Independent Pricing and Regulatory Tribunal

Water scarcity: Does it exist and can price help solve the problem?

By Gerard O'Dea & Jennie Cooper

Water — Working paper

January 2008

ISBN 978-1-921328-26-8

Inquiries regarding this paper should be directed to:

Gerard O'Dea (02) 9290 8439

Jennie Cooper (02) 9290 8403

Independent Pricing and Regulatory Tribunal of New South Wales
PO Box Q290, QVB Post Office NSW 1230
Level 8, 1 Market Street, Sydney NSW 2000

T (02) 9290 8400 F (02) 9290 2061

www.ipart.nsw.gov.au

Contents

1 Overview

One of the major issues for the next Sydney Water price determination is whether there is a continuing water scarcity issue and if so, whether this is best addressed by restrictions or whether a scarcity pricing mechanism may deliver the same result, but with greater economic efficiency.

Our analysis reveals that, given the commitment to build a desalination plant capable of producing 250ML per day, Sydney is unlikely to be capacity constrained in the medium term (ie, until at least 2028). The modelling includes the impact of desalination and recycling projects, and includes a portion of the benefits from the Government's current and proposed demand management programs. However, it is important to note that the Government will make a decision on changes to the environmental flow regime by 2015 and this may have an impact on available supply beyond 2015.[1]

In addition to these developments, the significant rise in dam levels indicate that short term water scarcity is not currently a problem either. However, limited instances of short term scarcity are still likely to emerge in the future, when drought conditions return.[2]

Our modelling indicates that, if price increases were used to replicate the demand reduction achieved by level 3 water restrictions, residential water (usage) prices would need to rise by between 62 per cent and 143 per cent. If the water (usage) price increase applied to both residential and non-residential consumption, prices would need to rise by between 57 per cent and 121 per cent.

The modelling also indicates that in addition to demand reduction achieved by water restrictions, the inclining block tariff introduced by the Tribunal at the last determination has reduced water consumption by (at most) 1.3GL per annum.

This paper is structured as follows:

1 Personal communication between the authors and the Department of Water and Energy, 5 December 2007. It should also be noted the Premier has said "Sydney is now in a position to secure its water supplies in the face of severe drought-and even potential climate change impacts-and has more than enough water to meet its normal growth demands for at least the next 10 years" Source *Securing Sydney's Water Supply-Metropolitan Water Plan-February 2006 Progress Report*. (p. 1)

2 That is, restrictions may still be necessary to guarantee that Sydney does not run out of water, but they will not need to be imposed for more than 3 per cent of the time.

- Section 2 provides a background on the theory of setting efficient prices for monopoly services, which is generally considered to be a two-part tariff. It also discusses why the Tribunal departed from a two-part tariff when it introduced an inclining block tariff at the last price determination, to help address the water scarcity problem.
- Section 3 compares and contrasts the use of water restrictions or price in allocating water in periods of short term scarcity. It then presents the results of our analysis of the change in price required to replicate the different levels of water restrictions.
- Section 4 discusses whether Sydney is capacity constrained either in the short term or over the medium term, given the decision to proceed with a desalination plant, commitments to recycled water projects and current dam levels. The paper concludes by asking whether an inclining block tariff is appropriate in the absence of water scarcity.

2 Price structures

2.1 Introduction

This section discusses the theory of setting efficient prices for monopoly services. It then provides a brief background leading up to the Tribunal's decision to introduce an inclining block tariff for residential water customers in 2005.

2.2 Efficient pricing of monopoly services

Economic theory suggests that an efficient price structure is one that encourages an efficient allocation of resources in the economy via the signals that it sends to consumers and producers.[3] This is achieved by setting prices at the marginal cost of supply. Marginal cost is the increase in total costs resulting from the production of one more unit of output.[4]

If prices are set lower (or higher) than marginal cost, this will understate (or overstate) the sacrifice that society makes in producing this product over others - known as the opportunity cost. Rational consumers will respond by over-consuming (or under-consuming) that product. As explained by Kahn (1988):[5]

> …only [when prices reflect the opportunity cost] will buyers be judging, in deciding what to buy and what not, whether the satisfaction they get from the purchase of any particular product is worth the sacrifice of other goods and services that its production entails.

The marginal cost of supplying water is largely dependent on the capacity of large, indivisible capital investments, such as dams and transmission pipelines. Once the cost of building a dam or pipeline has been incurred, the marginal cost of supplying water is much lower than the average cost of supply.[6] If prices are set to marginal cost, the utility may not fully recover its costs. This will impact on the utility's incentives to invest in the future.

---

3 IPART, *Investigation into Price Structures to Reduce the Demand for Water in the Sydney Basin, Final Report*, July 2004, p 20.

4 Marginal cost should also include any costs or benefits accruing to third parties (ie, those external to the transaction). These costs/benefits are known as externalities.

5 Kahn, A.E. (1988) *The Economics of Regulation: Principles and Institutions*. The MIT Press: Cambridge, Massachusetts, p 66.

6 Marginal cost can be low for long periods of time. However, as capacity is taken up, marginal cost increases as the next augmentation approaches (and may exceed average cost).

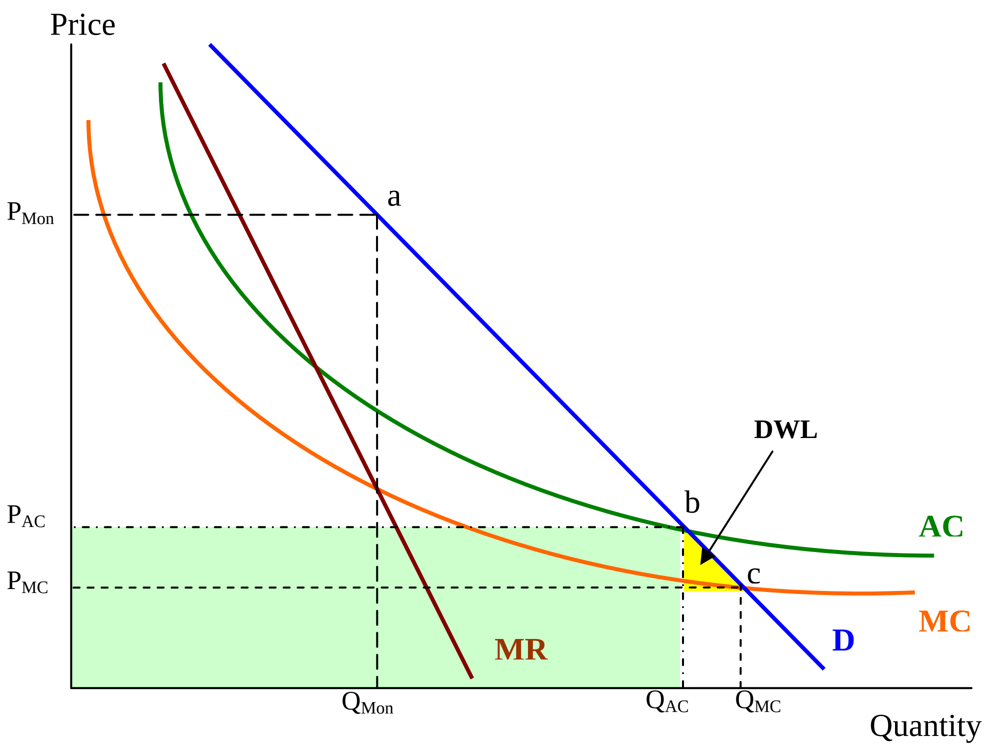
Therefore, it is generally accepted that pricing of monopoly services is efficient if it meets the following objectives:

1. It signals to consumers the costs imposed (or avoided) if they increase (or reduce) their consumption by a small amount – the **marginal cost pricing objective**.
2. It allows utilities to recover the efficient cost of service provision and recovers these costs with the least harm to economic efficiency - the **cost recovery objective**.

2.2.1 An efficient price structure

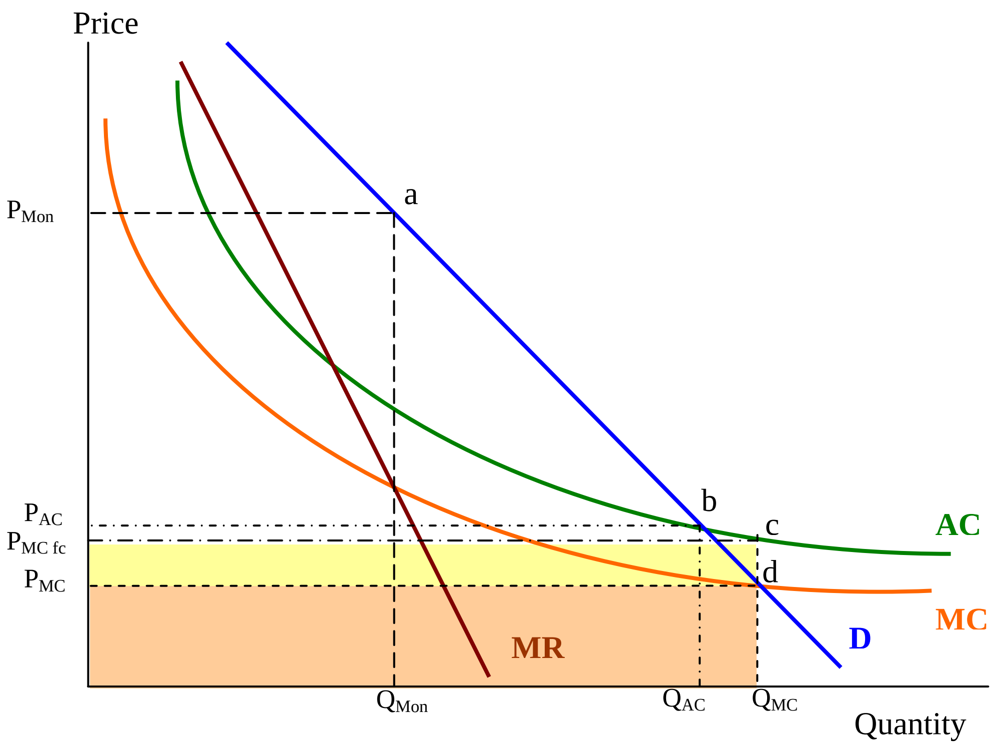
As depicted in figure 2.1 below, if a single usage charge is set, it would be at P_{AC} (ie, the point where the demand curve intersects the average cost curve) and the quantity demanded would be Q_{AC}. This would produce total revenue equal to the green shaded box, which just covers total costs. However, this results in a deadweight or efficiency loss. This is equal to the yellow shaded triangle. An efficient loss arises because consumers place a higher value on additional units of the good/service than the cost of cost of producing those additional units.

Figure 2.1 Single usage charge (average cost pricing)



As depicted in Figure 2.2 below, this problem can be overcome by setting price equal to marginal cost, which produces revenue equal to the orange shaded box. However, this is less than total cost, which is equal to the orange shaded box *plus* the yellow shaded box. To fully recover costs, the amount represented by the yellow box would need to be recovered through a fixed charge. This is commonly referred to as a two-part tariff. A fixed charge is considered to eliminate the deadweight loss because it is levied independently of water usage and does not distort the pricing signal sent by the usage charge.[7]

Figure 2.2 Two-part tariff (usage charge = marginal cost)



2.3 A history of price structures in Sydney

Prior to 2005, all customers in Sydney Water's area of operations were subject to a two-part tariff, with a single usage charge (for all units of consumption). The Tribunal phased in this structure between 1993 and 1995 to replace the existing price structure that was based, in part, on the value of the property being serviced. Its

7 The theory supporting this assumes that people react to marginal price. An international literature review (conducted in 2002) indicates that water customers react primarily to average price, although there is some reaction to marginal price. This result is generally explained by infrequent billing. This differs from groceries or petrol where the price signal is received at the time of use/purchase. Source: IPART, *Is Price an Effective Demand Management Tool? Unpublished Secretariat Paper*, March 2002, p 11; and OECD (1998) *The Price of Water-Trends in OECD Countries*, OECD, Paris, p 134.

objectives were "to encourage more efficient resource allocation, move towards cost reflective pricing, and send a stronger conservation message to customers."[8]

A summary of the price structures that currently apply in other cities in Australia is provided in Appendix C.

2.3.1 Why did the Tribunal introduce an inclining block tariff in 2005?

The Tribunal implemented an inclining block tariff (IBT), with a two-tiered usage charge[9] for individually metered residential customers in its 2005 price determination. For the reasons explained in section 2.3.3 below, a two-part tariff was retained for non-residential customers and residential customers (with shared water meters).

The introduction of an IBT stems from the Tribunal's 2003 investigation into price structures, which was initiated at the request of the NSW Government. The Tribunal was asked to conduct an investigation into alternative structures to assess their potential to reduce demand in the Sydney Basin. The purpose of the investigation was to inform the Government's broad water policy development process, and to provide input to the 2005 metropolitan water price review, where the issue of price structure was considered.[10]

While an IBT is not as efficient as a two-part tariff (because it results in at least some consumption being priced at a level either above or below marginal cost), the Tribunal concluded that an IBT was likely to be the most suitable price structure for Sydney at that time, for the following reasons:[11]

- it had considerable potential to reduce demand, given the significant supply and demand imbalance
- it could be used to target discretionary water uses (eg, car washing, garden watering) by sending a strong conservation signal to heavy water users
- the step quantity could be set high enough to avoid capturing too much non-discretionary use
- it could minimise the exposure of vulnerable customers to higher prices.

Further information on the structures introduced for residential and non-residential customers in 2005 is provided below.

---

8 IPART, *Investigation into Price Structures to Reduce the Demand for Water in the Sydney Basin, Final Report*, July 2004, p 11.

9 An IBT is a rate structure in which the usage charge of each succeeding block of usage is charged at a higher unit rate than the previous block(s). The number of rate blocks and size and pricing of each block can vary. The usage component is often accompanied by a fixed charge.

10 See IPART, *Investigation into Price Structures to Reduce the Demand for Water in the Sydney Basin, Final Report*, July 2004, p 11.

11 IPART, *Investigation into Price Structures to Reduce the Demand for Water in the Sydney Basin, Final Report*, July 2004, pp 14, 21 and 58.

2.3.2 Residential customers (individually metered)

Individually metered residential customers are subject to an IBT with a two-tiered usage charge. The tier 1 usage charge (currently $1.34/kL) reflects the lower end of the Tribunal's estimate of the long run marginal cost (LRMC) of supply (at the time prices were determined) and is applicable to the first 400 kL[12] of water purchased per annum.[13] The tier 2 usage charge (currently $1.83/kL) applies to each kilolitre of water consumed thereafter.[14]

In making its price determination, the Tribunal was aware of the impact of high water prices on vulnerable consumers. Consequently, the consumption level at which the higher tier 2 usage charge applies was set so that most households would be able to meet their basic, non-discretionary needs without incurring the higher charge.[15] In addition, low income households with 6 or more occupants are eligible for a rebate of up to $40 per annum if they consume more than 400 kL per annum (the threshold at which the higher tier 2 usage charge starts applying) and meet certain eligibility criteria.[16]

In 2006/07, around 120,000 households (representing 8 per cent of all households) paid the tier 2 charge.[17] Tier 2 consumption was around 19,000 ML, representing 6 per cent of residential consumption (or 4.2 per cent of total consumption).[18] The Tribunal's 2006 household survey[19] found that approximately 19,500 low income households[20] in Sydney Water's area of operations used in excess of 400 kL of water in 2006, compared to approximately 26,000 high income households.[21]

IBTs currently apply to residential customers in most other capital cities (ie, Melbourne, Brisbane, Canberra, Adelaide and Perth). IBTs also apply to non-

12 Note that: 1 kL (kilolitre) = 1,000 litres; 1,000 kL = 1 megalitre (ML); 1,000 ML = 1 gigalitre (GL).

13 In practice, a daily allowance of 1.096 kL applies to allow for minor variations in the quarterly billing cycle.

14 In addition to usage charges, all properties pay a fixed charge (currently $14 per quarter or $56 per annum).

15 This was supported by a finding of IPART's 2003 household survey, which found that "pre-restriction average annual consumption for households of 5 or more people was 398kL per annum – and with recent efforts in demand management, this average consumption may well have fallen." See IPART, *Sydney Water Corporation, Prices of Water Supply, Wastewater and Stormwater Services from 1 October 2005 to 30 June 2009 - Final Report*, June 2005, p 139.

16 To be eligible, a customer must: (1) be the owner/joint owner of an individually metered house/strata unit; (2) be the holder of a Health Care Card issued by Centrelink; (3) reside in a household with 6 or more permanent occupants; and (4) have fitted water-efficient devices.

17 Sydney Water, *Submission to the Independent Pricing and Regulatory Tribunal Review of Prices for Sydney Water Corporation*, 14 September 2007, p 76.

18 Source: Sydney Water.

19 IPART, *Residential energy and water use in Sydney, the Blue Mountains and Illawarra, Results from the 2006 household survey*, November 2007, p 54.

20 Low income households are defined as those households earning less than $31,200 per year.

21 High income households are defined as those earning more than $104,000 per year.

residential customers in all of these cities except Melbourne, where two-part tariffs apply.[22]

2.3.3 Non-residential customers + residential customers (shared meters)

Residential properties with shared meters (such as apartments or units) pay the tier 1 usage charge (currently $1.34/kL) for all volumes of water consumed. Since these customers usually pay a pro-rated amount based on total consumption and the number of units in the block, the Tribunal decided that the higher usage charge would be an ineffective signalling device for these customers.[23]

Non-residential customers are also exempt from paying the tier 2 usage charge. This is because the nature of their water use is likely to vary significantly, making it difficult to set an equitable step quantity.[24]

Of Australia's capital cities, two-part tariffs apply in:

- Darwin - to all customers, and
- Sydney and Melbourne - to non-residential customers only.

22 Strictly speaking, the price structure that applies to non-residential customers in Perth is a combination of an inclining and declining block tariff. That is, the second tier price is higher than the first tier price, but the third tier price is slightly lower than the second tier price.

23 IPART, *Investigation into Price Structures to Reduce the Demand for Water in the Sydney Basin, Final Report*, July 2004, p 10 and IPART, *Sydney Water Corporation, Prices of Water Supply, Wastewater and Stormwater Services from 1 October 2005 to 30 June 2009 - Final Report*, June 2005, p 136.

24 IPART, *Investigation into Price Structures to Reduce the Demand for Water in the Sydney Basin, Final Report*, July 2004, p 10.

3 Water restrictions vs scarcity pricing

3.1 Introduction

This section compares and contrasts the use of water restrictions or price in allocating water in periods of short term water scarcity. It then provides the results of our analysis of the change in price required to replicate the different levels of water restrictions.

3.2 Water restrictions versus scarcity pricing

The price of many goods and services rise and fall to reflect their relative scarcity. For example, when a cyclone destroyed banana plantations in Queensland in 2006, the price of bananas rose dramatically. The price of petrol also rises and falls, often on a daily basis. However, water is treated differently. In times of water scarcity, governments have chosen to rely on water restrictions to balance supply and demand, rather than price.

There are pros and cons of using scarcity pricing and water restrictions and decision-makers will generally need to choose one of these options. If scarcity pricing is chosen, prices rise when dam levels fall below critical levels and prices fall when dam levels rise above critical levels. If restrictions are chosen, the severity of restrictions increases as dam levels continue to fall to elicit greater demand reductions. Regulators will often try and reinforce the demand reductions during periods of water restrictions, by introducing tariff structures such as inclining block tariffs. However, our analysis shows that the inclining block tariff introduced in Sydney in 2005 (when Sydney was subject to water restrictions) reduced consumption by no more than 1.3GL.[25]

25 The detailed calculation of this figure is provided in Appendix G.

Many economists argue that water restrictions are economically inefficient, because water is not allocated on the basis of marginal willingness to pay. This means that there are some high value uses of water that are unrealised with mandatory restrictions.[26] As explained by Duke and Ehemann (2002):[27]

> Although mandatory restrictions and rationing are widely used to conserve water during droughts, only pricing efficiently signals water scarcity. The importance of conservation is not clearly conveyed with restrictions and rationing because the price of water remains artificially low. Conservation pricing, however, is flexible. Droughts can end abruptly and so can the price premium. Conservation pricing also provides a clear incentive to consumers, which rewards those who conserve, but which also allows people to use nonessential water as long as they are willing to pay for it.

Grafton and Ward (2007)[28] estimate the annual welfare loss of using level 2 water restrictions in Sydney to be $235 million for the 12 month period from June 2004 to June 2005.[29]

The Allen Consulting Group (2007) identifies further costs associated with the use of water restrictions, including: [30]

- time and inconvenience costs – for example, hand watering of gardens at specific times
- investment in high cost water sources – for example, rainwater tanks, domestic recycling systems
- flow on effects to businesses as a result of reduced demand for services – for example, garden centres
- costs of administering water restrictions – for example, advertising and compliance costs.

However, there are also several benefits of using water restrictions. First, restrictions appear to have broad community acceptance. The Tribunal's 2003 household survey found that around 63 per cent of people were willing to have water restrictions once every year, 11 per cent were willing to have restrictions every two or more years. Only 9 per cent were never willing to accept water restrictions.[31]

---

26 For instance, see Duke, J.M. and Ehemann, R., *The Conservation of Residential Water – Scarcity Pricing of Water in Northern New Castle County*, January 2002; and Grafton, Q. R. and Kompas, T. (2007) "Pricing Sydney water" *The Australian Journal of Agricultural and Resource Economics*, Volume 51.

27 Duke, J.M. and Ehemann, R., *The Conservation of Residential Water – Scarcity Pricing of Water in Northern New Castle County*, January 2002, p 2.

28 Grafton, R.Q. and Ward, M., *Prices versus Rationing: Marshallian Surplus and Mandatory Water Restrictions*, October 2007, p 10.

29 However, this estimate is highly sensitive to a number of assumptions, including the levelised cost of rainwater tanks and elasticity of demand.

30 Allen Consulting Group, *Saying goodbye to water restrictions in Australia's cities: Key priorities for achieving water security*, A Report to Infrastructure Partnerships Australia, February 2007, p 2.

31 IPART, *Residential water use in Sydney, the Blue Mountains and Illawarra, Results from the 2003 household survey*, April 2004, p 31. Note that this survey was conducted when voluntary water restrictions were in place. At that time, mandatory water restrictions had not been imposed since 1994.

Four years since the introduction of mandatory level 1 restrictions and more than two years since the introduction mandatory level 3 restrictions, Sydney Water's research has found that there is still support for water restrictions. In September 2007, around 80 per cent of research participants were in total support of current water restrictions, while nearly 70 per cent were in total support of restrictions remaining in place for the foreseeable future.[32]

In addition, restrictions may be more effective than price at managing short term supply shortages. Studies have shown that demand is more responsive to price in the long run. This reflects the time it takes for price information to flow through to customers and the time it takes to invest in water saving devices (eg, water-efficient washing machines and showerheads) and to alter consumption behaviour (eg, having shorter showers, using a dishwasher less frequently).[33] This suggests that price may be more effective at balancing supply and demand in the longer term, than the shorter term.

Price signals are also likely to be less effective in the water industry than other industries, particularly due to the infrequency of billing. Unlike groceries or petrol, customers do not receive a price signal until up to three months after the consumption decision is made. Furthermore, Sydney Water reports that around 40 per cent of households do not pay individual usage related water charges,[34] meaning that they do not receive a price signal, and therefore cannot respond to it.

Restrictions also prevent the need for significant price rises and reduce price volatility. If restrictions are used to manage short-term supply shortages, it is then possible to set prices to reflect the (less volatile) long run marginal cost of supply. Significant price rises are likely to have particularly adverse impacts on vulnerable customer groups.

Furthermore, since the demand for water is generally inelastic (see section 3.4 below), and assuming that customers would pay the scarcity price to Sydney Water, price volatility would lead to the utility achieving large surpluses in times of water scarcity (because the scarcity price may exceed average cost), followed by large losses when water is abundant (because the price paid when water is not scarce may be much lower than average cost).[35] This would reward poor planning by providing incentives for Sydney Water to under-invest in supply capacity, in order to increase the scarcity of water, for the purposes of increasing the price and its profits.[36]

---

32 Source: Sydney Water research.

33 IPART, *Investigation into Price Structures to Reduce the Demand for Water in the Sydney Basin, Issues Paper*, December 2003, pp 15-18; NERA, *A Review of Melbourne's Water Tariffs – a Report for the Department of Natural Resources and Environmen*t, October 2001, pp 70-71.

34 Sydney Water, *Annual Report 2007*, see: www.sydneywater.com.au.

35 This occurs because the price elasticity of demand (PED) is less than one (PED<1). When PED<1, revenue increases with an increase in price. When PED=1, revenue is unhanged when price changes. When PED>1 (ie, demand is elastic) revenue decreases with an increase in price.

36 Nevertheless, it may be possible to return surpluses (or recover losses from) customers by varying the fixed charge or an account could be set up into which surpluses could be deposited and shortfalls recovered. Alternatively, the Government could tax away excess profits. However, each of these options would result in significant administration costs.

3.3 Scarcity pricing approaches

Alternative market based approaches have been proposed as a means of enhancing efficiency and accounting for the scarcity of water, through price. These include allowing prices to rise and fall with dam levels and introducing an urban water trading scheme.

3.3.1 Prices rising and falling with dam levels

Grafton and Kompas (2007) contend that the price of water should reflect its relative value as measured by the level of water storage:[37]

> A flexible volumetric water price is proposed that would rapidly adjust upwards as the amount of water in storage declines. At times of full water capacity consumers would be charged the short-run marginal cost of supply, but would pay much higher prices … when water storages are low. Flexible water pricing would help balance supply and demand and would obviate the need for on-going water restrictions. A much higher water price set to balance supply and demand in low rainfall periods could also encourage new sources of supply.

The authors argue that equity issues associated with high usage charges could be addressed by providing relief through the fixed charge.

Alternatively, households could be provided with a basic entitlement of water that would be charged at a lower price.[38] Water is used for a wide range of purposes. Some of these uses can be considered basic or non-discretionary. For example, uses related to drinking, bathing, cooking, washing and toilet flushing. Water is also used for discretionary purposes, for example, garden watering and car washing.

Grafton, Kompas and Ward (2007) propose a specific application of an IBT to Sydney Water, which incorporates an element of scarcity pricing, while protecting a basic level of consumption from high prices.[39] Under their proposal, a low tier 1 price is set (to cover the variable costs of production only) and this price is targeted at basic consumption.[40] The tier 2 price is then set at the rate necessary to bring supply and demand into balance. This price would adjust each quarter in response to the amount of water in the catchment dams, so that the divergence between the tier 1 and tier 2 prices is greater when water levels are low and smaller when water levels are high.

---

37 Grafton, Q. R. and Kompas, T. (2007) "Pricing Sydney water" *The Australian Journal of Agricultural and Resource Economics*, Volume 51, p 240.

38 Grafton, Q. R. and Kompas, T. (2007) "Pricing Sydney water" *The Australian Journal of Agricultural and Resource Economics*, Volume 51, p 240; and Submission by Quentin Grafton, Tom Kompas and Michael Ward of the Crawford School of Economics and Government, Australian National University, 12 October 2007.

39 Submission by Quentin Grafton, Tom Kompas and Michael Ward of the Crawford School of Economics and Government, Australian National University, 12 October 2007.

40 The authors propose a basic consumption entitlement of 50 litres per person per day.

3.3.2 Urban water trading

Young *et al* (2007)[41] propose the introduction of a water trading regime in urban areas (as already occurs in rural areas). The authors suggest that water users could be given a water entitlement that they may either consume or trade.

Commercial and industrial users might be given an entitlement based on their previous water consumption. Households could also receive an entitlement, with a certain portion of the entitlement made non-tradeable to protect vulnerable customers. Any unallocated water could be subject to a price that reflects relative water scarcity (eg, it rises and falls with dam levels). Alternatively, it could be sold in a market using a tender process. This would provide incentives for low water using customers to sell part of their entitlement to large water users.

The authors propose a solution to deal with population growth and new or expanding industries:[42]

> It would … be possible to make urban subdivision approval conditional upon the purchase of a water entitlement sufficient to supply the proposed development – as already happens in Arizona. New or expanding industries would also be required to buy water entitlements sufficient to cover their needs.

However, the establishment and ongoing administration costs of a water trading market need to be considered. The Allen Consulting Group (2007) suggests that they may be prohibitively high for small water users.[43]

3.4 How high would a scarcity price need to be?

We modelled the price increase required to replicate the demand reduction achieved with water restrictions. Three scenarios were modelled:

1. Where a single water usage price (scarcity price) applies to all residential consumption.[44]
2. Where a basic entitlement of water is charged at the current tier 1 price and a scarcity usage price (tier 2 price) applies to residential consumption in excess of this allowance.
3. Where a single water usage price (scarcity price) applies to all consumption (ie, residential and non-residential).

---

41 Young, M., McColl, J., and Fisher, T., *Urban water pricing: How might an urban water trading scheme work?* Droplet No. 5, 4 February 2007.

42 Young, M., McColl, J., and Fisher, T., *Urban water pricing: How might an urban water trading scheme work?* Droplet No. 5, 4 February 2007.

43 Allen Consulting Group, *Saying goodbye to water restrictions in Australia's cities: Key priorities for achieving water security*, A Report to Infrastructure Partnerships Australia, February 2007, pp 7 and 10.

44 Non-residential consumption is charged at the current tier 1 price.

Table 3.1 present the results of the analysis if price increases apply only to **residential consumption**. Three different estimates of the price elasticity of demand (PED) are assumed:[45]

- A demand elasticity of -0.3. This estimate is based on a survey of PED studies conducted by the Tribunal in 2003[46] and particularly studies of locations with broadly similar conditions to Sydney (ie, high rainfall variability, multi-year water storage and exposure to extended droughts). An estimate at the upper end of the range was selected.
- A demand elasticity of -0.17. This is the PED estimated by Grafton and Ward (2007) for the purposes of a study of the welfare costs of mandatory water restrictions in Sydney.[47]
- A demand elasticity of -0.13. This is based on a study conducted by Warner (1996). Warner used two models for the purposes of estimating the demand for water in the Sydney region, with similar results. He found that the PED for water in Sydney was -0.1266 under the first model, and -0.1242 under the second.[48]

45 The price elasticity of demand measures the percentage change in quantity demanded for a given percentage change in price. Where a small change in price results in a large change in the quantity demanded (ie, a PED of greater than 1 in absolute terms), demand is said to be elastic. Where a small change in price has little or no impact on the quantity demanded (ie, a PED of less than 1 in absolute terms) demand is said to be inelastic.

46 IPART, *Investigation into Price Structures to Reduce the Demand for Water in the Sydney Basin, Issues Paper*, December 2003, pp 15-18.

47 Grafton, R.Q. and Ward, M., *Prices versus Rationing: Marshallian Surplus and Mandatory Water Restrictions*, October 2007, p 7.

48 Sourced from: IPART, *Investigation into Price Structures to Reduce the Demand for Water in the Sydney Basin, Issues Paper*, December 2003, p 17.

Table 3.1 Residential water usage price increases necessary to replicate residential water restrictions

	Demand reduction (% of residential demand) [a]	Price elasticity of demand (PED)	Price increase (P_0 = $1.34)					
			No entitlement		Entitlement = 155 litres/day [b]		Entitlement = 220 litres/day [c]	
Voluntary restrictions	2%	-0.3	7%	($1.43)	17%	($1.57)	52%	($2.04)
		-0.17	12%	($1.50)	31%	($1.76)	92%	($2.57)
		-0.13	16%	($1.55)	40%	($1.88)	120%	($2.95)
Level 1 restrictions	10 %	-0.3	35%	($1.81)	90%	($2.55)	269%	($4.94)
		-0.17	61%	($2.16)	159%	($3.47)	475%	($7.71)
		-0.13	80%	($2.41)	208%	($4.13)	622%	($9.67)
Level 2 restrictions	15%	-0.3	50%	($2.01)	130%	($3.08)	390%	($6.57)
		-0.17	89%	($2.53)	230%	($4.42)	688%	($10.56)
		-0.13	116%	($2.89)	301%	($5.37)	899%	($13.39)
Level 3 restrictions	19%	-0.3	62%	($2.17)	160%	($3.48)	478%	($7.75)
		-0.17	109%	($2.80)	282%	($5.12)	844%	($12.65)
		-0.13	143%	($3.26)	369%	($6.28)	1104%	($16.13)

a Assumes the entire residential demand reduction achieved since the introduction of water restrictions is due to those water restrictions. Demand reductions were calculated using the year ending 30 June 2001 as a base year.

b Entitlement based on a Sydney Water estimate of the consumption of a typical water efficient household with 3 occupants, during water restrictions. Specified on a per occupant basis (ie, 465 litres/3).

c Entitlement based on the current tier 1 allocation of 100 kL/ quarter (1100 litres/day) which was set to meet the non-discretionary needs of a 5 occupant household. Specified on a per occupant basis (ie, 1100 litres/5).

Our analysis shows that:

- The higher the target demand reduction, the greater the required price increase. For instance, assuming the PED is -0.3 and the allowance is set at 155 litres, the price would need to increase by 90 per cent to replicate level 1 restrictions (ie, to achieve a 10 per cent demand reduction) and 160 per cent to replicate level 3 restrictions (ie, to achieve 19 per cent demand reduction).
- The higher the water allowance, the greater the required price increase. For instance, in order to replicate level 3 restrictions (ie, to achieve a 19 per cent demand reduction) and assuming a PED of -0.13, an allowance of 155 litres would require a 369 per cent increase in price, while an allowance of 220 litres would require a 1104 per cent increase in price.
- The more inelastic the demand, the greater the required price increase. The more elastic the demand, the lower the required price increase. For instance, in order to replicate level 3 restrictions (ie, to achieve a 19 per cent demand reduction) and assuming the allowance is set at 220 litres, a PED of -0.3 would require a 478 per cent increase in price, while a PED of -0.13 would require an 1104 per cent increase in price.

Table 3.2 present the results of the analysis if price increases apply to **all residential and non-residential consumption.** It assumes the same residential PEDs as in Table 3.1 and a non-residential PED of -0.05.[49] Our analysis shows that the price would need to increase by a smaller amount if it applied to all consumption (not just residential consumption).

Table 3.2 Residential and non-residential price water usage price increases necessary to replicate residential water restrictions

	Demand reduction (% of residential demand) [a]	Price elasticity of demand (PED): Residential	Price elasticity of demand (PED): Non-Residential	Price increase (P_0 = $1.34): No entitlement	
Voluntary restrictions	2%	-0.3	-0.05	6%	($1.42)
		-0.17		10%	($1.48)
		-0.13		13%	($1.52)
Level 1 restrictions	10 %	-0.3	-0.05	32%	($1.77)
		-0.17		54%	($2.06)
		-0.13		68%	($2.25)
Level 2 restrictions	15%	-0.3	-0.05	47%	($1.96)
		-0.17		78%	($2.38)
		-0.13		98%	($2.65)
Level 3 restrictions	19%	-0.3	-0.05	57%	($2.11)
		-0.17		96%	($2.62)
		-0.13		121%	($2.95)

Note: This table represents the price increase necessary to replicate the reduction in residential demand from water restrictions, when the increase in price is applied to all residential and non-residential consumption. Demand reductions were calculated using the year ending 30 June 2001 as a base year.

a Assumes the entire residential demand reduction achieved since the introduction of water restrictions is due to those water restrictions.

49 Commercial and industrial demand for water is a derived demand, ie, it is primarily related to the demand for an end product. As such, it is considered to be more inelastic to changes in price than residential consumption. The elasticity of demand can also be expected to vary more widely in the commercial and industrial sectors, given the heterogeneous nature of demand in those sectors. There are few published papers that separately identify the price elasticity of demand for commercial or industrial users, as such the value of -0.05 is an assumption made for the purposes of modelling in the absence of published data. If the price elasticity of demand were higher for commercial and industrial users (non residential) then the necessary increase in price would be reduced.

4 Does water scarcity still exist in Sydney?

4.1 Introduction

Given the decision to proceed with a desalination plant, commitments to recycled water projects and current dam levels, our analysis shows that Sydney is not capacity constrained today and is unlikely to be capacity constrained again (except in limited instances of short term scarcity during droughts)[50] until at least 2028.

4.2 Imposing and lifting water restrictions

The NSW Government is ultimately responsible for deciding when restrictions are imposed and when they are lifted. In the current drought (as displayed in Appendix E), voluntary restrictions were introduced when storage capacity fell below 70 per cent. Mandatory level 1 restrictions were imposed when dam levels fell below 60 per cent. Restrictions were tightened further to level 2 when storage capacity fell below 50 per cent and level 3 restrictions came into force when storage levels fell below 40 per cent.[51]

Prior to the imposition of restrictions in the current drought, annual demand was 625GL,[52] yet the latest estimate of the sustainable (system) yield is 570GL.[53] Therefore, even without the deep drought, Sydney had a water supply/demand imbalance. Without alternative sources of water (such as desalination) and/or water efficiency measures, it would be necessary to have restrictions in place for substantial periods of time.

50 That is, restrictions may still be necessary to guarantee that Sydney doesn't run out of water, but they won't need to be imposed for more than 3 per cent of the time.

51 Each level of mandatory water restrictions was expected to achieve a minimum demand reduction - see Appendix E. These were previously listed in the *Sydney Catchment Authority Operating Licence*, 19 April 2000, pp 48-49.

52 National Water Commission & Water Services Association of Australia (2007) *National Performance Report 2005-06: Major Urban Water Utilities*, p 27.

53 Sydney Catchment Authority, *Review of Sydney's Water Supply System Yield*, December 2006. This was revised down from the previous figure of 600GL. Ibid. Note that the 2006 Metropolitan Water plan reports a figure of 575GL, revised down from a previous figure of 605GL. See NSW Government, *2006 Metropolitan Water Plan*, April 2006, p 81.

4.2.1 What is the sustainable (system) yield?

The *Metropolitan Water Plan* defines the sustainable (system) yield as the amount of water that can be drawn down from the system each year without needing to impose drought (water) restrictions too frequently or for too long and without creating a risk that the system will approach emptiness during deep and prolonged drought.[54]

The sustainable (system) yield is recalculated from time to time based on a number of factors, including, updated climatic information, accessing deep water and environmental flow regimes.[55] It is also (currently) calculated on the basis that water restrictions will not need to be imposed more than 3 per cent of the time.[56]

Box 4.1 Environmental Flows

Environmental flows are releases of water from dams which attempt to arrest or reverse in-stream environmental deterioration arising from the damming of the river, and as far as possible, achieve a flow regime that mimics what would occur naturally. Such water releases vary in depth and frequency and also in the duration between releases. Some of the benefits of environmental flows are:

- the provision of migratory passage for native fish species, such as the Australian Bass, that need to return to brackish water of the estuaries to spawn
- the provision of wetland habitats for food and safety for local and migratory bird species
- an increase in water quality that facilitates human recreation in and around the river.

Source: NSW Government, *2006 Metropolitan Water Plan*, April 2006.

4.3 The new situation

Recent developments suggest that water is not likely to be scarce over the medium term. These developments include the construction of the desalination plant, increases in water recycling and investment in demand management measures.

Our modelling shows that once the desalination plant (250 ML per day or 91,250 ML per annum) is on line in July 2010,[57] supply will exceed demand until at least 2028.

Sydney Water proposes to operate the desalination plant at full capacity for two years to test the plant. Thereafter, it has indicated a possible approach of turning on the plant when dam levels fall below a given storage level (eg, 70 per cent) and

54 NSW Government, *2006 Metropolitan Water Plan*, April 2006, p 11.
55 NSW Government, *2006 Metropolitan Water Plan*, April 2006, pp 81-85.
56 NSW Government, *2006 Metropolitan Water Plan*, April 2006, pp 81-85.
57 Note that Sydney Water has announced that the desalination plant will be online by the summer of 2009/10. See Sydney Water website, *Construction updates*, downloaded from http://www.sydneywater.com.au/EnsuringTheFuture/Desalination/ConstructionUpdates.cfm on 15 November 2007.

switching off the plant when dam levels rise above a given level (eg, 80 per cent).[58] However the final decision on the operating rules will be made by the Government.

The modelling also includes Government commitments to recycling projects, which is projected to deliver 70 GL per annum by 2015, increasing to 100 GL per annum by 2032.[59] The results of the modelling are conservative as they assume a return to high levels of unrestricted residential demand and include less than 50 per cent of the 145 GL per annum water savings from demand management initiatives projected to be achieved by 2015.[60] Detailed results are provided in Appendix A.

In addition to these developments, the significant rise in dam levels (currently at 61 per cent capacity[61]) indicates that short term water scarcity is not currently a problem either. Furthermore, before the desalination plant is expected to be on line, and assuming that per capita demand increases to pre-restriction levels, even without rain, the modelling shows that Sydney has approximately two years supply left. If the rainfall assumption is changed to include the lowest annual inflows since 1940 (ie, 370 GL in 2004),[62] Sydney has over four years supply left.[63]

Nevertheless, it is important to note that the amount of water that can be drawn from the dams in each year (ie, the sustainable (system) yield) is calculated on the basis that water restrictions will still need to be imposed for around 3 per cent of the time. Therefore, limited instances of short term scarcity are likely to emerge in the future, when drought conditions return. Of course, it would be possible to invest in additional supply capacity so that demand could be meet at all times, including drought, thus preventing the need to ever implement water restrictions or scarcity pricing. However, this is likely to be extremely costly, as the additional supply capacity would be surplus to requirements for 97 per cent of the time.

Therefore, given the range of measures now in place or in planning – including the desalination plant - it could be argued that Sydney is not capacity constrained in the short or medium term. Recent statements by Sydney Water provide some support for this view.[64]

---

58 Independent Pricing and Regulatory Tribunal, *Public Hearings into a Review of Sydney Water's Prices for Water, Sewerage and Stormwater Services*, 7 December 2007.

59 See NSW Government, *FAQs Increasing Recycling*, downloaded from: http://www.waterforlife.nsw.gov.au/recycling/faqs_increasing_recycling on 14 January 2007. See also: *2006 Metropolitan Water Plan* (p 15) which refers to the 70 GL per annum as saving 59 GL of drinking (potable) water. This is because 11 GL per annum will be used for irrigation. It is unclear whether this 11 GL of recycled water is new demand or if it is replacing river extractions.

60 NSW Government, *2006 Metropolitan Water Plan*, April 2006, p 15.

61 Sydney Catchment Authority, *Bulk Water Storage and Supply Report*, 24 January 2008.

62 Source: Sydney Catchment Authority, November 2007. Note that 1940 had the lowest annual inflows on historical record.

63 Further information on these calculations is provided in Appendix A.

64 "I think that for the next decade at least and possibly longer Sydney Water doesn't have a problem with the security of its water supply." (Kerry Schott, Managing Director, Sydney Water Corporation). See Independent Pricing and Regulatory Tribunal, *Public Hearings into a Review of Sydney Water's Prices for Water, Sewerage and Stormwater Services*, 7 December 2007.

4.4 Should an inclining block tariff be retained?

Sydney Water has proposed retaining an IBT for the forthcoming determination period, but increasing the margin between the first and second tier prices. Sydney Water's proposal is summarised in Appendix D.

However, if a capacity constraint no longer exists, then economic theory would suggest that pricing should return to a two part tariff with the usage charge covering the long run marginal cost of supply and the fixed charge recovering the rest of Sydney Water's annual revenue requirement - see section 2.

Nevertheless, the Tribunal is required to consider a range of issues (including, but not limited, to economic efficiency) when determining the most appropriate price structure. These issues will undoubtedly be considered as part of the current price determination process.

Appendices

A Supply and demand modelling

A.1 Water Supply and Demand in Sydney to 2028

Analysis has been undertaken of the expected supply and demand conditions until 2028, if water restrictions were immediately lifted. The results of the analysis are set out in Table A.1 below.

In order to conduct this analysis, it was necessary to estimate supply and demand in each year:

- **Total annual supply** was estimated using the current estimate of the sustainable (system) yield (less the portion attributable to desalination readiness) and the announced increases in supply from other sources, ie, recycling and desalination.[65] We note that the Government will make a decision on changes to the environmental flow regime by 2015 and that this may have an impact on available supply beyond 2015.[66]
- **Total annual demand** was estimated in three stages.

  Stage 1 – Baseline demand. Firstly, residential per capita consumption is assumed to revert to its pre-restriction level of 92 kL/annum (up from 75 kL/annum in 2005/06). It is then multiplied by the population, which is estimated to grow by 1.054 per cent annually.[67] Secondly, total non-residential consumption is assumed to remain constant at its pre-restriction level. Finally, total annual baseline demand is calculated by adding annual residential consumption and annual non-residential consumption.

---

65 The availability of additional supply from a 500 ML/day desalination plant (which would operate when dam levels fell to 15 per cent and continue production until dam levels recover to 30 per cent) contributes 66GL to the sustainable yield of 570GL. (See Sydney Catchment Authority, *Review of Sydney's Water Supply System Yield*, December 2006). Given that the 250ML/day desalination plant can produce up to 92.5GL per annum (once constructed) and in order to avoid any potential for double counting, once the desalination plant is online, 66 GL is subtracted from the estimate of the sustainable yield giving an adjusted yield of approximately 504GL. Total supply is then calculated by adding to this, the total annual capacity of the desalination plant (92.5GL) along with additional supply available from water recycling(100GL by 2032).

66 Personal communication between the authors and the Department of Water and Energy, 5 December 2007.

67 Based on 13 year average population growth rate in Sydney Water's area of operation. Sourced from various Sydney Water Corporation Annual Information Returns to IPART.

Stage 2 – Demand management savings. The Government has announced that it expects to achieve savings of 145,000 ML per year by 2015, through various water saving measures (eg, leakage reduction, water efficient appliance rebates and retrofits).[68] However, of the 145,000 ML, the savings attributable to the inclining block tariff price structure and outdoor water savings measures are estimated at 24,000 ML. As it was not possible to separately identify the savings attributable to the inclining block tariff, we have reduced the expected savings by the entire 24,000 ML. Furthermore, given the difficulty in estimating demand savings, we have assumed that only 50 per cent of the remaining savings (ie, 50 per cent of 121,000 ML) are actually achieved by 2015/16.

Stage 3 – Total annual demand. Total annual demand was calculated by subtracting demand management savings from baseline demand.

We consider that these are conservative assumptions and that actual demand is likely to be significantly less. This is due to an increase in water conservation consciousness by households, and more efficient water use in industry, coupled with a trend for heavy industry to move out of Sydney Water's area of operations. Furthermore, our analysis has assumed that less than half of the savings expected through the Government's water savings measures will be achieved.

68 NSW Government, *2006 Metropolitan Water Plan*, April 2006, pp 13-15.

Table A.1 Supply versus demand from 2008-2029 (year ending 30 June)

	2007/08	2008/09	2009/10	2010/11	2011/12	2014/15	2019/20	2024/25	2027/28	2028/29
Dam yield [a]	570,000	570,000	570,000	504,000	504,000	504,000	504,000	504,000	504,000	504,000
Recycled water [b]	22,000	28,000	34,000	40,000	46,000	64,000	77,059	85,882	91,176	92,941
Desalinated water [c]	-	-	-	91,250	91,250	91,250	91,250	91,250	91,250	91,250
Total supply	592,000	598,000	604,000	635,250	641,250	659,250	672,309	681,132	686,426	688,191
Baseline demand	650,255	654,478	658,745	663,056	667,414	680,763	703,967	728,419	743,718	748,925
less demand mgmt savings [d]	20,168	25,210	30,252	35,294	40,336	55,462	60,500	60,500	60,500	60,500
Total demand	630,087	629,268	628,493	627,762	627,078	625,301	643,467	667,919	683,218	688,425
Surplus (deficit) [e]	(38,087)	(31,268)	(24,493)	7,488	14,172	33,949	28,842	13,213	3,209	-234

a This is the current estimate of the sustainable (system) yield until 2010/11. Once the desalination plant is online in 2010/11, we have adjusted the yield downwards by 66,000 ML, which is the amount attributable to desalination readiness. See Sydney Catchment Authority, *Review of Sydney's Water Supply System Yield*, December 2006, pp 2-4.

b Sydney Water currently recycles 22,000 ML per annum. (See Sydney Water, *Saving Water by Recycling*, downloaded from www.sydneywater.com.au on 15 November 2007). However, the NSW Government has set targets in the *Metropolitan Water Plan* and the *State Plan* for Sydney to recycle 70,000 ML per annum by 2015/16 and 100,000 ML per annum by 2032/33. (See NSW Government, *FAQs Increasing recycling*, downloaded from www.waterforlife.nsw.gov.au on 11 December 2007). Production is assumed to increase at a constant annual rate to reach 70,000 ML by 2015/16 and 100,000 ML by 2032/33.

c Assuming that the plant produces at its maximum capacity of 250 ML per day (91,250 ML per year) and capacity is not increased. The plant is assumed to be operational from July 2010. (Note that Sydney Water has announced that the plant will be online by the summer of 2009/10 - see Sydney Water, *Sydney's Desalination Project - Construction updates*, downloaded from www.sydneywater.com.au on 15 November 2007).

d Savings from the Government's demand management programs were assumed to increase at a constant annual rate from 2004/05 to reach 60,500 ML by 2015/16.

e Calculated by subtracting total demand from total supply.

Note: All figures are in ML per annum.

A.2 Could Sydney run out of water before the desalination plant is online?

We have calculated the number of years until Sydney would run out of water assuming:

4. zero inflows into the catchment
5. lowest annual inflows into the catchment since 1940 (ie, 370GL in 2004).

The analysis (see Table A.2 below) shows that Sydney has approximately 2 years supply (assuming zero inflows) and just over 4 years supply (assuming the lowest annual inflows since 1940). The results show that even if drought conditions continue, Sydney will not run out of water before the desalination plant is online in 2010.

Table A.2 Calculation of the number of years until Sydney would run out of water

	Zero inflows	Lowest inflows since 1940
Available supply [a]	**1579GL** Calculation: 61.1% multiplied by 2584 GL [b]	**1579GL** Calculation: 61.1% multiplied by 2584 GL [b]
Annual draw down	**737GL** Calculation: 629GL (usage) [c] + 105GL (evaporation) + 3GL (seepage) [d]	**367GL** Calculation: 629GL (usage) [c] + 105GL (evaporation) + 3GL (seepage) [d] – 370GL (inflows)
Number of years until Sydney runs out of water	**2.1 years** Calculation: 1579GL/737GL	**4.3 years** Calculation: 1579GL/367GL

a As at 24 January 2008. Excludes recycled water.

b 61.1% was the storage level of the catchment as at 24 January 2008. 2584 GL is the storage capacity of the 11 water reservoirs that make up the catchment. See Sydney Catchment Authority, *Bulk Water Storage & Supply Report,* 24 January 2008.

c This figure is obtained by taking the average annual forecast total demand until 2010/11, when the desalination plant comes online. See Table A.1 above.

d 105 GL (evaporation) is the estimated loss due to evaporation annually. (See Sydney Catchment Authority, *Leakage and loss management in the water supply system*, April 2007, p 8.) 3.0 GL (seepage) is the Sydney Catchment Authority's estimate of annual losses due to seepage through rock beds. However a PPK study in 2002 said that the losses through seepage where in the range of 20-200GL per annum. Ibid.

B Other price structures

In addition to two-part tariffs and inclining block tariffs, other price structures include:

- declining block tariff
- usage charge (no fixed charge)
- fixed charge (no usage charge).

B.1 Declining block tariff (DBT)

A declining block tariff (DBT) is a rate structure in which the unit price of each succeeding block of usage is charged at a lower unit rate than the previous block(s).[69] Similar to an inclining block tariff (IBT), the number of rate blocks and the size and pricing of each block can vary under a DBT. No capital city in Australia currently uses this price structure.[70]

A DBT (like an IBT) is less efficient than a two-part tariff because at least some usage is charged at a rate(s) either above or below marginal cost. Under a DBT, there is also some risk of revenue volatility, because a portion of costs is recovered through a usage component. The higher the usage component, relative to the fixed charge, the greater the risk of revenue volatility and the utility either under-recovering or over-recovering its costs.

In addition, a DBT is not as simple to design or explain as other structures and judgement is required in determining the number of blocks, the size of the blocks and the price levels of the blocks. Nevertheless, once implemented, a DBT is likely to be relatively simple to administer. However, it is likely to be a difficult structure for customers to understand, because they are unlikely to know what consumption block they are in and, consequently, the price they are paying at each point in time.

69 American Water Works Association (2000) *Manual of Water Supply Practices - M1: Principles of Water Rates, Fees and Charges*, AWWA: United States, p 91.

70 However, a DBT currently applies to large non-residential customers in Hunter Water's area of operations. See IPART, *Hunter Water Corporation, Prices of Water Supply, Wastewater and Stormwater Services from 1 October 2005 to 30 June 2009 - Final Report*, June 2005, p 118.

B.2 Usage charge (no fixed charge)

Under this price structure, customers pay a usage charge, but no fixed charge. If the same usage charge applies to all customers, then it must be set at the average cost of supplying a unit of water, in order to recover the utility's costs.[71] No capital city in Australia currently uses this price structure.

If a single usage charge is set for all customers, it would not be economically efficient because average cost is rarely equal to marginal cost in capital intensive industries, such as water. The greater the difference between average cost and marginal cost, the more inefficient the charge will be. There is also a high risk of revenue volatility, because all costs are recovered through a usage charge. However, a single usage charge would be simple to administer and easy for customers to understand.

B.3 Fixed charge (no usage charge)

Under this price structure, each customer pays a fixed charge which is unrelated to the amount of water used. If the same fixed charge applies to all customers, then it must be set at the average cost of supplying a customer, in order to recover the utility's costs.[72] While no capital city in Australia *strictly* applies this price structure, in Hobart each customer pays a fixed charge and usage is not charged for unless consumption exceeds a free allowance.[73]

A fixed charge is not economically efficient, because it does not signal to consumers the cost consequences of their consumption. This is likely to result in an over-consumption of water, relative to efficient levels. However, there is a low risk of revenue volatility, because the recovery of costs does not rely on the level of consumption. A fixed charge is simple to administer and would be easily understood by customers. It does not require meters to be read or maintained, with customers receiving the same bill each quarter, regardless of their water usage.

71 There is also scope to vary the usage charge between customer groups, so that some customers pay a price that is higher than average cost and others pay a price that is lower than average cost.

72 There is also scope to vary the fixed charge (for example, on the basis of the property's market rental value or household income.

73 The fixed charge and free water allowance are determined on the basis of the property's market rental value.

C Price structures in Australia's capital cities

Residential customers in all Australian capital cities pay a usage charge and a fixed charge. However, the composition of usage charges varies, as follows:

- Single usage charge (in excess of free water allowance) – Hobart.
- Single usage charge (no free water allowance) – Darwin.
- Inclining block tariff – Sydney and Adelaide (two tiers), Melbourne, Brisbane and Canberra (three tiers), Perth (five tiers).

Non-residential customers also pay a usage charge and a fixed charge. The composition of usage charges varies, as follows:

- Single usage charge (in excess of free water allowance) – Hobart.
- Single usage charge (no free water allowance) - Sydney, Melbourne, Darwin.
- Inclining block tariff – Adelaide (two tiers), Brisbane and Canberra (three tiers).
- Inclining then declining block tariff – Perth (three tiers).

Table C.1 summarises current water prices and price structures in each city.

Table C.1 Water prices in Australia's capital cities

Sydney, NSW (Sydney Water)	
Residential customers Fixed charge = $56/annum Usage charges (per kL): ▾ <400 kL/annum = $1.34 ▾ >400 kL/annum = $1.83	*Non-residential customers* Fixed charge is dependent on meter size (meter size of 20mm is $56/annum; meter size of 100mm is $1,404/annum) Usage charge = $1.34/kL
Melbourne, VIC (South East Water, Yarra Valley Water & City West Water)	
Residential customers Fixed charge (per annum) = $48 (South East Water); $63 (Yarra Valley Water); $106 (City West Water) Usage charges (per kL): ▾ <160 kL/annum = $0.84 (South East Water); $0.85 (Yarra Valley Water); $0.86 (City West Water) ▾ 160-320 kL/annum = $1.00 (Yarra Valley Water & City West Water); $1.02 (South East Water) ▾ >320 kL/annum = $1.48 (Yarra Valley Water & City West Water); $1.65 (South East Water)	*Non-residential customers* Fixed charge (per annum) = $48 (South East Water); $103 (Yarra Valley Water); $154 (City West Water) Usage charge (per kL) = $0.92 (Yarra Valley Water); $0.95 (City West Water); $1.02 (South East Water)
Brisbane, QLD (Brisbane Water)	
Residential customers Fixed charge = $140/annum Usage charges (per kL): ▾ <255 kL/annum = $1.19 ▾ 256-310 kL/annum = $1.23 ▾ >310 kL/annum = $1.69	*Non-residential customers* Fixed charge = $140/annum Usage charges (per kL): ▾ 0-200 kL/annum = $1.29 ▾ 201-300 kL/annum = $1.39 ▾ >300 kL/annum = $1.74
Perth, WA (Water Corporation)	
Residential customers Fixed charge = $163/annum Usage charges (per kL): ▾ <150 kL/annum = $0.57 ▾ 151-350 kL/annum = $0.78 ▾ 351-550 kL/annum = $0.98 ▾ 551-950 kL/annum = $1.32 ▾ >950 kL/annum = $1.66	*Non-residential customers* Fixed charge is dependent on meter size (meter size of 20mm is $545/annum; meter size of 100mm is $13,613/annum) ▾ Usage charges (per kL): ▾ 0-600 kL/annum = $0.81 ▾ 601-1,100,000 kL/annum = $0.88 ▾ >1,100,000 kL/annum = $0.87

Adelaide, SA (SA Water)	
Residential customers Fixed charge = $157/annum Usage charges (per kL): ▾ <125 kL/annum = $0.50 ▾ >125 kL/annum = $1.16	*Non-residential customers* Fixed charge (per annum) = 0.09% of property value, subject to minimum of $175 (commercial customers); and $175 (other non-res customers) Usage charges (per kL): ▾ <125 kL/annum = $0.50 ▾ >125 kL/annum = $1.16
Canberra, ACT (ActewAGL)	
Residential customers Fixed charge = $75/annum Usage charges (per kL):[a] ▾ <100 kL/annum = $1.42 ▾ 100-300 kL/annum = $2.31 ▾ >300 kL/annum = $3.21	*Non-residential customers* Fixed charge = $75/annum Usage charges (per kL):[a] ▾ <100 kL/annum = $1.42 ▾ 100-300 kL/annum = $2.31 ▾ >300 kL/annum = $3.21
Darwin, NT (Power and Water Corporation)	
Residential customers Fixed charge is dependent on meter size (meter size of 20mm is $110/annum) Usage charge = $0.73/kL	*Non-residential customers* Fixed charge is dependent on meter size (meter size of 20mm is $110/annum; meter size of 100mm is $1781/annum) Usage charge = $0.73/kL
Hobart, TAS (Hobart City Council)	
Residential customers Fixed charge is by way of a tax based on the property's annual assessed value (AAV), which is an estimate of the property's market rental value. No usage charge, unless customer is deemed to be a high water user. High water users pay $0.90/kL for water consumed in excess of free allowance (which is linked to the property's AAV).	*Non-residential customers* Fixed charge is by way of a tax based on the property's annual assessed value (AAV), which is an estimate of the property's market rental value Usage charge is $0.90/kL for water consumed in excess of a free allowance, which is linked to the property's AAV

[a] Includes water abstraction charge (WAC) and Utilities Network Facilities Tax (UNFT) recovery.

Note: Water prices are current as at December 2007.

Source: Water utility websites. Email from Ed Kleywegt, Hobart City Council, 3 September 2007.

D Sydney Water's proposed water prices (2008-2012

In its submission to the current price review process, Sydney Water has proposed retaining the current price structure for residential and non-residential customers, respectively. However, it argues that the margin between the first and second tier prices should be increased to 50 per cent[74] to send a stronger price signal to high water users.[75]

Table D.1 Sydney Water's current and proposed water prices

		2007/08[a] (current)	2008/09[b] (proposed)	2009/10[b] (proposed)	2010/11[b] (proposed)	2011/12[b] (proposed)
Residential Customers (individual meters)	Fixed charge	$14.05/qtr	$17.04/qtr	$20.59/qtr	$21.21/qtr	$21.85/qtr
	Usage charge <100 kL/qtr	$1.34/kL	$1.62/kL	$1.96/kL	$2.02/kL	$2.08/kL
	Usage charge >100 kL/qtr	$1.83/kL	$2.44/kL	$2.95/kL	$3.03/kL	$3.13/kL
Non-residential Customers & Residential Customers (shared meters)	Fixed charge	Based on size(s) and number of meter(s) serving the property				
	Usage charge	$1.34/kL	$1.62/kL	$1.96/kL	$2.02/kL	$2.08/kL

a Current water prices are in 2007/08 dollars.
b Proposed water prices are in 2008/09 dollars.

Sydney Water has also proposed removing the requirement that a household must consume 100 kL of water per quarter to be eligible for the large household rebate, because an average 6-occupant household would be expected to consume more than this amount to meet its basic needs. It also argues that the rebate should be set equal to the cost of the water service charge and that it should be paid as a flat rate (ie, regardless of usage) in order to avoid distorting the signal contained in the usage charge.[76]

74 The tier 2 price is currently 37 per cent higher than the tier 1 price.
75 Sydney Water, *Submission to IPART Review of Prices for Sydney Water Corporation*, 14 September 2007, p xi and pp 76-77.
76 Sydney Water, *Submission to IPART Review of Prices for Sydney Water Corporation*, 14 September 2007, pp 96-97.

E Water restrictions in Sydney

Level	Requirements	Date Introduced	Storage level at introduction
Voluntary Level 1	▼ Hand held hoses for lawns and gardens allowed. ▼ Watering systems or sprinklers allowed only before 8am and after 8pm. Drip irrigation allowed. ▼ No hosing of hard surfaces (ie, buildings and paths).	15 November 2002	67.4%
Mandatory Level 1	▼ Hand held hoses for lawns and gardens allowed. ▼ No watering systems or sprinklers are to be used at any time. Drip irrigation allowed. ▼ No hosing of hard surfaces (including vehicles) at any time. *Targets at least 7% demand reduction. Not intended to operate more than 3% of the time.*	1 October 2003	59.0%
Mandatory Level 2	▼ Hand held hoses for lawns and gardens allowed only on Sundays, Wednesdays and Fridays, before 10am and after 4pm. ▼ No other watering systems or sprinklers are to be used at any time. Drip irrigation allowed. ▼ A permit from Sydney Water is required to fill new or renovated pools bigger than 10,000 litres. ▼ No hosing of hard surfaces (including vehicles) at any time. *Targets at least 12% demand reduction. Not intended to operate more than 1% of the time.*	1 June 2004	49.3%
Mandatory Level 3	▼ Hand held hoses for lawns and gardens allowed only on Sundays and Wednesdays, before 10am and after 4pm. ▼ No other watering systems or sprinklers are to be used at any time. ▼ A permit from Sydney Water is required to fill new or renovated pools bigger than 10,000 litres. ▼ No hosing of hard surfaces (including vehicles) at any time. *Targets at least 20% demand reduction. Not intended to operate more than 0.5% of the time.*	1 June 2005	39.1%

F Water supply data – Sydney Water

Table F.1 Water supply data - Sydney Water (year ending 30 June)

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Water supplied						
Residential (ML)	375,274	375,211	387,618	345,961	329,635	320,509
Commercial and Industrial (ML)	115,355	112,377	111,012	109,533	103,229	146,937
Other (ML) [a]	134,251	136,673	136,112	107,252	93,503	60,814
Commercial, Industrial and Other (ML) [b]	*249,606*	*249,050*	*247,124*	*216,785*	*196,732*	*207,751*
Total (ML)	624,880	624,261	634,742	562,746	526,367	528,260
Connections supplied						
Residential Connections (000)	1,470	1,497	1,522	1,544	1,566	1,582
Commercial and Industrial (000)	111	113	116	117	119	124
Total Connections (000)	1,581	1,610	1,638	1,661	1,685	1,706
Population supplied						
Population (000)	4,069	4,110	4,150	4,189	4,228	4,267
Consumption per capita						
Residential usage (kL/annum)	92	91	93	83	78	75
Residential usage (litres/day)	253	250	256	226	214	206
Total usage (kL/annum)	154	152	153	134	124	124

Source: Adapted from National Water Commission & Water Services Association of Australia (2007) *National Performance Report 2005-06: Major Urban Water Utilities*, p 27.

a "Other" water supplied was not defined by the National Water Commission until 2005/06. Prior to this, it was defined by individual water utilities and the definition varied from year to year. The National Water Commission defines "Other" as total estimated non-metered consumption by other users. This includes water used for fire-fighting, mains flushing, losses due to customer meter errors, water taken by councils or contractors and any other consumption due to operations and leakages. Leakages have only been separately estimated for 2005/06 and were 59.778 ML (or 11.3% of total water supplied).

b "Commercial, Industrial and Other" water supplied is displayed as a separate line in red type because of the inconsistent definition of "Other" over time (see Note a). Many of the uses now allocated to "Other" were previously allocated to "Commercial and Industrial".

G Demand reduction achieved in Sydney due to inclining block tariff

The demand reduction achieved in Sydney in 2006/07, due to the inclining block tariff, was calculated as follows:

$$\varepsilon_d = \frac{\%\Delta Qd}{\%\Delta P} = \frac{Q_2 - Q_1 / Q_1}{\%\Delta P}$$

$$\varepsilon_d \times \%\Delta P = \frac{Q_2 - Q_1}{Q_1}$$

$$\varepsilon_d \times \%\Delta P \times Q_1 = Q_2 - Q_1$$

$$(Q_2 - Q_1) = \varepsilon_d \times \%\Delta P \times Q_1$$

$$(Q_2 - Q_1) = -0.3 \times 22.6\% \times 19.27\,GL = 1.309\,GL$$

Where:

ε_d = the price elasticity of demand, which we have assumed is -0.3. This is the high end of the range used in this paper and gives the highest possible demand reduction.

Q_2 = the total quantity of residential water demanded (above 400 kL per property) if the tier 2 price ($1.59) was removed and the tier 1 price ($1.23) applied to all units of water.

Q_1 = the total quantity of residential water demanded (above 400 kL per property) if the tier 2 price applied to each unit of water above 400 kL per property. Sydney Water reports that this is the amount of water charged at the tier 2 price in 2006/07.

$\%\Delta P$ = $\left(\frac{P_2 - P_1}{P_1}\right)$

P_1 = the tier 2 price of $1.59/kL (in 2006/07).

P_2 = the tier 1 price of $1.23/kL (in 2006/07).

G Demand reduction achieved in Sydney due to inclining block tariff