DISTRIBUTED RECYCLED WATER SYSTEMS – HARD TO JUSTIFY IN SYDNEY, BUT IT'S A GREAT PLACE TO LEARN

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ABSTRACT

There are strong drivers for small recycled water systems in the wider Sydney area. However, a particular set of historical and contextual factors unique to Sydney limit the viability of small systems, and need to be overcome if small scale systems are to reach their potential to contribute to improving the value and overall robustness of the Sydney network. This paper identifies those factors and discusses why some of the factors also make Sydney a great place to test and learn from these new systems.

INTRODUCTION

Sydney is the largest city in Australia. The water and wastewater supply for the Greater Sydney Region services over 4.6 million people. Its centralised water supply and wastewater disposal is provided by a government owned monopoly provider, Sydney Water. There is significant investment in large water supply options, wastewater treatment plants and networks to transport the water and wastewater.

Over 80% of water is sourced from Warragamba Dam. Towards the end of the recent drought a desalination plant was built providing water security for the next 30 years. Over 75% (or about 900ML/d) of Sydney's wastewater is disposed of at one of three primary treatment plants, with disposal via a deep ocean outfall. The water network is over 21,000 km of pipes, the wastewater network has over 24,000 km of pipes. Overall it is estimated there are over $30 billion of assets[1].

The existing large centralised services provide many health, environmental and efficiency benefits. In the last 10 years though, a number of separate, but compounding drivers have led practitioners in the water industry to consider alternatives to the large, separated, centralised water and wastewater service delivery paradigm.

These drivers are powerful when making choices between small systems or centralized systems. However, the decision making process can become more complex when a centralized system already exists. In these circumstances there is often a range of historical and contextual factors that make it difficult to fairly compare alternatives, so they work to negate the benefits of small systems and limit their uptake.

This paper uses Sydney as an example to specifically consider the factors that limit sustainable investment in small recycled water systems as a complement or competitor to existing centralized services (called distributed recycled water systems in the rest of the paper, see (Watson 2011)). The paper then goes on to demonstrate why, if we are serious about developing a competitive and integrated water industry, some of the factors also make Sydney a great place to test and learn about these new systems.

WHY SHOULD WE CONSIDER ALTERNATIVES TO THE CENTRALIZED SYSTEM IN SYDNEY

There have been a number of changes in the water industry over the last few decades. The increasing use of sustainability principles has meant we look for options that mimic the natural water cycle, rather than separating water, wastewater and stormwater services. Recent droughts and a better understanding of the impacts of climate change and population growth have led us to consider additional, reliable supply sources. Many major cities have extensive but ageing and capacity-constrained networks. Expanding these networks to meet the demands of population growth is challenging financially, technically and logistically.

These infrastructure challenges and changes have been coupled with political and policy decisions that aim to promote recycled water options and support increased competition within the water sector. In the residential sector, planning legislation that drives potable water reduction targets for new developments can often require alternative sources. Some local governments are also undertaking their own master planning processes to identify local opportunities for recycling (see for example City of Sydney's Decentralised Master Plan). If we place these drivers in the context of rapid advances in the capability and cost of small scale treatment systems and an active market for 'green products', we can see that there are many reasons to consider alternatives to centralized services, and distributed recycled water systems in particular.

[1] Depreciated replacement cost of assets.

WHAT LIMITS DISTRIBUTED RECYCLED WATER INVESTMENT IN SYDNEY?

Despite the many drivers for distributed recycled water systems there are still a wide range of historical and contextual factors that are limiting investment. These factors are reinforced through regulatory, policy and institutional arrangements. The main factors in Sydney are outlined in Figure 1 and include:

- It is challenging for recycled water to compete with more conventional water and wastewater services on cost and price
- The current regulatory pricing rules create greater risk for investing in recycled water compared to conventional centralized water and wastewater services
- The current regulatory environment is complex, inconsistent and fluctuating, making investment in recycled water, particularly distributed recycled water, time and resource intensive
- Current centralized planning and investment policies and decision making processes preference large, just in time, centralized solutions.

Figure 1: Limits to recycled water investment

Some of these issues affect recycled water products in general, and some issues affect just small recycled water (distributed recycled water) products. Some are relevant to private investment or public investment only, and some are relevant to both. The spread of these issues is outlined in Table 1.

Table 1: Limitations vary depending on who is investing and at what scale

	Planning favours centralised solutions		Hard to compete on price		High investment risk		Complex regulatory environment	
	Information asymmetry	Bias towards status quo	Low cost	Low price	Avoided cost risk	Cost recovery rules	Regulation uncertainty	Time delays
Private investor	✓		✓	✓	✓		✓	✓
Public investor	✓	✓		✓	✓	✓	✓	✓
	Distributed only		All scales					

Some limits apply in all situations, regardless of scale or investor: competing on price is always hard and there is always uncertainty in avoided cost recovery. Some limits impact private providers more strongly: the regulatory environment is always complex and time consuming with uncertain outcomes. Some limits apply only to public investment: different cost recovery rules for recycled water compared to conventional alternatives are an issue for any public recycling scheme. Some limits apply only to distributed systems: planning's preference for centralised solutions impacts on both private and public investment in distributed systems. Below, we explore and explain these factors in more detail.

Factors that make it difficult for recycled water to be price competitive

There are several geographical and system design features that provide Sydney with low cost solutions for the bulk of its water and wastewater services. These low costs are exaggerated in the price through regulatory decisions that exclude some costs from being considered in pricing determinations. The resulting low price particularly affects the ability of private recycled water systems to compete on price alone with the more conventional alternatives. The low average cost and price of conventional services has less effect on the choice between options for public investment. This is because when system augmentation is required they include the next most efficient option and roll that into the average price.

The average cost of water and wastewater services are low in Sydney

Sydney has a number of factors that contribute to the low average cost of water and wastewater services. Over 80 percent of water is sourced from Warragamba Dam. This water is relatively cheap[2]. About 75 percent of Sydney's wastewater flows mainly via gravity to three large primary treatment

[2] Dam water and treatment is about $166 of $1000 water bill and is about 80% of the water. Desalinated water accounts for about $100 of $1000 bill and is only 15% of the water (Sydney Water 2010).

plants and the disposed of in ocean outfalls. This is also a very cheap form of wastewater disposal. Sydney's geography also means it has very low water and wastewater transport requirements (Cook, Hall & Gregory 2012). Combined, this makes the current average cost of water and wastewater services very low.

The price of water and wastewater services are low in Sydney

On top of the low average cost of water and wastewater services there have been a number of regulatory decisions that make the price of water services even lower. This makes it even harder for recycled water services to compete. In 2000, when price regulation began in Sydney, the asset base was substantially written down[3]. The depreciated replacement cost of assets is estimated to be over $30 billion while the regulatory asset base is only $13 billion (Sydney Water 2010). This should be corrected, as new assets are added, but the correction will take a very long time. Based on the current situation, prices should increase by 1-1.5% each year to cover these replacement costs (Sydney Water 2011).

In addition the rate of return on assets since price regulation has traditionally been very low. Between 2005-2009 many utilities across Australia earned well under the average 10 year government bond rate of 5 percent, which is the minimum rate to be considered commercially viable (Productivity Commission 2011). In IPART's latest pricing decision for Sydney Water they allowed a rate of return of about 5.6%, which will be achieved only if demand forecasts are not overstated and efficiency measures are met (Independant Pricing and Regulatory Tribunal 2012). It is important to note that this low rate of return is on the already substantially written down regulatory asset base.

Factors that increase the investment risk

The current regulatory environment in NSW makes investment in recycled water services more risky than conventional water and wastewater services. This is true for public and private investors. The rules for revenue recovery discriminate in several ways between conventional water/ wastewater services and recycled water, increasing revenue risk for recycled water. There is the potential ability to avoid some costs by using recycled water, either through reduced water and wastewater charges or more formal avoided cost payments. However, these are also uncertain and subject to change.

Different cost recovery rules for different services

The current price regulation framework in NSW differentiates between the way costs are recovered for conventional services and recycled water services. This greatly affects the revenue and investment risk profile for utility-driven recycled water. There are no developer charges in Sydney for water and wastewater services[4]. The cost of servicing new growth is recovered from the whole customer base. However, for recycled water, developer charges must be recovered directly from the users of the system. Similarly water and wastewater services have a postage stamp price. That is, the price is the same throughout the system regardless of how much it costs to service the customer. For recycled water, each scheme must reflect the true cost, and be recovered directly from the customers using the system. These rules were developed to assist with customer choice and to facilitate private competition. However, in practice it means in addition to challenges competing with conventional services due to cost and price issues, recycled water services are required to be locally cost reflective as opposed to conventional services which are currently not cost reflective at either the local scale or across the whole area of operations.

These rules not only differentiate the price for the two services, but also increase the revenue risk for the utility. This is because the revenue for conventional water and wastewater services is fully recovered from the whole customer base (over 1.7 million households and businesses) (Sydney Water 2012b). Connection to a recycled water system is discretionary, so not only is the revenue recovered from a smaller customer base, thereby increasing demand risk, but also it is subject to connection (or customer number) uncertainty.

Rules for avoidable or avoided costs

In Sydney there are two ways developers and users of local recycled water schemes can avoid some costs. The first is by setting up the system to reduce payments for conventional water and wastewater services. The current pricing framework in Sydney sets prices based on the customer type: residential or non residential; and meter size. If a residential complex installs a local recycled water system there is the potential to change to a non-residential wastewater discharge structure, and use a smaller water meter, both of which have the potential to reduce yearly fixed costs. However, this reduction is not certain. Due to pricing rules, special exemptions need to be gained to allow the change in classification, even though it reflects the low impact the customers are having on the water and wastewater networks. A recycled water system will also provide savings, by using less water and discharging less wastewater. However, even the relative savings here are subject to change. In their latest pricing determination, IPART changed the price structure for fixed and variable charges, as they were concerned that by not reflecting short run

[3] The depreciated replacement cost of assets is estimated to be over $30 billion. The regulatory asset base is only $13 billion. (Sydney Water 2010)

[4] Water and wastewater developer charges in Sydney were abolished on 17 December 2008 to facilitate housing affordability (Premier Nathan Rees 2008)

marginal cost. They believed the existing structure created 'perverse incentives for large customers to adopt on-site recycling where it was not efficient' (Independant Pricing and Regulatory Tribunal 2012). This meant usage charges reduced by over 30% in the four year regulatory period, decreasing the savings from on-site recycling.

In theory there are methods to calculate and recover avoided costs. These are costs in the centralised water and wastewater system that are avoided by recycling. However, in practice these avoided costs are difficult to identify and collect. The nature of the existing assets and system design requirements in Sydney limits the impact an individual small recycled water system can make (scale). The outcome of the formula is also uncertain. This is perhaps best highlighted through the decision on avoided costs for Sydney's Rouse Hill recycled water system. Sydney Water had applied the formula outlined by IPART and liaised with IPART during the calculation process. Yet, in their draft determination IPART rejected the estimates, leaving Sydney Water 'with no confidence in IPART's regulatory framework for recycled water avoided costs' (Sydney Water 2012a). As private developers have even less access to the information required for the formula, their risk is even greater.

Complex regulatory environment

Despite substantial reforms over the past two decades, the regulatory framework is still overly complex (National Water Commission 2011; Power 2010). For example, in NSW a decentralised recycled water system may trigger six Acts, be covered by four specific guidelines and require the approval or advice of up to eight authorities, although this is currently under review (NSW Government 2012).

The change in focus from prescriptive end product management to a risk management approach for recycled water[5] (LECG Limited Asia Pacific 2011) has failed to deliver. While a risk management framework is, in theory, more flexible, it has been suggested that the uncertainty surrounding new technologies and unclear policy positions has created a climate of risk aversion (Tjandraatmadja et al. 2008). This has resulted in delays and additional costs (for example validation testing (Power 2010)) and a perception that best quality and not 'fit for purpose' water is required which again increases costs (Tjandraatmadja et al. 2008).
In NSW the *Water Industry Competition Act 2006* was designed to encourage competition for water and wastewater services and facilitate investment in recycled water infrastructure[6]. However, the Act is in its infancy and has already been subject to several changes, and the current review proposes more. These changes include licensing schemes that previously fell outside of the Act, which has the potential to increase operating costs substantially.
The complexity of regulation, combined with the risk adversity and rapidly changing rules has the potential to make investing in distributed recycled water systems expensive, uncertain, prolonged and too difficult to pursue.

Policy choice uncertainty

Government policies have the ability to distort or restrict the market for distributed recycled water or introduce further risk. In addition to setting efficiency and recycled water targets, Australian governments have occasionally limited or restricted certain supply options, such as decisions on dams (Welcome Reef Dam in Sydney) and indirect potable reuse. These decisions introduce additional risk for private investment, as investments may become redundant if barriers to cheaper sources were removed in the future (LECG Limited Asia Pacific 2011).

Planning and institutional frameworks that favour large centralised solutions

The current planning, regulatory and institutional frameworks have been developed over a long period of time based on public monopoly supply of standard centralised services. In recent years they have been adjusted and adapted to accommodate integrated options and private competition. However, there are a number of factors that result in conventional centralised services being chosen over local recycled water solutions.

Urban water planning is undertaken by the centralised utilities or government agencies. There are no formal processes in most jurisdictions for identifying opportunities for small systems in advance of centralised investment and communicating this to the market. This is exacerbated by the limited institutional and regulatory coordination between stormwater service providers and the water and wastewater utilities. This lack of information limits the ability of private investors to suggest other alternatives or plan local recycled water developments to maximise benefit to both their customers and the wider centralised system.

Decisions tend to bias towards maintaining the status quo (investments that are similar to ones we have made in the past) (Hammond, Keeney & Raiffa 1998). When a centralised agency is making choices between options it is likely they will bias

[5] Specifically a change from the prescriptive National Water Quality Management Strategy (NWQMS) *Guidelines for Sewerage Systems: Use of Reclaimed Water* (ARMCANZ-ANZECC-NHMRC 2000) to the risk management approach outlined in the Australian Guidelines for Recycled Water (AGRW) 2006

[6] *Water Industry Competition Act* 1996 Long title: An Act to encourage competition in relation to the supply of water and the provision of sewerage services and to facilitate the development of infrastructure for the production and reticulation of recycled water; and for other purposes.

towards conventional centralised solutions. Finally historical asset choices can influence the future cost difference between options. For example in Sydney, a decision was made to construct the majority of the infrastructure for both stages of the desalination plant. This decision means supplying the next phase of desalination is cheaper than the current phase. This dramatically reduces the viability any other supply options, including demand reduction.

HOW DO THESE BARRIERS PROVIDE OPPORTUNITY?

In the context of the discussion above, it would seem very difficult to justify investment in recycled water, particularly small recycled water schemes, in Sydney. However, many of these factors have the potential to change in the medium to long term. For example the combination of changing pricing policies, the need to duplicate extensive network infrastructure and further efficiency developments in small scale treatment could significantly improve price competitiveness. Yet, as we have seen towards the end of the last drought, our current planning system encourages waiting until capacity is very limited then investing in large scale expensive assets to ensure capacity for another 30 plus years (desalination plants around Australia illustrate this example well)(White, Noble & Chong 2008).

Small scale recycling has the potential to increase the number of customers that existing networks can support and reduce demand on water supplies and wastewater treatment. This is particularly valuable for the large amount of infill growth that major capitals are expecting, where augmentation and duplication is problematic. For this potential to be realised, investment is required continually over a sustained period of time. However, there is a great deal of uncertainty that surrounds the viability of this strategy. Nearly every scheme that has been developed has provided some form of learning opportunity, and that is where we can see Sydney as an opportune testing ground.

The large size of the Sydney system gives it capacity to provide redundancy for these systems at negligible additional cost. Most of Sydney's sewage is largely untreated before ocean discharge, so the additional environmental impact of distributed system discharge to sewer is negligible, and the cost/energy impost is also negligible. From a process perspective, Sydney's high sewer flows minimize the potential for local sludge issues. At the same time, there is an apparent willingness to pay in the high-end property and urban irrigation markets.

Combining these opportunities and potentials makes Sydney an ideal location to test, monitor and develop the capacity of both the systems and the private sector operators, without placing unacceptable impacts on the existing system, the environment or the community.

CONCLUSION

While Sydney has a number of drivers that should make it an opportune location for distributed recycled water uptake, this paper has identified a wide range of limiting factors. These factors are generally based in regulatory, policy or institutional arrangements. It includes factors that influence the price differential between general water services and recycled water, factors that influence risk and uncertainty and factors that hinder efficient decision making.

Making these limiting factors explicit and acknowledging the interplay between them is critical for developers, operators, regulators and policy makers. Firstly, making them explicit opens the potential to assess the scale of their impacts. Secondly, by acknowledging the limiting factors it is possible to develop strategies to address them. This assumes there is a desire to support the private recycled water market in Sydney, and throughout Australia in the long term.

However, the same factors that limit the opportunities for recycled water investment in Sydney also provide a unique, low risk environment to learn about and test the value of these systems. Supporting and monitoring the private recycled water market in this short period of low risk to the existing system, the environment or the community may help create a viable market long term that would substantially change the way water and wastewater services are delivered into the future.

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