NSW GOVERNMENT SUBMISSION

TO

PRODUCTIVITY COMMISSION INQUIRY INTO MICROECONOMIC REFORM IN THE URBAN WATER SECTOR

NOVEMBER 2010

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NSW Government submission

on Productivity Commission Issues Paper

Australia's Urban Water Sector, September 2010

1 INTRODUCTION

The NSW Government has introduced a range of major reforms in the urban water sector, both in large metropolitan centres and in non-metropolitan NSW. These have delivered significant efficiency gains and helped secure water supplies in the face of unprecedented drought conditions. The NSW Government continues to examine opportunities for further gains, taking account of progress to date and of the diverse nature of the sector.

The NSW Government endorses the Productivity Commission's proposed approach of considering the lessons learnt from other sectors and the degree of their applicability to the urban water sector, having regard for its unique characteristics (which differ within and between jurisdictions). These characteristics include climatic, geographic, demographic and institutional issues that have evolved over time and provide a backdrop for the development of potential reform options.

The NSW Government also encourages the Commission to identify the further data needs, analytical work, pilot studies and other research that will be required to identify efficiency gains and to consult with stakeholders on the nature and scale of potential options for reform and the practical implementation issues associated with potential reform options.

This submission describes the urban water sector in NSW, outlines reform achievements to date, and identifies emerging issues and areas where national processes could efficiently support improved outcomes.

While the submission does not canvass all questions posed in the Issues Paper, it seeks to inform deliberations regarding key issues. To this end it has grouped discussion by reference to the headings used in the Issues Paper relating to consumption and pricing, scope for competition and contestability, tools and options for achieving reform, and implementing reform.

2 THE URBAN WATER SECTOR IN NEW SOUTH WALES

The urban water sector in NSW comprises two distinct components –

- the metropolitan urban water sector: comprising Sydney Water Corporation (SWC), Sydney Catchment Authority (SCA) and Hunter Water Corporation (HWC), which together serve a population of nearly 5 million people; and
- the non-metropolitan urban water sector: comprising 106 local water utilities (including the Central Coast) serving a population of around 1.8 million people.

While there are cross-sectoral issues of relevance to both the metropolitan and non-metropolitan parts of the NSW urban water sector, the two components of the sector differ in scale, structural and regulatory arrangements. Appendices 1 and 2 describe the institutional and governance arrangements in metropolitan and non-metropolitan NSW.

2.1 Setting objectives (Issues Paper p15)

There is inherent diversity in the urban water sector within and between jurisdictions, and between water users across Australia. This diversity and different user preferences reflect varying geographic, climatic, demographic and economic factors. In turn, they should inform the development of urban water objectives.

The NSW Government's objectives for urban water are securing supply through integrated water cycle management, protecting the environment and public health, and cost effectiveness. In addition:

- the objective of the 2010 Metropolitan Water Plan for greater Sydney is – in summary – to secure Sydney's water needs for growth and drought, help protect river health, and do so at least cost to the community; and
- in non-metropolitan NSW, the goal of the Country Towns Water Supply and Sewerage Program is the provision by local water utilities of 'appropriate, affordable and cost-effective water supply and sewerage services in urban areas of non-metropolitan NSW which meet community needs, protect public health and the environment and make best use of regional resources'.

In Sydney, the NSW Government undertakes careful and comprehensive water planning, a core part of which is community consultation. Community consultation undertaken during the review of the 2006 Metropolitan Water Plan has identified three key values:

- having a safe and affordable water supply for homes;
- considering the needs of future generations in decision-making and water planning; and
- ensuring human needs for water are balanced with those of the environment.

This consultation process developed the following community planning principles which underpin the delivery of the 2010 Metropolitan Water Plan:

- provide water that is affordable and safe to drink;
- ensure enough water to meet both environmental and human needs – one not more important than the other;
- ensure a dependable long-term water supply for current and future generations;
- maximise water efficiency and recycling, especially capturing stormwater and invest in research and innovation;
- restore clean healthy waterways and ensure health of catchments by reducing pollution;

- ensure government and community take joint responsibility for water management; and
- share water – taking into consideration all relevant sectors and regions.

The way that NSW utilities frame their water supply and security objectives is discussed in Appendices 1 and 2.

2.2 Characteristics of the urban water sector (Issues Paper p16)

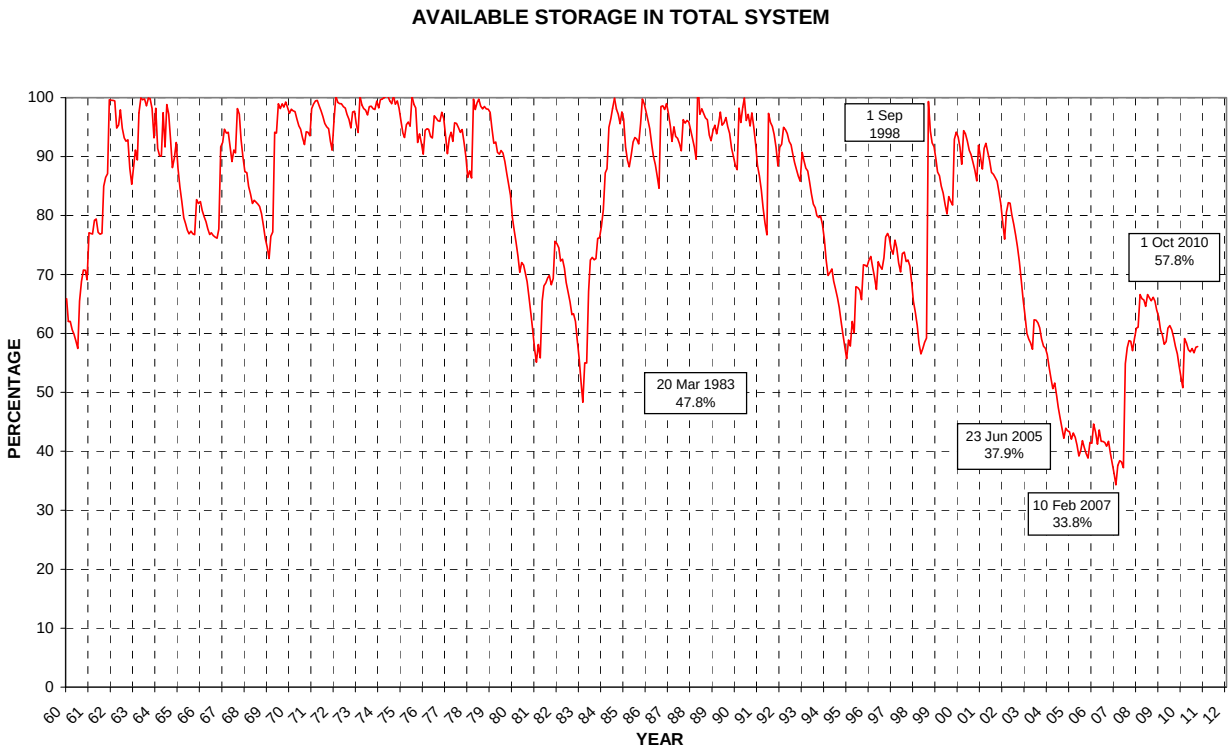
The NSW Government agrees with the Commission that the characteristics of the urban water sector need to be considered when attempting to identify opportunities for efficiency improvements and in the design of possible reform options.

2.2.1 Variability

As noted on page 16 of the Issues Paper, a unique feature of the urban water sector is the challenge posed by production variability caused by highly variable rainfall and inflows. Climate change creates further uncertainty, risk and potential cost. Supply side volatility is an important characteristic of the urban water sector in NSW. Inflows of water to the Sydney system are three times more variable than inflows to the Melbourne system. This variability of supply poses major challenges to water planners, as recognised by the Working Group on Climate Change and Water in its 2008 report to COAG (p48):

> The current program of investment in new supply options is sometimes characterised as reflecting poor planning by jurisdictions. On the other hand, investing pre-emptively in supply capacity sufficient to avoid deep and prolonged restrictions in the current drought, which is the worst on record in a number of areas, would likely have entailed high costs and could have been characterised as 'gold-plating'. The uncertainties associated with potential climate change exacerbate the challenge already faced by urban water planners in managing climate variability.

As variability has implications for asset utilisation and return on investments, it is an important consideration in the identification of opportunities for efficiency improvements. Sydney dam storage levels have historically been at or above 90 per cent full for 56 per cent of the time. Storage levels have been subject to infrequent but deep drought from which they have generally recovered quickly. This variability presents a risk for potential investors. This needs to be included in any assessment of the practicality and projected benefits of market-oriented reforms (as discussed in the Issues Paper, page 17).



Storages in the Sydney system from 1960 to the present. Source: Sydney Catchment Authority

2.2.2 'In situ' risk management

In the electricity sector, supply scarcity risk is managed across an integrated grid. When it is hot in Sydney and air conditioning demand is high, the interconnected grid enables Sydney electricity users to draw on peak generation capacity in other parts of the multi-state system. This improves the utilisation rate of peak generation capacity and reduces the cost of generation to meet peak demand.

This is not possible in the water sector when water systems are geographically separate from each other. For example, in Sydney, where water supply security must be managed 'in situ' (ie within the geographic scope of the system).

Providing sufficient capacity to meet unrestricted demand at all times, including during severe drought, would be more expensive than delivering the same level of supply security for electricity because there is no means to cost effectively distribute large volumes of water across a larger market area. This suggests that there is an economic benefit in using drought restrictions, demand management measures or pricing signals to help manage demand when dam storages fall to low levels, as recognised by the National Water Commission in its 2009 Biennial Assessment:

> 100% security may only be attainable by constructing an unaffordable water supply system (p227).

2.2.3 Infrastructure and transportation costs

The cost of transporting water is relatively low in gravity fed systems but infrastructure and transport costs increase markedly when water needs to be pumped long distances or uphill. For this reason, and given the distances separating most urban centres in Australia, many water supply systems are relatively limited in scale. In non-metropolitan NSW for example, there are 340 separate water supply systems and 290 wastewater treatment systems. This is in marked contrast with the National Electricity Market (NEM).

Another important characteristic of the urban water sector is that it comprises both upstream (water supply and treatment) and downstream infrastructure (wastewater

treatment and disposal). As the Commission notes, much of the sector involves natural monopoly characteristics and the provision of essential services.

Delivering water and wastewater services to end users at least cost involves both upstream and downstream considerations. New technologies mean that there is overlap between the two systems. For example, treating effluent to high standards for re-use in industrial applications can reduce pressure on potable supplies, mitigate costs associated with wastewater systems augmentation, and help manage environmental impacts. Targeting such opportunities and maximising avoided costs can improve efficiency and help reduce total costs.

2.2.4 Environmental impacts

An important characteristic of the urban water sector is the critical local and regional environmental impacts associated with the provision of water and wastewater services. These include the impact on river health (flows and nutrient levels) of diverting and extracting river water and of the disposal of wastewater and the impacts on local flooding and the quality of receiving water of sewage discharges and stormwater flows.

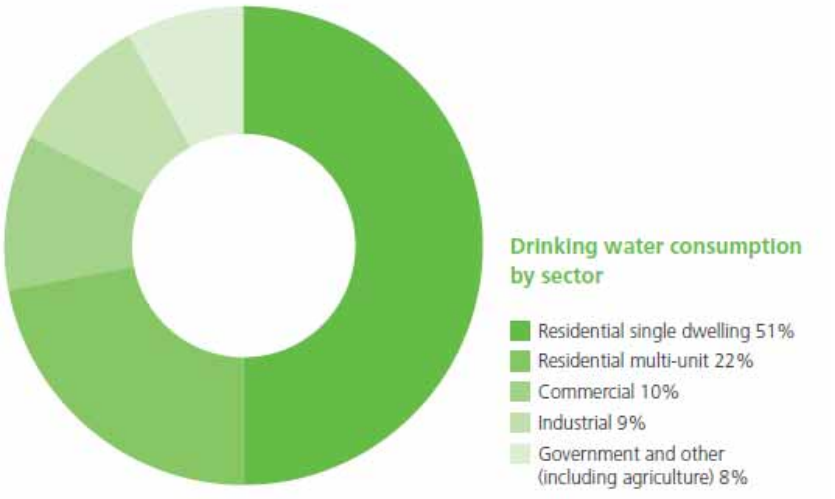
Environmental impacts associated with the urban water sector make it important to integrate environmental considerations into water planning and pricing, and not rely on complementary policies to address these impacts 'ex post'.

2.2.5 The pattern of end use demand

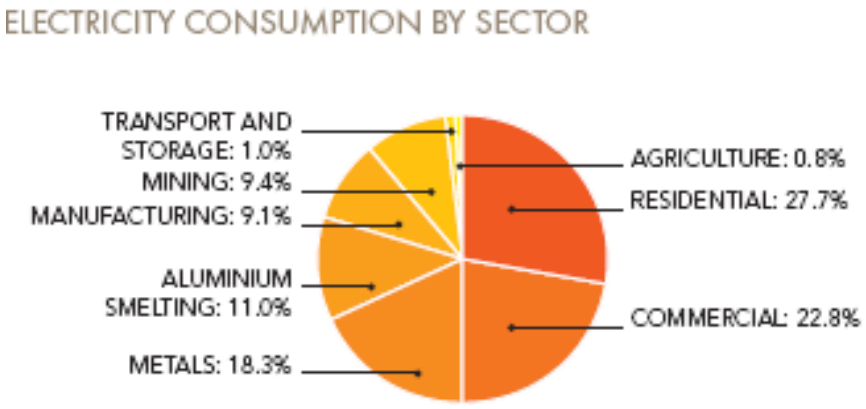
Another important characteristic of the urban water sector is the nature of the end users in the sector. The nature and size of the end users in a water supply system will have important implications for the potential to identify and realise efficiency gains.

In greater Sydney, water demand in the residential sector accounts for 73 per cent of total water demand. By comparison, in the National Electricity Market, residential demand accounts for only 28 per cent of demand, as illustrated below.

The urban water sector in Sydney is dominated by a large number of small customers who use relatively small amounts of water. The average household demand for potable water in Sydney is around 200kL per year. By contrast, end users in the electricity market include a number of very large energy users, for whom energy consumption is a major cost component.



Source: 2010 Metropolitan Water Plan



Source: Australian Energy Market Operator, *An Introduction to Australia's NEM*, July 2010

3 REFORMS TO DATE (Issues Paper p17)

NSW has introduced major reforms to the urban water sector. In the Sydney metropolitan area, responsibility for bulk water supply has been separated from responsibility for delivering water to end use customers and billing them for water use. The NSW Government has corporatized many water utilities, including Sydney Water Corporation, Hunter Water Corporation and State Water. Consistent with the principle of competitive neutrality, these corporations pay and publicly report on dividends and tax equivalent payments. In addition, there is a clear separation of responsibility between policy making, regulatory functions and operations in the NSW urban water sector. The following pages discuss some notable recent reforms implemented in NSW.

3.1 National Water Initiative

The NSW Government, along with other jurisdictions, has committed to implement the urban water reforms in the National Water Initiative (NWI), including actions in demand management, and innovation and capacity building to create water sensitive cities. NSW and the other parties to the NWI agreed (clause 90) that the outcome for urban water reform is to:

1. provide healthy, safe and reliable water supplies;
2. increase water use efficiency in domestic and commercial settings;
3. encourage the re-use and recycling of wastewater where cost effective;
4. facilitate water trading between and within the urban and rural sectors;
5. encourage innovation in water supply sourcing, treatment, storage and discharge; and
6. achieve improved pricing for metropolitan water (consistent with paragraph 66.i) to 66.iv)).

Under the NWI (paragraphs 64 to 68 inclusive), jurisdictions agreed to implement best practice water pricing. To this effect, in 2010, jurisdictions agreed the NWI pricing principles, which cover recovery of capital expenditure; urban water tariffs; recovering the costs of water planning and management; and recycled water and stormwater use.

The National Water Commission's 2009 Biennial Assessment of progress in implementing the NWI states that NSW is well progressed in implementing the agreed outcomes and commitments to specific actions for best practice pricing and institutional arrangements.

3.2 Pricing

The NSW Government has long been a leader in urban water reform in Australia. It was the first jurisdiction to introduce independent economic regulation of water utilities, user pays pricing and long run marginal cost pricing, to develop detailed principles for recycled water pricing and to enact legislation to support competition in the urban water sector. Independent economic regulation by IPART is promoting transparency, rigour and consistency in price setting processes. NSW has achieved lower bound pricing and price setting processes are consistent with or moving towards upper bound pricing for metropolitan water storage and delivery.

Consumption based pricing is substantially progressed in NSW, with all free water allowances for potable water supply abolished since 2007. NSW moved away from the use of inclining block tariffs for Sydney Water Corporation in 2008-09 and implemented a two part tariff, comprising a fixed charge and a volumetric charge.

The 2007 and 2009 Biennial Assessment of the NWI found that NSW has one of the most developed policies for recycled water and stormwater pricing. In September 2006, IPART released its determination on pricing for recycled water and sewer mining for SWC, HWC, Gosford City Council and Wyong Shire Council. IPART also sets recycled water prices for the Rouse Hill residential recycling scheme, the largest residential dual reticulation scheme in Australia. For other recycled water schemes, IPART has developed a pricing framework based on different types of schemes.

The Issues Paper asks at page 22 about the achievement of social and equity objectives. In NSW, these objectives are achieved outside the pricing system by way of pensioner concessions which are largely funded from consolidated revenue. Sydney Water Corporation and Hunter Water Corporation are required to comply with a Community Service Obligation. Local water utilities are subject to the pensioner concession provisions in the *Local Government Act 1993*. The NSW Government is currently undertaking a review of pensioner concessions to address issues relating to differences of approach across NSW.

3.3 Third party access

NSW has established Australia's first state-based third party access regime for the water industry. The *Water Industry Competition Act 2006* (the Act) enables the private sector to enter the industry and provide drinking water, recycled water and wastewater services. The NSW Government introduced this reform to harness the innovation and investment potential of the private sector in the water and wastewater industries. The Act establishes a licensing regime for private sector entrants to ensure the continued protection of public health, consumers and the environment.

IPART administers the licensing regime. By the end of September 2010, six network operator licences and five retail supplier licences had been issued.

- One project proposes to supply wastewater services in regional NSW.
- Another will build and operate a new recycled water plant at Fairfield, which will initially provide 4.7 billion litres of high-quality recycled water a year to industrial and irrigation customers via a network of retrofitted gas pipes.
- A licence has been issued to operate a recycled water treatment plant in Sydney's Central Business District which will supply recycled water for indoor non-drinking uses.
- Another project is licensed to undertake sewer mining at Darling Harbour to provide recycled water for non-drinking purposes.

3.4 Reforms in non-metropolitan NSW

The NSW Government's Country Towns Water Supply and Sewerage Program is a comprehensive program of micro-economic reform including Best Practice Management

Guidelines and annual performance monitoring of non-metropolitan local water utilities. Details are provided in Appendix 2 and further information is available at www.water.nsw.gov.au. Key achievements include improved planning processes (including the development of 30-year integrated water cycle management strategies), increased water use efficiency and affordable customer bills.

The NSW utilities are national leaders in providing strong pricing signals to encourage efficient water use. The median residential water usage charge in real terms increased from 79c/kL in 1999-00 to 150c/kL in 2009-10. However, typical residential bills have increased by only 5 per cent over this period due to significantly improved water use efficiency. In 2008-09, the median 'average annual residential water supplied' was 47 per cent lower than in 1990-91.

The overall level of compliance by the 106 non-metropolitan NSW utilities with the requirements of the Best-Practice Management Guidelines is 82 per cent.

In 2008, the NSW Government established the independent *Inquiry into secure and sustainable urban water supply and sewerage services for non-metropolitan NSW.*

The inquiry's objectives were to identify the most effective institutional, regulatory and governance arrangements for the long term provision of water supply and sewerage services in NSW, and ensure that these arrangements are cost-effective, financially viable, sustainable, optimise whole of community outcomes, and achieve integrated water cycle management. The Government is considering its response to the Inquiry Report.

3.5 Supply augmentation planning and decision making (Issues Paper pp 17-19)

Greater Sydney's Metropolitan Water Plan (MWP) sets out the optimal mix of water demand and supply measures to provide water security for the Sydney region. The Best-Practice Management Guidelines require non metropolitan utilities to implement an Integrated Water Cycle Management Strategy.

Metropolitan Sydney

The evolution of the MWP since 2004 has delivered major efficiency gains. The 2004 Plan ranked possible supply and demand side options according to levelised cost and multi-criteria analysis was used to take account of environmental and social impacts. In 2006, the Plan adopted a portfolio approach to optimise the mix of measures (rather than focussing on the cost of individual measures within the portfolio). The 2006 Plan also adopted a 'real options' analytical framework. It included the development of 'readiness strategies' to enable drought response options (eg desalination and groundwater pumping) to be deployed once drought conditions emerge, rather than pre-emptively.

The recently released 2010 Plan sets out how the NSW Government will achieve its objectives for the urban water sector in greater Sydney:

- providing a secure supply of water to meet the medium-term needs of a growing city, while keeping long-term goals in mind;
- helping protect river health;
- ensuring water supplies are adequate during drought; and
- minimising costs to the community.

The 2010 Plan builds on the approach underpinning the 2006 Plan. Development of the 2010 Plan was informed by community consultation and a cost-effectiveness analysis of a number of different portfolios. This analysis took account of a wide range of costs and benefits – including capital and operating costs, the cost of drought restrictions, environmental costs and benefits. Where social and environmental impacts could not be monetised they were subject to qualitative assessment by two expert panels. The development of the plan was also informed by two rounds of community consultation.

The Issues Paper asks on p19 whether there is scope to increase the efficiency of supply augmentation planning and decision making. In response, the NSW Government notes that the inclusion of readiness strategies in the 2006 and 2010 Plans represent an important efficiency gain. In 2006, the NSW Government decided to build the Sydney desalination plant in the event that dam storage levels reached critical levels, rather than pre-emptively. The decision was estimated at the time to save around $1 billion. Further information regarding estimated savings is set out in the independent expert analysis undertaken to inform the 2006 Plan, which is available online at the NSW Government's Water for Life website (www.waterforlife.nsw.gov.au).

The NSW Government also considers the cost effectiveness analysis undertaken for the 2010 Plan an improvement relative to past approaches. However, issues remain in incorporating environmental externalities and social impacts into decision-making frameworks. In non-metro NSW integrated water cycle management strategies are evaluated on a triple-bottom line basis and the applicability of this approach will be examined in the non-metro area. However, this is an area where further nationally coordinated research could assist.

Further information regarding the Metropolitan Water Plan is provided in Appendix 3.

Non metropolitan NSW

Supply augmentation planning in non-metropolitan NSW is undertaken in accordance with the NSW Government's *Best-Practice Management of Water Supply and Sewerage Guidelines*. The Guidelines require non-metropolitan utilities to develop and implement an optimal 30-year Integrated Water Cycle Management (IWCM) Strategy.

This includes consideration of opportunities for water recycling, stormwater harvesting, water sensitive urban design and the use of sources such as rainwater tanks. The strategy must be reviewed and updated by the utility every 6 years.

3.6 Utilising and operating sources of supply

The Issues Paper discusses the issue of operating costs for desalination and recycling on page 20. Developing an optimal operating regime for an asset such as a desalination plant is a complex matter. It includes consideration of factors such as minimising operating costs, the value that operating the plant can deliver (including reducing the time spent in drought restrictions) and the probability of having to make further capital intensive investments in additional capacity.

Consistent with the 2010 Plan's portfolio approach discussed above, a critical issue for the 2010 plan was to identify how the Sydney desalination plant could best contribute to the portfolio of measures. Work undertaken to identify the most cost effective operating regime considered a range of financial and economic factors, including the impact on time spent in drought restrictions, the impact on system spills, the probability of triggering further capital investments, and environmental costs and benefits. Further information is available on www.sydneywater.com.au.

Another important factor is portfolio optimisation is the implications for infrastructure planning and costs of intermittently operating desalinations plants and, in particular, recycling plants. If a recycling plant were to be turned on and off in response to storage levels, it would not be possible to avoid any costs associated with the provision of infrastructure for the supply of potable water and wastewater services. In other words, investment would be required in both the recycling scheme and the infrastructure necessary to enable an alternate water supply (ie mains supply) to be used when the recycling plant is not operating. The potential for a recycling scheme to avoid costs in the wastewater sector would also be lost.

In addition to short run operating costs of individual plants, it is important to have regard for the capital and operating costs of the whole water supply and wastewater system. Depending on the technology used, intermittent operation of recycling and desalination

involves ramp up and down costs, for example, associated with preserving reverse osmosis membranes.

A further consideration is the impact of intermittent operation on dam storage levels and spills. Debate about operating costs (and by implication the probability of storages spilling) tends to focus only on the costs associated with operating measures in the portfolio. However it is important that external benefits are also taken into account.

While there is value in managing a portfolio to avoid undue operating costs, there is also value in maintaining an appropriate buffer of water in storages to reduce the probability of having to invest in additional supply capacity in response to drought conditions.

3.7 Consumption and pricing

The NSW Government considers that demand management (DM) and temporary drought restrictions both have critical roles to play in securing water needs at least cost – both financial and economic.

3.7.1 Demand management

In this paper, the term demand management, or DM, is used to describe measures that reduce demand on potable supplies in an enduring way by improving end use efficiency (though it can sometimes be used to encompass recycling schemes which substitute 'fit for purpose' alternate water supplies for potable water and thus reduce demand on rainfed supplies). Temporary drought restrictions are qualitatively different in that they proscribe certain water uses in order to temporarily reduce demand for water in response to drought conditions.

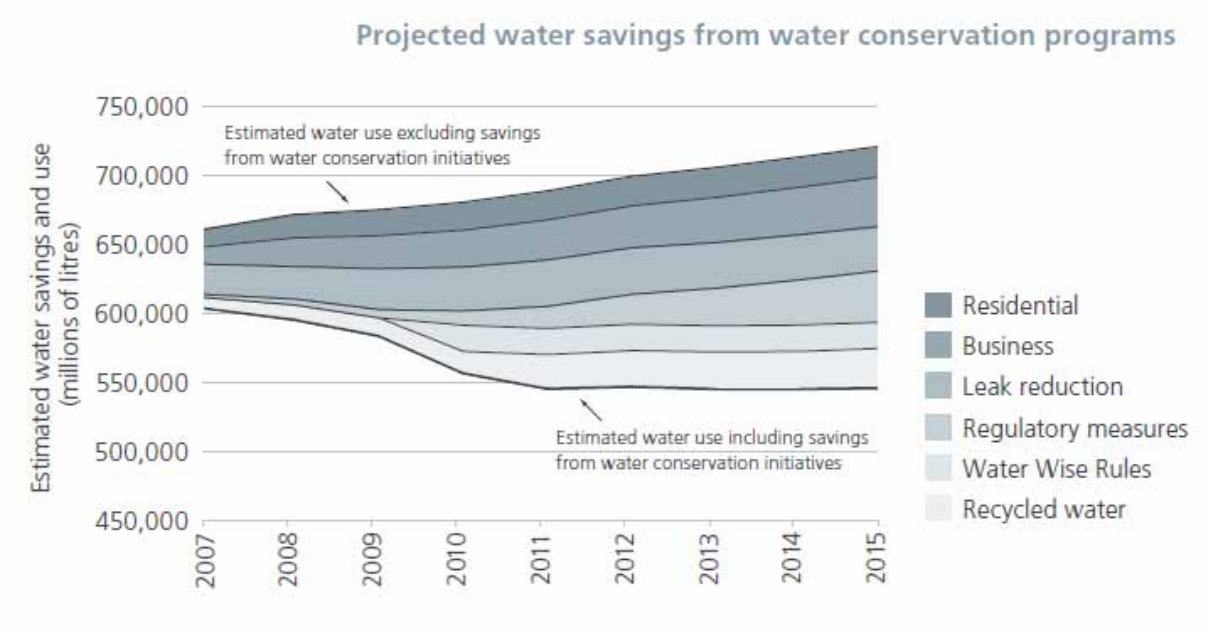
Sydney is using the same amount of water as it did in the early 1970s, despite an increase in population of 1.4 million people since then. Between 1991 and 2010, water demand in Sydney fell from 506 to 314 litres per person per day. Similarly, the non-metropolitan NSW local water utilities have achieved a 47 per cent reduction in the average annual volume of water supplied per residential property since 1991, which equates to a saving of 160 gigalitres per year.

Current DM programs in NSW

Sydney has a comprehensive and coordinated range of water saving initiatives tailored to all major water users. These initiatives make up the largest demand reduction program in Australia and one of the most comprehensive and diverse urban water saving efforts internationally.[1] Results are reported annually and can be accessed online at Sydney Water's website.

The 2006 and 2010 Plans include a water conservation target of 145 GL per year by 2015. This accounts for 24 per cent of current water needs and is second in size after water from dams. The mix of DM measures that will achieve the 145GL target is shown below.

[1] Sydney Water Corporation has won several major international awards for its water conservation programs, including the Stockholm Industry Water Award in 2006, the 2010 Public Water Agency of the Year Award at the Global Water Intelligence Conference in Paris, France, and a Green Globe Award in 2008 for its Best Practice Guidelines for Water Conservation in Commercial Office Buildings and Shopping Centres.



Source: 2010 Metropolitan Water Plan

Sydney Water has reduced water lost through leakage by around 30 billion litres per year and is in the top performance band for leakage according to the World Bank Institute Banding System, which stipulates international standards.

The role of DM measures in enhancing security of supply

As noted in the Issues Paper, some contend that drought restrictions limit customers' utility by removing their freedom to use water in accordance with their preferences. Measures that improve end use efficiency do not have this result.

DM measures are well suited to managing demand growth over time. They can also play a valuable role in drought by slowing the rate at which storage levels fall. This was evident in the recent drought when Sydney Water initiated additional DM measures to help slow depletion rates and complement the savings achieved through temporary drought restrictions.

Analysis undertaken for the 2004 Plan highlighted the low levelised cost of many DM measures. Saving water by minimising waste and improving efficiency was found to be more cost-effective than most other options. Real options analysis for the 2006 Plan highlighted the additional value of incremental investments such as DM in that they can maximise flexibility and avoid risks associated with more 'lumpy' and irreversible capital investments.

In addition to reducing pressure on potable supplies, DM can also deliver positive environmental benefits, such as reducing the amount of energy used by hot water systems and for pumping water to deliver it to customers and reducing wastewater volumes and associated pumping and treatment costs.

Given the valuable role that DM can play in securing water needs at least cost, it is important that micro-economic reforms preserve the gains made in this area. Implications for DM need to be factored into consideration of any reform options. If reforms occur at the expense of DM, costs to end users could rise significantly.

The Commonwealth has a valuable role to play in supporting DM. The Water Efficiency Labelling and Standards (WELS) Scheme has achieved significant efficiency gains for both end users and whole of system operation, including water and wastewater service provision and energy consumption. Over the period of 2005 to 2021, the WELS scheme is estimated to reduce water consumption nationally by 800 billion litres at a cost of $0.08 –

$0.21/kL. This compares favourably with supply augmentation measures (with levelised cost estimates for desalination and recycling ranging from ~$1 to $4/kL)[2]. For greater Sydney, WELS is estimated to save over seven billion litres of water each year.[3]

The NSW Government has introduced permanent Water Wise Rules to enhance security of supply. Details can be found on page 43 of the 2010 Metropolitan Water Plan.

3.7.2 Projected impact of climate change on demand (Issues Paper p22)

One study of the impact of climate change of Sydney's water supply and demand concluded that climate change is not projected to have a significant impact on water demand in the greater Sydney region, though the analysis suggests that climate change will impact rainfall and runoff, leading to a minor increase in rainfall and runoff in the coastal catchment and reduced rainfall and runoff in the inland catchment.

The study was a major collaboration between the NSW Government (NOW and SCA), the Commonwealth Government, Sydney Water Corporation, the University of New South Wales and the CSIRO. The Commonwealth made an important financial contribution to the project which led to advances in climate modelling, particularly on the demand side, that will be of interest and benefit to water planners around the country and internationally.

Further information about the study is set out in Appendix 4.

There is considerable scope for further nationally coordinated and funded research to address current limitations with climate models, particularly in relation to modelling future droughts – a key consideration for water planning. Another important issue is the potential impacts of climate change on weather events including east coast low pressure systems which play an important role in filling storage systems. The NSW Government is leading the development of the Eastern Seaboard Climate Change Initiative (ESCCI) to investigate these issues. Further information is provided in Appendix 4.

3.7.3 Pricing arrangements

The Issues Paper states on p24 that setting water prices at Long Run Marginal Cost (LRMC) is less efficient because 'it encourages underconsumption [sic] when water is abundant and overconsumption when water is scarce'. However, so called under-consumption when water is abundant creates valuable capacity to withstand drought periods without additional investment in supply capacity.

Using water efficiently – thus leaving more water in dams rather than increasing consumption when storages are relatively high – is perhaps the cheapest form of drought insurance available. It helps avoid or delay major capital investments. In addition, if stored water is later spilled, it delivers environmental benefits in the form of improved river health. The combined value of this 'insurance' water, the potential environmental benefits and savings which accrue to the wastewater sector, suggests that it is inaccurate to describe consumption at optimally efficient levels as 'under consumption'.

The Issues Paper asks (page 25) whether current pricing arrangements are achieving objectives such as efficiency and equity, and whether there is scope for more efficient pricing.

As noted earlier, many factors need to be considered to determine the optimal mix of measures in an integrated water plan – including river health, water quality, flood mitigation, and infrastructure costs.

NSW is committed to the NWI pricing principles, which require regulators to have regard to the LRMC when setting the usage charge. The pricing principles do not preclude

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[2] J Chong, A Kazaglis, D Girurco, 2008, Cost effectiveness analysis of the Water Efficiency Labelling and Standards Scheme – Final report, Institute of Sustainable futures for the Department of the Environment Heritage and Arts. p ii

[3] 2010 MWP page 40.

consideration of other factors such as the achievement of broader policy objectives relating to equity, demand management and recycling.

In assessing reform options relating to scarcity-based or dynamic pricing, it will be important to consider the possible implications of such approaches for:

- the ratio of fixed to usage charges;
- consequences for recycling and conservation investment that may flow from adjustments to LRMC estimates and thus usage charges; and
- equity implications that may arise due to increased fixed charges.

Such issues have been raised in submissions to IPART by the Metropolitan Water Independent Review Panel, the Public Interest Advocacy Centre and Jemena Ltd discussed these issues in their submissions to IPART regarding the price determination for the Sydney Catchment Authority. These submissions are available at IPART's website.

To inform further deliberations regarding scarcity or dynamic pricing, it may be useful to explore in detail how users respond to water prices, including at what point the usage charge conveys a strong conservation message. Work needs to be done to estimate price elasticity of demand for discretionary and non-discretionary water use, including during drought, since this is an important input to discussions regarding dynamic pricing. (See the discussion in ISF's *Review of Water Restrictions*, 2009, at p51.)

3.7.4 Drought restrictions (Issues Paper pp 23-28)

The Issues Paper seeks views on possible pricing reforms. A key issue is whether more flexible pricing could complement or replace drought restrictions as a means of managing demand during drought. A number of interrelated issues are discussed below.

Drought restrictions have been used very successfully in greater Sydney, and with strong community support, to reduce demand in drought. The drought restrictions regime imposed in Sydney during the recent drought was not severe by comparison with other parts of NSW and Australia where different drought restrictions regimes apply, reflecting different climatic and hydrological characteristics. More onerous drought restrictions were removed from the Government's drought response toolkit in early 2006 so as to avoid more significant impacts on the community. This was possible due to the capacity to deploy desalination within a short lead time in the event of extreme drought.

The NSW Office of Water conducted research on community sentiment in greater Sydney during the recent drought. The research indicated that a majority of respondents felt that drought restrictions did not detract from their quality of life. Only around 5 per cent of respondents thought that drought restrictions should be removed when the drought ended.

There is only limited discussion in the literature regarding the difficulties associated with putting a monetary value on the cost of drought restrictions. See for example ISF and ACIL Tasman, *Review of Water Restrictions* prepared for the National Water Commission, in particular the discussion on the difficulty of estimating the cost of drought restrictions (pages 44 ff and Appendix 2). As noted in the report, such methodologies may over-estimate the cost of drought restrictions for a number of reasons.

The NSW Government has retained drought restrictions as an important part of its drought response toolkit – both in metropolitan areas and throughout regional NSW. For dams in non-metropolitan NSW, drought restrictions are part of the design parameters. The adoption of a new drought restrictions regime in the 2010 Metropolitan Water Plan is based on cost effectiveness analysis which took account of the cost of drought restrictions, weighed against their system-wide benefits. A summary of the process of developing the MWP is available online at the NSW Government's Water for Life website.

The NSW Government has replaced drought restrictions with permanent Water Wise Rules. Details are available at page 43 of the Metropolitan Water Plan 2010.

3.7.5 Scarcity pricing

Recently, there has been significant interest in scarcity-based pricing, as noted on page 25 of the Issues Paper. Scarcity pricing seeks to ration demand when water is scarce by linking the price of water to its relative availability. Under this approach, the price of water would be higher when water supplies are low, sending a message about the value of scarce water. The central argument for this form of pricing is one of economic efficiency. Recent literature also refers to this concept as "dynamically efficient pricing" (reflecting the fact that water availability ranges from scarce to plentiful).

Theory suggests this is a more economically efficient means of:

- balancing water demand and supply over time (including reducing demand during drought periods),
- signalling how elements in a portfolio should be operated, and
- signalling when additional investment should occur.

The introduction of usage based pricing in the Hunter region in 1982 and in Sydney in 1990 demonstrated that price can be used as a tool to manage water demand. However, water pricing is a complex issue.

Scarcity pricing, along with other drought response measures, will be further evaluated by the NSW Government in the course of developing the next iteration of the Metropolitan Water Plan, due in 2014.

The NSW Government considers that substantial work is needed before scarcity pricing could be considered. Critically, any approach adopted would need to ensure that essential water supply is affordable for all households. Whether scarcity pricing would have the desired impact and how it would impact on investment in other water sources (such as recycled water) are important considerations.

IPART has indicated that it will consider scarcity pricing as part of its next price review for the Sydney Catchment Authority to be completed in 2012.

NSW encourages the Productivity Commission to undertake assessment of alternative pricing options against the criteria of equity, efficiency, flexibility, simplicity, transparency, revenue adequacy and having regard to any constraints for the adoption of each option.

Further work would be valuable to examine the practical implementation issues, costs and benefits that could arise if a new approach to pricing were to be adopted, including:

- Metering and billing (capital costs and benefits associated with new meters and timely billing systems, and ongoing administrative costs and benefits)
- Costs and benefits of community engagement (to inform users about prices changing over time)
- Cost of risk management strategies (in case pricing does not work – eg readiness strategies to implement supply augmentation if critical storage levels are reached)
- Consultation with industry stakeholders to understand the implications of new pricing approaches for third party investment in water infrastructure
- Consideration of whether dynamic pricing could increase the risk of triggering supplier of last resort events (as occurred in the electricity market in 2007 in response to dynamic price impacts on supplier profitability. Further information is available online at the website of Allens Arthur Robinson.)
- Measures that may be required to mitigate impacts on low income households.

Further work may also be valuable to determine expected price increases required to achieve the same level of water savings achieved by drought restrictions, including better

understanding of price elasticity, the willingness to pay to avoid future drought restrictions, and changes to community attitudes under different conditions.

This work should examine in detail how water users respond to water prices, including at what point the usage charge conveys a strong conservation message. Work needs to be done to estimate price elasticity of demand for discretionary and non-discretionary water use, including during drought.

There may also be merit in further assessing the degree to which current economic analysis of drought restrictions aligns with community values. Further analysis of the potential for scarcity-based or dynamically efficient pricing should have regard for empirical analysis of community attitudes through site specific and well informed choice modelling and/or willingness to pay and willingness to accept surveys. This could complement efforts to test community values as an input to the development of agreed service levels.

Using scarcity pricing to signal how portfolio elements should operate

Further work is needed to examine the impacts that scarcity-based or dynamic pricing would have on signalling when to draw on various water sources, such as inter-basin transfers and desalination. Scarcity pricing alone may not sufficiently reflect the complex nature of hydrological systems and the multiplicity of objectives that need to be considered, including how best to optimise system yield and secure supplies in the face of climatic uncertainty, how to protect river health and manage the impact of inter-basin transfers. Such hydrological and whole of system economic considerations need to inform decisions about how elements within a portfolio should operate.

For Sydney's Metropolitan Water Plan, modelling has been undertaken to identify how best to operate the measures within the portfolio so as to optimise available water at least financial and economic (including environmental) cost. For example, prior to 2009, water was transferred from the Shoalhaven River system during drought when Sydney's total storage fell below 60 per cent. However, investigations have shown that more water can be sourced from the Shoalhaven when water is readily available rather than accessing low flows during drought periods – with less impact on the health of the Shoalhaven River and fewer amenity and economic impacts on the local communities. A new approach to operating the Shoalhaven transfers scheme was adopted in 2009 following extensive research, analysis and community consultation. Under the new approach, transfers from the Shoalhaven will commence once Sydney's total dam storage level falls to around 75 per cent and continue until the total dam storage level rises above 80 per cent.

It is not clear that using scarcity or dynamic prices to determine when transfers should occur would achieve optimal hydrological (or economic) outcomes. Under a scarcity pricing approach, transfers might commence when the variable price rises to a point where it covers pumping costs associated with transferring water. Commencing transfers at this point could have implications for river health, and reduce the amount of water available in the overall system, thus increasing the probability of needing to invest in additional capacity in response to severe drought. Further work is needed in this area.

The same is true in relation to desalination. Following detailed hydrological modelling and cost effectiveness analysis, the 2010 Metropolitan Water Plan has adopted an operating regime whereby the Sydney desalination plant (with a capacity of 250ML/day) will operate when storages fall below 70 per cent and continue until storages exceed 80 per cent. This is designed to create a buffer of water in the dams and thus reduce the probability of having to invest in further supply capacity. Modelling for the 2010 Plan showed that an alternate approach of operating the plant when storages reach much lower levels would not secure water supplies in the event of prolonged drought (because the plant can only produce around 15 per cent of Sydney's current water needs), thus increasing the probability of having to upscale the plant.

While some supply measures (eg desalination and inter-catchment transfers) lend themselves to operating in response to varying storage levels, DM programs are less suited to this approach. The increments involved are relatively small and the water savings achieved by DM build up over time. Ongoing investment is required, particularly given the institutional capacity required to achieve DM outcomes.

3.7.6 The value of effectively managing demand during drought

When considering how best to manage the impacts of drought, and what approaches will deliver the most certain outcomes, it is important to consider issues relating to asset utilisation and the potential cost of investing in additional capacity as an alternative to reducing demand through drought restrictions and/or pricing.

In Sydney, dam storage levels have been subject to infrequent but deep drought, with storage levels often recovering quickly. The additional capacity that would be required to avoid the need for drought restrictions and/or scarcity pricing would be significant and would be underutilised for much of the time. (The low utilisation rate of some assets is an increasingly costly feature of the electricity market. IPART has estimated that 10 per cent of electricity assets are used less than 1 per cent of the time: *Inquiry into the Role of Demand Management and Other Options in the Provision of Energy Services*).

In accordance with the design criteria for the Sydney water system and in particular the 97 per cent reliability criterion, drought restrictions are to be imposed no more than 3 per cent of the time (averaged over the long term). This means that investing in additional capacity as an alternative to imposing drought restrictions could result in assets being required for only small periods of time on average.

Tools that can reliably flatten demand when storages are impacted by drought may have considerable economic value and help avoid high capital costs and low utilisation rates. See also ISF, ACIL Tasman and SMEC, *Review of the Metropolitan Water Plan: Final Report*, April 2006, pp46 ff, www.waterforlife.nsw.gov.au. However, where tools designed to reduce demand entail a high degree of uncertainty, inefficient outcomes, including additional investment in capacity that is then under-utilised, may result.

Experience with drought restrictions indicates that the volume of water saved can be estimated with a reasonably high degree of confidence. Such assumptions underpin estimates of yield from storage systems. The level of demand response that can be achieved in response to scarcity-based pricing is not yet known and further work is needed in this area. Yield estimates may need to include more conservative assumptions regarding the effect of such price signals, reducing the amount of water that could sustainably be drawn from storages on an annual basis. This may have implications for whole of system costs. For further information see SCA, *Review of Sydney's Water Supply System Yield* available at the Sydney Catchment Authority's website www.sca.nsw.gov.au and ISF, *Review of the Metropolitan Water Plan: Final Report*, April 2006, available at www.waterforlife.nsw.gov.au .

Another aspect of scarcity pricing that requires further investigation is its possible impacts on the need for additional investment in storage supplies. Lower prices when storages are full are likely to increase water consumption, which would reduce the buffer of water available in dams to manage periods of low inflows, increasing the probability that storages will fall to levels at which investment in additional supply capacity is required.

4 SCOPE FOR COMPETITION AND CONTESTABILITY

4.1 Factors affecting potential for competition

The Issues Paper seeks input as to the main impediments to competitive pressure developing (p31).

By creating a state-based third party access regime in the *Water Industry Competition Act*, the NSW Government has facilitated the entry of new players into the urban water sector

and thus enabled competitive pressures to emerge. Details are provided above on page 11 of this submission.

Notwithstanding steps to remove regulatory impediments to competition, an important consideration is that, in many parts of Australia, low cost sources of water have been accessed and future options entail higher costs. This means that new entrants will face higher costs than incumbents – a factor that may be magnified by the inability of new entrants to spread costs over a large rate base.

Given the geographically limited scope of most water supply systems, institutional economy is an important factor when considering the appropriate and cost effective market 'architecture'. As noted above, in Sydney around 73 per cent of water is consumed by the residential sector, with an average household consuming around 200 kilolitres per year. This contrasts with the electricity market, which has a much larger proportion of industrial and commercial demand. The NEM's governance and commercial arrangements are complex, and the NSW Government is unaware of evidence to suggest that such national market arrangements would be appropriate for the urban water sector in Australia. This issue is recognised in the Frontier Economics report *Urban Water Markets*, 2009 and by SKM in *New water entitlement products for Australia*, 2008.

4.2 Efficient procurement

The Issues Paper refers on page 29 to promoting efficient procurement of upstream water supply services. There may also be scope to implement such an approach in the downstream wastewater sector. For example, prior to making significant capital investments in the wastewater system, metropolitan utilities could be required to test the market for innovative solutions.

A similar approach has been adopted under the National Electricity Rules. Transmission Network Service Providers (TNSPs) are required to undertake an annual planning review with each Distribution Network Service Provider (DNSP) connected to its network. This includes identifying the nature and location of emerging constraints in the network and forecasting constraints and inability to meet network performance requirements. TNSPs are required to publish Annual Planning Reports that set out the results of these reviews. This allows the market to identify potential DM solutions to network constraints. The TNSP can issue a request for proposals for augmentation or non-network alternatives to address these constraints.

The NSW Government supports the Productivity Commission investigating further means to promote competition and contestability within and across the water and waste water sectors.

5 TOOLS AND OPTIONS FOR ACHIEVING REFORM

Prior to considering whether there is a case to undertake further major reforms, there may be benefit in undertaking a stock take of the implementation of existing reforms in order to identify those sectoral objectives that are not yet being fully met and where further effort may deliver most value. The NSW Government considers that the forthcoming Biennial Assessment of the National Water Initiative could inform such deliberations and avoid duplication of the analytical effort. This may include developing tools to enable jurisdictions to effectively implement existing reforms prior to considering another round of reforms.

While substantial reforms have already occurred (particularly in relation to pricing), there is a need to ensure that reforms are mutually supportive and integrated. An important challenge is to ensure that future pricing and economic reforms align with the objectives of integrated water planning, so as not to undermine the benefits achieved under a system-wide planning approach that incorporates broader policy objectives.

5.1 Incorporating externalities into decision-making

Inclusion of externalities in pricing arrangements ensures that the full cost to society of providing a service is reflected in its price. To improve efficiency, further nationally coordinated work could be helpful to incorporate environmental externalities into decision-making processes and water charges.

5.2 Metering technologies

The Issues Paper asks on page 25 whether improvements can be made in the area of metering and billing and, if so, what changes could be made.

A challenge facing the urban water sector in the greater Sydney area is that around 40 per cent of households do not pay water usage charges because their water consumption is not metered individually. For example, most people living in apartments pay a pro rata share of the building's total water use, rather than paying according to their actual consumption. As a result, there is less incentive for such users to use water efficiently.

Recognising that sending direct price signals to as many water customers as possible will help promote more efficient water use and reduce pressure on supplies, Sydney Water has undertaken a trial to examine the costs and benefits of individual metering in multi-unit apartment buildings.

In addition, to investigate the benefits of smart metering, Hunter Water is partnering with Energy Australia in the *Smart Grid, Smart City* demonstration project. The project will roll-out 1000 smart water meters that send hourly consumption data via the electricity meter.

While retrofitting is costly, new technologies may make individual metering more practical and cost effective. The Commonwealth could play a valuable role by facilitating a nationally coordinated approach to the development / bulk procurement of new metering technology that could enable cost-effective retrofitting of existing apartment buildings.

As with residential customers living in multi-unit apartments, shopping centre tenants generally pay for a share of the total building's water consumption (eg based on floor space rented), rather than paying according to actual usage. Metering and charging for individual water usage would overcome this, allowing price signals to be sent direct to water users and thus encouraging efforts to increase water efficiency.

There may be value in investigating the relative costs and benefits of including sub-metering requirements in relevant building and planning codes (eg the Building Code of Australia) to facilitate efficient pricing and water use. While energy efficiency measures for multi-residential and commercial properties are included in the Building Code of Australia, the inclusion of water efficiency requirements warrants consideration.

Non-metropolitan local water utilities are encouraged by the Best Practice Management Guidelines to mandate separate metering in all new multi-unit residential developments (both strata and non-strata) approved after 1 July 2004. In addition, all free standing residential premises are required to be separately metered since 1 July 2007. The Guidelines also state that local water utilities should encourage separate metering of existing multi-unit residential developments, where cost-effective.

Recent changes to the *Residential Tenancies Act 2010* allow landlords to charge tenants for water use if the premise has water efficient appliances and is separately metered. These provisions are designed to encourage greater efficiencies in the rental sector.

5.3 Supporting uptake of recycling technologies

To support the uptake of recycling, further work is needed to develop national validation guidelines and a validation register for recycling technologies. Current project specific validation requirements impose costs on proponents and may hinder the uptake of

recycling, especially in smaller schemes where it can be hard to justify the cost of validating the process to ensure it achieves the required water quality.

The National Water Commission is currently undertaking a review associated with this issue. The Commonwealth has an important role to play in this area, particularly given Mutual Recognition legislation and the need for national consistency to minimise costs to industry. The development of a database of recycling technologies and their ability to achieve certain water quality outcomes would reduce the cost for proponents and support the uptake of safe recycling technologies.

6 IMPLEMENTING REFORM

Consideration of potential competitive reforms needs to be supported by inclusive cost benefit analysis, which takes account of the wider implications of market reforms. It is also important to consider externalities particularly given the challenges of improving river health in the face of projected climate change impacts. Consideration of social impacts is also important, especially in relation to the provision of affordable and equitable water services to low income households.

The Productivity Commission noted in its 2008 report that 'an incremental approach, starting with modest reforms, may offer advantages' (page 126) and that 'abrupt or large scale changes could generate excessive transactions, implementation and adjustment costs' (page xxix).

Given the diversity within the sector, it may be that the development of guiding principles and a toolbox of potential responses is a useful approach – enabling each jurisdiction to assess what issues most need to be addressed, what the options are for addressing such issues, and tools/criteria to analyse and identify the best response. This approach would be consistent with the approach taken in developing the COAG endorsed urban water planning principles, and recognise the valid differences in circumstances and approach within and between jurisdictions.

6.1 Efficient reform processes

The NSW Government notes the importance of ensuring that reform processes are themselves efficient.

Having regard for the wide range of interrelated consultancies and inquiries currently underway, the Productivity Commission Inquiry presents an opportunity to ensure that analytical and research effort across these processes is optimally coordinated so as to maximise benefits and manage resource implications for all stakeholders. This is important given the finite resources and the concurrent work associated with major investment programs underway.

A valuable output from the present Inquiry would be recommendations for institutional arrangements to coordinate these processes, including greater clarity regarding roles and responsibilities, consistent with the discussion on page 33 of the Issues Paper.

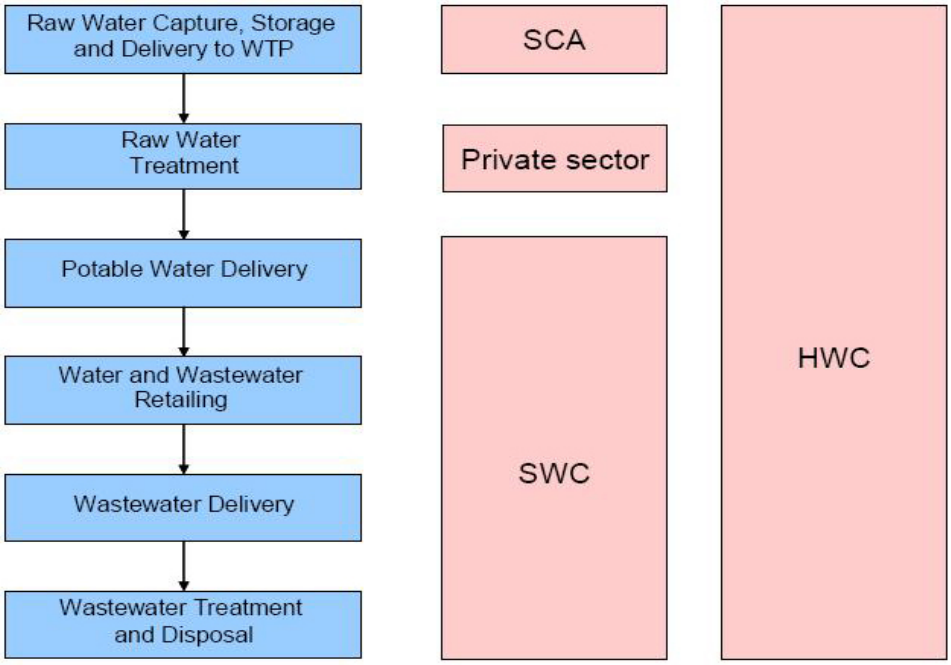
The urban water sector in metropolitan NSW

The metropolitan urban water sector in NSW comprises Sydney Water Corporation (SWC), Sydney catchment Authority (SCA) and Hunter Water Corporation (HWC) which service a population of almost 5 million.

Sydney's bulk water is provided by the Sydney Catchment Authority (SCA), which was separated from Sydney Water (SWC) in 1999. The SCA has responsibility for the supply of bulk water to the water treatment plants, which are typically privately owned and operated. SWC then retails treated drinking water to residential and business customers, and provides wastewater and some stormwater services.

Hunter Water (HWC) is an integrated entity that manages both the bulk water supplies and water delivery system (including retail functions) and wastewater services for the Lower Hunter region.

The figure below illustrates the current water industry structure and responsibilities for Sydney and the Hunter. Since the commencement of the *Water Industry Act 2006,* 11 new licences have been granted (six network operator licences and 5 retail supply licences). Most of these licences are yet to start operating. The exception is the Sydney Desalination Plant Pty Ltd, which holds both a network operator and a retail supply licence. The desalination plant began producing water in January 2010.



Operations

Sydney Catchment Authority

The Sydney metropolitan system is primarily served by two public entities. The SCA is responsible for raw water capture and storage and for delivery of bulk water to the water treatment plants. The water treatment plants are largely private companies who treat water to specified conditions and supply it to the SWC. The SWC is responsible for all other aspects of the water process, including retail functions.

The SCA was established as a statutory authority representing the Crown in January 1999. It was established in response to a major water quality incident sparking public health concerns about the safety of Sydney's drinking water supply. The discovery of the

micro-organisms *Cryptosporidium* and *Giardia* within the water supply system resulted in a 'boil water' alert remaining in place for Sydney for several weeks. Following an inquiry conducted by Justice McClellan, bulk water and catchment management functions were separated from SWC. These new governance arrangements were aimed at ensuring there was a dedicated agency focussed on managing the health of the catchments that contribute to Sydney's drinking water supply.

The SCA manages and protects Sydney's drinking water catchments and catchment infrastructure, and supplies bulk water to its customers, including SWC and a number of local councils. The SCA's customers then filter the water the SCA supplies and distribute it to households, businesses and other users. More than four million people, about 60 percent of the NSW population, use water supplied by the SCA.

The *Sydney Water Catchment Management Act 1998* (SWCM Act) defines the roles, functions and objectives of the SCA. The SCA's principal objectives under the Act are to:

- manage and protect the catchment areas and the catchment infrastructure to promote water quality;
- protect public health and safety, and the environment;
- ensure that water supplied by the SCA complies with appropriate quality standards;
- conduct its activities, where they affect the environment, in compliance with the principles of ecologically sustainable development; and
- manage the SCA's catchment infrastructure works efficiently, economically, and in accordance with sound commercial principles.

The main functions of the SCA under its Act are to:

- protect and enhance the quality and quantity of water in the catchments;
- manage and protect the catchment areas, and catchment infrastructure;
- supply bulk water to Sydney Water, other water supply authorities and direct customers;
- protect and enhance water quality;
- research catchments generally, and the health of its own catchments in particular; and
- help educate the community about water management and catchment protection.

Other instruments that govern the way the SCA operates include:

- An operating licence (regulated by the Independent Pricing and Regulatory Tribunal (IPART) in accordance with the SWCM Act) setting out the standards and obligations that the SCA must satisfy
- A water management licence issued under the *Water Act 1912* which defines the SCA's water access rights and obligations and authorises the operation of its water management works including all the major dams and weirs for Sydney's water supply[4]
- Bulk water supply agreements (between SCA and SWC)

The SCA operating licence prescribes standards and obligations that the SCA must satisfy. SCA prices are regulated by IPART.

The SCA is responsible for implementing the *Healthy Catchments Strategy 2009-12* which sets out the following broad initiatives to protect catchment health and water quality:

[4] Water sharing plans for the river water sources and ground water sources of the Sydney Greater metropolitan Region are currently being developed under the *Water Management Act 2000*. Once these plans are in force, major utility access licence/s will be issued to the SCA under the same Act.

- increase adoption of water quality best management practices in rural land uses and activities;
- minimise the impact of sewage and stormwater on Sydney's drinking water catchments;
- manage lands to contemporary standards to protect and optimise water quality, and to conserve the ecological integrity, and natural and cultural values of the area;
- carry out statutory and regulatory operations including compliance and land use planning; and
- develop and maintain catchment partnerships that support collaborative and sustainable contributions to protect the catchments.

The strategy is delivered through a statutory role in land management and regulatory instruments for development and land use planning.

The Sydney Catchment Authority uses a complex hydrological model (known as WATHNET) to determine the system's annual water supply availability – referred to as the 'yield' of the system – that is, the annual volume that can safely be drawn from the dam system without compromising system security or triggering unacceptably high frequency of drought restrictions. This assessment is based on system performance criteria, the current system's capacity and constraints combined with 2000 synthetically generated streamflow sequences based on around 100 years of historical streamflows. To estimate future water availability, WATHNET is adjusted to represent the different system configurations or climatic conditions under consideration. If any of the inputs to the model change, then the calculated amount of water that can be drawn from the system annually also changes.

The SCA model also applies performance criteria to determine how much water can be drawn from the storages annually without imposing drought restrictions too frequently, for too long, and without imposing an unacceptable risk that the storages will approach emptiness. The current performance criteria for the Sydney supply system are:

- *Reliability*: estimates that, on average, drought restrictions due to drought will not need to be applied more than 3 per cent of the time, often expressed as "97% reliability".
- *Robustness*: estimates that, on average, not more than 10 years in 100 years will be affected by restrictions due to drought (where a year is considered to be affected by restrictions if restrictions are applied on any one day in that year). This is expressed as 90% robustness.
- *Security*: requires that the dams must not approach emptiness (less than 5% of total storage) more than 0.01% of the time. That is, in a period of 8,333 years, only in one month should the combined level of the operating storages approach emptiness.

Some Australian storage systems use similar design criteria to estimate 'yield', however the values used vary to reflect the different characteristics of each system. For example, Melbourne and the ACT use a reliability standard of 95%, which reflects the less variable nature of local rainfall patterns. The SCA is currently reviewing its yield estimate in response to the finalisation of the 2010 MWP.

Sydney Water Corporation

SWC provides drinking water, recycled water, wastewater services and some stormwater services to more than four million people in Sydney, Illawarra and the Blue Mountains. Drinking water is sourced from the network of dams managed by the SCA, then treated and delivered to customers' homes and businesses by SWC. Since the beginning of 2010, water has also been sourced from the Sydney desalination plant which is owned by a wholly owned subsidiary of SWC.

SWC was established as a statutory state owned corporation by the *Sydney Water Act 1994*. As a state owned corporation, SWC is also subject to the provisions of the *State*

Owned Corporations Act 1989. Prices set by SWC are regulated by IPART under the *IPART Act 1992* and SWC operations are also governed by the *Sydney Water Act*, the *Sydney Water Regulation* 2006 and SWC's operating licence (which is also regulated by IPART).

SWC is wholly owned by the New South Wales Government. It has three equal, principal objectives:

- to protect public health;
- to protect the environment; and
- to be a successful business.

SWC also has a number of responsibilities under its legislative and licensing regime including:

- drinking water (health and aesthetic) requirements;
- infrastructure performance requirements;
- customer and consumer rights;
- system performance standards (continuity, water pressure & sewage overflows);
- water conservation targets, demand management and recycling requirements; and
- environmental reporting and management.

Under its operating licence, the SWC is required to give due consideration to demand side management as a basis for planning for future services. The operating licence also includes a water conservation target to reduce water consumption by 35 per cent (compared with 1990/91 levels) by 2010/2011. SWC must report annually to IPART on the implementation of its demand management strategy and progress against its conservation target. For more information regarding the wide range of demand management and recycling programs implemented by SWC, see the annually produced Water Conservation and Recycling Implementation Report, available on line at Sydney Water's website here.

Hunter Water

HWC collects, treats and then delivers drinking water to over half a million customers in the lower Hunter region. The HWC Board oversees the Corporation's policies, management and performance. It sets strategic direction for the organisation and ensures HWC achieves its business and regulatory commitments.

HWC also transports, treats and disposes of the region's wastewater. HWC supplies an average 25 megalitres each day to the Central Coast (depending on the Hunter's storage levels), following completion of the new pipeline connection in December 2006.

Like SWC, HWC is a statutory state owned corporation, established under the *Hunter Water Act 1991*. HWC's prices are regulated by IPART under the *IPART Act 1992*. It is also subject to the provisions of its operating licence (also regulated by IPART) and the *Hunter Water (General) Regulation 2005*.

Central Coast

Currently, Gosford City Council and Wyong Shire Council (as the Gosford Wyong Water Authority) are responsible for the provision of Central Coast water supply and sewerage services under the *Water Management Act 2000.* In early 2006, the NSW Government considered whether a joint water corporation – jointly owned by Gosford and Wyong Councils and governed by an independent board – should be created.

The *Central Coast Water Corporation Act 2006* was enacted and enables Gosford and Wyong to voluntarily merge their water businesses into a local water corporation. In October 2010, the *Central Coast Water Corporation Amendment Bill 2010* passed both

Houses of Parliament. The Bill facilitates the establishment of the Central Coast Water Corporation by providing the Councils with greater powers in relation to the transfer of functions, assets, rights and liabilities.

Private sector

The urban water sector also includes a growing number of comparatively smaller entities – such as private companies undertaking recycling schemes (for example Jemena has been licensed under the *Water Industry Competition Act 2006* (WIC Act) to undertake a major recycling scheme in western Sydney). Local councils (who, as local water utilities, play a major role in non-metropolitan NSW) are also playing an increasing role in metropolitan Sydney - for example undertaking a growing number of stormwater harvesting and reuse schemes.

Economic regulation

IPART

The Independent Pricing and Regulatory Tribunal (IPART) was established in 1992. Its role includes

- setting prices for a range of services provided by SCA, SWC, HWC and Gosford/Wyong Councils – including water and wastewater services, stormwater management charges, recycled water prices;
- regulating utilities such as SWC and HWC, which are required by their respective Acts to hold an operating licence administered by IPART;
- providing advice to the Minister for Water regarding the issuing of licences under the *Water Industry Competition Act 2006.*

Historically, water charges in NSW were based on property values, not on the amount of water actually used. The introduction of 'user pays' pricing in the early 1990s sent signals directly to customers about the cost of consuming water and contributed to a significant reduction in per capita demand.

Consistent with National Water Initiative pricing principles, IPART sets water usage charges with regard for long run marginal cost (LRMC). A fixed charge recovers a return on capital and a return of capital (being the regulatory asset base determined through the IPART process) and is used to recover the utility's revenue needs that are not met by revenue from the usage charge.

Pricing reform has continued to evolve. An inclining block tariff (IBT) was incorporated in the price determination for Sydney Water in 2005 in response to worsening drought conditions. It was designed to encourage water conservation by setting a higher price for household consumption above a threshold of 100 kL per quarter. The IBT was removed in the most recent price determination based on concerns about its economic efficiency, and in response to improving storage levels and the construction of the desalination plant.

IPART has also been investigating alternate pricing approaches such as the use of scarcity pricing, and has indicated an intention to further examine these issues in future price determinations. The NSW Government has also – in the 2010 MWP – indicated its intention to further examine alternate pricing approaches.

Policy

The NSW Office of Water

The NSW Office of Water (NOW) is a separate office within the NSW Department of Environment, Climate Change and Water. It is responsible for the management of the State's surface water and groundwater resources.

NOW reports to the Minister for Water for water policy and the administration of key water management legislation, including the *Water Management Act 2000*, *Water Act 1912*, and the *Hawkesbury-Nepean River Act 2009*.

Responsibilities include:

- determining the volume of water available for allocation each year to towns, water users and the environment, particularly during times of severe water shortage
- ensuring all users, including the environment, have access to sustainable water supplies
- developing statutory water sharing plans which set the rules for sharing water between users, and between users and the environment
- negotiating interstate and national water agreements particularly in view of the significant institutional changes occurring in the Murray-Darling Basin
- approving the extraction and use of water, and the policies and procedures for the permanent trade of water entitlements and the annual trade of available water
- coordinating the development of metropolitan, town and non-urban water policy
- monitoring the quantity, quality, and health of our aquatic ecosystems and water extractions
- approving council-led recycling schemes, which require approval under s60 of the *Local Government Act 1993*.

The vertical separation between the SCA and SWC means that a process is required to coordinate the delivery of water services to secure Sydney's water needs at least cost, including environmental and social impacts. This coordinating role is the responsibility of NOW. NOW chairs a Committee of Chief Executive Officers which oversees the development and integration of policy relating to water supply in Sydney.

As well as the SWC and SCA, the Committee comprises other agencies that play a key role in the urban water sector including the Department of Premier and Cabinet, Treasury, the Department of Environment, Climate Change and Water (responsible for environmental protection), the Department of Industry and Investment and the Department of Services, Technology and Administration.

The Committee oversees the development and implementation of the Metropolitan Water Plan (MWP) and further input is provided by the Metropolitan Water Independent Review Panel.

Department of Environment, Climate Change and Water

The Department of Environment, Climate Change and Water (DECCW) is the lead NSW Government department with responsibility for protecting and caring for the environment, managing water resources and developing and coordinating programs to address the impacts of climate change in NSW. DECCW oversees the delivery of climate change adaptation , greenhouse gas reduction policies and programs and energy efficiency programs for NSW. These involve communities, local councils, and business and government agencies working together to minimise the impacts of climate change.

DECCW has programs to encourage sustainability through environmental education, and grant and incentive programs to reduce or more efficiently use resources including water. Grant programs include the Climate Change Fund which includes various rebate schemes for water savings initiatives and the Environment Trust. Funding is available for initiatives such as stormwater harvesting and sewage effluent recycling.

DECCW is also the environmental regulator of the water authorities and local water utilities.

NSW Health

Drinking water and water that comes into contact with people should be safe to use. Water also needs to be available in sufficient quantity so that it promotes good health and

hygiene. NSW Health is involved in developing various standards for water quality for these different purposes:

- Drinking water quality – NSW Health is involved in drinking water quality monitoring programs to ensure the availability and adequate supply of water for drinking, food preparation and personal hygiene;
- recreational water quality where lakes, dams, rivers, streams and beaches/ocean may be used for recreational purposes;
- Swimming pools and spa pools water quality – NSW Health provides guidelines to control the public health risk associated with public swimming and spa pools; and.
- Household water quality – NSW Health provides guidelines and accreditation for wastewater and sewage to safely reuse wastewater for toilet flushing, clothes washing, general household cleaning, fire fighting, garden watering and car washing.

Department of Planning

The Department of Planning is responsible for land release and coordinating provision of services in growth centres. The Department is also responsible for development and implementation of BASIX, which reduces demand for potable water in new homes by up to 40 per cent.

National policy processes

Since the signing of the NWI in 2004, the Commonwealth Government has become a more active stakeholder in the urban water sector. The National Water Commission is a major stakeholder with a work program that encompasses a wide range of urban water issues and related processes. The Murray Darling Basin Authority has a key role to play in relation to non-metropolitan urban water.

The development by COAG of the enhanced urban water reform agenda in 2008 and the biennial assessment of the NWI are important factors driving the wide range of inquiries and work programs currently underway.

Other studies are being progressed by Infrastructure Australia and the Committee for the Economic Development of Australia.

The urban water sector in non-metropolitan NSW

Urban water supply and sewerage services to the 1.8 million population in urban areas of non-metropolitan NSW are provided by 104 non-metropolitan LWUs

The annual revenue of the utilities is around $950 million and the current replacement cost of the infrastructure employed is almost $20 billion.

The NSW Minister for Water oversees the performance of the non-metropolitan local water utilities (LWUs). The major instruments used by the Minister in this role are NSW Government's *Country Towns Water Supply and Sewerage Program*, sections 283 to 322 of the *Water Management Act 2000*, and sections 56 to 66 of the *Local Government Act 1993.*

Country Towns Water Supply and Sewerage Program

The Country Towns Water Supply and Sewerage Program aims to assist the LWUs to achieve appropriate, affordable, cost-effective and sustainable water supply and sewerage services[5]. The NSW Office of Water manages the Program.

The Program oversees and monitors the performance of the LWUs. It also builds local water utility capacity to achieve best-practice through statutory approvals, provision of guidelines, manuals, software, expert advice, technical assistance, inspections and training, and financial assistance towards the capital cost of backlog water supply and sewerage infrastructure, as at 1996[6].

The two major aspects of the Program are the *NSW Annual Performance Monitoring System* and the comprehensive *Best-Practice Management of Water Supply and Sewerage Guidelines*[7] .

The *Performance Monitoring System* has been in place since 1986 and comprises:

- An annual *Performance Monitoring Report* which discloses the Statewide performance, interstate comparisons and key performance indicators for all NSW water utilities. In addition, the comprehensive annual *Benchmarking Report* provides the full suite of performance indicators and enables each utility to monitor trends in its performance indicators over the last six years and to benchmark its performance against that of similar utilities.
- A separate annual triple bottom line *Performance Report* for each NSW utility, which shows the utility's performance for over 50 key performance indicators. Each utility is required to review its *Performance Report* and prepare an annual *Action Plan to Council*.

Best-Practice Management of Water Supply and Sewerage Guidelines

In its *Pricing Principles for Local Water Authorities 1996,* the Independent Pricing and Regulatory Tribunal (IPART) sets out the overall framework for pricing and cost-recovery for water supply and sewerage services by the LWUs . The principles address the requirements of the Council of Australian Governments' *Strategic Framework for Water*

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[5] Appropriate, affordable and cost-effective water supply and sewerage services in urban areas of non-metropolitan NSW which meet community needs, protect public health and the environment and make best use of regional resources (Program Goal).

[6] In addition to meeting all operation, maintenance and administration costs, the NSW utilities are required to meet the full capital cost of all renewals, as well any infrastructure required to serve growth since 1996 or to provide improved standards since 1996.

[7] The Best-Practice Management Guidelines, the Integrated Water Cycle Management Guidelines, the 7 IWCM Information Sheets, the annual NSW Water Supply and Sewerage Performance Monitoring Reports and Benchmarking Reports and the Liquid Trade Waste *Regulation Guidelines* are available on the NSW Office of Water website (www.water.nsw.gov.au).

Reform and they are embodied in the NSW Government's *Best-Practice Management of Water Supply and Sewerage Guidelines (2007*). :

NSW Office of Water guidelines require each LWU to consult its community on the levels of service to be provided for water supply and sewerage services. Services must comply with regulatory requirements (environment, health, occupational health and safety, dam safety etc) and provide the levels of service the community wants and is willing to pay for. Each LWU is required to prepare a strategic business plan, including a 20 to 30 year financial plan, an asset management plan and an operation and maintenance plan.

The existing 'light handed' regulatory framework in non-metropolitan NSW is based on the *Best-Practice Management of Water Supply and Sewerage Guidelines*, which build on the *IPART Pricing Principles.* The Guidelines set out key criteria which LWUs should meet to achieve best-practice:

- Strategic Business Planning and Financial Planning;
- Pricing and regulation of Water Supply, Sewerage and Trade Waste (including pay-for-use water pricing[8], full cost recovery, commercial sewer usage, trade waste and developer charges and a trade waste regulation policy);
- Water conservation and demand management[9];
- Drought Management;
- Performance Monitoring; and
- Integrated Water Cycle Management.

The Guidelines were revised in August 2007. They will be updated regularly.

Integrated Water Cycle Management

Integrated water cycle management (IWCM) is the integration of urban water supply, sewerage and stormwater services. This requires that water services be managed sustainably and with due consideration of natural processes, other water users (including the environment) and broader catchment issues. It also requires evaluation of a broad range of scenarios on a rigorous triple bottom line basis involving environmental, social and economic considerations, together with extensive community involvement.

The utility can thus identify an optimal 30-year IWCM strategy, which would include consideration of opportunities for water recycling, stormwater harvesting, water sensitive urban design and the use of sources such as rainwater tanks. The IWCM scenarios must be evaluated on a rigorous triple bottom line basis to determine the scenario which provides the best value for money on the basis of social, environmental and economic considerations. The strategy must be reviewed and updated by the utility every six years.

In examining options for development of water supply and sewerage systems, all available options must be considered, unless demonstrably inferior. Further information is available at www.water.nsw.gov.au.

NSW Reference Rates Manual

The NSW Office of Water published the *NSW Reference Rates Manual for Water Supply, Sewerage and Stormwater*, which provides comprehensive unit rates for estimating the current replacement cost and the fair value of a utility's water supply, sewerage and stormwater infrastructure. The unit rates in the Manual have been developed on the basis

[8] NSW water utilities which comply with the water supply pricing requirements of the *Best-Practice Management Guidelines*, also comply with the *National Water Initiative Pricing Principles,* which were released in April 2010.

[9] Table 8C on page 146 of the *2008-09 NSW Water Supply and Sewerage Benchmarking Report* discloses the water conservation initiatives implemented by each NSW local water utility.

of comprehensive NSW data from competitive tendered prices for such infrastructure. The Manual has been used extensively for asset valuation by the NSW utilities and is suitable for use/adaption by other states. A new Manual which takes account of recent tendered prices is being developed for release in early 2011.

Climate Change

The NSW Office of Water is finalising a pilot study on assessing the impact of climate change on the security of 11 urban water supplies in non-metropolitan NSW. Guidelines for the NSW utilities are being prepared for assessing water supply security with climate change along similar lines to that carried out in the pilot study. Future IWCM Strategies prepared by LWUs will need to include assessment of climate changed secure yields in accordance with the new guidelines.

Security of supply

Water supply headworks in non-metropolitan NSW are sized using the NSW Security of Supply basis to ensure that, in the event of droughts of similar severity to those which have occurred since the 1890s, the utility will be able to maintain water supply services without the need for drought restrictions of an excessive duration, frequency or severity.

Appendix 3

The Metropolitan Water Plan – 2004, 2006 and 2010

The Metropolitan Water Plan (MWP) is the overarching strategy that secures the water needs of greater Sydney – both for people and the environment. This appendix provides further information regarding the evolution of the MWP since 2004.

The MWP was first released in 2004 in the face of deepening drought. It was the first time that the NSW Government had developed an integrated whole of government policy to secure the water needs of the greater Sydney metropolitan area both in drought and for the longer term. The selection of measures in the plan was informed by analysis of a wide range of supply and demand side measures which were ranked by reference to their levelised cost. Multi criteria analysis was also used to incorporate environmental and social impacts in the choice of measures.

The 2004 Plan was revised as the drought continued and the twin objective of managing growth and securing supplies in drought was further developed. The 2006 Plan moved away from the previous plan's focus on the levelised cost of individual measures and instead focussed on selecting a least cost *portfolio of measures*. Under this approach, individual measures that have higher unit costs can nonetheless play a valuable role in securing overall water needs at least cost. The focus is on how best to integrate the different types of measures to minimise costs to the community.

Individual measures within a portfolio have different characteristics. Some options (such as desalination, inter-basin transfers and – if built in future – groundwater pumping) lend themselves to operating in response to changing storage levels. Other measures (such as demand management and recycling) often involve smaller increments of water saved or substituted and these increments need to build up over time in order to make a significant contribution to the supply demand balance. In addition, measures such as demand management require substantial institutional capacity which, to a significant degree, needs to be maintained over time – not switched on and off in response to changing storage levels.

Consistent with an integrated water cycle management approach, several measures in a portfolio may have multiple objectives. For example, stormwater harvesting and reuse schemes may be designed to address local flooding and water quality concerns, as well as delivering benefits in terms of potable substitution. Similarly, large scale recycling schemes (such as that at Rouse Hill in Sydney) contribute to achieving river health outcomes by reducing effluent loads discharged by STPs. As such, optimising the mix of measures in the portfolio entails a complex range of considerations and objectives.

Using this portfolio approach, combined with 'real options' analysis, the 2006 Plan identified the Government's preferred portfolio of measures to meet Sydney's water needs in drought and for the longer term. Key measures included water from dams, water conservation, recycling, drought restrictions, and 'readiness strategies' relating to desalination and groundwater.

Readiness strategies involve investing in preparatory work in order to shorten the lead time required to deploy new measures such as desalination and groundwater pumping (for example by acquiring sites, undertaking blueprint planning, obtaining planning approvals). By reducing the lead time in this way, it becomes possible to deploy such options once drought conditions emerge rather than pre-emptively. This in turn reduces the probability of having to invest in the option. Some describe such options as 'virtual water' (ie water options that, while still unbuilt, boost system capacity and diversity).

The Issues Paper asks on p19 whether there is scope to increase the efficiency of supply augmentation planning and decision making. In response, the NSW Government notes that the inclusion of readiness strategies in the 2006 Plan represented an important efficiency gain. The decision to defer construction of the desalination plant until storages

reached critical levels, rather than build it pre-emptively, was estimated at the time to save in the order of $1 billion. For further information regarding estimated savings see the independent expert analysis undertaken to inform the 2006 Plan, available online at the NSW Government's Water for Life website.

The 2006 Plan also emphasised the importance of adaptive management and the benefit of retaining flexibility by proceeding carefully where investments may preclude other options in future. The Metropolitan Water Plan is reviewed every four years to ensure that it continues to reflect changing circumstances, advances in technology, new information about water demand, climate change research, recent hydrological patterns and community views.

The 2010 Plan was developed using financial and economic analysis which combined quantitative cost effectiveness analysis (including costing the impact of temporary drought restrictions and some environmental impacts) and qualitative analysis of non-costed environmental impacts and social impacts. A document outlining the process for developing the Plan is available on line, as is the cost effectiveness analysis that underpins the Plan.

As with the 2006 Plan, the approach underpinning the analysis for the 2010 Plan was to develop and analyse portfolios of water supply and demand management options (rather than individual measures) to take account of the interactions between different measures.

Various portfolios were assessed under thousands of possible rainfall and inflow scenarios, including a drought more than twice as severe as the recent drought. In an extension of the 2006 approach, the portfolios that performed well were assessed in greater detail using a cost effectiveness analysis, which compared and ranked portfolios, based on their total financial, economic, social and environmental costs and their ability to provide a secure and reliable water supply. Where social and environmental impacts could not be monetised they were subject to qualitative assessment by panels of experts. Development of the 2010 Plan was also informed by two rounds of community consultation.

The 2010 Plan sets out how the desalination plant will be operated (namely, the plant will operate at full capacity when storage levels fall below 70 per cent and continue until storage levels exceed 80 per cent). It also retains the readiness strategy approach in the 2006 Plan. Options that could be deployed in the event of future severe drought include augmenting the capacity of the Sydney desalination plant, accessing groundwater to boost supplies on a temporary basis, and implementing voluntary usage targets.

The 2010 MWP is available on line at the NSW Government's Water for Life website here.

Appendix 4

Climate change studies relating to the urban water sector in NSW

A number of studies have been undertaken or are underway to improve understanding of the projected impacts of climate change on the urban water sector in NSW. Presented in this appendix is further information regarding:

- a major collaborative study that examines the impact of climate change on water supply and demand in greater Sydney, and
- an initiative to examine projected climate change impacts on the eastern seaboard.

A pilot study has also been undertaken to examine possible climate change impacts on water availability in non-metropolitan NSW.

Climate change and its impact on water supply and demand in Sydney

To better understand the projected impacts of climate change on water supply and demand, the NSW Government undertook a collaborative study with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Australian Government Department of Climate Change and Energy Efficiency, the Sydney Catchment Authority (SCA), Sydney Water and the University of NSW (UNSW).

The objective of the study was to

- investigate if the recent climate fluctuations in Sydney fall within the instrumental record of natural climate variability or whether they can be attributed to the effects of climate change
- downscale climate change projections to the regional scale for use in hydrological modelling, and to assess the changes in the rainfall, temperature and evaporation that may occur under a range of future greenhouse gas emission scenarios (ie the Intergovernmental Panel on Climate Change greenhouse gas emission scenarios known as B1, A1B and A2)
- use regional climate change projections to estimate climate change impacts on inflows and water availability under a range of greenhouse gas emission scenarios
- determine the likely urban water demand for Sydney under a range of emission scenarios, improve knowledge of the link between key climate variables and demand, and understand the potential impact of climate change for future drought response initiatives

A ground breaking part of the study was to examine the projected impact of climate change on both supply *and* demand at the regional or catchment level.

The scientific methodologies used and developed in this study were based on the best available information in Australia at the time. The outcomes have provided a good basis for investigating climate change impacts on water supply and demand and, as the science and modelling capabilities improve, so too will the information available for assessing these impacts.

'Downscaling' techniques were used by UNSW to transform the coarse resolution global climate model (GCM) outputs from a model known as 'CSIRO Mk3' to a finer spatial scale (around 5km x 5km, or at point locations). The statistical downscaling framework developed by UNSW (Mehrotra and Sharma 2010) consisted of daily mathematical models for rainfall occurrences, rainfall amounts (volume), temperature and pan evaporation based on daily atmospheric variable outputs from the CSIRO Mk3 model. As the 'skill levels' of GCMs for rainfall prediction are low, the downscaling method for this

study used variables (other than rainfall) that are predicted well by GCMs, such as temperature and surface pressure.

The downscaled rainfall and evaporation data was put into the SCA's rainfall/run-off model, Hydrological Simulation Program-FORTAN (HSPF), to generate the run-off data. This model was used to estimate streamflows from rainfall and evaporation data. The model allows for rainfall distribution within the catchment based on soil infiltration rates, vegetation holding capacity, root depth and transpiration rates, return of flows to streams (base-flow) and flows to the deeper groundwater aquifers. Soil moisture accounting in a continuous timescale is of paramount importance for the prediction of inflow changes during periods of drought.

The SCA developed and calibrated four HSPF models to represent the main water supply catchments. Each of these models has sub-catchments within them to allow adequate representation of the spatial variation in meteorological, geological and topographical conditions. A time series of rainfall and evaporation provides the temporal variation.

The run-off and evaporation data from HSPF was then fed into the SCA's water supply system simulation model, Water Headworks Network (WATHNET), to estimate the impacts of climate change on water supply availability under a range of greenhouse gas emission scenarios.

The downscaled data was also used by Sydney Water in their demand model to determine future climate change impacts on urban water demand. This model was built using the relationship developed in the study between key climate variables and the water demand of individual sectors (single residential, multi-residential, industrial, commercial, primary produce, government and others). To capture the spatial variation of climate in the Sydney region, the demand model was divided into 14 water supply zones.

To produce monthly demands for each end use sector in each supply zone, a range of data was included in the model – including population projections, dwelling type projections, savings from water conservation programs, climate conditions from various emission scenarios and the relationship between demand and climate variables for each sector in each water supply zone.

The possible impact of climate change on demand was estimated by calculating the difference in demand between future greenhouse gas emission scenarios and the current climate scenario in a given year.

Impacts on demand

The results of the study show that the increase in average demand due to climate change is relatively small, about 1.1 per cent by 2030 (6.2GL) and 3.0 per cent (25.1GL) by 2070 under a medium to high emission scenario (A2).

The highest increase in average annual demand due to climate change (~25GL/year in 2070, under the A2 emission scenario) is much less than the estimated range for natural variability in water demand (52 GL/year in 2030 and 73 GL/year in 2070) under the A2 scenario. That is, the increase in water demand for Sydney is projected to be influenced more by natural climate variability than by human induced climate change impacts.

Impacts on supply

The study is the only report to date that provides a detailed projection of the impacts of climate change on rainfall, run-off and inflows to the Sydney Water supply system. A modified system yield (system output) was used to determine yield changes.

On average it is forecast that there will be a reduction in system output for both 2030 and 2070, however there is considerable uncertainty surrounding the projections. The projections indicate a decrease in annual rainfall and runoff in the inland catchment and minor increase in the metropolitan catchment by 2030.

Further work is required to improve the capacity of current models to project climate change impacts on future water availability. In particular, current models have limited ability to model 'low frequency persistence' (ie extreme events like droughts and floods). Given the importance of understanding potential changes to extreme events, this is an area where further nationally coordinated research would be valuable.

The Eastern Seaboard Climate Change Initiative:

The Eastern Seaboard Climate Change Initiative (ESCCI) is a cooperative research consortium addressing information gaps about Australia's east coast, ranges and inshore marine climates. ESCCI will provide much needed information about the area of land between the Great Dividing Range and the coast of New South Wales and southern Queensland, which is home to more than nine million people. This area suffers from extreme weather, including damaging winds, flooding, hail, heavy seas and swell, which affects the State's key infrastructure and communities. Rainfall in the area also plays a critical role in NSW water supply systems, filling dams and supplying base flows for inland river systems and groundwater recharge. However, the climatic processes in this part of Australia are the least well-understood in terms of climate change and its impacts.

ESCCI will combine the resources of government and non-government research institutions to build understanding of how climate change will affect this important region. ESCCI will provide this information for key sectors such as health and urban planning, emergency and bushfire management, coastal management, agriculture, and infrastructure and utilities, including water, energy and transport.

The parties involved in this Initiative include the Bureau of Meteorology, Sydney Institute of Marine Sciences, NSW Government and the University of Newcastle, Macquarie University and the University of New South Wales. Other partners will be invited as the initiative expands.