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Taking the public seriously: the case of potable and non potable reuse

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Abstract

Introducing reclaimed water as an alternative to the traditional mains water supply involves change in practices as well as technology. Therefore, the social effects of innovative solutions to sustainable water management need to be carefully considered. This paper will present findings from research undertaken in California and Florida, USA, and Australia. What is the community response to recycling reclaimed water? Are there ways of involving the public so that the change involved in introducing reclaimed water achieves sustainable outcomes? Results from a series of case studies where indirect potable reuse has been planned will be considered along with the findings from a range of industry surveys, mainly conducted in the USA. In relation to non potable reuse, this paper will cover acceptance of some of the main uses, and householder's experience of recycling water for residential use. The resulting analysis suggests that the shift from traditional, centrally controlled water supplies to innovative alternatives, requires a corresponding shift in resources to support what is essentially a social transformation in water service delivery and management.

Keywords: Potable reuse; Non potable; Reclaimed water; Sustainability

1. Introduction

During the last Australian summer (2003/04), residents in every capital city except tropical Darwin were subjected to water restrictions. Long term drought conditions and increasing demands on the River Murray and other sources of urban water supplies in the east, south and west of Australia have meant that a range of options, that have been examined over a number of years, with some being tentatively introduced, are now being seriously considered for wider implementation. This paper presents the experience of water reuse, the beneficial use of reclaimed water — water sourced from treated sewage effluent — however,

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the overall findings can be applied to other alternative sources of water. Water reuse generally involves non potable reuse — recycling reclaimed water for non drinking purposes. This is distinct from potable reuse, where reclaimed water travels through a higher treatment train to produce water to meet drinking water quality standards. The central purpose of this paper is to explore what may constitute successful implementation of alternative water sources by deconstructing the meaning of 'sustainable outcomes'.

1.1. Outline of the paper

This paper provides an overview of the key findings rather than a detailed report of the research undertaken into water reuse to illustrate the main commonalities and differences between the data. The case of potable reuse is discussed in relation to recent experience in the USA and Australia. What led to the postponement or transformation of most potable reuse proposals? Alternatives, such as non potable reuse, are then reviewed to highlight the level of acceptance of reclaimed water and the effect of salience. A second question is investigated through the experience of residential reuse. This term identifies the recycling of non potable reclaimed water through a dedicated, second reticulated water network for non drinking purposes such as garden watering. Based on established as well as new experiences of residential reuse, how can the systems be managed to effect sustainable, long term benefit?

1.2. Relevant literature

The literature on acceptance and perceptions of risk finds that once an issue becomes salient, rather than being considered in the abstract sense, public opinion becomes polarised [1,2]. However, those already exposed could be in denial of the risk; the hazard has become known and familiar to them and their experience is that it is not threatening [3]. The acceptability of risks is also "a function of the degree to which the institutions which are responsible for the assessment and management of risks are trusted" [4]. The development of 'active trust', enabled through educational, regulative and material support, allows individuals and social groups to be actively involved rather than "have things happen to them" [5]. Therefore, both top-down and bottom-up processes are important to the development of trust, and cooperation in civil society will be influenced by the state through the role of legal and political institutions [6,7].

It is argued that effective public consultation involves respectful deliberation [8–10] that promotes community involvement of the process [11]. This contrasts with the alienating approach of strategic communication [8] employed to market or 'educate' the public in Decide, Advise, Defend (DAD) experiences that reduce public involvement to tokenism [12,13]. Further, processes that put chosen consultation groups ahead of wider public participation will generate distrust regardless of whether the final decision is 'right' or 'best' [14]. Therefore, democratising power relations between the centre and the local level will aid in the delivery of sustainable outcomes. [15,16].

1.3. Research design

This paper draws from comparative sociological research conducted in the USA and Australia. The ethnographic field work from 2000 to 2003 involved the collection and audit of industry surveys and other documents, attendance at water reuse seminars and conferences, on site investigations at 14 locations, and interviews with water reuse industry managers to build case studies of reclaimed water experience. In-depth case studies of residential reuse were undertaken at Altamonte Springs and Melbourne in Florida and New Haven Village and Mawson Lakes in Adelaide, South Australia. Eighty research participants (twenty at each site) were interviewed following a semi-structured design to aid comparison of the data. The response rates at the sites ranged from 67%

to 87% and involved in-depth, face-to-face interviews in Adelaide and on site telephone interviews in Florida. The duration of experience in using reclaimed water spanned from twelve years in Altamonte Springs through to five years at New Haven, compared to the expectations of the residents at Mawson Lakes where the system was not completed. Subsequent research continues to update and expand the investigation and analysis.

2. Potable reuse

Indirect potable reuse is being practised at several sites in the USA and direct potable reuse was introduced to Namibia in 1968. All of these systems were introduced at a time when minimal public consultation was required and undertaken. Currently, the main reason for recycling reclaimed water, for any use, is to reduce the dependence on imported water sources, or to correct the balance between available water sources and projected growth. However, in the USA and Australia, an earlier goal is still relevant today, and that is to eliminate costly improvements to sewage treatment infrastructure by substituting effluent reuse for environmental discharges and also to capitalize on the value of the higher quality effluent imposed by regulatory authorities.

Recent attempts to introduce potable reuse in the USA and in Australia have involved some form of public engagement. Eight locations were researched as listed in Table 1, which summarises the type of consultation undertaken and the public response. The San Diego, Tampa and Noosa projects involved supplementing surface waters with reclaimed water, while the remaining five entail the recharging of groundwater. In the case of San Diego, Dublin San Ramon, Denver and Orange County, the advanced treatment of sewage effluent would involve microfiltration and reverse osmosis, the same process used for desalination. Despite assurance of safety, in all cases except Orange County, the proposals met with public opposition and were either shelved or withdrawn. Orange County continues its public consultation process to gain acceptance of the Groundwater Replenishment System, which is due to go on line in 2006. The proposal is similar to an existing system that is being expanded in Carson, California, and the proposals for East Valley, San Gabriel Valley and Dublin San Ramon. It involves direct injection as well as percolation of reverse osmosis treated reclaimed water to the groundwater which will then take from six months to a year to reach the potable wells.

Overall, a lack of transparency at the earliest planning stages, and limited community outreach, characterises the public consultation efforts at each of these sites. There seemed to be ample opportunity for sharing the concept with the public, especially during pilot, demonstration phases, evident in the San Diego (1984–93), Denver (1980s) and Tampa (1987–89) cases. The value of tours of reclaimed water treatment plants has been demonstrated in Irvine where pre-test : post test survey results show from 14% to 30% increase in support of a range of uses, including groundwater recharge. However, in most of these eight cases, emphasis has been placed on marketing the proposal, rather than keeping the public fully informed and offering deliberative consultation. For example, one focus group reports that "purification" was a better term for the process of supplementing drinking water supplies with highly treated reclaimed water, because research participants "felt that 'repurified' sounded as if the water had already been used". There was also an obvious reluctance to draw attention to existing indirect potable reuse sites located in the same county where proposals for similar projects were underway. Therefore, the opportunity to establish transparency and public familiarity with existing potable reuse processes was missed.

It is also apparent that the messages conveyed through survey data were not taken seriously. A wealth of historical data established that opposition to drinking water sourced from reclaimed

Table 1
Recent proposals for indirect potable reuse

Site	Public consultation	Indications of the public response
San Diego 1993–99	Over a six month period, 1800 education packages distributed, 60 presentations to groups.	1993: 59% would drink 1998: 60% "good idea"
San Gabriel Valley, LA 1993–2001	Minimal process.	Prior to EIS hearing citizens group published "toilet to tap" opposition. Miller Brewing withdrew support; agreed to modified version.
Dublin San Ramon District 1993–98	Although "extensive education campaign", court ruled in 2002 that consultation inadequate.	High acceptance in Dublin (85%); opposition registered in other cities (72%).
East Valley, LA 1990s	Minimal process. In 2002 Councilman claims authorities "failed to adequately inform residents".	2000: 65% agreed to the policy; 38% to the idea of drinking the water. "Toilet to tap" headlines publicised project "days before" due on line. Homeowners' association/residents opposition.
Denver, Col. 1990s	Focus group early 1990s: "They wanted us to just get on with it".	1973: 49% approval for drinking; 1983: 32% approved; 1985: 29% approved.
Tampa, Florida 1996–97	Aim: "To develop the purification option, rather than compare it to alternative sources".	1995: 51% "appealing"; 62% "safe" 1996: 46% policy support; 42% would drink it. However, 75% supported desalination.
Noosa, Qld. 1993–94	Stakeholder Group represented 30 'opinion leader' groups. Council newsletter/survey to all householders; 2 workshops.	Around 45% support for some form of potable reuse. Survey (10% response rate) was the only information received by many respondents; unhappy they were excluded from process.
Orange County, LA 2000–present	Top down process: educated 23 city councils plus community groups. Information to 80,000 households; 4 workshops.	1997: short and long descriptions to split sample: 51% and 65% agree. 2000: 51% and 67% agree. No direct question on whether respondents would drink the water.

water in the 1980s hovered around, or well below, 50% in the ten populations surveyed [e.g. 17]. More recent data, collected from where indirect potable reuse was proposed, confirm these results, although few surveys actually asked whether people would drink the water [18]. In line with the literature, because support was not forthcoming from the majority, attempts to introduce potable reuse met with effective opposition. Where public opinion was polarised, politicisation of the controversy was inevitable. Now, only the Orange County proposal is forging ahead, flanked by an intensified level of public education to reach all constituents.

A more recent development in the experience of potable reuse is being celebrated in Singapore. Up to 1% of the island-state's water supply now includes reverse osmosis polished reclaimed water to augment sources of fresh water imported from Malaysia. This advanced system is proudly showcased to the public and along with the distribution of bottled 'New Water', the public outreach is helping to build community support for indirect potable reuse. In evaluating this development, it can be seen that the historical context is an important factor in influencing public acceptance. Patriarchal governance and a long and harrowing dependence on Malaysia's water exports

contrasts with the more democratic political economies of the USA and Australia, coupled with the wider range of options available to them.

3. Alternatives to potable reuse

Alternatives, such as desalinated water, are preferred over potable reuse options. Bruvold's Californian respondents in 1972 [19] clearly ranked desalination and importing surface water (36% each) over the non-specified "reclaimed water" option (10.5%). Yet, of the eight potable reuse case study sites summarised in Table 1, only the survey of the Tampa population offered the desalination alternative, and this was the favoured option. By March 2003 the Tampa Bay Seawater Reverse Osmosis Plant was producing desalinated seawater drawn from the Tampa Bay. However, financial setbacks, control of the project, and problems with Asian green mussels have hampered its operation. In the meantime, due to improvements in the technology and increasing threats to imported water sources, San Diego is now also planning to build a desalination plant, regarding it as cost competitive compared to other sources of water.

Non potable reuse is another feasible alternative. Reclaimed water is treated fit for purpose for a range of uses that do not require water of drinking quality standard. Historical survey data has consistently shown that the public will tolerate and even welcome non potable uses of reclaimed water [17]. Yet, in each of the eight cases reviewed above, it was either not fully developed or not established when potable reuse was being proposed. Nor was non potable reuse offered as an option in surveys of public opinion conducted at these locations. Reclaimed water for industrial uses or municipal irrigation is only now being implemented or being further developed in those sites where potable reuse has been rejected. It can be logically predicted that if non potable reuse fares well in these areas, the experience will provide an opportunity to build the degree of familiarity and trust required by the public for acceptance of higher contact uses. Yet, acceptance of non potable uses cannot be taken for granted, even where they are salient.

A case in point is illustrated in Table 2. Generally, the public indicates high acceptance levels for industrial reuse and the irrigation of golf courses, public parks and, to a lesser extent, school grounds. In Irvine and Monterey, California, where the use of reclaimed water for irrigating vegetable and fruit crops has been practised for some time (20 years in the case of Irvine), public acceptance is lower than in Sydney. Residential reuse in the form of supplying reclaimed water for individual household garden irrigation is also less accepted in Irvine than in Sydney. Reclaimed water for garden irrigation is used in only a select number

Table 2
Percentage of respondents favouring non potable reuse

	Monterey 1996 $n = 602$	Monterey 2000 $n = 584$	Irvine 1998 $n = 400$	San Jose 1999 $n = 400$	Sydney 1995 $n = 1000$	Sydney 1999 $n = 1300$	Perth 1999 $n = 666$
Industrial uses	95	90	89	79	92	90	
Irrigation:							
golf courses	98	91	88	83			95
parks	95	91	88	83	94	97	89
school grounds	83	76		71			
vegetable crops	68	63	74	62	96	94	
household garden			47		97	95	88

Note: Valid percentages are shown that do not take into account unsure, don't know and nil responses.

of private properties in Irvine. However, its use for common area and public garden irrigation is widely established.

The risk perception literature explains that acceptance of risk is generally higher when it is considered in the abstract. This may partly account for the high level of acceptance in Sydney, particularly for agricultural reuse, compared to locations where the use of reclaimed water is more widespread. However, in the case of Monterey, the fall in support over time indicated by the responses for all five non potable uses can not be easily explained by the full range of data collected at this site. For example, a concerted effort was made to keep the public informed of the development of agricultural reuse through regular newsletters. From all accounts, there has been no adverse publicity and the reclaimed water system for agricultural produce in this area is regarded as a model project. Despite the distribution of informative leaflets, as well as educational outreach in local schools, it is clear from the responses to open ended questions in the Monterey findings [20], that not enough was known about reclaiming and recycling water. This suggests that multiple sources of information and various methods of communication and dialogue are required to fully inform and involve the public.

4. Residential reuse

The importance of taking the public seriously and building a sense of co-management of sustainable water resources is best exemplified in residential reuse developments. Reclaimed water for household non potable uses is only in its infancy in California, but has been established in Florida for over twenty years for outdoor uses (predominantly for garden watering, but also for car washing). In Australia, in the few residential developments that feature dual pipe reticulation, reclaimed water is provided for both outdoor uses and indoor toilet flushing. A comparison between the Florida model and the Australian development highlights several factors that may shape the future success of non potable reuse, all of which hinge on the nature and extent of public involvement.

4.1. Contracts and configurations in Florida

Field work at Altamonte Springs, Sandford, Melbourne (Brevard County) and St. Petersburg in Florida ascertained that customers are required to lodge an application to connect to the reclaimed water service. Comprehensive information is provided to each customer and they are required to sign an agreement to abide by a set of rules governing the safe use of the water. The rules explain the undertakings of the provider as well the obligations of each customer to use the water appropriately. Throughout Florida, the service is primarily provided for connection to garden irrigation systems at the curb side of each property. Customers know that if they wish to use the water for car washing or hand watering they are required to make a separate application for a special hose connection. This is located in a below ground service box so that it cannot be easily accessed by children or the unaware.

4.2. The Australian model

One of the earliest examples of residential reuse in Australian is located at Wagga Wagga in New South Wales and perhaps by default, follows the Florida example of distributing reclaimed water for garden irrigation only through a connection not easily confused with drinking water taps. However, the more recent, sophisticated residential reuse developments stipulate special purple taps with removable handles for accessing reclaimed water and the continuation of the lilac reclaimed water pipe through the wall cavities to toilets within the house to provide water for toilet flushing. These residential reuse sites are found in full-scale operation at Newington (Sydney Olympic Park Authority's Water Reclamation and Management System), and Sydney Water's Rouse Hill in New South Wales, and a development soon

to go on line at Mawson Lakes in Adelaide. An earlier demonstration project at New Haven in Adelaide does not feature the purple taps and instead has only the direct connection to irrigation systems. However, like its more modern counterparts, the dual pipe is extended into the house for toilet flushing at single or multiple locations throughout the house.

4.3. Implications for controlling risk

This comparison suggests that the Australian model sets up a residential reuse system that involves a higher level of public health risk than the Florida configuration. Firstly, the taps may be more easily accessible than underground connections, particularly if the handle is not removed or can be located by children. Secondly, there is a higher risk that the lilac pipes will be cross connected with drinking water pipes during plumbing maintenance or house extensions. Therefore, the communication to customers and plumbers is of particular significance. Customers that buy into these developments receive building encumbrance documents which set out the requirement to use the correct reclaimed water connections accompanied by a list of appropriate uses for water. Additionally, at Rouse Hill and Newington, an informative customer brochure lists the appropriate uses for reclaimed water and uses that are not recommended. This type of communication, however, falls short of underlining the importance of adhering to rules of use in the same formalised manner that is standard practice in Florida. The connection between controlling risks through some form of contractual agreement between provider and user of reclaimed water is an important one [e.g. 21].

4.4. Cross connections

Problems with cross connections involving non potable water have arisen, mainly in the establishment phase of reuse systems, and in some cases these have been publicly documented. The City of Newport Beach has learned that retrofitting reclaimed water to existing open space irrigation is problematic. Even if original plumbing plans are available, they may not represent recent changes that could include cross connections deliberately set up by home owners illegally drawing water from public irrigation systems. Sydney Water's experience at Rouse Hill illustrates that despite building specifications, and the stipulations outlined in customer brochures (including a useful leaflet on how to self-check for cross connections), plumbing violations and direct cross connections still occur [22]. Therefore, institutional arrangements need to be developed to prevent mishaps occurring because of unwanted public interference or inadequately informed service personnel. The plumbing industry is alert to the need for reclaimed water accreditation for plumbers [23]. Additionally, a routine program of cross connection checks needs to be part of responsible governance effected at residential reuse sites, as established in Florida, in the new Newport Coast project in California, and now being implemented for existing and expanding residential developments at Rouse Hill and at Mawson Lakes.

4.5. Consumer awareness

The cooperation of residents is fundamental to the long term success of integrated water initiatives. Therefore, a first step will be an appreciation of the reclaimed water system. This should include the benefits of using reclaimed water, that it is sourced from sewage effluent and whether or not the household is connected to the system. Additionally, it should be demonstrated that residents respect the rules restricting its use and value the reclaimed water.

While only one or two respondents were not aware of the source of reclaimed water at Altamonte Springs, Brevard and New Haven, almost two-thirds of the twenty residents interviewed at Mawson Lakes either thought the water would not include wastewater from toilets or that it would

be stormwater only. Additionally, a quarter of the respondents at this site thought the system was already 'on line', while a tenant interviewed at New Haven was unaware that reclaimed water was being recycled.

The cost-saving benefit was nominated by the majority of respondents across all sites with lesser emphasis placed on the conservation of natural resources and the potable water supply. The appreciation of cost savings was artificially enhanced at Mawson Lakes because most respondents mistakenly thought that it would be a quarter to a third of the cost of potable water, whereas at New Haven, respondents were the least appreciative of the cost-benefit due to the confusion generated by poor billing methods. However, New Haven respondents were more aware that recycling helped to reduce the effluent discharge load to the Gulf (60% compared to 30% or less at other sites). This reflects the fact that, with the exception of the tenant, all respondents knew that their sewage was being treated at a small, aesthetically designed but visible, neighbourhood plant for recycling back to their village.

Respondents at Altamonte Springs and Melbourne in Florida clearly understood and respected the fact that reclaimed water was to be used only for connection to an irrigation system, unless the resident had successfully applied for a special underground hose connection for washing the car. One respondent at Altamonte Springs admitted that he previously had an over-spray problem from the garden into the swimming pool, but this had now been corrected. Others explained that they were not able to hand-water or wash cars because they had not applied for the underground connection. By contrast, it was observed that six respondents at New Haven had illegally connected taps to the reclaimed water irrigation system (proudly displayed to the researcher in some cases) while half the Mawson Lakes respondents had installed ordinary taps instead of the more expensive purple taps. Additionally, six residents interviewed at Mawson Lakes were unaware that the water should not be used to fill swimming pools.

Valuing the water involves an inextricable linkage between price and water conservation. For example, the managers at the two Florida case study sites, as well as St. Petersburg, wrestled with the fact that because reclaimed water is levied at a low, flat monthly rate, their customers used it excessively. The City of Altamonte Springs has had some success in controlling over-use through restrictions and fines, while neighbouring Sandford is metering its customers to encourage conservation. Meters are used in the Australian sites but, at Rouse Hill, the tariff is a fraction of the charge made for potable water (27c/kL compared to around a $1/kL). Reclaimed water at Newington is more realistically priced (78c/kL). However, at all residential reuse sites, there is insufficient reclaimed water to meet irrigation demands in the dry weather and the water is either 'topped up' with expensive potable water (at no direct cost to the user) or rationed through an interruptible supply (Melbourne, Brevard County).

4.6. Quality of the service

The overall experience of using reclaimed water should be a positive one. This in fact came across at each of the three study sites where respondents have had experience. New Haven respondents were particularly aware of the 'feel good' factor in recycling water. Yet the New Haven respondents proved to be remarkably forbearing. They have had to weather variation in water quality, often attributed to damage to pipes during house constructions or irregular maintenance of the treatment plant. Thirteen respondents related accounts of interruptions to supply when buckets had to be used to flush toilets, and all either described unwanted characteristics such as odour, sediment or a murky colour that was occasionally detected when flushing the toilet. When this experience is coupled with the lack of knowledge of user-rules, the potential health risk

is increased. This situation is linked to the weak structural support for managing residential reuse at this site [24].

4.7. Co-management of residential reuse

When the range of implications of making reclaimed water available for residential reuse is considered, a case is drawn for institutionalising co-management of the community systems. This occurs to some extent at the Florida sites. The water suppliers communicate with home owners' associations on water quality, interruptions to the service and suitable planting. Residents are invited to give feedback; for example, the provision made on the Brevard County website, where householders can also access full details of the reclaimed water system, including rules and regulations. A residents' group is developing at Mawson Lakes, however, membership is not compulsory. While at New Haven, residents managed to cope with the variations in water quality and service only because of the informal coordination between the engineering contractor and three male residents who voluntarily notified their neighbours when the system was 'down' or back 'on line'. However, this arrangement is no substitute for more formal and responsible governance of the system that includes management of reclaimed water at the individual household level.

5. Public consultation

While it is not possible here to elaborate on approaches to public involvement in alternative water resource supply and management, it can be seen that getting this right is integral to the success of new technologies or new ways of doing things. The experience of recent potable reuse proposals illustrates that public involvement is both an expectation and requirement for the introduction of innovative solutions to water management. There needs to be greater dialogue throughout whole communities that includes government representatives, politicians, water industry professionals, the media, business and special interest groups, as well as the general public. Informed deliberations should include complete information on the status quo (including instances of 'unplanned' and existing potable reuse) and the full range of alternatives available, which may include further conservation efforts. The aim of these negotiations should be to arrive at a sustainable outcome, not the acceptance of a system preferred by its proponents.

For introducing non potable reuse, the process of consultation may not be as resource intensive with respect to inputs of time, effort and funding when compared to the more controversial potable reuse proposals. This is because research has shown that these uses are more likely to be valued and accepted, or at least tolerated, by the public. Nevertheless, public involvement in the decision making process is vital to ensure initial and then ongoing support and cooperation from all constituents. And, in the case of residential reuse, the community that will have hands-on use of reclaimed water will need to be made aware of their responsibilities in managing the service. A healthy collaboration between providers and end-users will be required to achieve long-term, beneficial outcomes.

6. Conclusion

What is meant by 'sustainable outcomes' in innovative water management? Several explanations emerge from the data presented here. Overall, the consistent theme that emerges is that, either one way or another, public involvement is inevitable in the processes of acceptance and effective management of reclaimed water.

Due to a more risk aware public, which has historically opposed the concept, the implementation of potable reuse is problematic. The community to be affected should be actively involved in the decision-making process which allows this option to be considered amongst other, alternative

options. As a consequence, the adopted change in technology may not be potable reuse, but a desalination plant or non potable reuse. However, because it has been actively and publicly deliberated, it is more likely to be successfully implemented and enjoy ongoing acceptance.

In the case of non potable reuse, it has been illustrated that retrofitting reclaimed water for even common garden irrigation, should be approached with caution. Community involvement is required to assist in updating plumbing plans and cooperating with inspections to identify past plumbing violations. It has been argued that contractual arrangements for all reuse systems, between the water provider and end-user, will help inform, identify and secure respective obligations and responsibilities.

In relation to residential reuse, an evaluation of the long term benefits of including toilet flushing should be made by the community concerned. It may be decided that the inclusion of indoor uses requires a higher water quality, at a higher cost to the end-user, with the greater potential for cross connection incidents. These costs may be compared to the limited conservation or environmental benefits involved.

To guide the day-to-day management of residential reuse, consideration should be given to institutionalising residents' or home owners' associations to assist in keeping householders informed, to monitor rule compliance for the safe use of the water, and to generate feedback from local experience to improve the system.

Finally, if the public are to value reclaimed water for residential reuse, it should be priced at a rate that will deter over-use and be subject to water restrictions if necessary in order for this to be achieved. This will assist with the sustainable management of the receiving environment as well the economic management of the system by avoiding the need to top-up the system with costly potable water. Public acceptance of higher prices for reclaimed water and restrictions on its use will be more readily achieved through the community's co-management of this resource. This more active role, acknowledged and supported by the authorities, may ensure that residential reuse fulfils a sustainable function.

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References

[1] I. McAllister and D.T. Studlar, Trends in public opinion on the environment in Australia. Intern. J. Public Opinion Research, 5(4) (1993) 353–361.
[2] A. Szasz, EcoPopulism: Toxic waste and the movement for environmental justice, Vol. 1, Social Movements, Protest, and Contention, Bert Klandermans, ed., University of Minnesota Press, Minneapolis, 1994.
[3] G. Gregory, Persuading the public to make better use of natural hazards information. Prometheus, 13(1) 1995 61–71.
[4] J.F. Short, Jr., The social fabric at risk: toward the social transformation of risk analysis, American Sociological Association, 1984 Presidential Address, American Sociological Review, 49 (1984) 711–725.
[5] A. Giddens, Beyond Left and Right, Polity, Cambridge, 1994.
[6] B.A. Misztal, Trust and cooperation: the democratic public sphere. J. Sociology, 37(4) (2001) 371–386.
[7] P. Sztompka, Trust: A Sociological Theory, Cambridge University Press, Cambridge, 1999.
[8] J. Habermas, Moral Consciousness and Communicative Action, translated by C. Lenhardt and S. Weber Nicholsen, MIT Press, Cambridge, Mass, 1990.
[9] T. Webler and S. Tuler, Fairness and competence in citizen participation: theoretical reflections from a case study. Administration and Society, 32(5) (2000) 566–595.
[10] G.J. Syme and B.E. Nancarrow, Evaluation of public involvement programs: measuring justice and process criteria. Water, June (2002) 18–24.
[11] P. Cullen, Empowering communities — challenges

for technical communicators, Conference paper. Stockholm Water Symposium, 1996, pp. 1–8.
[12] J. Marks, The sociology of disgust towards the use of reclaimed water, in T. Gardiner and D. McGarry, eds., Water Recycling Australia 2nd National Conference, AWA, 1–3 September, Brisbane, 2003.
[13] N. Stennekes, H.K. Colebatch and T.D. Waite, Water recycling and policy making, in T. Gardiner and D. McGarry, eds., Water Recycling Australia 2nd National Conference, AWA, 1–3 September, Brisbane, 2003.
[14] R. Williams, Frustration with community consultation. Australian Environ. Rev., 17(3) (2002) 8–9.
[15] M.B. Abbott, The democratisation of decision-making processes in the water sector. J. Hydroinformaticsm 03.1 (2001) 23–34.
[16] A. Fung and E.O. Wright, Deepening Democracy: Institutional Innovations in Empowered Participatory Governance, The Real Utopias Project IV, Verso, London, 2003.
[17] W.H. Bruvold, Obtaining public support for reuse water. AWWA J., 77(7) (1985) 72–77.
[18] J.S. Marks, Advancing community acceptance of reclaimed water. Water, August (2004) 46–51.
[19] W. Bruvold, Public Attitudes Towards Reuse of Reclaimed Water, Contribution No. 137, School of Public Health, University of California, Berkeley, 1972, pp. 1–54.
[20] J. Tiernan, Customer Opinion Survey Results 2000, Unpublished Report for the Monterey Regional Water Pollution Control Agency, 2000.
[21] L. Moore, Reclaimed water: managing the legal risks. Water, December (2003) 70–74.
[22] E. de Rooy and E. Englebrecht, Experience with residential water recycling at Rouse Hill, in T. Gardiner and D. McGarry, eds., Water Recycling Australia 2nd National Conference, AWA, 1–3 September, Brisbane, 2003.
[23] G. Workman, R. Herbert and G. Tink, Overview of plumbing legislation reform needed for urban water recycling, in T. Gardiner and D. McGarry, eds., Water Recycling Australia 2nd National Conference, AWA, 1–3 September, Brisbane, 2003.
[24] J.S. Marks, A sociological analysis of the sustainable management of decentralised, residential water reuse, International Water Association Conference, 10–14 February, Fremantle, WA, 2004.