservoir, and
- an assessment of when the next water source for the ACT is needed.

[1] *ACT Gov. (2004);* Think water, act water, *Vol. 1 - Strategy for sustainable water management in the ACT, April 2004.*

2 Water Resources

2.1 Water Resources within the Murray-Darling Basin

Canberra is the largest city within the Murray-Darling Basin (Figure 2-1). The ACT is a signatory to the Murray-Darling Basin Initiative and considers its commitments to the Basin when assessing natural resource issues including water management.

The Murray-Darling Basin Initiative is the partnership between the Governments and the community which was established to give effect to the 1992 Murray-Darling Basin Agreement. The purpose of the Agreement is "to promote and co-ordinate effective planning and management for the equitable, efficient and sustainable use of the water, land and other environmental resources of the Murray-Darling Basin"[2].

Figure 2-1: The southern portion of the Murray-Darling Basin.

Source: http://www.mdbc.gov.au/naturalresources/pdf/water_volume.pdf

Within the Murray-Darling Basin, many rivers have been over allocated and insufficient water is available to meet the needs of water users and the environment.

In the early 1990s it had become clear that the rivers of the Murray-Darling Basin were under stress. The level of salinity in the Lower Murray was causing concern, the numbers of native fish were in severe decline, wetlands and red gum forests were suffering from a reduction in the frequency of flooding and in 1991 a toxic blue-green algae bloom extended for 1000 km along the Darling River. The level of diversions in the Basin's river systems and the changed flow regimes they had produced came under increased scrutiny at this time. A need to strike a balance between consumptive and in-stream uses of the water was identified and there was a realisation that there was a finite amount of water in the Basin[3].

This situation is in stark contrast to the ACT, where careful water resource management has ensured sufficient water is firstly allocated to the environment and the remaining water is then available for use by the community. Prudent management of the ACT's water resources has resulted in efficient use of water by the community of the ACT and Queanbeyan. Significant

[2] *MDBC (NOV 2004); The Murray-Darling Basin Initiative — Overview* http://www.mdbc.gov.au/about/governance/overview.htm
[3] *MDBC (NOV 2004); The Murray-Darling Basin Cap on Diversions Water Year 1997/98.* *http://www.mdbc.gov.au/naturalresources/pdf/Striking_the_Balance_Report_97_98.pdf*

water resources are available to provide for environmental flows and for future growth in the ACT and region.

2.2 Water Resources of the ACT

Volume 3 of *Think water, act water* sets out the water resources to the ACT. The average annual runoff from these catchments is 494 GL/yr (1 GL, or gigalitre, is equivalent to 1 billion litres). That is more than seven times the volume of water that ACTEW currently extracts from these rivers (65 GL/yr).

The ACT currently draws its water supply from the Cotter River (via Corin and Bendora reservoirs) and the Queanbeyan River (via Googong reservoir). Another reservoir on the Cotter River, the oldest and smallest reservoir, Cotter reservoir, has not been used as a standard part of the water supply system since the 1960s (other than for a short period in 1983).

The ACT has been foremost in the Australian States and Territories in allocating water to environmental flows. More than half the total water resources of the ACT are allocated to environmental flows – 272 GL/yr out of the total of 494 GL/yr (55% of the total volume of water available). 222 GL/yr is available for human use. Relative to current water use patterns, the 222 GL/yr that remains after environmental flow allocations could meet the needs of around one million people.

At present, ACTEW extracts only about one third of this resource (65 GL/yr) to supply water to about 370,000 people in the ACT and Queanbeyan. In addition, the ACT returns about half of this water to the Molonglo River which flows to the Murrumbidgee River. This water provides a valuable resource to the environment and downstream water users in NSW along the Murrumbidgee River within the Murray-Darling Basin. In addition, all the flow of the Murrumbidgee River that enters the ACT flows through into NSW.

2.3 Increased Water Efficiency

It is widely accepted that water should be used more efficiently. The ACT Government's target is to reduce water use by 25% by 2023[4]. This report assumes that the ACT community is prepared to pay for those water efficiency measures and that they will be achieved.

2.4 Export of Water from the ACT

The ACT plays an important role in the Murray-Darling Basin. Canberra is the largest city in the basin and therefore in planning water management the ACT needs to consider upstream and downstream communities. Unlike coastal cities where water discharged from sewage treatment plants is mostly released into the ocean, the ACT discharges into the Murray-Darling Basin.

About half of the water used by the residents of the ACT will make its way into ACTEW sewers for treatment and discharge from the Lower Molonglo Quality Control Centre (LMWQCC). There, by a series of sophisticated treatment processes, ACTEW removes the waste materials and produces high quality water for discharge into the Molonglo River which then flows into the Murrumbidgee River.

[4] *ACT Gov. (2004),* Think water, act water, *Vol. 1 - Strategy for sustainable water management in the ACT, April 2004.*

So, for every litre of water used by the ACT approximately half is returned to the river system and is reused downstream. After discharge, this water mixes with river water and flows downstream to Burrinjuck reservoir. From Burrinjuck the water provides environmental benefits and is also distributed to irrigation areas downstream – for example the Coleambally and Murrumbidgee Irrigation Areas. It is estimated that up to 80% of the LMWQCC discharge is reused downstream in NSW and South Australia (SA)[5].

Downstream water users benefit from ACT water management in the following ways:

1. Environmental Flows – the ACT has committed 272 GL/yr (which is about 55% of the ACT's water resource) to environmental flows;
2. Human Use – the ACT (and Queanbeyan) has an average gross use of 65 GL/yr. This is only one third of the water currently available for human use (222 GL/yr). The remainder (157 GL/yr – about 32% of the ACT water resources) is also released as flows into NSW.
3. Return Flows – After treatment, ACTEW returns 35 GL/yr, about half of the water extracted for human use, to the river as high quality water. This water is ultimately reused downstream.

When these three releases are summed, 94% of ACT water resources are available for environmental flows and for the use of those living downstream (Figure 2-2).

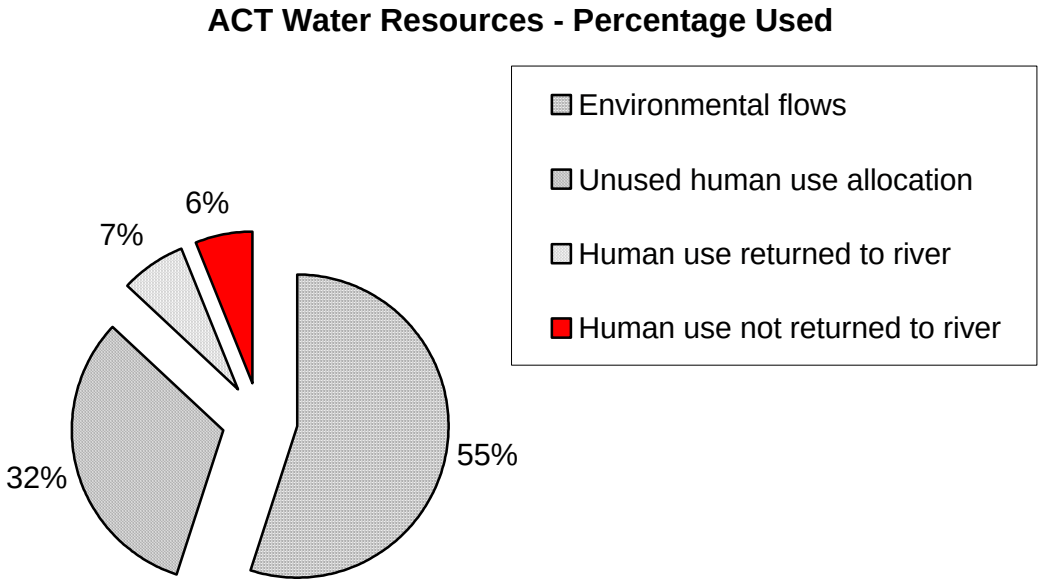


Figure 2-2: The effects on downstream users of ACT's water use.

In addition, all the water that enters the ACT through the Murrumbidgee River from NSW flows through the ACT and back into NSW at the northern border.

[5] *CEE (2004); Value of Effluent Discharged from LMWQCC to Murrumbidgee River, Report – 25 pages (ACTEW Corp. Doc. No. 3978).*

2.5 Summary of ACT Water Resources

From the perspective of downstream users, the flow downstream of the ACT includes all the Murrumbidgee River inflows into the ACT plus 94% of the water resources controlled by the ACT. The ACT is a net exporter of water (Figure 2-3).

From the perspective of people living in the ACT region, the ACT has enough water to supply more than a million people. This is not surprising as the original decision for the location of the ACT was, in part, based on the availability of water resources.

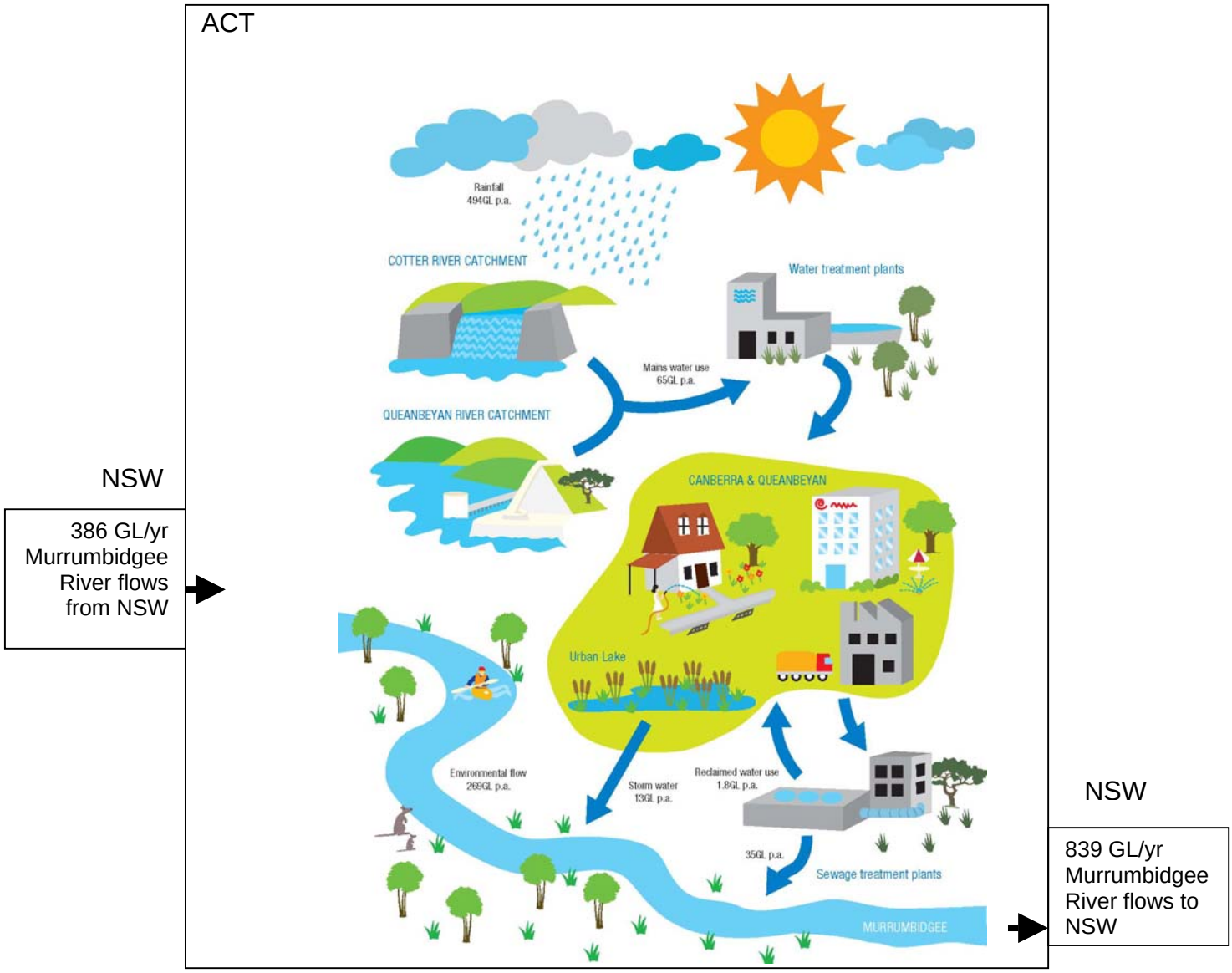


Figure 2-3: Schematic diagram of average NSW/ACT inflows, rainfall runoff & outflows

(Source:http://www.thinkwater.act.gov.au/water_flow.shtml)

3 Water Availability – is there sufficient for current and future populations?

Even though the total water resources of the ACT are many times more than what is needed for the current ACT population, forward planning of infrastructure to store and deliver water is still required. This is because the number of people that can be reliably supplied with water is limited by the capacity of the ACT's water storage to capture variable inflows and supply water to consumers in times of drought.

ACTEW has previously determined that additional water storages were not needed until about 2017[6] and planning would have commenced in about 2007. However, more recent scientific information on climate variations, climate change and natural disaster events, notably the bushfires of January 2003 and the worst drought in our climatic records, have required the previous position to be reviewed.

Future water storage inflows depend on conditions in the water catchments under future climatic conditions. Recent studies have shown that the 2003 bushfires in the Cotter catchment and the potential effects of climate change will reduce the amount of water that runs off the catchments in the future.

To plan for the future, these and other factors must be taken into account. Some of these factors are the size of the population of the ACT and surrounding region where water could be supplied and the demand for water (or put another way – how efficiently water is used). The ACT's water restrictions and environmental flows are mostly determined by ACT Government policies.

This section of the report outlines the water planning variables. Computer models developed by ActewAGL[7,8] incorporating these variables were used to assess when additional storage would be required.

3.1 Natural Environmental Risk Factors

There are two risk factors that cannot be controlled. These are climate (variability and change) and the bushfire effects on the Cotter catchment. Scientific uncertainties make it difficult to quantify the impact of these factors. Therefore a conservative approach is taken, as the consequences of being wrong are serious.

3.1.1 Climate variability of future rainfall and evaporation

Taking account of climate variability involves an assessment of whether or not the climate (rainfall, evaporation, temperature) records for the ACT reflect the range of floods and droughts that might be experienced in the future. With only 90 years of record of ACT climate, clearly the answer is no. Even without accounting for climate change, the ACT is almost certain to experience future droughts worse than those experienced in the past. In fact, this current drought is now the worst on record and would have been difficult to predict even a few years ago.

[6] *ActewAGL (2004); Yr. 2017 Timing Assessment. (Appendix of ACTEW Corp Doc. 3962).*
[7] *SKM (2003); Technical Review of the ActewAGL Water Resources Model for the Canberra and Queanbeyan Bulk Water Supply System, Report - 74 pages (ACTEW Corp. Doc. No. 3992).*
[8] *ActewAGL (2004); Description of REALM Model, Report – 143 pages (ACTEW Corp. Doc. No. 3758).*

The historical climate record only allows examination of the worst drought during this 90 year period. The standard hydrological approach to gain more information from the existing historic climate record is to extrapolate from existing data to help understand how the water supply system may behave in extreme droughts[9].

3.1.2 Climate change in the ACT

There are two climate change risks, firstly whether or not climate change happens, and secondly, if it does (or has) happen what will be the impact.

Work has been done by CSIRO on climate change projections for the ACT region[10] There are uncertainties in projections and new information continues to give a better understanding of the possible impacts of climate change. The following is the best available thinking on key topics:

• **Temperature change:** Projections indicate that the mean annual temperature could increase by up to 1.5ºC by 2030 and 5ºC by 2070. Increases in temperature will lead to changes in the frequency of extreme temperatures in the ACT Region;

• **Rainfall change:** By 2030, projected average winter and spring rainfall could reduce by up to 9% (the distribution between summer and autumn rainfall changes by 2030 are not as clear). Models also indicate an increase in the frequency and intensity of extreme rainfall under climate change conditions;

• **Evaporation change:** By 2030, evaporation could increase by up to 10%; and

• **Temporal shift:** In the 1970s a sudden shift in climate saw runoff from water supply catchments in the southwest of Western Australia reduce significantly. It is possible that the climate in the ACT region could also shift in a short period to a new state producing reduced runoff from ACT catchments.

The impacts of these elements of climate changes are interconnected. Increases in temperatures are likely to result in increased evaporation, meaning more water use. During wet years, rainfall effectiveness would be reduced by higher evaporation associated with higher temperatures. Under these circumstances a 10% reduction in rainfall and changing rainfall patterns could result in a reduction of runoff up to 20% into the ACT's reservoirs in 2030.

It has been assumed in this report that the future climate would be similar to that predicted to occur in 2030 by CSIRO.

3.1.3 Bushfire impact on storage inflows

The 2003 bushfires have changed water inflows to the reservoirs in the Cotter catchment. The chance of severe bushfires increases during severe droughts. One consequence of the 2003 bushfires is a reduction in the inflows into the reservoirs on the Cotter River. This is because more water is taken up by vegetation regrowth following bushfire, leaving less runoff into streams and reservoirs.

[9] *SKM (2004); Update of Water Resources Strategy for Canberra and Queanbeyan - Stochastic Generation of Climate Data, Report - 65 pages (ACTEW Corp. Doc. No. 3959).*
[10] *CSIRO (2003); Climate Change Projections and the Effects on Water Yield and Water Demand for the Australian Capital Territory – Executive Summary, Report – 6 pages (ACTEW Corp. Doc. No. 3948).*

To determine the magnitude of this effect, ACTEW has commissioned a study of the likely reduction in inflows due to the 2003 bushfires[11]. Figure 3-1 below shows the expected reduction in inflows to the Corin Reservoir, which is the main water supply storage in the Cotter catchment. The reduction in inflows is expected to be approximately 15% in about 17 years after the bushfires, with reduced flows expected to occur for more than 50 years.

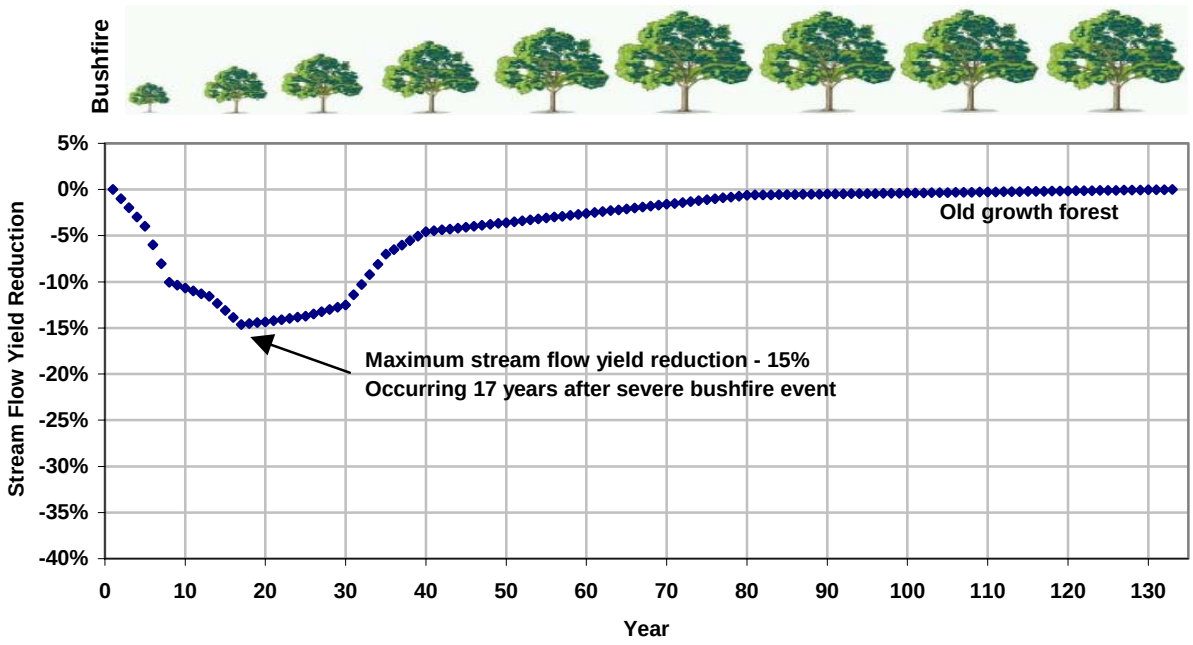


Figure 3-1: Impact of bushfires on catchment runoff

Predicting the amount and timing of reduced inflow is difficult to assess as vegetation growth, particularly re-growth, is heavily dependent on the climatic conditions during each growing season. The assessment and modelling work for the whole Cotter catchment is continuing and will be updated as the catchment recovers. The recent spring rainfall will provide valuable information on vegetation re-growth for that season.

3.2 Government Planning Parameters

3.2.1 Population Growth

The Canberra Spatial Plan addresses population growth scenarios for use in planning the future of the ACT. *Think water, act water* also addressed the issue of planning for population growth.

This study has used the ACT Demographer figures for the combined Canberra/Queanbeyan population and assumes 500,000 people in 2032[12].

[11] *DHI/Ecowise Environmental (2004, in prep*); *Predicted Impact of Bushfire on Corin Dam Catchment Yield.*
[12] *ACTPLA (2004);* The Canberra Spatial Plan, *produced by the ACT Planning and Land Authority in March 2004.*

3.2.2 Cross Border water supply

The ACT Government is currently working with the NSW Government on water supply across the border into NSW to align Canberra and NSW regional planning. It is anticipated that by the end of 2004 both Governments will agree on the main components of further supply of water into NSW[13]. This report has assumed an additional cross border population of around 26,400 being served by 2030[14].

3.2.3 Water efficiency

The ACT Government has set targets for a 12% reduction in mains water use by 2013 with a total reduction of 25% by 2023[15]. It is assumed the projected water use reductions will occur progressively over the 20-year period.

The Institute of Sustainable Futures at the University of Technology, Sydney assessed the measures that could be used to meet these targets and the cost implications for the community[16].

The measures required to meet the water efficiency targets include subsidised programs for the residential, commercial, institutional and public housing sectors, permanent water conservation measures, increases in the price of water and education and awareness programs. It is anticipated new housing estates and commercial buildings will be significantly more efficient than conventional ones. It should be noted that achieving the 25% efficiency target will not be easy.

Cost to meet these targets

The Institute of Sustainable Futures predicts that water efficiency options alone will achieve the 12% target in 2013 at a present value whole of society cost of $45 million. To achieve the 25% target by 2023 the modelling suggests the use of source substitution (eg using rainwater or greywater instead of mains water), the Queanbeyan water efficiency program and reuse will all be required. To meet this target the present value whole of society cost would exceed $400 million. However, as reuse and rainwater tanks are very expensive, the modelling suggests that a target of about 23% could be obtained for a present value whole of society cost of about $165 million[18].

Review of the water efficiency program

Progress towards meeting the water efficiency targets will be reviewed on an annual basis to determine whether the range of measures being implemented are able to deliver the targets. Meeting these targets is dependent upon the availability of and acceptance by the ACT's residential and business communities of the measures and rebates being offered by the ACT Government. The first year review of the program is currently underway and will be completed in the second quarter of 2005.

Figure 3-2 shows the relative costs, expressed as $ per kilolitre (kL or one thousand litres) for the three supply options, reuse, source substituent by rainwater or greywater use and a range of demand management (water efficiency) options. The analysis allows comparison of the costs

[13] *ACT Gov. (2004);* Think water, act water, *Vol. 1 - Strategy for sustainable water management in the ACT, April 2004.*
[14] *ActewAGL (2004); Population Projections (ACTEW Corp. Doc. No. 219105).*
[15] *ACT Gov. (2004);* Think water, act water, *Vol. 1 - Strategy for sustainable water management in the ACT, April 2004.*
[16] *ISF (2003); ACT Water Strategy – Preliminary Demand Management & Least Cost Planning Assessment (Final Report), Report - 61 pages (ACTEW Corp. Doc. No. 3964).*

of each of these measures to aid in deciding whether to progress with water efficiency measures, reuse or adding additional supply. The graph shows that water efficiency programs are generally more cost effective than additional supply options. The water efficiency measures are generally less than $1/kL. The cost of a new supply is more cost effective than source substitution and reuse. (Note that the costs for the new supply and the other options were based on the best figures available in 2003). ACTEW is currently reviewing these costs as well as the environmental, social and economic costs and benefits of additional water storage as part of the *Future Water Options Project*.

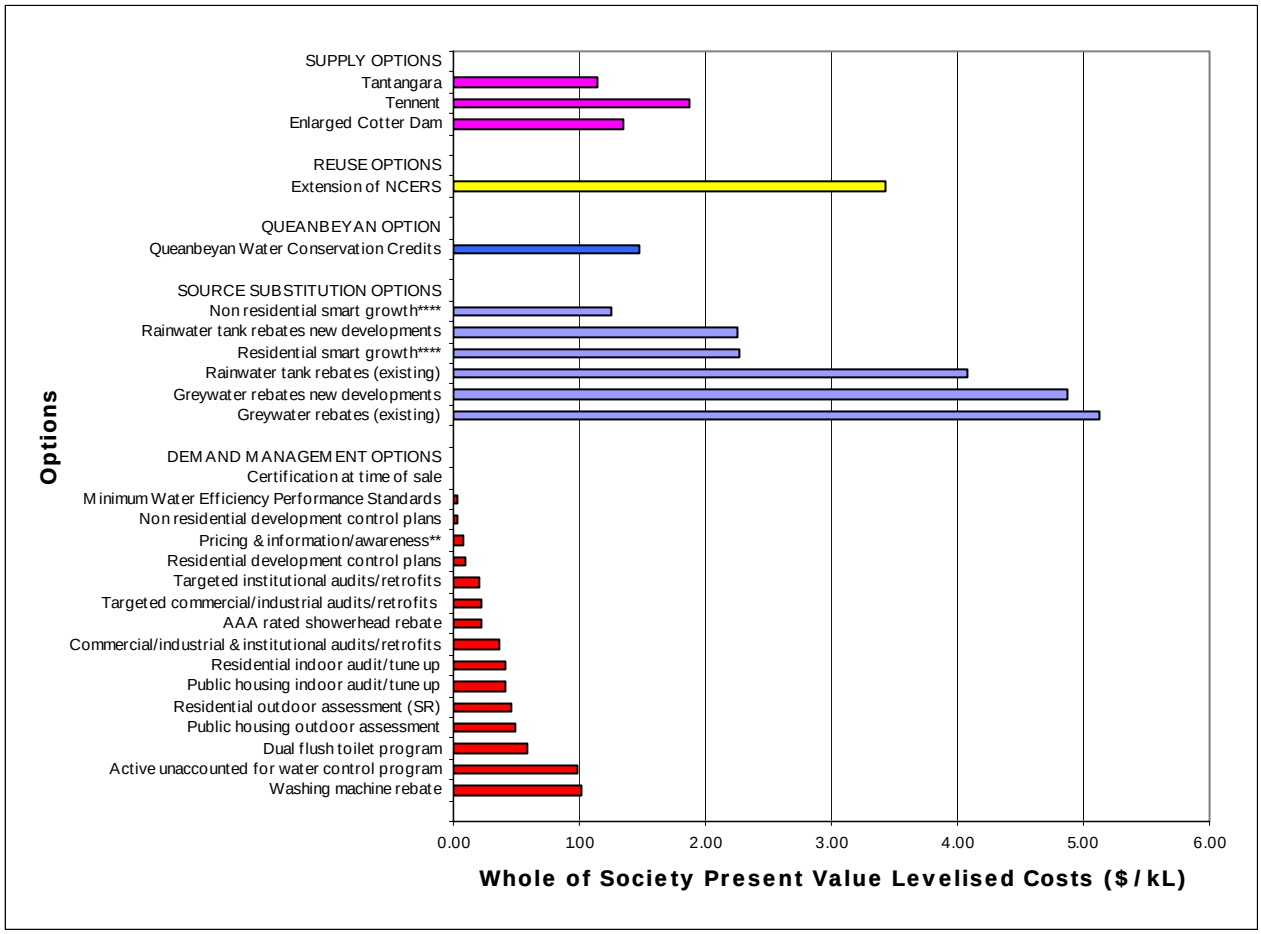


Figure 3-2: Costs of water efficiency, source substitution and new water supply options.[17]

3.3 Factors Affecting the Timing of the Next Supply within Government and Community Control

3.3.1 Environmental flows

Environmental flows in the ACT are of two types. There are those flows that naturally flow down river systems that do not have any reservoirs, weirs or other structures. Examples in the ACT are the Murrumbidgee, Naas, Gudgenby and Paddys rivers.

[17] *ISF (2003);ACT Water Strategy – Preliminary Demand Management & Least Cost Planning Assessment (Final Report), Report - 61 pages (ACTEW Corp. Doc. No. 3964).*

The other type of environmental flows in the ACT are those released from water storages to mimic natural stream flows as far as possible with the objective of maintaining downstream ecological systems. In general low flows are allowed to "pass through" ACTEW dams and water is captured from high flows. The required levels of environmental flows are set out in the *Environmental Flow Guidelines 1999*[18]. The current guidelines also allow for reduction of environmental flows during droughts. Even in dry periods reservoir outflows are not more than reservoir inflows, except below Googong reservoir where there is a requirement to release 2 megalitres (or two million litres) each day regardless of the amount of inflows into Googong reservoir.

ACTEW's licence to take water (issued under the *Water Resource Act 1998*[19]*)* includes provisions to ensure environmental flows are protected as a first priority.

The Environment Protection Authority has advised that the Environmental Flow Guidelines will be reviewed in late 2004, with draft proposals being forwarded to the ACT Government in March 2005. It is anticipated that the review will be finalised in August 2005. This review may result in changes to environmental flow requirements, which could have an impact on the timing and a choice of the next ACT water source. To test the sensitivity to environmental flows on the timing for a new supply for the ACT, Environment ACT provided data so that a modified environmental flow scenario[20] could be compared with the existing guidelines. This is discussed in section 5.2.

3.3.2 ACT Water Restrictions

In the ACT, water restrictions are used to limit water consumption during periods of drought or unplanned circumstances – such as the 2003 bushfires. Indicative storage levels at which each Stage of restrictions may be introduced are: 55% for Stage 1; 45% for Stage 2; 40% for Stage 3; 35% for Stage 4 and 30% for Stage 5. However, other considerations such as water quality or likely rates of future catchment inflow or infrastructure/equipment problems may warrant the introduction of a particular stage of restrictions notwithstanding that actual storage levels are above these indicative levels. The indicative levels for each level of restriction as outlined in the water restrictions scheme have been used in the modelling to determine the timing to increase the ACT's water storage.

In practice, restrictions have been imposed when the storage levels are higher than the indicative levels foreshadowed in the restrictions scheme. This was due to the bushfires in 2003 and in 2004 Stage 3 was implemented when storage levels were at 43% due to the very dry catchment and the future weather predictions.

In order to defer the timing of a new water supply for the ACT, restrictions could be brought on earlier, or restrictions at say Stage 3 and Stage 4 could be put in place for longer periods of time.

The implementation of the current restrictions in the ACT was unexpected and is due to a combination of two natural events; the bushfires of 2003 and the continuing drought.

To understand the impacts of the restrictions on the ACT community, ACTEW is undertaking a study to assess the social and economic costs of the current restrictions to the ACT community and also its willingness to pay to avoid these restrictions.

[18] *ACT Government (1999); Environmental Flow Guidelines, produced by Environment ACT in May 1999.*
[19] *ACT Government. Water Resources Act 1998. No 63. Prepared by the ACT Parliamentary Counsel's Office.*
[20] *ActewAGL (2004); Environmental Flow Scenarios, Environment ACT Personal Communication File Note - 3 pages (ACTEW Corp. Doc. No. 3755).*

The ACT Government proposes to implement permanent water conservation measures. The experience gained in the implementation of water restrictions over the past few years and the need to understand the economic and social consequences of these restrictions, suggests that the current water restrictions scheme should be reviewed during 2005.

4 Timing to Increase the ACT's Water Supply

4.1 How much water is enough for a secure supply?

The primary and most obvious objective of water supply planning is to ensure that the water supply does not run out during periods of drought.

It is not just sufficient, however, to plan for water storages that never run empty – as this can be achieved by imposition of lengthy and severe water restrictions during periods of drought.

There is also a community expectation that water planners will ensure the duration and frequency of water restrictions will be within "reasonable" bounds. For example, the expectation may be that severe water restrictions such as Stage 4 should not be planned for and that Stage 3 restrictions would not occur more than say one year in every 25 years. An assessment of a adequacy of water supply during times of drought should be based on the measures shown in the Table 4-1 below.

Table 4-1: Measuring adequacy of water supply during drought

Measure	Indicator
Security of supply	Minimum amount of total storage at the end of the most severe drought event (more severe than any event the ACT has experienced to date)
Level of drought service	Percentage of time in all stages of water restrictions (duration as % of time)
	Frequency of imposition of water restrictions
	Severity: expressed as the time in Stage 3 restrictions or greater

These measures and indicators determine if, when and by how much the existing ACT water storage will need to be increased.

A review of the indicators adopted by other Australian water utilities shows some differences in approach[21]. Some utilities use historical climate records and set a minimum limit of 30% of total storage capacity to ensure they have a buffer against a drought much worse than has been experienced in their records. Other utilities set a target that the minimum storage level should not be below 5% of total storage over a very long period, containing the most severe drought theoretically likely to occur.

The choice of these measures and targets has also been examined by the NSW Independent Pricing and Regulatory Tribunal (IPART) as part of their review of the Sydney Catchment Authority's licence to take water[22].

Based on the measures and indicators of other Australian water utilities, there is currently a consensus that duration of restrictions should not be for more than 5% of the time and the frequency of restrictions should not occur on average more than 1 year in 10 years.

Some utilities have indicators which involves the imposition of Stage 3 restrictions or higher. Typical indicators for those utilities are that Stage 3 restrictions occur no more than once in 25

[21] *ActewAGL (2004); System Performance Criteria, Report – 37 pages (ACTEW Corp. Doc. No. 3962).*
[22] *IPART (2003); Review of the Performance Criteria of Sydney Catchment Authority's Operating License, Report prepared by SKM for IPART, dated July 2003.*

years, and their duration be limited to less than 0.5% of the time. Based on the feedback from the community to ACTEW, there is a perception that the ACT community wishes to avoid prolonged imposition of Stage 3 or higher restrictions.

The Water Services Association of Australia and a number of utilities are reviewing their indicators in the light of recent droughts [23,24].

A number of utilities are also proposing, or have introduced permanent low-level restrictions (often called permanent water conservation measures) as water efficiency measures. *Think water, act water* foreshadows the introduction of these measures into the ACT[25].

4.2 Increased Efficiency of the Existing Water Infrastructure

An assessment has been made on how to increase the efficiency of the existing water infrastructure. The use of Cotter reservoir, together with improved operating rules is the main way that efficiency can be improved. Other measures, such as leakage control, are an ongoing activity. At present, ACTEW's leakage control program is Australian best practice when compared to other Australian utilities, with losses of less than 7%[26].

4.2.1 Use of Cotter Reservoir

Cotter reservoir has not been routinely used since the 1960's. It was last in service for a very short period during the drought in 1983. The relatively poorer water quality in the Cotter reservoir, coupled with lack of adequate treatment facilities at Mt. Stromlo have made it difficult to use water from the Cotter reservoir in recent years.

This situation has now changed.

One of the benefits of the recent investment of $40 million by the ACT Government and ACTEW in a new Stromlo Water Treatment Plant is that it now opens up the opportunity to reliably use water from Cotter reservoir.

ActewAGL has developed new operating rules that incorporate the use of water from the Cotter reservoir as part of the normal operations of supplying water to the residents of Canberra and Queanbeyan[27]. The cost of delivering water from the Cotter reservoir is higher than delivering water from either Bendora or Googong reservoirs because of additional pumping costs.

The return of Cotter reservoir to active service as a water supply storage means the combined yield[28] of the ACT storages has now been increased by up to 10%.

[23] *IPART (2003); Review of the Performance Criteria of Sydney Catchment Authority's Operating License, Report prepared by SKM for IPART, dated July 2003*
[24] *WSAA (in prep); Framework for Urban Water Resource Planning*
[25] *ACT Gov. (2004);* Think water, act water, *Vol. 1 - Strategy for sustainable water management in the ACT, April 2004*
[26] *WSAA, (2001); The Australian Urban Water Industry 2001 WSAAfacts*
[27] *ActewAGL (2004); System Operation Optimisation Report 25 pages (ActewAGL Doc. No. 216437)*
[28] *Yield refers to the amount of water available to the city when considering the amount of inflows to the storages, evaporation and water allocated for other uses such as environmental flows. Yield is different to storage volume – storage is the amount of water that is capable of being captured in the dams.*

5 Discussion

The ACT will need more water storage when the capacity of the existing storage is inadequate to serve the needs of the people of Canberra and the region.

Computer modelling has been carried out to predict the timing to increase the ACT's water storage using the following assumptions:

- Natural Environmental Risk Factors
    - climate variability and climate change in the ACT
    - the impact of bushfires on storage inflows
- Government Planning Parameters
    - population growth of 500,000 in 2032, and supplying growth in surrounding NSW
    - meeting the *Think water, act water* water efficiency targets
- Factors within Government/Community Control
    - environmental flows
    - ACT water restrictions

The results of that modelling have been used to address the following questions.

5.1 Is there enough water now?

Security of supply: With a repeat of the worst drought on record in the ACT, storage levels in the ACT will not fall below 30%. When modelled with a simulation of the worst possible drought it is very unlikely that the ACT storages would fail. This level of security, however, is achieved through the imposition of lengthy and severe water restrictions.

It is predicted that restrictions of some form would occur on average about every six years and last for a period of two years (ie the ACT would be in restrictions about 35% of the time – see Figure 5-1).

Based upon the current water restriction scheme, Stage 3 restrictions or greater are predicted to occur for about two consecutive summers in a decade (about 8% of the time). This would mean that for periods of about 15 months continuously, the use of sprinklers would be banned and watering of gardens could only occur morning and evenings every second day based on the odds and evens system.

Stage 4 restrictions would occur once in every 25 years and last for about 10 months (ie about 4% of the time). During this time all outdoor water use would be banned.

The time in restrictions does not change appreciably between now and 2023 since the savings in water use obtained from the water efficiency program would be sufficient to offset the impact of increases in population growth (Figure 5-1). This highlights the significance of achieving the water efficiency targets and the need for the ACT Government and community to invest about $400 million to do so.

Consideration needs to be given to the impact of future restrictions. By meeting the ACT Government's water efficiency targets, water use will be reduced by 25% in 2023. Under this

situation it would be difficult (perhaps impossible) to achieve a further 40% reduction in water use by imposing Stage 3 restrictions. The computer modelling to support this report assumes that less than a 40% reduction in Stage 3 (as an example) will be obtained in the future.

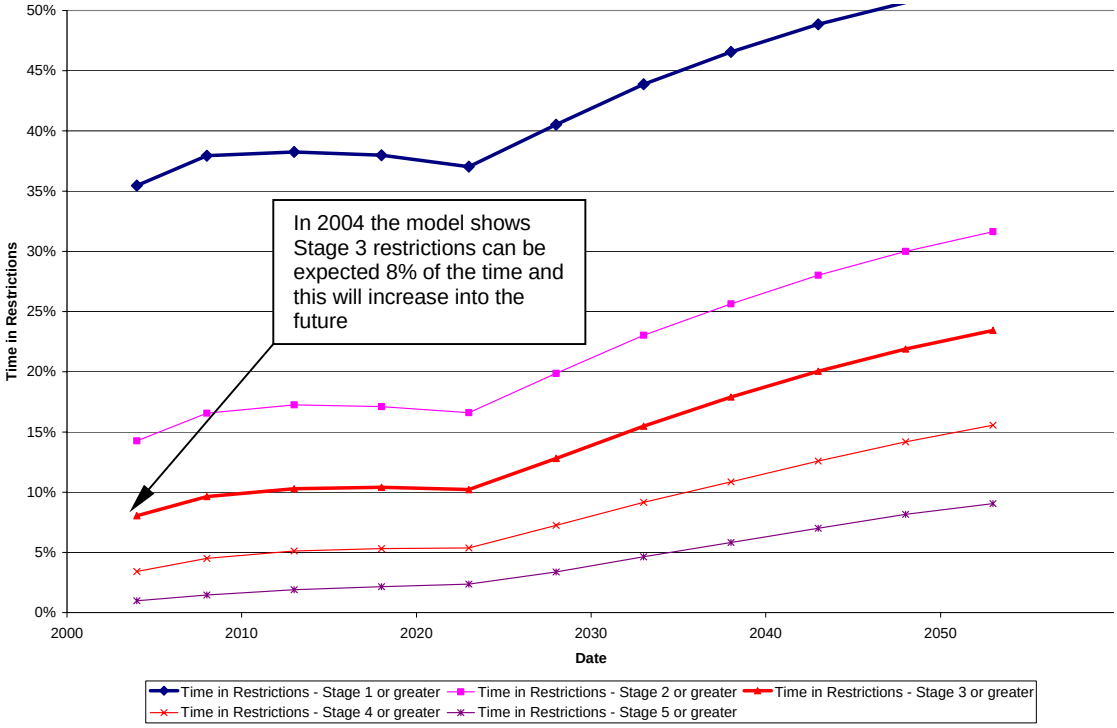


Figure 5-1: Restriction profile

5.2 What impact would a reduction in environmental flows have?

The current environmental flow guidelines protect the low level flows in rivers by requiring ACTEW to release from the reservoirs an amount of water equivalent to that which enters the reservoirs during low flow periods. This means that in an average year about 46 GL of water is released from the reservoirs. Spills from reservoirs are not counted in the current environmental flow rules. ACTEW has requested that the Environment ACT review of environmental flows examines how spills can be managed and be counted in the environmental flow allocations.

Environment ACT provided data solely for the purpose of allowing ACTEW to test the impact of environmental flows on the need for increased water storage capacity. This is not trying to pre-empt the outcome of the current environmental flow review being conducted by Environment ACT. The "modified environmental flow scenario" developed from the data assumes that the normal releases below Cotter reservoir are reduced to 5ML/day (1 ML or megalitre is equivalent to 1 million litres) and half the normal releases occur below Googong reservoir. Reduced drought flows from Cotter and Googong reservoirs are included in the modified flow scenario. In addition, fish spawning flows are eliminated below Corin reservoir[29].

Table 5-1 compares the average annual releases based upon the current environmental flow guidelines and the modified environmental flow scenario. This comparison was modelled using the same assumptions as in Section 3 (but with the current ACT population) to compare the

[29] *ActewAGL (2004); Environmental Flow Scenarios, Environment ACT Personal Communication File Note - 3 pages (ACTEW Corp. Doc. No. 3755).*

relative releases of water required under both environmental flow situations to understand the impact of changes in environmental flows on the timing for the next ACT water storage.

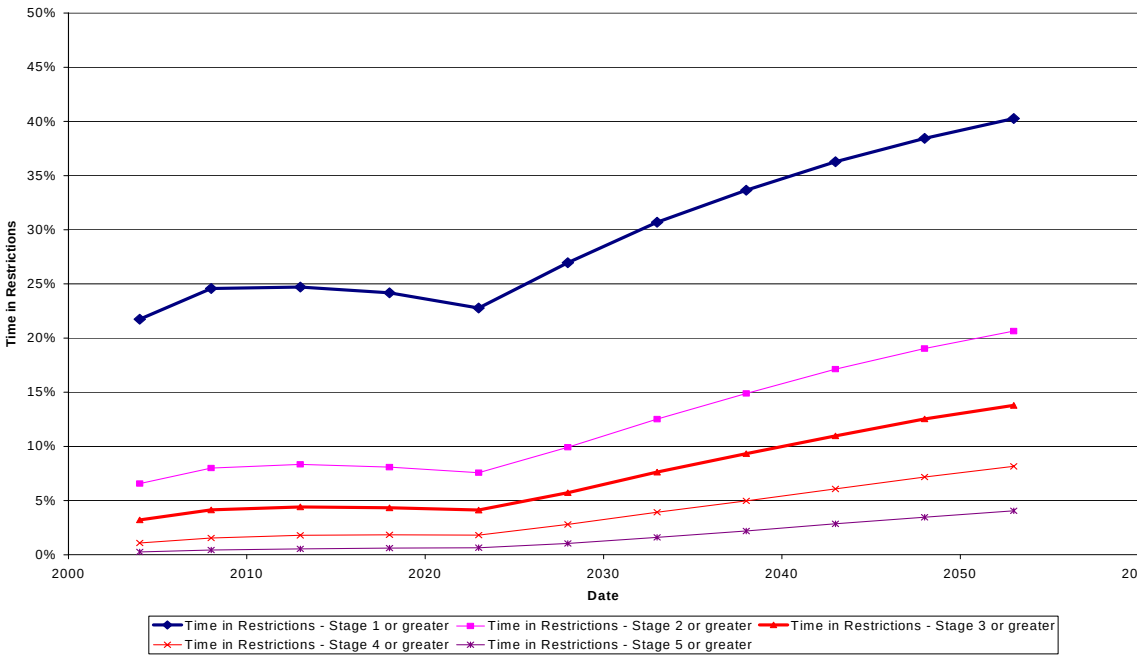
Table 5-1: Indicative relative volumes of annual environmental flow releases.

	Current (GL)			Modified (GL)		
	Cotter	Googong	Total	Cotter	Googong	Total
Average annual release	35	10.6	45.6	1.8	5.5	7.3
Average annual spills	39.7	35.4	75.1	73.6	35.8	109.4
Total	74.7	46	120.7	75.5	41.3	116.7

During wet periods, spills are a much larger volume of water than that specifically released for environmental flows, particularly under the modified scenario. This is shown above when comparing the modified scenario with the current guidelines, where on average the same amount of water is released to the river each year (about 120 GL).

During dry periods, the modified environmental flow scenario allows for significantly reduced flows below Cotter and Googong reservoirs meaning more water is available for human use. As a result, under the modified environmental flow scenario it is predicted the time in Stage 3 restrictions (measured in 2004) will be halved, as well as reducing the overall time in restrictions from 35% to 22% (see Figure 5-2 when compared to Figure 5-1). While these reductions are significant, the time in restrictions is still much higher than most other Australian cities. Most water utilities plan for restrictions to occur about 5% of the time.

Figure 5-2: The effect of a modified environmental flow scenario on restrictions.



In summary, the environmental flow review will be an important input in assessing the next storage for the ACT. It appears that a significant change to the environmental guidelines would be needed to defer the need to add additional storage within the ACT. Spills from the ACT's reservoirs are a critical component of the environmental flow review. The revised environmental

flow guidelines could impact on the size or specific option selected for any additional storage, but does not eliminate the need for additional storage.

Variations in the timing of environmental flow releases during droughts may provide benefits to the ecology of rivers (through variable flows) and benefits to human use by having more water available in dry periods. When considering the options for the ACT's next water storage, environmental flows below a new Tennent reservoir or an enlarged Cotter reservoir will need to be understood when determining the relevant merits of these two options.

5.3 How important are water restrictions?

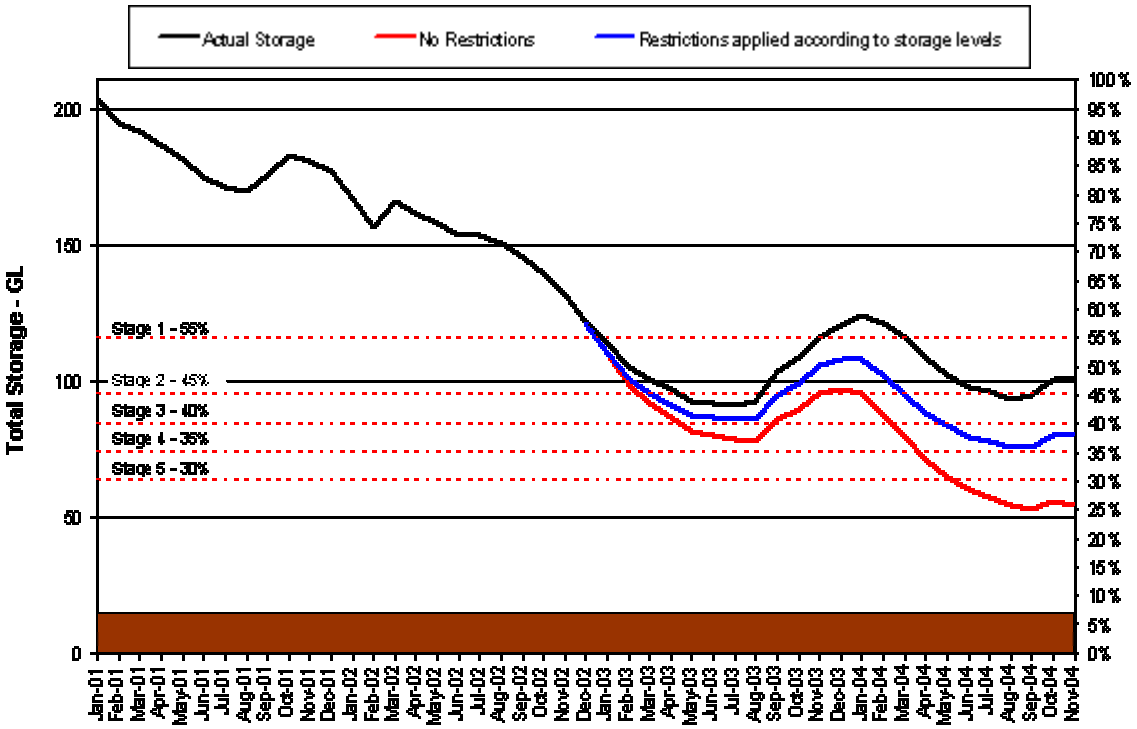


Figure 5-3: Storage Scenarios - Restrictions During the Drought

The above analysis of the amount of time spent in restrictions is based upon applying the indicative levels for each level of restriction as outlined in the water restrictions scheme. Over the past two years, however, restrictions generally have been brought on earlier due to the bushfires and also because of unfavourable forward climate projections. The differences between the introduction of restrictions at the levels identified in the scheme compared to the levels when restrictions where actually applied is shown in Figure 5-3. This analysis demonstrates that if the restrictions were applied according to the indicative levels in the scheme, current reservoir storage levels would be less than 40% (in November 2004), rather than the 50% of storage being experienced. If no restrictions were applied the storage levels would only be about 26%. This analysis suggests that if the modelling carried out for this report was based upon the reservoir levels when the restrictions were actually introduced, then the ACT community would be in restrictions more often than one year in every three.

5.4 Is it premature to make a decision whether more water storage is needed in the ACT?

There are several key factors to be taken into account in deciding if and when the ACT water storage needs to be increased. There is still uncertainty associated with some of these factors.

Environment ACT is currently reviewing the environmental flow guidelines and during 2005, will present revised environmental flow guidelines to the ACT Government. This review is an important input into the decision on the next ACT water storage. It is unlikely that the revised environmental flows would have a significant impact on whether additional water storage is needed unless the environmental flows were substantially reduced below current levels.

Examining the predicted performance of the existing water supply system (see figure 5-1), it can be seen that the community's attitude to regular and/or severe water restrictions is a key issue in making the decision about if and when to increase the ACT's water storage. As mentioned earlier in this report there is enough water available in the ACT to supply a population of more than one million people, but currently there is insufficient storage to service a population of this size.

The deterioration of public assets during the current drought includes the closure of 83 ha (out of a total of 213 ha) of sports fields and playing grounds in the ACT due to water restrictions, damage to the streetscape, including heritage areas with long-established trees and the anticipated cost of reinstating public gardens and sports fields after the restrictions are lifted. Preliminary estimates are that the reinstatement cost alone is more than $1 million[30].

There are additional social issues related to water restrictions such as the deterioration of the Canberra urban landscape and possible long-term effects on tourism, population growth and economic development as well as the loss of amenity and inconvenience to the community.

These social and economic factors are an important consideration. ACTEW will have more information on these matters in the report to the ACT Government in March 2005.

The amount of additional storage that will be required for the ACT has yet to be determined. The infrastructure and hydrology studies are now being progressed to assess the amount of additional storage that would be required and results of this work will be included in the March report by ACTEW to the ACT Government.

It is always necessary to continue to assess the assumptions underpinning the planning for future water storage. By adding additional storage infrastructure incrementally, it is possible to reassess the assumptions over time and modify the investment as required. This approach lowers the risk of over investment in infrastructure that may not ultimately be required.

[32] *McNulty, Hamish (Pers. Comm), Executive Manager, City Management, Department of Urban Services, October 2004*

6 Conclusion

New scientific knowledge of the potential combined effects of climate change and bushfire impacts has meant that additional water storage will be needed sooner than previously expected.

Planning forecasts for the ACT's water supply have been assessed for the next 50 years using the following assumptions:

- Natural Environmental Risk Factors - Climate variability, climate change and the bushfire impact on storage inflows in the ACT.
- Government Planning Parameters - Population growth to 500,000 in 2032, water supply into NSW and meeting water efficiency targets in *Think water, act water*.
- Factors within Government/Community Control – Environmental flows and the application of water restrictions in the ACT.

Without increased storage capacity water restrictions are predicted to apply for a high proportion of the time. Stage 1 restrictions or greater are predicted for one year in three and Stage 3 and Stage 4 restrictions for about 8% of the time (perhaps two successive summers each decade). Of this, Stage 4 restrictions (which bans all outdoor watering) would occur for 10 months once every 25 years. Such frequent and severe water restrictions are significantly more onerous than those that have been planned for in Canberra or anywhere else in Australia. Furthermore, over the coming years these restrictions will bring increasingly more pain to the community and at the same time be less effective. This is because restrictions would come on top of a substantial reduction in per capita water use through meeting the water efficiency targets, which within themselves will require permanent water restrictions.

Under current estimates, the ACT Government and community will need to commit about $400 million to meet these water efficiency targets. Meeting these targets would balance any future demand from increased population growth till 2023.

Unless the ACT is willing to accept the regular recurrence of water restrictions of a severity and frequency unprecedented in planning elsewhere in Australia, then additional water storage will be needed in the ACT.

The role of environmental flows is significant in determining the preferred option for the next water source for the ACT. The environmental flow review will be an important input in assessing the nature of the next storage for the ACT. It is unlikely, however, that any changes to the environmental flow guidelines will defer the need to add additional storage in the ACT unless changes are substantial. The revised environmental flow guidelines could impact on the size or specific option selected for any additional storage. Environment ACT currently proposes to have the draft review of environmental flows completed by March 2005 and finalised in August 2005.

There is some uncertainty about the impact of climate change and the bushfires and a conservative approach has been taken in regard to these factors in this report. It is also possible that a drought much worse than previously experienced could occur, higher population growth may arise or the water efficiency targets may not be met. If these scenarios eventuate, then the outlook would be worse than predicted in this report.

This report concludes that planning must continue to identify the next ACT water storage.

ACTEW's second report to the Government in March 2005 will set out options for a program to provide a long term, secure water supply for the ACT and region. Such a program might well be implemented in stages, but would need to begin now. The second report will examine opportunities to implement this program in stages which will allow time to assess whether or not the assumptions underpinning this work, for example population growth, come to fruition.

7 Further Information

For further information on this report, contact:

Dr Gary Bickford

Principal Strategic Planner

ACTEW Corporation

GPO Box 366 Canberra ACT 2601

Phone 02 6248 3186

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