Introducing competition into urban water networks: virtual water suppliers and enhanced third party access

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Working Draft

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Abstract

This paper discusses an institutional approach to bring market competition to the provision of bulk water supply in urban settings. The proposal involves periodically allocation (e.g. by auction) of existing water stock held in urban reservoirs to virtual water suppliers (VWS) who then compete in the provision of bulk water. The approach aims to address concerns over inefficient pricing under the current arrangement. Competition is also improved by enhanced third party access, which would give appropriate incentives for further investment in urban water infrastructure. The paper discusses many of the implications and design considerations.

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1. Introduction

In recent years there are growing concerns about the availability and sustainability of water supplies in all mainland Australian capital cities. For instance, water storages for Sydney have remained low since 2002. The long term growth in the use of water is such that, without significant rainfall, some cities will run out of water in a matter of a few years. A common response to this 'water crisis' by state government authorities has been one typically advocated by economists: it is to impose increasingly severe water restrictions rather than use price signals. Although these water restrictions have appeared to reduce water use in the short term, long run trends in demographic growth suggest that eventually water use will outstrip supply. This is particularly concerning given the relatively modest and slow investment in augmentation of the water networks.

In public debate the current drought is blamed for this state of affairs. Poor policy, investment planning and pricing associated with the current institutional structures have not come under significant popular scrutiny. It is the contention of this paper that the current 'crisis' is due to poor incentives facing water utilities and regulators, which has led to the current crisis. It proposes an alternative market regime for urban water which provides agents with the incentives to avoid similar crises in the future.

The current institutional arrangements encourage the politicisation of water provision. Both the water authorities and regulators do not have sufficient independence from governments. Governments unwilling to price properly, have an incentive to price so as to subsidise the median voter. Similarly, subject to pressure groups regarding infrastructure development: e.g. recycling vs desalination in Sydney. There is also a tendency for government to take short term view of returns to water authorities. Implies under investment in urban water infrastructure.

~~The major challenges to an efficient outcome under the current arrangements appear to be two fold. Firstly, there is the complexity in determining an efficient price. An appropriate price needs to take account of future demand, the erratic Australian rainfall patterns and the potential for alternative sources of supply such as recycled water plants and salinity plants. Secondly, there is a political challenge. In preference to raising water prices in the short term Governments can too easily defer the problem.~~

The currently regulatory regime has not yielded sufficient price flexibility and competition in urban water provision. The reforms that have occurred under NCP beginning in the 1990s have been insufficient and ineffective. They have not removed water provision from vagaries of government influence. The main impact of NCP reforms is that most urban water authorities are now providing taxpayers with market rate of return. There has been some movement toward volumetric pricing, thought such volumetric charges are not economically efficient.

Conventional wisdom sees urban water networks as natural monopolies, and therefore appropriate candidates for government ownership and regulation. In this view the market would not efficiently provide water, with a monopolist pricing excessively to maximise profits. This conventional view is challenged by recent movement to private water concessions in many countries.

In this paper we describe a competitive market mechanism that, in contrast to the popular view, can be readily introduced into Australian urban water provision. In doing so, market mechanisms can be invoked to provide adequate and reliable water supplies at an efficient price. The implication of the analysis is that the current water crisis is due to poor institutional arrangements adopted in urban water provision.

The paper proposes consideration of establishing virtual water suppliers (VWS) to provide competition with the existing providers of bulk water. This proposal calls for a decoupling of infrastructure control and ownership of water. In particular, it is suggested that management of dams be separated from the ownership of water stored there. Note it is also possible to separate ownership and management of dams, with government retaining ownership, but management being contracted to private operators. We assume dam remains in government ownership with regulated operating, storage and extraction costs.

Suppliers of bulk water sell water in a bulk water market to distributor/retail firms. Retailers must contract with the operators of the reticulation network operator to move bulk water from it place of storage/treatment to consumers.

We suppose the reticulation network infrastructure is operated by a corporatised government business enterprise. Retailers <water owners?> would have to pay a fee for pumping and treatment. These fees are regulated

Although NCP reforms call for third party access to government controlled infrastructure, this has not occurred in the urban water market. Furthermore restrictions can impose significant costs on society.[1] In parallel governments are evaluating substantial investments in alternative water provision such as recycled water plants and desalination plants. These investments are themselves the subject of significant controversy.

Entry of new privately owned suppliers – recycling and desalination plants to supplement dam water. These entrants could be required to auction off future supply (as with VPP). However there is probably sufficient competition from VWS to make this unnecessary.

Together VWS and third party access (new entrants) should provide sufficient competition in supply of water to ensure efficiency in the long run

This paper is divided into 4 further sections. The following section provides a background that describes the typical Australian urban water supply system and current regulatory and pricing arrangements. Section 3 describes the details of the proposed changes to introduce a competitive water market. Section 4 considers the issue of pricing access to infrastructure under the proposed regime. Section 5 concludes the paper.

[1] These costs include significant deadweight losses. See Mansur and Olmstead (2006) for an estimate of deadweight loss associated with water restrictions in urban areas in North America.

2. Current water supply and pricing arrangements

In Australia urban water supply falls under the legislative control of state governments. Unsurprisingly each state has its own idiosyncratic institutional arrangement for urban water supplies. However since the mid 1990s there has been a broad common approach to urban water provision across the states. Typically <semi?> corporatised, government-owned, water monopolies supply treated water to major metropolitan areas. Pricing and quality oversight is provided by a regulatory authority. For instance, in NSW IPART provides regulatory oversight of Sydney Water and the Sydney Catchment Authority. Investment decisions remain with the water authority under government supervision.

The typical Australian urban water supply system is depicted in Figure 1 below. The primary supply of urban water supply typically involves the collection of water from surface catchments where it is then stored in dams or reservoirs. Water may also be abstracted from ground water basins or potentially extracted from sea water using a desalination plant. From the primary supply water is then pumped to a Water Treatment Plants (WTPs) where it is treated and then delivered to the end users directly or via bulk storage facilities. Waste water from the end users is captured and treated before discharged or recycled for further use.

In Australia there is a small amount of recycling of water. There is also increasing discussion of the development of desalination plants. Water from primary supplies may also be diverted to non-urban water uses such as irrigation or for environmental release purposes.

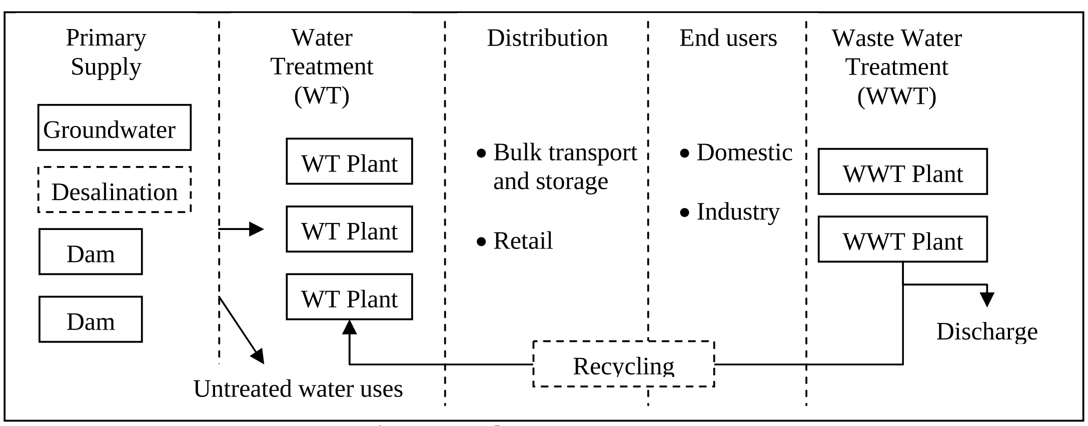

Figure 1: Urban Water System

Adapted from NWI Steering Group on Water Charges (2007)

The supply of urban water typically involves large fixed costs, small variable costs and fixed capacity in the short term. There are significant fixed costs in building infrastructure (e.g. dams, treatment plants and pipe networks) and ongoing maintenance and administration. The variable costs primarily include some costs associated with the cost of pumping, treating water and the opportunity cost of the alternative uses including irrigation or for environmental purposes. There are capacity constraints in both the treatment and distribution and in the bulk supply. In terms of bulk water supply, which is the focus of this paper, the capacity constraint relates to capacity of the reservoirs and the associated available stock of water.

There is significant state ownership and regulation in the primary supply and treatment and distribution of water. Urban reservoirs are typically considered natural monopolies with a unique catchment area. Similarly due to the network infrastructure the water treatment and distribution is also typically state owned and regulated.

In most Australian jurisdictions the process of primary supply (the water catchment) and the process of treatment and distribution is separately managed and regulated from other sections of the value chain. For example in Sydney, the Sydney Catchment Authority (SCA) operates a number of dams. The SCA sells bulk water to Sydney Water who manages the water treatment distribution and the waste water treatment. The prices at which bulk water is sold by SCA and the price at which Sydney Water services are both regulated by IPART.

In Australia, the pricing regulations and their implementation vary by state. In general regulators pricing is established to meet objectives of efficiency and of cost recovery. Pricing is generally set to include a fixed user charge and a volumetric charge (i.e. a unit charge). As discussed in Sibly (2005) the volumetric charge is generally calculated first and then the fixed charge calculated so as to meet cost recovery objective.

The appropriate pricing for water has been significantly debated. This debate has largely centred on the appropriate volumetric charge for water. For allocative efficiency the volumetric charge should be established such that the price of a unit of water equals its marginal cost (including external costs). Debates have emerged as to what is the true marginal cost of water and in particular the distinction between the short run and the long run marginal cost. In the short run, the marginal cost of water provision of bulk water is very low up until a capacity limit.

Not surprisingly, the water crisis has been accompanied by a call from many economists for using price measures to address the shortage. Nearly all urban water use is metered and charged subject to a volumetric rate. Charging a rate which takes account of the future is likelihood shortage is thus potentially simply implemented. An effective price solution would provide market incentives for investment in new infrastructure.

If the existing catchments were sufficient to meet future demands then the short run marginal cost and the long run marginal cost of water in a dam would be close to zero. Unfortunately due to growing demand and variable weather, the long run marginal cost of the water may be significantly more. In many areas existing catchments are not sufficient and eventually new very expensive alternatives will need to be developed.

It appears likely in the near future existing capacity in many urban areas will be exhausted and new infrastructure will be required. In addition to demand management methods, such as water restrictions, Governments are considering new infrastructure investments in desalination or in recycling.

Many commentators have been raised concerns about the management of urban water. A common concern is that pricing is too low and does not adequately reflect the long run marginal cost of water supply. The alternative demand management policy of water restrictions is recognised as imposing significant costs on those who place greater value on water. There are significant debates also over the need and timing of investment in alternative water infrastructure.

The concerns raised over the current management of bulk water supply could be largely addressed if there were a competitive market for the supply of bulk water. If such a market existed then the market price of water would quickly adjust to a level that adequately reflected available knowledge on long term supply and demand and the need for price regulation would be limited to other functions of the water supply system. Furthermore competition would result in the potential for private investment in new infrastructure for water supply.

There have been a number of attempts to develop markets for water in Australia (see ACIL Tasman (2003) for a summary). Many of these existing and prospective approaches have focussed on the rural and industrial markets and for trading between urban and non-urban uses. We are unaware of any proposal that create competitive markets for urban water usage.

3. Competition in the short run: virtual and actual bulk water suppliers

The approach considered in this paper is to introduce competition into bulk water supply by separating the ownership of water from ownership of infrastructure. Rights to portions of the water stock in the water catchment dams are to be allocated to new owners. This would in effect create virtual water suppliers (VWSs) who would then compete with each other, and possibly also the incumbent physical supplier, in the provision of bulk water. Through competition the spot price for bulk water to be supplied from each dam would come to reflect the opportunity cost of keeping the water to meet future demand.

Although we are unaware of any previous proposals for this approach, the approach has similarities with capacity share schemes for water markets and similar virtual schemes established for electricity markets.

A capacity share scheme effectively establishes that users with water entitlements to a share in a water resource. Systems of water accounting keep track of the volume in each individual's users share. Such a system has been established for users of the St George Water Supply Scheme in Queensland and was recommended by ACIL Tasman (2003) as an area for consideration. The key distinction between this proposal and existing capacity share schemes is that this proposal establishes virtual suppliers independent of users to establish a market price for bulk water.[2]

The general approach, and the term Virtual Water Suppliers, is similar to the concept of Virtual Power plants (VPP) that are used in the electricity industry. Virtual Power Plants (VPPs) have been implemented by European regulators as a means of mitigating market power.[3] Effectively these involve requiring the incumbent power plant to sell part of its future production capacity. The sale of the capacity is virtual as no production capacity changes hands. The VPPs, the virtual owners of the future production capacity, compete in the provision of electricity with the physical owner of the power plant. Competition from the VPPs mitigates the physical power plant's market power and encourages more allocative efficient pricing.

A virtual arrangement is possible because, like electricity, water is a commodity whereby each unit is indistinguishable from other units. In addition, there are some characteristics of the water industry that make it more conducive to the use of virtual suppliers to manage market power and introduce competition.

Unlike electricity, water is very durable has very low marginal storage costs (discussed in the next section below). The high storage costs of electricity mean that electricity is generated to

[2] Other distinctions discussed later in the document.

[3] For a discussion of Virtual Power Plants and their use in Europe see Willems (2005).

meet current demand.[4] In contrast water is collected significantly in advance of its consumption. Many Australian cities need to store water for long periods because of erratic rainfall patterns. This characteristic means that whereas Virtual Power Plants need to be allocated a level of future production capacity, in the case of water, Virtual Water Suppliers could be allocated a portion of the stock of existing water supply. It would also be possible to allocate a portion future catchment inflow (analogous to production) but as discussed below this is not necessary and may be not desirable.

Another common feature of the water industry is that the water suppliers have very large dams which can meet the demands of existing users for substantial periods of time. This feature allows sufficient stock to be allocated to Virtual Water Suppliers such that no single supplier, including the incumbent, is required to meet the demand for a reasonable period of time. If this were not the case the largest supplier could have some market power as in any trading period they could hold back supply to obtain a higher market price.

The durability and large stocks of water also means that unlike electricity markets water pricing does need to be established for small intervals. In Australia offers of supply to the National Electricity Market are made every 5 minutes so as to match generating capacity with fluctuating demand throughout the day. Due to the high storage costs and fluctuating demand the wholesale price of electricity fluctuates significantly.[5] As discussed below, even though water demand may fluctuate, due its low cost of storage the market price for water is unlikely to fluctuate significantly over time.

<u>The High Level Market Process for bulk water</u>

A potential high level operational process covering the allocation, trading and execution is depicted in Figure 2 below.

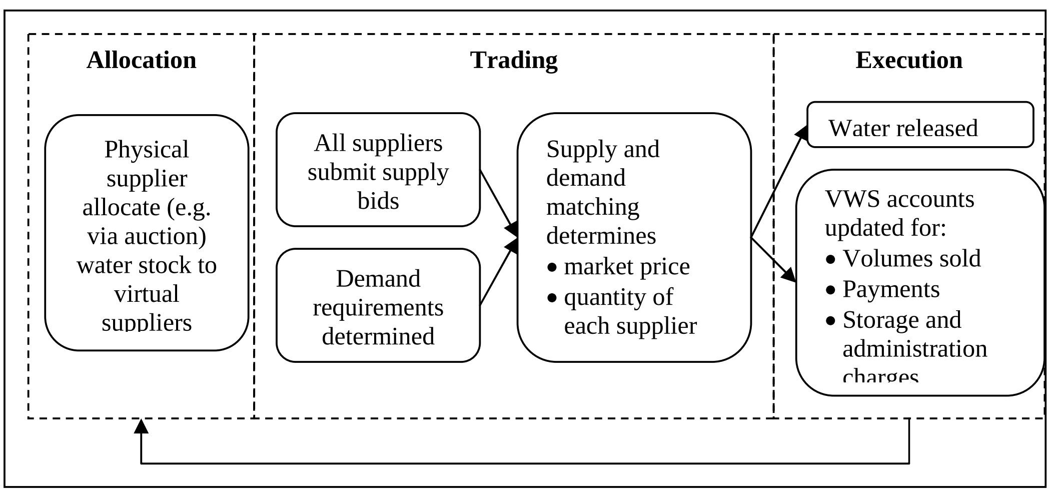

Figure 2: The Operational Process

<figure 2 needs to be re-cast to reflect entire water network and ownership.>

[4] Electricity is commonly described as a commodity which 'cannot be stored for future use' NEMCO (2005), pg. 4 but as described by Hunwick (2005) there are a variety of alternative, albeit expensive storage options.

[5] The National Electricity Market Management Company, NEMCO reports Regional Reference Price (RRP) for NSW and other regions. According to NEMCO price tables the from1 -23 March 2007 the daily average RRP for NSW varied from $27/MWh to $128/MWh with a peak as a high as $178/MWh

The allocation process involves requiring the incumbent physical water supplier to allocate virtual portions of its existing water stock to new suppliers. New owners of the rights to the water stock effectively become the Virtual Water Suppliers (VWS). Each VWS would have an account which specifies their volume of the stock of bulk water available for distribution.

A simple auction process (similar to that used to establish Virtual Power Plants of for auctioning of other commodities) could be used to allocate water stock. Given the commodity nature of the water an auction process could be conducted reasonably efficiently and simply with few restrictions on participants.

At the beginning of the trading process each supplier (including the incumbent physical supplier) has a water account simply describing the stock of water held by the VWS at each dam. To start trading each supplier (each VWS and the incumbent) decide for the trading period how much of their water account they wish to sell and at what prices. The trading process could be similar to that of electricity generators selling into the wholesale electricity market.

A water market management organisation (potentially similar in function to the National Electricity Market Management Company, NEMCO) would be responsible for matching supply and demand using the supply bids and the demand requirements. The demand requirements could be determined by this market management organisation or potentially with by the water distributor(s) e.g. Sydney Water (As discussed below regulator involvement is still likely to be necessary in establishing prices for water distribution). The market matching process would determine the quantity of water sold by each supplier and the market price.

Execution would involve release of the bulk water and administration of the supplier accounts. In execution there is no further requirement for activity by the VWS. The quantity sold by each VWS would simply be updated against each VWS's account. Water not sold by a supplier would be retained in the bulk water supply and recorded against the supplier's water account. Each VWS's water and financial account would be updated to reflect the quantities sold and retained and the marginal storage and administration costs.

The allocation process and trading processes are then continually repeated (and potentially undertaken in parallel).

The following section considers the implications of the approach and a number of design considerations.

Other Market Design considerations

While relatively simple in operation, there are a number of market design considerations. These include:

- How much of available water stock should be allocated to VWSs?
- The length of trading period
- Should future flows (in addition to stocks) be allocated?
- ~~Consideration of storage and administration costs~~<treated below>

How much of the available water stock be allocated to VWSs?

A target minimum level of *private* stock is determined by the need to maintain a competitive market. To achieve a competitive market, an allocation needs to sufficient such that no single supplier has market power. This can be achieved by ensuring that for any trading period the mix of stock held is such that no single supplier is required to meet demand for the trading period. If this were not the case, the largest supplier may hold back on release so as to increase the market price.

There are a number of considerations as to the maximum amount sold-off. Firstly, to avoid potential complex compensation arrangements it would appear preferable to ensure that there is negligible risk of the physical supplier being unable to provide for the virtual suppliers stock. Secondly, the physical supplier has in effect a number of commitments it must meet. Environmental guidelines may require a minimum release of water each period. Furthermore, as discussed below the evaporation loss is best largely best borne by the physical supplier.

Additional stock would need to be allocated when the ownership mix of water stock risks falling to a point such that the incumbent has some market power. Some simple rules could be established to ensure this does not occur.

Length of trading period <this is unclear>

There is a degree of flexibility as to the length of the trading period used in pricing. A balance needs to be achieved. It is undesirable to have too short a trading round as there are administrative costs to the trading process. Too long a period may result in the largest supplier being required to meet demand and thus having some market power. Also suppliers being concerned over too much risk if they to commit large volumes for significant periods.

Allocation of future catchment flows

Potentially the incumbent (the owner of the catchment) could sell off shares of future catchment flows. Although this is possible, there appears no benefit to doing so over selling current water stock given the very low storage costs or simply future water stock (which is effectively the same as selling a fixed volume of future catchment). A potential problem with selling a share of future catchment flows is that it may weaken the incentive for catchment managers to improve the catchment.

~~*Implications*~~

~~*The proposed approach has a number of important implications for the pricing of water, efficiency of water allocation and the incentives for future investment.*~~

~~*The pricing of water*~~

~~*For a water supplier to be indifferent between selling water in the current period and holding onto the water for following periods it must be that:*~~

$$P_t = (E_t[P_{t+1}] - E_t[S_{t+1}])/(1+r) \qquad (1)$$

~~*Where:*~~

~~*P_t is the wholesale price of bulk water received by a supplier in period t; and*~~
~~*S_{t+1} is the marginal storage charge of holding the water from period t to period t+1*~~
~~*r is the interest rate*~~
~~*E_t is the expectations operator*~~

~~*The expected operator is applied to the future price and because of the uncertainty associated with storage costs the marginal storage charge S_{t+1}.*~~

~~*Equation (1) is a modified Hotelling Rule which takes into account the storage costs. There are a number of important implications of Equation (1). Firstly, for non-zero marginal storage costs the wholesale price of water is expected to rise by at least the interest rate. Although this is a result which in theory maximises social surplus, the result may be politically unsatisfactory. This relationship with the interest rate could be changed with a simple change in the billing and payments design. For example, the interest accrued on the proceeds of the initial auction could be credited onto the supplier's account until their water stock is sold.*~~

~~*Equation (1) also has implications for pricing once the development of alternative primary supply and pricing behaviour once alternative supply has been developed. Eventually the wholesale price will eventually rise to a point that alternative water supply arrangements are feasible. Once an alternative supplier is in place the inter-temporal pricing decision becomes interesting. <To develop>*~~

~~*A final implication is that we would expect the wholesale price to be reasonable stable over time. Assuming no changes in information prices in two periods will differ only by the rate of interest and the marginal storage costs (which as discussed below are expected to be small). Price fluctuations may occur as new information comes to light. For example, we would expect the spot prices to vary with changes in reported dam levels and even changes in forecasted weather. As discussed below we would expect marginal storage costs, S_{t+1} to be small.*~~

<I think this is for another paper.>

4. Access pricing for infrastructure

Infrastructure consists of storage and reticulation networks. Provision and use of these infrastructures imposes (fixed and marginal) costs.

<u>Dam and water storage</u>

Operators of dam could be thought of as providing storage services to the owners of water. The operators would charge both a storage and extraction cost. This raises the potential that operators could act as a monopoly and set excessive charges. One approach could be regulation – this is less likely to be politically sensitive than setting retail price of water. Thus regulation is more likely to be effective.

An alternative to regulation is to adopt some private sector participation in the management of infrastructure. For instance, they might be managed by delegation. A concession might be offered to private water firm to manage and charge for water storage. However dams have a social value beyond their value as water storages, thus there is a case for retaining them in government ownership.

Storage costs

Following the marginal cost pricing principle it is important that the VWSs are charged only the marginal cost of storage cost of each unit of water. There are three basic types of storage costs:

- Direct storage costs
- Loss from evaporation
- ~~Loss from risk of overflow/release~~ <overflow can simply be treated as un-allocatable inflow.>

Direct storage costs are those cost relating to the maintenance and operation of a dam. Although maintenance and operation costs of a dam are significant it is expected that these costs are primarily fixed and do not change with the level of water of in a dam. Thus the marginal storage costs (i.e. with respect to an additional unit of water) are expected to negligible. *Monthly storage rates per GL would be included as part of the initial contract arrangements.*

~~Evaporation is the process by which water is converted from its liquid form to its vapour form and thus transferred from land and water masses to the atmosphere.~~ Evaporation can be a significant cost removing up 10% of a water stock per year[6] and are routinely estimated at major dams.[7]

The volume loss from evaporation is expected to be will be largely independent of the volume supplied. The rate of evaporation depends on a number of factors including the weather[8] and the surface area of the water supply.

The decision of a VWS to retain an additional unit of water will only have a marginal impact on the surface area of the water supply. Due to the physical nature of dams the surface area of the dam increases with the volume in the dam. ~~Thus some, albeit very small, evaporation charge should be levied against the VWS~~. < I would argue there should be a loss of physical allocation due to evaporation. This loss could be included part of the initial contract arrangements.>

~~The final storage cost considered is the loss from overflow/release. If dam levels rise significantly the dam manager may be required to release water for overflow. This cost may seem unlikely given the shortage problem being considered. A question then arises as to how this impacts on VWS supply accounts.~~
~~<To consider further – key points>.~~

- ~~The marginal costs of holding water is high – in terms of that any additional water held will necessarily be lost~~
- ~~The value of the water being lost – will, given the state of the dam be extremely low if not zero – and thus the question of the allocation is moot.~~
- ~~A reasonable rule may be that loss from overflow/release be apportioned according to supplier volumes as the overflow is directly related to volume.~~

Extraction costs <was The total volume of available water>

There is a cost associated with the extraction of water from the storages.

This cost should be refected in a fee paid by water owners at the time of extraction.

~~The total volume of available water is an important concern for potential VWSs. The value of a VWS's stock is ultimately significantly determined by the total volume of available supply. If there were a limitless supply the marginal value of a VWS's water stock effectively becomes zero.~~

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[6] A rough estimation WA dam estimated evaporation rate at around 17gigalitres for a 200gigalitre dams so an evaporation rate of <10% per year

[7] For example see http://www.toowoomba.qld.gov.au/eBiz/artis/CressDam.php

[8] Evaporation rates increase with higher wind speeds, higher temperatures and lower humidity.

~~A challenge will be in determining what the total volume of available supply is.~~
~~There are a number of considerations. Firstly,~~ not all water in a dam is equal in quality and accessibility. The water residing at the bottom of dams is known as 'deep water storage'. This water is distinguished by being less accessible as it is usually at a point below where the water can be easily extracted via gravity. < is this true? what references? Increased access costs?>

By installing pumping or alternative access points this water may be made accessible.[9] In essence the available water in a dam may be increased but potentially at a marginal cost. 'Deep water' may also incur additional treatment costs as it may be considered an inferior quality of water.

Note that it potentially separate virtual 'deep water' accounts could also be allocated to VWSs and sold through a similar system.

~~A second issue in determining the total available supply relates to one of transparency of information. The scarcer capacity appears the higher will be the prices obtained from an auction. The catchments manager thus has incentive to make it appear that that the ultimate capacity is less than the true value and that incremental costs of additional catchments are greater. This incentive may be reduced if the auction proceeds did not flow to the physical supplier (or were used to merely offset the fixed charge).~~

~~Finally, this may be far from an exact science. Both the total volume of dam is unclear and the useable quantity may be unclear. Uncertainty is not a problem in itself. There are many more causes of uncertainties for the VWSs.~~

~~<Some other considerations to develop and incorporate>~~

- ~~To give VWSs some certainty a minimum dam level could be set, however~~
- ~~As the water level drops better information as to an appropriate level may become available~~
- ~~The true social cost of going beyond the limit will not be a discrete change but rather be a continuously increasing cost~~
- ~~Consider the scenario~~
    - ~~A minimum dam level is set.~~
    - ~~VWSs use this information to determine prices of supply~~
    - ~~The dam falls close to minimum level.~~
        - ~~Price of water sky rockets.~~
        - ~~As a result of Government pressure the regulator buckles and reduces the minimum level further.~~
        - ~~Presumably the VWSs could claim Government compensation~~

Secondary markets

There is potential for secondary markets for water to develop. Secondary markets would help bring liquidity to the market for supply of water and thus might be encouraged.

<expand or delete>

[9] For example, the Sydney Catchment Authority (SCA) is currently modifying existing and installing supplementary infrastructure to access 'deep water storage' at its Warragamba and Avon/Nepean Dams.

Special owners

It is often argued certain demand levels are required for the special needs of a fire service. To address this need a VWS account could be provided for the fire service. The fire service could be provided with an initial allocation. Additional allocation to fire fighting from each storage facility could be established using a market process.

<u>Reticulation and distributional infrastructure access pricing: Pumping and treatment costs.</u>

Management of the reticulation network could be undertaken either by a government business enterprise or by delegated to a private operator. In this case the reticulation and purification costs would be imposed by operator of network onto the water owner or retailer.

Regulation of network charges.

- pumping costs
- leakages
- Quality monitoring costs.

<u>Regulation of charges for infrastructure use</u>

The approach proposed in this paper does not remove the need for price regulation over the other aspects of the supply chain. Although there will be competition for water supply, the charges for infrastructure use are not set competitively. Thus, to achieve efficiency, and in the absence of a competitive, market based mechanism to set these prices, it will be necessary to regulate them. This will certainly be the case if the ownership and management of the dams and reticulation network remains with a government business enterprise.

Need a strong form of regulation of infrastructure operators. The regulator must be free of government and political influence.

Economic efficiency should be the only criteria for setting fees. Providing CSOs, such as lower rates to the poor, should be explicitly identified and paid for through general tax revenue.

< To expand>. Considerations

- The maintenance and operation of the dam costs which are largely fixed will still need to be recovered
  - if charged per unit volume they will increase as storage levels fall.
- Funds from auction could contribute to cost recovery of dam. The ~~fixed~~ user charge could still be used to make up the difference. <I think a fixed user charge would be anti-competitive. I don't think there is much efficiency loss due to average cost pricing for the dam.>
  - Under NCP the dam itself should make a normal economic rate of return (say 4 to 6%). Perhaps should treat this as an average, with high returns in wet years and low return in dry years. Much as any farm!!
- The volumetric costs with other aspects of the supply chain would need to added to the price of water at the dam to get the final volumetric charge.

The regulation of these charges could be conducted in much the same way as currently. A straight forward audit of costs will determine many of these charges.

5. Third party access, incentives for Private Investment, and long run price

To achieve efficiency in urban water provision it is necessary that there are appropriate incentives for future private investment in water supply infrastructure. It is proposed that there is enhanced third party access to the existing water network, subject only to appropriate controls on water quality.

There are three issues in regards to incentives that lead to efficient private provision of:

1. a competing water supply into a competitive market e.g. a desalination plant
2. improvements in catchment / retention by the physical water supplier; and
3. a new water supply which would if unregulated have market power but that would be subject to VWS arrangements

The current absence of a regulated, inefficiently low price for bulk water supply means that there is insufficient private incentive in competing water supply infrastructure. A competitive market price free from regulatory interference, as proposed above, would result in appropriate price signals for future private investment. As the price of wholesale water rises it will at some point reach a level such that an alternative water supply (such as a desalination plant or recycling) becomes economically viable for private investment.[10]

<Paragraph on how this might occur>

This proposed arrangement provides incentives only for appropriate low cost investment. Eg desalination plants vs recycling, siting the investment at appropriate locations etc. Whereas under the current politicised arrangements projects with political appeal, rather than economic efficiency, are likely to be undertaken.

Potentially the dam owner may be able make investments decisions that improvement the catchment capacity (or conversely reduce wastage) of the dam. In the absence of competition from alternative providers (such as a desalination plant) the dam owner is a monopolist in regards to the supply of the additional capacity that may be developed. As such it may choose to restrict its additional investment. <To consider further>. In bidding for stock and supply decisions during the trading process VWSs will naturally consider the dam owners capability to expand its catchment.

The third investment issue to consider is the case of private investment in a new water supply (e.g. a dam) which would, if unregulated, have market power but instead will be subject to VWS arrangements. < Would a new water supplier build a dam knowing that they will not have monopoly power once built? – is there a way to ensure cost recovery - need further consideration – probably drop this consideration>

<I don't think the above is an issue. VWS should provide sufficient competition to allow unregulated entry.>

[10] In practice there will be other issues with private investment in alternative infrastructure including the externalities associated with desalination plants generate environmental externalities and community perceptions over drinking recycled water.

Incentive of network operator to accept third party access. Under the proposed arrangement the operator receives additional revenue from additional water provision. Contrast with the current arrangement whereby water authority resists third party access because it represents additional competition.

6. Conclusion

This paper is not concerned with an ideological question of whether private or public management or ownership is better. It addresses the incentives provided by managers of urban water providers. The current public sector ownership does not provide appropriate performance incentives and leaves operational matters open to political interference. Water is currently underprice and there is inadequate infrastructure spending.

We propose VWS as a mechanism to ensure efficient pricing, and thus efficient allocation across consumers and across time. Enhanced third party access, such as privately owned delastination and recycling plants, or privately owned extensions to the existing network, allows for appropriate incentive to invest

A virtual water supplier model appears to be a practical and efficient method of ensure an efficient price is established for the supply of urban bulk water. The implementation and effectiveness should be easier than the similar Virtual Power Plant approach has proved effective in mitigating market power in the electricity generation market in Europe.

The approach does not remove the need for price regulation over the other aspects of the supply chain. Dams and reticulation networks continue to be monopolies with unique assets and there is no change to the institutional arrangements for the treatment and distribution of water.

VWS introduce potential competition into the water market. This competition ensures that the price of water reflects the opportunity cost. However there might be potential for large owners to undertake anti-competitive behaviour. For example, some might unite in a cartel. It would be prudent to have either Trade practices clauses in the legislation covering the water market, or ensure that the TPA applies to all buyers and sellers of water.

<Develop further>

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Appendix

Nothing as yet