2. Securing Sydney's water needs

What this chapter is about

- The findings of independent experts engaged by the NSW Government to review the supply and demand balance and provide advice for this *Plan*
- The substantial benefits of adopting a new approach to securing Sydney's water needs
- The implications of this new approach for managing the supply and demand balance

What has been done already

- An initial report by the independent experts was published in February 2006
- The NSW Government made a number of decisions on the basis of this advice, as outlined in *the February 2006 Progress Report*
- A further report provides more detailed analysis of the supply/demand balance and the optimal mix of measures for securing Sydney's future water needs. This report has informed the approach adopted in this *Metropolitan Water Plan*

What will be done next

- The Government will implement the range of actions identified in this *Plan* to augment supply and reduce demand
- Further analysis will be undertaken over time to ensure that the mix of measures continues to deliver optimal results, including:
  - underlying demand trends,
  - potential climate change impacts on supply and demand, and
  - emerging options that can help balance supply and demand over time.

2.1 Introduction

The Government engaged the Institute for Sustainable Futures at the University of Technology, together with ACIL Tasman and the Snowy Mountains Engineering Corporation, to provide expert advice regarding the optimal mix of measures to secure Sydney's current and future water needs.

The consultants delivered an initial report which informed decisions taken by Government and were announced in the *February 2006 Progress Report*. A further report has been prepared which provides more detailed analysis of the supply and demand balance and the optimal approach to securing Sydney's current and future water needs.

Both reports are available at **www.waterforlife.nsw.gov.au**

This chapter outlines the consultants' findings and explains why the *2006 Metropolitan Water Plan* adopts a new approach to meeting Sydney's growing water needs, and securing our water supplies in the face of drought and potential climate change impacts. The Government endorses the broad findings and recommended directions in the consultants' report and has based this *2006 Plan* on those findings and directions.

The consultants' report also suggests some issues for further investigation. It identifies options which are not currently Government policy, to address any gap in the supply and demand balance that emerges beyond 2015; this is discussed further in this Chapter at section 2.6. It also raises issues relating to institutional arrangements, which are discussed in Chapter 10, section 10.2. The Government will consider these suggestions further in the context of the regular reviews of the *Metropolitan Water Plan*.

2.2 'Growth water' and 'security water'

Drinking water for the Sydney metropolitan and surrounding areas is principally supplied by rainfall over the storage catchments. Sydney's highly variable rainfall, and long periods of low inflows, pose a unique challenge for water planners: how to meet the water needs of a growing city and secure supplies in the face of uncertainty, while minimising economic and environmental costs.

Historically, rainfall dependent supplies have been used to meet all of Sydney's water needs. This necessitated pre-emptive investment in dams to provide a buffer capable of meeting water needs during drought periods. As a result, Sydney has a large storage capacity which can sustain our water needs even in severe drought conditions. The capacity of the system on a per capita basis is one of the highest in the world.

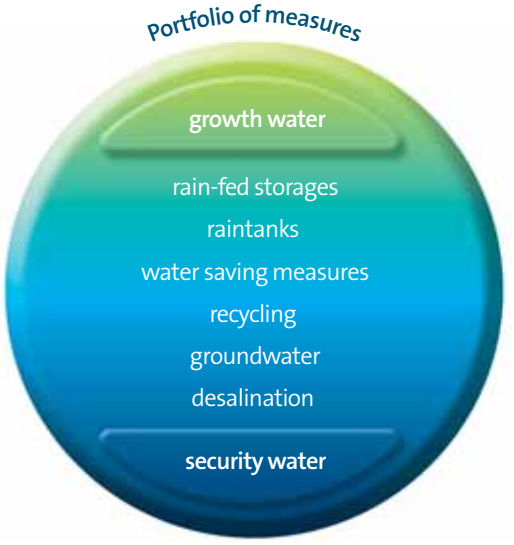
This approach has served us well – even well into the second worst drought on record, the fact that extended storages remain at 43.9% (as at 27 April 2006) is testament to the system's capacity to withstand prolonged periods of low rainfall. Now, however, non-rainfall dependent options are available which can be incorporated into a more diverse supply and demand mix. Options such as groundwater and desalination can be deployed relatively quickly – if and when severe drought conditions emerge. Because such options do not require pre-emptive investment to secure supplies, they open up the possibility of adopting a new approach to meeting our water needs.

In particular, they allow the Government to use different measures to:

- meet Sydney's normal water needs as it grows over time, and
- secure Sydney's water supplies in the face of drought (and, in the longer term, potential climate change impacts).

These related but contrasting needs can be described as 'growth needs' and 'security needs'. In this chapter, reference is also made to 'growth water' and 'security water' – that is, water provided by options that are best suited to meeting these different kinds of needs.

The challenge of meeting Sydney's growth and security needs at least economic and environmental cost is central to the advice provided by the consultants. They have examined the options currently available and conclude that a 'one size fits all' approach (for example, relying solely on rain-fed supply sources to meet needs, is not optimal). Instead, targeted investment in a range of diverse measures can meet Sydney's growth and security needs at substantially lower economic and environmental cost than was possible in the past.



Achieving an optimal supply and demand mix requires careful consideration of how all these options interact as part of a portfolio of measures. Importantly, this requires considering the cost of the whole portfolio of measures, not just the cost of each option in isolation. Some options (for example desalination) have a higher unit cost than others, however they can play an important role in achieving a cost effective portfolio of measures and thus represent good value for money. This is because, as described further below, options that can produce water in times of scarcity have greater value than those which do not.

2.3 Maximising the value of our water investments

The amount of water that can be drawn from Sydney's supply system each year is estimated by the Sydney Catchment Authority using a hydrological computer model known as 'WATHNET'. Annual water availability – generally referred to as system 'yield' - is estimated by reference to (among other things):

- the system's total storage capacity
- inflows to the system that have been observed over the last 96 years which are amended as additional data becomes available and includes several drought periods
- savings expected to be achieved by imposing water restrictions during drought, and
- the releases from the dams needed for river health.

Using this data, WATHNET estimates the amount of water than can be drawn from the system each year without needing to impose drought restrictions too frequently or for too long, and without creating a risk that the system will approach emptiness during deep and prolonged drought.

The result is that, while the system's extended usable capacity is 2,600 billion litres when full (including deep storages at Warragamba and Nepean Dams), the amount that can safely be drawn from the system each year is set at less than one quarter of this. This approach ensures that the system can meet Sydney's water needs even in severe droughts.

While rain-fed storages will continue to supply the bulk of Sydney's water needs by volume, non-rainfall dependent options such as groundwater and desalination have an important role to play because they can produce guaranteed water when storages are low. By providing assurance that Sydney's water needs in deep drought can be met, they increase the amount of water that can safely be drawn from the storages on an annual basis. This is because they free up water which historically has been held in reserve in order to deal with the risk of deep and prolonged drought.

As such, groundwater and desalination 'punch above their weight class': they produce relatively small volumes of water (or no water if they are yet to be constructed) but the ability to deploy them quickly during a drought improves system security and thus increases the amount of water that can be drawn from the dams each year. For this reason, groundwater and desalination can be very valuable from a portfolio viewpoint, compared to options which are unable to guarantee water production in times of scarcity (eg dams, raintanks, stormwater harvesting).

Another useful feature of groundwater and desalination is that they can be turned on and off in response to low storage levels more easily than other options (such as recycling systems). This minimises operating costs while maximising benefits for system yield.

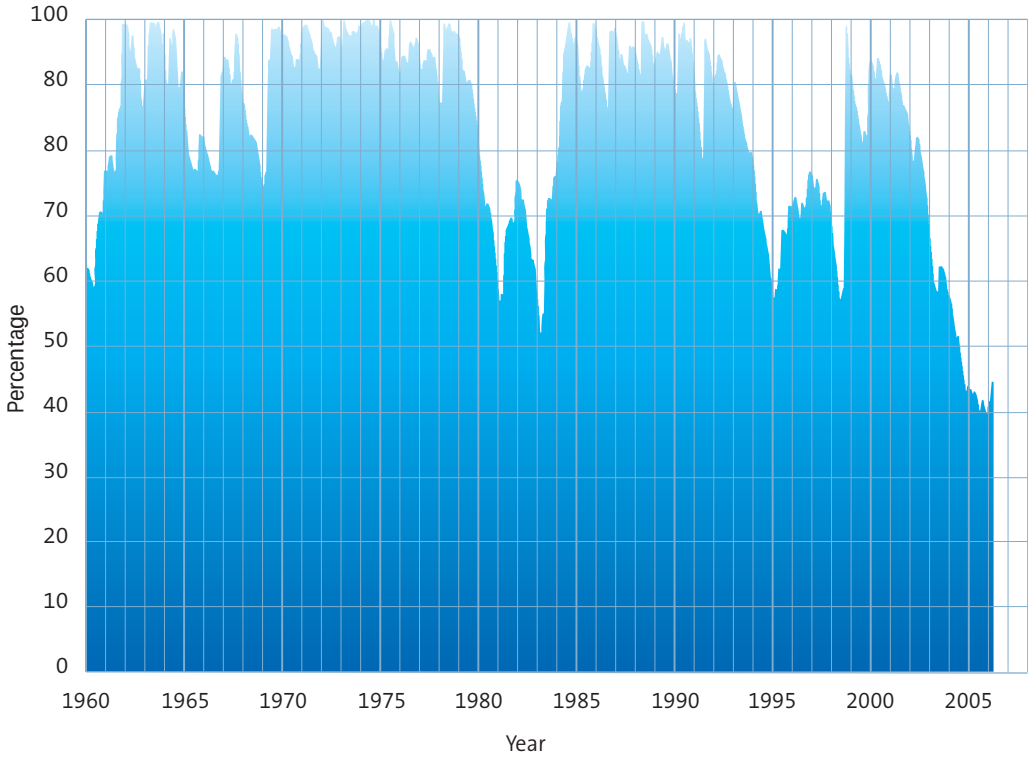
By contrast, options which are designed to operate continuously (eg recycling, water saving measures) will produce more water by volume than groundwater and desalination, but will have a proportionately smaller benefit in terms of system 'yield' or annual water availability. This is because by operating continuously, options like recycling and water saving measures reduce the amount of water extracted from dams each year. This reduces the available 'headroom' and means that the system will spill more frequently – thus reducing the 'system yield' benefit relative to the volume of water substituted or saved downstream of the dams.

By contrast, groundwater and desalination produce water when storage levels are low – meaning that there is less chance of this water being lost due to spills. This is another reason why such options have a big benefit for the system 'yield', even if they produce small volumes of water.

Of course, water saving and recycling measures have many other benefits that need to be taken into account, including:

- the incremental nature of investment in water saving and recycling measures – making them well suited to an adaptive approach, compared with lumpier investments that may become 'stranded' if circumstances change
- the ability to avoid other costs and impacts by reducing the amount of energy required to treat water and wastewater, to transport water and wastewater to and from end users, and to heat water for end-use
- benefits for river health associated with reducing nutrient discharges from wastewater treatment plants
- reducing the rate at which storages deplete during drought, thus reducing the likelihood of needing to invest in groundwater and desalination in response to drought, and
- providing a buffer against the risk of potential climate change impacts.

Sydney's dam levels from 1960 to 2006



An optimal supply and demand mix will take account of all these factors and include an appropriate mix of measures designed to operate continuously, and measures able to guarantee supply when storage levels are low. Too much investment in either type of measure will lead to suboptimal and costly outcomes. For further discussion of this complex issue, refer to section 5 of the consultants' report.

2.4 'Growth water' needs – balancing supply and demand to 2015

The independent consultants have analysed the range of supply and demand side measures that are now in place or agreed. They conclude that, together, these measures are sufficient to meet Sydney's growth needs until 2015. Beyond that time there are a range of options available, discussed at section 2.6.

On the supply side, the following factors (which are already in place or agreed on) contribute to the amount of water now available annually from the storage system:

- the effect of low inflows during the current drought (recent inflow data has been incorporated into WATHNET and has reduced annual water availability by 25 billion litres)
- deep storages at Warragamba and Nepean Dams (is boosting annual water availability by 40 billion litres)
- agreed Upper Nepean environmental flows (which will reduce annual water availability by 25 billion litres)
- the effect of removing Level 4 and 5 restrictions from the suite of possible drought response options
- the Western Sydney Recycled Water Initiative, one component of which will replace the current flow releases from Warragamba Dam
- the effect of being ready to access groundwater in the event that storages fall to around 40% (even if only operated in severe drought, groundwater resources would increase annual water availability by between 5 and 10 billion litres);
- the effect of being ready to build a desalination plant in the event that storages fall to around 30% (even if only operated in extreme drought, desalination would increase annual water availability by between 30 and 70 billion litres), and
- the effect of the current Shoalhaven transfers scheme (that is, without raising Tallowa Dam wall and assuming current operational settings).

The consultants conclude that the net effect of these factors is **an annual supply availability of 575 billion litres.** This is lower than the water availability figure used in the *2004 Metropolitan Water Plan* (605 billion litres). However, the consultants have concluded that the range of measures now in place to reduce water demand means that this level of supply will exceed demand until at least 2015.

Option / Sector	Estimated reduction by 2015 (billion litres per annum)	Description
Non-residential	38	Combination of regulatory (Water Savings Action Plans), funding (Water Savings Fund) and cooperative partnerships (Every Drop Counts Business Program) and other smaller programs to work with organisations to reduce water use.
Recycling*	35	Involves the use of recycled water replacing potable water use in industry (notably BlueScope Steel), at sewage treatment plants. To avoid double counting, drinking water savings that result from dual reticulation in new release areas to support BASIX are included in that estimate below.
Pressure and leakage reduction	33	Includes Active Leak Detection Program, pressure reduction and improved break / leak response time.
BASIX	23	The Building Sustainability Index (BASIX) is an assessment tool that mandates a level of water demand reduction in new and renovated homes and apartments.
Stepped tariff for pricing and outdoor water savings measures	24	Includes the introduction of step pricing as recommended by IPART. The outdoor water saving measures involve the Residential Landscape Assesment and Rainwater Tank Rebate Programs, and the introduction of ongoing low level outdoor water use measures commencing at the end of the current drought and supported by ongoing community education.
Appliance standards and labelling	15	This program involves the introduction of mandatory labelling followed by minimum standards for a range of water-using appliances under the Commonwealth Government's Water Efficiency Labelling Scheme (WELS).
Residential indoor	12	Promotes the use of water efficient appliances in the home through retrofits and rebate programs.
Total	180	

**Note: The total volume of water to be recycled is anticipated to be more than 70 billion litres per year by 2015. In addition to savings identified above, recycled water will be used to substitute for releases from Warragamba Dam, for irrigation and other purposes.*

On the demand side, there is now a wide range of water saving and recycling measures in place or agreed which will reduce pressure on storages and are projected to make a significant contribution to the supply and demand balance. These are outlined in the table above and are described in detail in the chapters on Recycling (Chapter 5) and Reducing Demand (Chapter 6).

The savings expected to result from these measures are a key input to estimating Sydney's future water demand. The way that this is done is to estimate what demand would be in the absence of these water saving and recycling measures (known as 'base case demand'), and then deduct the impact of the measures. To estimate the base case demand in 2015, the projected population of Sydney in 2015 is multiplied by an estimate of water demand per person. The projected impact of the water saving and recycling measures is then netted off the base case demand to work out the projected actual demand for water. By 2015, the measures outlined in the table are expected to reduce the base case demand by 180 billion litres, leading to an actual **annual water demand of 542 billion litres in 2015.**

The estimate is considered conservative because conservative savings estimates were used (and overlaps between related measures were addressed to avoid double counting), and a conservative approach was taken to estimating the base case demand.

The base case incorporates a per capita water

demand figure of 426 litres per capita per day (lcd) - the same figure as was used in the *2004 Metropolitan Water Plan)*. The consultants consider this estimate to be high. Using a less conservative figure of 400 lcd would lower the projected actual demand in 2015 to 502 billion litres – down from the above estimate of 542 billion litres – thus considerably increasing the projected surplus.

The current *Plan* uses the 426 lcd figure in order to be conservative, but the above example illustrates the importance of improving our understanding of underlying demand trends. This will be possible once the current drought has ended and restrictions are lifted. (The factors that influence future water demand are discussed further in Chapter 6 and in section 3 of the consultants' full report.)

The consultants conclude that, in 2015 the combined effect of the water saving and recycling measures listed above on the base case demand is a net annual water demand of 542 billion litres. With estimated water availability of 575 billion litres in 2015, this results in a **surplus of 30 billion litres** in 2015.

It is important to note that these figures will change over time, according to supply-side and demand-side developments. The water availability figure of 575 billion litres may change relatively soon, to reflect the Government's decision on operational changes to the Shoalhaven Transfers Scheme and the new regime of environmental flow releases from Tallowa Dam on the lower Shoalhaven River, about which community consultation is now under way (further discussed in Chapter 7, section 7.4). Over time, the introduction of any new recycling projects or water savings programs would see the demand figure drop, and any new supply sources identified would see the water availability figure rise. The changing nature of these figures is one aspect that will be reviewed by the Independent Review Panel in its review of yearly status reports and four-yearly reviews of the *Metropolitan Water Plan*.

The **balance between supply and demand** – with a surplus as a "safety margin" – ensures that Sydney has sufficient water to meet its needs to at least 2015. This is depicted in the pie chart below, which shows the contribution made by supply side measures and demand side (water saving and recycling) measures. The sum effect of these measures is to deliver water in excess of growth needs to 2015 (that is, including a safety margin or buffer of 30 billion litres). This chart is used throughout this document to indicate how the elements of the *Metropolitan Water Plan* deliver an integrated approach that will meet Sydney's growth and security needs over time.

Throughout this *Plan*, water drops are also used to highlight the contribution of individual measures to the above supply and demand balance.

The numbers in each drop relate to the contribution of each measure to the supply and demand balance in terms of annual water availability, not neccesarily to the amount of water actually produced by each option. These figures are very different. For example, the capacity to deploy groundwater and desalination may involve very little water production (or none, prior to construction of a borefield or desalination plant), but can have a substantial impact on water availability thanks to their benefits for security of supply.

2.5 Factors affecting the supply and demand balance

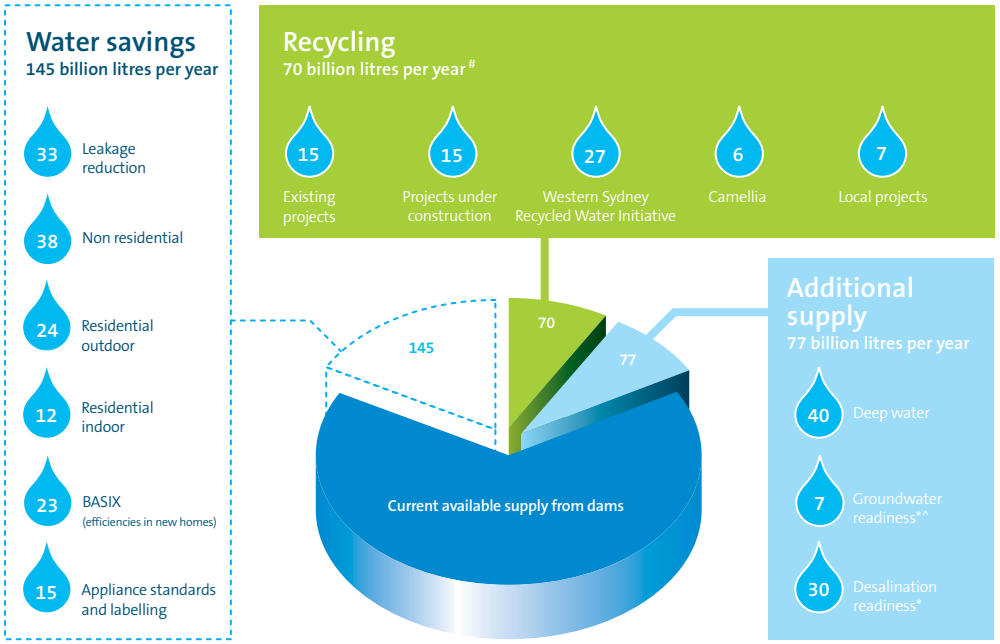
A number of factors influence the supply and demand balance and require careful monitoring. In particular, the consultants note that the above supply availability estimate (575 billion litres per year) is sensitive to the value of many variables and operating parameters. These include, most significantly:

- the reliability criterion, which specifies the maximum percentage of time that customers are subject to restrictions (currently 3%, that is on average 3.6 months every 10 years)
- the various levels at which drought restrictions are triggered and the assumed percentage savings
- the trigger level for water transfers from Tallowa Dam (that is, the storage level for the whole system at which pumping from the Shoalhaven system commences), and
- the trigger levels for water supply from a desalination plant and groundwater (that is, the whole-system storage levels at which work to proceed with construction would commence).

The consultants note that there are still uncertainties in a number of factors which impact on the supply availability, including the yield associated with groundwater resources that have been identified but not 'proved up', and the Shoalhaven environmental flows and operating rules (which are currently the subject of community consultation). These two issues will be resolved in the near term, providing greater clarity about annual water availability for planning purposes.

Climate change is another factor that may impact annual water availability over the longer term. While many assume that climate change will reduce water availability through higher temperatures and longer, more intense droughts, it is also possible that more intense storms over the catchment area will increase the frequency of events which fill the dams. Studies regarding the potential impacts of climate change on supply and demand are under way, as outlined in Chapter 4, and will improve our understanding of these potential impacts. In the interim, however, the suite of measures outlined in this *Plan* provides confidence that the supply and demand balance will continue to be met in the near to mid term, even if climatic conditions worsen.

Meeting Sydney's water needs in 2015



The above mix of supply and demand measures is sufficient to meet Sydney's growth needs to 2015 and to secure drought needs to 2015 and beyond.

#The total volume recycled is anticipated to be more than 70 billion litres every year by 2015. However, the use of recycled water for some purposes does not save drinking water. The total amount of drinking water expected to be saved through recycling is 59 billion litres per year.

**By investing in being ready to access groundwater and desalinated seawater in severe and extreme drought - even if such drought does not occur - more water can now be drawn from the dams without affecting the security of supply; for this reason the calculated water availability figure has increased even without accessing these sources.*

^ In a severe drought, new bore fields would be constructed to enable access to around 30 billion litres of groundwater a year for about three years for drought needs.

The consultants' analysis examined the probability of storages reaching critical levels in future, thus triggering the need to deploy options such as groundwater and desalination in response to severe drought conditions. Based on hydrological modelling using inflow data from the last 96 years, and incorporating simulations of substantially worse drought possibilities, the consultants concluded that the approach adopted in this *Plan* will be sufficient to secure Sydney's water supply needs. In particular, the combined effect of Sydney's large storage capacity, the ongoing programs to increase water conservation and the uptake of recycling, as well as the capacity to deploy groundwater and desalination, mean that Sydney is able to secure its water needs in the face of severe drought. This conclusion holds true even if dam levels decline substantially faster than has been recorded. In other words, Sydney already has some capacity to deal with potential climate change impacts on future water availability.

Given the uncertainties inherent in estimating potential climate change impacts, an adaptive approach is required that can respond to circumstances as they evolve over time. Investing pre-emptively in anticipation of uncertain climate change impacts risks imposing high costs on the community without necessarily enhancing supply security.

The consultants note that there is also uncertainty associated with the estimated projections of demand due to uncertainty in the base case demand and the demand reductions that will be achieved from the range of water saving and water recycling measures that are committed and approved. To reduce uncertainty, it will be important to continually monitor whether the measures outlined above are delivering savings on the scale anticipated, and to improve our understanding of demand trends once the current drought ends.

The consultants have strongly recommended that, given the unavoidable level of uncertainty in key parameters, an adaptive approach is essential, involving regular re-assessments of the demand projections, estimates of supply availability and the other factors in the supply and demand balance. The features of an adaptive management approach are discussed in Chapter 10, section 10.2.

2.6 Measures to balance supply and demand beyond 2015

The above analysis indicates that, with the range of supply and demand side measures currently in place, Sydney has enough water to meet its growth needs until at least 2015. At that time, in line with the adaptive management approach, more will be known about demand trends, population growth and demographic change, the impacts of climate change on water supply and demand, technological developments, and so on.

Importantly, there will also be better information on the effects of increased flows on the Upper Nepean river systems from monitoring of the improved flows due to commence there in 2009. This information will feed into decision-making about a new regime of environmental flow releases from Warragamba Dam, to protect the health of the Hawkesbury Nepean River. This matter is discussed further in Chapter 8, at section 8.3. If it is decided to proceed with increased flow releases, these could reduce annual water availability by some 83 billion litres. In that case, the Western Sydney Recycled Water Initiative (discussed further in Chapter 5, at section 5.5) could provide highly-treated recycled water to substitute for some of the additional flows.

If a supply and demand gap were projected to emerge after 2015, as a consequence of population growth, new environmental flows or other factors, the consultants have identified a number of options which could be deployed:

- revising the reliability criterion: this would involve a marginal increase in the frequency of restrictions and would increase annual water availability
- revising the pump mark for transfers from the Shoalhaven: this would increase annual water availability
- further water savings and recycling measures
- increasing the likelihood of a desalination trigger event (relative to the current, very low probability)
- further augmenting transfers from the Shoalhaven – eg through a tunnel or pipe;
- indirect potable reuse.

None of these options are part of the Government's policy settings for the *Metropolitan Water Plan*, but the Government has noted the consultants' findings on the capacity of such options to address any gap between supply and demand which emerges in the long term. The Government will review demand and supply trends and the full range of options available, as part of its regular reviews of the *Metropolitan Water Plan* (discussed further in Chapter 10).

2.7 'Security water' needs – guaranteeing supplies in the face of deep drought

Section 2.2 discusses how meeting Sydney's future water needs involves having a mix of measures in place that is capable of providing both 'growth water' and 'security water'.

Measures to meet Sydney's 'growth water' needs to about 2015 are outlined in section 2.4. Chapter 3 discusses the consultants' findings about the options available to provide 'security water' – that is, water that is needed for drought times. It also outlines the Government's new approach to drought management, developed in light of the consultants' findings.

In short, the emergence of non-rainfall dependent options such as groundwater and desalination means that it is now possible to adopt a new approach to delivering security of supply in the face of deep drought. The fact that such options can be constructed with short lead times means that it is possible to deploy them once deep drought conditions emerge, rather than pre-emptively as in the past. This can deliver substantial cost savings by deferring investment until required, and can also enable us to make better use of our existing storage system, as discussed in section 2.2.

2.8 Responding to the consultants' findings

As previously stated, the Government endorses the broad findings and recommended directions in the consultants' report and has based this *2006 Plan* on those findings and directions. The consultants have also pointed to areas requiring further work (discussed in more detail in Chapter 10) which the Government will be addressing to feed into subsequent iterations of the Plan.

What will be done next

- The Government will implement the range of actions identified in this Plan to augment supply and reduce demand.
- Further analysis will be undertaken over time to ensure that the mix of measures continues to deliver optimal results, including:
  - underlying demand trends
  - potential climate change impacts on supply and demand, and
  - emerging options that can help balance supply and demand over time.