THE FUTURE FOR WATER RECYCLING IN AUSTRALIA'S CITIES AND TOWNS

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SUMMARY

Although studies commissioned in 1977-8 identified scope for Australia to recycle water, it was only through the introduction of EPA discharge standards from the early 1990s that effluent treatment authorities began to achieve improved environmental management of treated effluent streams. The droughts of 2001-3 reinforced the need for more effective water management, with recycled wastewater, urban stormwater and rainwater being seen as resources rather than problems. The recent Australian Academy of Technological Sciences and Engineering review *Water Recycling in Australia* showed that by 2001-2, over 500 wastewater treatment plants were recycling some or all of their treated wastewater, while the first projects to harvest and treat stormwater had also been set in place. Inland country towns were earlier adopters than coastal and capital cities. Canberra, Melbourne and Perth have since set recycling targets of 20% by 2010-12. Adelaide was already claiming 19.2% recycling by 2003-4. Issues discussed include ownership and entitlement to stormwater and recycled water, recycling quality standards and the underpinning of public health, better awareness of the need to separate drinking water and recycled water streams, harmonised plumbing and drainage regulations, liability issues, streamlined planning approval mechanisms, equitability of headworks charges, the relationship of recycling plants to market demand and distribution, scope for stand-alone in-house treatment and recycling within high rise buildings, dual reticulation in new developments and retrofitting in existing developments, the role of rainwater tanks, the impact of price on consumption and the need for consistency of policies at a whole-of-government level. The subsequent signing of the Intergovernmental Agreement on the National Water Initiative and the creation of the Australian Government Water Fund has laid the foundation for encouraging innovation and water use of recycled water in Australia's cities and towns. The numerous issues to be considered in developing water recycling schemes are discussed. Above all, the community must appreciate the importance of the entire hydrologic cycle and the principles of water sensitive urban design and be involved in any decision processes that may lead to increased recycling of wastewater and stormwater.

INTRODUCTION

Australia is a large continent with only a small population to husband its land and water resources. Most of its rainfall soaks into the ground. Only 12% of its rainfall runs off and is collected in rivers. Much of this is in tropical monsoon areas with sparse communities and little development. The National Land and Water Resources Audit (NLWRA 2002) showed that water resources from 26% of Australia's surface management areas and 31% of its groundwater management units were fully or over-allocated. In 1996-7, Australia used 26,000 GL of water, 75% for irrigation, 20% for urban and industrial purposes and 5% for stock and domestic use. Water is a valuable resource in Australia, but in short supply.

THE DEVELOPMENT OF WATER RECYCLING IN AUSTRALIA

In 1977, the Australian government commissioned a report on the potential for water recycling. The report's recommendations (GHD 1977) included:-

- A national program of research, demonstration and education
- An integrated approach to water supply, sewerage and solid waste disposal as an integral part of one planning process
- Smaller, simpler sewer networks based on regional plants located near opportunities for reuse,
- A major thrust towards irrigation, both landscape and agricultural, with agricultural use reoriented to agricultural gain rather than disposal,
- Use for conserving water resources in rivers and streams and recharging aquifers providing nutrients were controlled
- Current world potable water standards be extended, related to Australian conditions and applied to existing situations of inadvertent use
- Melbourne being seen as offering scope for a variety of reclaimed water uses
- Assessing the substitution of recycled water for freshwater in Adelaide and inadvertent groundwater recharge in Perth
- Assessing the elasticity of demand for various uses of water and the real cost of providing for variations in demand
- Representative studies of the economics of reclaimed water projects where reclaimed water might be economic, encompassing issues of the definition of the reclaimed water 'system', to take into account savings in conventional water supply and waste disposal systems, use of marginal costs rather than average or historical costs and definitions of methods of financing reclaimed water schemes where comparisons over the total 'system' including social costs, show this to be economically preferable
- Development of conceptual models, pilot applications and some full scale projects, particularly for the 'interception' method (presumably 'sewer-mining') and the 'dual pipe' supply concept.

A further report for the Victorian Government in the following year (GHD 1978) reiterated most of these points, and further concluded:-

- …marine disposal was to regarded as a last resort rather than a favoured one… the decision whether to consider a substance a 'waste' rather than a 'natural resource' is based on economic rather than scientific principles,
- …the approach to sewage treatment in Australia has perpetuated the patterns established by tradition and experience… 'resource consciousness'....is a relatively recent concept,
- …increasing water deficits are expected in Victoria by the year 2000
- …increasing re-cycling of water in industries and in homes, garden watering restrictions, use of sewage effluent and higher costs for water supplied are all possible developments in this state,
- Flushing of toilets represents 30% of domestic usage.
- Home garden watering is generally wasteful of good quality (potable) water
- Land use planning can facilitate the use of sewage, *i.e.* location of suitable industries adjacent to treatment plants (and *vice versa*)
- A suburban neighbourhood of 5,000-8,000 persons could be served by a viable local treatment and reuse system

Initially, these reports attracted little attention and had little impact.

However, since the 1980s, issues of environmental health, sustainability, water availability and water quality for consumptive uses have emerged as significant political issues (Taylor and Dalton 2003). By 1988, Victoria had the statutory State Environment Protection Policy (Waters of Victoria). It listed water recycling as the preferred approach for managing treated sewage. Water recycling was given an impetus from the early 1990s as the States established Environment Protection Authorities which imposed compositional standards on the discharge of treated effluents from sewage treatment plants (STPs), resulting in increased interest in recycling for productive purposes on land as an alternative to installing expensive biological nutrient removal plants. Meanwhile, sewage treatment systems were coming to Australia's small country towns. Many of these, particularly in dry inland areas, recognised that the effluent from their plants could be usefully applied to amenity areas and recreational facilities such as golf courses and sports ovals.

THE NATIONAL WATER REFORM FRAMEWORK

A Productivity Commission inquiry into water resources and waste disposal (Productivity Commission 1992) highlighted the need for wide ranging reform of the water industry to improve its efficiency (Productivity Commission 1992), and led to the Council of Australian Governments *National Water Reform Framework* (COAG 1994). This encompassed urban and rural water and wastewater industries and explicitly links economic and environmental issues within a coherent and integrated package of reform measures. These measures included:

- pricing water for cost recovery and removing cross subsidies;
- comprehensive systems of water allocations and entitlements, separated from land, and backed by secure access rights to water;
- providing for trading in water entitlements;
- specific provision of water for ecosystems;
- water service providers to operate on a commercial basis;
- improved institutional arrangements, including separation of service provision from regulation and devolution of responsibility to the lowest possible level; and
- public consultation and education.

Recognition of Water Recycling

However, it was only in 2003 that water recycling was brought within the National Water Reform Framework.

A further impetus for recycling arose from the widespread drought in 2001-3 and the recognition that water catchment volumes in cities were reducing. This led to suggestions for more effective conservation of drinking water supplies by using recycled water for purposes for which drinking water standards were unnecessary.

In 2004, the Australian Academy of Technological Sciences and Engineering (ATSE) published its review *Water Recycling in Australia* (Radcliffe 2004), available without charge from the Academy. A 30 page illustrated summary was also prepared for community use. The review described water recycling schemes extant across Australia as at the end of 2003. It found that over 500 Australian Sewage Treatment Plants (STPs), a significant proportion of them operated by local government, recycled some or all of their effluent. However, water recycling was greater in the rural and regional areas than in the capital cities, and greater in

inland cities than coastal cities, many of which continue to discharge to ocean. This was well illustrated by figures from rural New South Wales showing that there was 50% reuse from plants west of the Great Dividing Range, 20% reuse from inland plants east of the Great Dividing Range, but only 2.5% reuse from Coastal STPs. The Academy review concluded that:

- Recycled effluent, rainwater and stormwater are additional resources rather than disposal problems and should be recognised as complementary to water harvested from catchments.
- Maintenance of trust between water agencies and consumers is paramount.
- "Drinking water" should be adopted as the term to describe potable water.
- Policy makers, developers and the entire community should develop a wider appreciation of the complete hydrologic cycle.
- Areas of limited water resources should be defined as "Water Resource Caution Areas" similar to the model adopted in Florida.
- Wider use should be made of recycled water where water of drinking water quality is not required. In some areas, mandating its use may be required
- Titles to water should be extended to cover recycled water.
- The *National Water Quality Management Strategy Guidelines* should be revised, including completing the new *Water Recycling Guidelines* as soon as possible. New *Stormwater Guidelines* should be revised to encompass water harvesting, and *Use of Rainwater* brought within the NWQMS Guidelines.
- States and Territories should harmonise their plumbing and drainage regulations to achieve standardised outcomes.
- The plumbing industry and consumers must have a much greater awareness of the need to maintain complete separation of drinking water and recycled water supply systems.
- Planning approval mechanisms for water supply and effluent treatment provisions in new developments should be streamlined.
- Water authority "headworks" charges should be made more equitable to reflect recognition of drinking water savings achieved where recycled water is included in developments.
- Greater attention should be given to possible cost savings and benefits from locating small STPs close to new developments rather than using long supply lines to older centralised treatment systems.
- Recycled water providers need legislative or regulatory provisions to be able to lay appropriate infrastructure on equal terms with other service providers.
- "In-house" recycling systems should be encouraged in new high-rise office and apartment buildings.
- A national approach should be developed to the costing and pricing of drinking water and recycled water.
- Any recycling projects must define their market before commencement to avoid the risks of making over-optimistic assumptions.
- Any residual liabilities within the *Trade Practices Act 1974 (Cwlth)* should be clarified with respect to residual liabilities that might otherwise accrue to water authorities operating in compliance with current Australian and State legislation.
- Industry attraction incentives should recognise the benefits of locating large non-drinking water quality industrial water users close to sewage treatment plants.
- There should be a greater use of wetlands for water quality remediation, particularly stormwater but they must have adequate maintenance.

- The potential role of effluent treatment facilities in biodiversity conservation should be recognised.
- Further research should be encouraged into water and wastewater treatment processes including areas suggested by the Working Party presentation (Rathjen *et al.* 2003) to the Prime Minister's Science, Engineering and Innovation Council on November 28 2003.
- Investment in innovative community-scale water recycling projects should be stimulated
- Any separation of responsibilities for the ultimate management of water and wastewater resources should be discouraged.
- Governments must resolve at whole-of-government level the conflicts of interest evident between portfolio agencies in environmental management, water resource provision, revenue generation and pricing determinations as they affect water policy.
- Ensuring public participating in decision making, and gaining public confidence and trust in future water recycling initiatives is absolutely essential to the greater use of water recycling in Australia.

THE NATIONAL WATER INITIATIVE

In June 2004, all of the Australian States and Territories except Western Australia and Tasmania signed the 108 clauses Intergovernmental Agreement on the National Water Initiative with the Australian Government (COAG 2004). The Parties agreed to the establishment of a National Water Commission (NWC) to assist with the effective implementation of the Agreement. The NWC, established under the *National Water Commission Act 2004 (Cwlth)*, held its first meeting in March 2005, will accredit implementation plans under the National Water Initiative to ensure consistency with an agreed implementation timetable (NWC 2005).

The agreement included achieving urban water reform to:

i) provide healthy, safe and reliable water supplies;
ii) increase water use efficiency in domestic and commercial settings;
iii) encourage the re-use and recycling of wastewater where cost effective;
iv) facilitate water trading between and within the urban and rural sectors;
v) encourage innovation in water supply sourcing, treatment, storage and discharge; and
vi) achieve improved pricing for metropolitan water

Parties to the agreement undertook to perform the following actions in regard to innovation:

i) develop national health and environmental guidelines for priority elements of water sensitive urban designs (initially recycled water and stormwater) by 2005;
ii) develop national guidelines for evaluating options for water sensitive urban developments, both in new urban sub-divisions and high rise buildings by 2006;
iii) evaluate existing 'icon water sensitive urban developments' to identify knowledge gaps and lessons for future strategically located developments by 2005;
iv) review the institutional and regulatory models for achieving integrated urban water cycle planning and management, followed by preparation of best practice guidelines by 2006; and
v) review incentives to stimulate innovation by 2006.

Parties to the Agreement have determined that an important outcome is to engage water users and other stakeholders in achieving the objectives of the Agreement by:

i) improving certainty and building confidence in reform processes;
ii) transparency in decision making; and
iii) ensuring sound information is available to all sectors at key decision points.

The Agreement identifies a number of areas where there are significant knowledge and capacity building needs for its ongoing implementation. These include: regional water accounts and assessment of availability through time and across catchments; changes to water availability from climate and land use change; interaction between surface and groundwater components of the water cycle; demonstrating ecological outcomes from environmental flow management; improvements in farm, irrigation system and catchment water use efficiency; catchment processes that impact on water quality; improvements in urban water use efficiency; adoption of urban sensitive water design in new developments and independent reviews of the knowledge base. The needs for scientific, technical and social aspects of water management are seen as multi-disciplinary and extend beyond the capacity of any single research institution. Since March 2004, most states have released new water strategies encompassing recycling, affecting Australia's major cities. Canberra, Melbourne and Perth have set recycling targets of 20% by 2010-12.

The Australian Government Water Fund

The *National Water Commission Act 2004* also established the Australian Government Water Fund (PM&C 2005). The National Water Commission is responsible for advising the Prime Minister on the use of this fund for the $1.6 billion Water Smart Australia programme to accelerate the development and uptake of smart technologies and practices in water use across Australia, as well as managing a $200 million Raising National Water Standards programme to advance Australia's national capacity to measure, monitor and manage its water resources. The $200 million Water Fund Communities Programme, administered by the Departments of Agriculture, Fisheries & Forestry and Environment & Heritage, is also supported from the Australian Government Water Fund. Applications are open to State and Territory governments that are signatories to the Intergovernmental Agreement on the National Water Initiative, local government, the private sector, industry and other organisations and community groups. Projects are expected to achieve outcomes consistent with the Intergovernmental Agreement on the National Water Initiative.

The Agreement encompasses the area of Urban Water Reform (paragraph 90). There is scope to make better use of recycled water, stormwater and rainwater as additional water resources to achieve some of the outcomes to which the signatories have agreed.

THE MARKET FOR RECYCLED WATER

Where we do recycle water, we should make sure that it goes to the best uses. Melbourne used to treat much of its sewage by spreading it on pastures at Werribee to fatten beef cattle. Now it claims 14% recycling, but almost all of that treated wastewater is going onto the same beef pastures - one of the lowest value uses for irrigation water. By contrast, Adelaide is managing 19% recycling due to new schemes that are being used to grow high value vegetables north of the city and wine grapes in the Southern Vales.

Recycling opportunities also occur in industry. A number of projects have already shown the way. Bluescope Steel at Wollongong was using 20 Megalitres (ML) a day of water that would

otherwise go into the drinking water system. Now it is using recycled water from the Wollongong wastewater plant. In Brisbane, the Amoco-BP refinery is taking up to 13 ML of recycled water daily from the adjacent Luggage Point wastewater plant, saving the cost of a new pipeline from the Brisbane Water supply, as well as saving drinking water.

Rouse Hill in Sydney is the first major suburb in Australia with a dual water supply. Drinking water is used in the kitchen and bathroom, recycled water in the toilet and garden, and now it can be used in laundries. Other similar subdivisions are being built at Aurora in Melbourne and Mawson Lakes in Adelaide. Gold Coast Water is evaluating recycled water as a component for the provision of water resources for Gold Coast development.

Price is an important issue. Rouse Hill was a learning experience. With the recycled water so cheap at 28 cents per kilolitre, compared with drinking water at 98 cents per kilolitre, residents have used more water in total than people living in conventional subdivisions, albeit it is argued that block size is large at Rouse Hill. High use has not been a problem at Sydney's other dual supply development, Olympic Park/Newington, where the recycled water is 83 cents per kilolitre.

The issues to be considered

Mills and Asano (1998) have identified sixteen components that need to be considered in surveying the potential market for recycled water. These are listed below. Parenthetic comments have been added to highlight potential issues to address.

1. Specific potential uses of recycled water,
   (The objective of developing the market needs to be clearly defined – is it driven by the recognition that there are very limited water supplies to support new development, is it primarily to encourage savings by substituting for potable water use, is it primarily driven as a disposal to land project with opportunities to encourage economic development, is it an environmental improvement project, or is there an expectation that after developing a project, a market will appear from somewhere?)

2. Location of users,
   (Piping infrastructure and pumping are major costs impacting on the economics of a recycling scheme. Distribution costs are in proportion to the proximity of user markets.)

3. Recent historical and future quantity needs (because fluctuations in water demands, at least three years' past use data should be collected),
   (Technological change and the impact of industry adjustment including loss of old industries and development of new ones should be considered.)

4. Timing of needs (seasonal, daily and hourly water demand variations),
   (Industrial markets are much more regular in their demands than seasonal irrigation markets, and more nearly match the relatively even supply of sewage effluent provided stormwater surges can be minimised.)

5. Water quality needs
   (Water quality should be fit for its intended purpose, though it may well ultimately be more economical to generate all the water to advanced Class A to

provide greater diversity of market opportunity if no major “lead market” is evident.)

6. Water pressure needs

   (Some schemes provide recycled water to agriculturists unpressurised, with growers then having to install their own storage, pumping and distribution system, whereas the others supply recycled water pressurised to growers who maintain only a filtration and distribution system, but their water price will higher. Other schemes supply dual-reticulation urban developments where the recycled water should be provided at a lower pressure than drinking water to minimise risks of cross contamination.)

7. Reliability needs – how susceptible are users to supply interruptions?

   (Some industries moved to recycled water in the face of drinking water restrictions in the recent drought, demonstrating the potential for using recycled water to maintain critical industrial processes. Slightly more flexibility may be possible for irrigation users, but supplying peak demands to meet the expectation of dual supply markets may present difficulties.)

8. To what extent is the user likely to want to dispose of residual recycled water after use?

   (An incentive for potential industrial users of the developing Kwinana Water Recycling Project in Perth is the ability to discharge surplus water and industrial effluents [subject to Trade Waste requirements] into the Cape Peron outfall.)

9. Identification of on-site treatment or plumbing retrofit needed to accept recycled water,

   (These issues and their costs can be a significant component of introducing recycling schemes, where the customer faces significant retrofit costs. There may be attraction in a discounted cost for the first couple of years as an incentive to access a recycling scheme. Where recycled supply is being offered to existing potable water-using industries which will need retrofitting, the most economical approach is to target a small number of potentially large consumers close to the recycling plant.)

10. Internal capital investment and operating and maintenance costs for on-site facilities to accept recycled water,

    (Where there is a combined market of agricultural users who can accept lower quality recycled water, and specific industrial users who demand a higher quality water, it may be more attractive for the water authority to recycle to a base standard, with those users with specialised needs purchasing recycled water relatively inexpensively and installing their own additional treatment plant.

11. Needed monetary savings on recycled water to recover site costs or the desired pay-back period and rate of return on capital,

    (This issue in Australia has revolved around considerations of private and public benefit, and the extent to which environmental costs and benefits, which

may be difficult to quantify, affect the equation. This then can influence the extent of available grant funding.)

12. Present source of water, who supplies, and at what cost?
    (Although Australia has in recent years separated the water resource management and supply functions, they have remained within government, even in cases where the service functions are subcontracted to the private sector. However, there are already examples of competing suppliers, for example in South Australia between Salisbury Council and SA Water Corporation, and which could have effects on both supply price and efficient capital management. Are the costs of potable supply any more near to the true costs of supply than the recycled sources?)

13. When would user be willing to start taking recycled water?
    (Is attraction to use recycled water going to need financial incentives and can the level of incentive be correctly judged? Alternatively, is the market influenced by there being no alternative source of supply?)

14. Future land use trends that could eliminate recycled water use, such as conversion of farm lands to urban development
    (This is a potential problem for schemes where the plants are close to the edge of cities. There may be scope to plan an orderly evolution of the use of recycled water from land-based agricultural use to industrial use.)

15. For developing user projects, when would access be required, and what is the current status and schedule for the development?
    (Many overseas projects have over-estimated the likely market demand.)

16. After informing users of potential project conditions, a preliminary indication of the willingness of the user to accept recycled water.
    (Accurate forecasts of the recycled water market are necessary to avoid unrealistic cost-recovery projections for new projects.)

Above all, there must be an assurance that recycled water systems fully meet health standard requirements and their management includes an audit trail to show that this is being achieved. To underpin this need, the Natural Resource Management Ministerial Council is currently finalising new set of HACCP-based *Guidelines for Recycled Water* under its National Water Quality Management Strategy.

To be ensure successful acceptance, any recycling project must have the commitment of its local community before it is undertaken, and the community must have had input to, and hence ownership of the decision to proceed.

CONCLUSION

Australian cities and towns have the opportunity collectively to provide world best practice in water resource management. Water recycling has a role to play. Australia already has a substantial range of expertise and experience in its introduction, management and use. The Intergovernmental Agreement on the National Water Initiative and the availability of the Australian Water Fund's $1.6 billion Smart Water Fund and its $200 million Water Fund

Communities programme provide powerful incentives for cities and town to consider including water recycling in their water development plans.

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