

Supplementing City Water Supplies: The Social Potential of Alternative Water Sources

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Abstract: The need to conserve and reuse natural resources is a key factor in making our cities more ecologically sustainable. Urban water supply is one of the most pressing concerns which will require more than conservation or demand management if future water security is to be realised. Therefore, this paper aims to clarify several key aspects of public acceptance of alternative water sources that are currently under consideration in different parts of Australia. Firstly, the acceptability of different scenarios are reported for recycling water from effluent, stormwater, greywater, as well as the capture of rainwater and desalination of seawater. These data for each of seven Australian capital cities that have experienced water restrictions during the prolonged drought are drawn from the first national survey ($n=2504$) on this topic. Secondly, levels of confidence in using recycled water are explored, derived from three case studies of 'third pipe' (or dual reticulation) systems in the Rouse Hill area and Newington in Sydney and Mawson Lakes in Adelaide. Thirdly, the paper summarises national survey respondents' reasons for hesitation or concern. Finally, the extent to which the general population were previously aware of the practice of recycling water is reported for each city. While the response to drinking water sourced from effluent or stormwater mirrors the outcome of the Toowoomba proposal, there is little evidence here that public perceptions justify hesitation in factoring in other alternatives.

Introduction

Since the revival of interest in public acceptance of water recycling in Australia, most publications focus on indirect potable reuse (IPR), the mixing of highly treated effluent with existing drinking water supplies held in surface or underground reservoirs. The vast socio-cultural, psychological and health risk differences between recycling water for human ingestion and recycling for all other uses is often overlooked. Historical accounts demonstrate that the public supports non potable (not for drinking) uses, but are opposed to potable reuse (Bruvold, 1972; Roseth, 2000; McKay & Hurlimann, 2003; Marks, 2004). This trend was confirmed in the findings of Australia's first national survey on public acceptance of water recycling (Marks et al, 2006). Hence the result in Toowoomba, Queensland, should not have come as a surprise to those who have been tracking public responses to potable reuse. By way of explanation, faced with a forecast of severe water shortages due to drought conditions and population growth, the Mayor of Toowoomba decided that IPR would be the most appropriate way forward, along with other measures, and submitted a proposal for funding from the National Water Commission in July 2005. Public consultation was introduced late in the planning stage and was shortened to a few months by a Federal government condition of funding, that the residents of Toowoomba give approval by voting in a plebiscite. In July 2006, a total of 38% supported the plan and this result was regarded by many (proponents, media reports) as a failure on the part of the residents to embrace this high technological solution. This assessment unfairly ignores other historical evidence in the USA and Australia that whenever IPR has been proposed with public awareness and approval, the concept has been rejected (e.g. Marks 2006).

What is new about these latest results – the national survey and the level of support in Toowoomba – is that, in general, publics in Australia appear to be more accepting of potable reuse than they have indicated previously. Earlier findings for surveys in Perth and Sydney in the late 1990s reported 16% in Perth (ARCWS, 1999), and around 25% support in Sydney (Roseth, 2000). The national survey, the Toowoomba plebiscite (both a measure of confidence) and more recent research in Perth (Po et al, 2005) and Sydney (Davies, 2005; Clean Water Campaign, 2005) found that support for proposals to introduce IPR now rests between 30 to 45%. The supply of additional drinking water through IPR is now proposed for South East Queensland and Canberra and is under consideration in Goulburn in New South Wales, and Perth in Western Australia. Therefore, this paper reports the levels of acceptance for IPR for each of the capital cities included in the national 2005 survey.

Desalination of seawater is another way to supplement drinking water and this has been implemented (for example, Kangaroo Island, South Australia, and Kwinana, Western Australia) or is under investigation in Australia. One Sydney survey explored public acceptance of this option and found 65% support for it at the height of a desalination versus recycled water for drinking debate (Davies 2005). Stormwater is also being tested for drinking through aquifer storage transfer and recovery (ASTR) in Adelaide. This paper

includes public willingness to drink water from desalinated seawater and reports both willingness and confidence levels for using stormwater.

Recycling water for non potable uses in community or regional scale schemes through what is commonly termed a 'third pipe' system involves dual reticulation of both potable water and recycled water. A small community scale system was first introduced successfully in Australia (a rudimentary but effective retrofitted system) in the 1980s in Wagga, New South Wales. This was followed by the South Australian demonstration site of New Haven, Adelaide, in 1995. Since then, three larger schemes have been implemented. The Sydney Olympic Park Water Authority's system that reticulates a combination of stormwater and water reclaimed from effluent came on line in Newington in April 2001 and services around 2,000 dwellings. In September of the same year Sydney Water's regional scheme commenced full-scale operations and now recycles water reclaimed from effluent to 15,000 households across five suburbs in the Rouse Hill Scheme area. Like Newington, a combination of stormwater and recycled water is used at Mawson Lakes in Adelaide, and is distributed to over 1,000 dwellings. In all three cases, the recycled water is mainly used for toilet flushing and garden irrigation. This paper details percentages of city populations in favour of non potable reuse and the confidence indicated by householders in the three case study sites for their daily, routine use of recycled water. Public support for non potable uses of stormwater and water sourced from on-site greywater units are also detailed.

The results section of this paper is concluded by a summary of reasons why people hesitate or are not willing to use alternative sources of water, followed by levels of prior awareness of existing uses of recycled water, planned and unplanned IPR. It is the intention of this paper that the quantity of tables presented will not overload the reader but will provide evidence of public support for a range of alternative sources of water that may be used to ease demand on city water supplies.

Theoretical considerations

Some of the theoretical concerns for this research and, specifically, for the material presented in this paper centre around risk, trust, and adoption of new technology. From the socio-psychological literature we learn that the characteristics of risk may have some bearing on acceptability, that is, whether it is perceived as voluntary, familiar, natural, (e.g. Fischhoff et al, 1978) or fair (e.g. Syme and Nancarrow, 2002). The sociological view argues that social relations are at the core of responses to low probability/high consequence risks. Acceptance is therefore influenced by the degree to which responsible authorities are trusted. Consequently, approaches to public participation – building public awareness, fostering respectful deliberation – not only engender trust but also lead to informed decision-making (e.g. Sztompka, 1999; Marks, 2004). And from the socio-cultural perspective, Douglas (1966) advises that rejection may not be so focused on dirt (for example, the yuk factor), but matter out of place (such as clean shoes on the dining room table). In other words, there are cultural cues (culturally agreed norms, mores and taboos) about what may flow into and out of the body and how waste is dealt with. The transgression of these categories or boundaries provokes emotional responses such as fear, dread, anxiety, frustration and rage (Lupton, 1999). In the applied literature on adoption of new technology, practical considerations are paramount: time and effort, limited advantages of adoption, high initial costs (Nowak & Korsching 1979), pre-adoption attitudes towards the innovation, water quality, and opportunity for control (Casey 1997); as well as access to information and availability of the technology (Wilkie 1986; Audirac & Beaulieu 1986).

Research design

To obtain national data on water recycling, a telephone survey of householders in the seven capital cities where water restrictions had been introduced (Adelaide, Brisbane, Canberra, Hobart, Melbourne, Perth and Sydney) was conducted from November to mid-December 2004, then early January 2005. The total finished sample of 2504, with approximately 357 respondents for each city, resulted in an overall response rate of 29.6%. Representativeness of the sample to the seven target populations was assessed by comparison with relevant Census data (2001) revealing some biases on age, education and gender. Post hoc weights were then constructed to correct these biases. A follow-up survey of non respondents (total n=400) confirmed that the initial non respondents did not vary greatly from the main sample. All results reported here do not include "don't know" responses or refusals, which were negligible.

A mail-back survey was conducted at each of the three water recycling case study sites. Cluster sampling was used to randomly select streets, then households and, as with the national survey, persons who last celebrated a birthday were invited to participate. An overall response rate of 45.3% yielded sample sizes of 338 for Mawson Lakes, 262 for Newington and 337 in the Rouse Hill water recycling scheme area.

Research results

Several measures of acceptance of recycled water were employed and results reported here include:

- willingness and confidence to use water from an IPR system
- favour/oppose for the public or municipal uses
- willingness to use the water for non potable household uses: (a) for a range of applications, (b) to use the water retrofitted to established homes for garden watering, (c) to buy into new housing developments where recycled water is reticulated for garden watering and toilet flushing and rainwater is provided for all other uses
- confidence of water recyclers in their current uses of recycled water

Potable uses

The question that described IPR was put to respondents after they had considered all other alternative water sources. It stated:

Reclaimed water – that is, water reclaimed from wastewater or sewage effluent - can also be treated to drinking-water-quality. It can then be mixed with traditional sources, such as water collected in reservoirs, and then treated and piped in the usual way to the whole city or town. ... How willing would you be to use water mixed with reclaimed water, treated to drinking water quality, for all your household needs?

The results for each of the seven capital cities are shown in Table 1.

Table 1 Willingness to use water from an IPR system (percent)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
<i>n=</i>	356	354	353	354	348	357	353
Without hesitation	25.3	23.2	25.5	21.2	19.8	25.2	22.7
Some qualifications	52.8	50.3	51.8	53.4	52.3	50.7	50.1
Not willing	21.9	26.6	22.7	25.4	27.9	24.1	27.2
Total percentage	100	100	100	100	100	100	100

Table 1 reveals consistent responses across these capital cities. The total of 'willing without hesitation' and 'willing with some qualifications' ranges from 72% in Melbourne through to 78% in Adelaide. All are relatively high levels, particularly when compared to recent research in Perth (31% willing, Po et al, 2005) and Sydney (48% 'support', Davies 2005; 47% 'favour', Clean Water Campaign, 2005).

A more robust measure was used to explore trust in using the water for potable household applications, as shown in Table 2.

Table 2 Confidence to use water from an IPR system (great plus moderate confidence)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
<i>n=</i>	357	356	355	356	351	356	358
Showering	78.4	76.1	85.1	75.8	74.6	76.4	76.0
Cooking	55.3	55.3	66.4	53.0	51.1	58.3	53.9
Drinking	43.8	42.3	55.6	41.9	37.3	48.2	41.7

In each city, confidence to use water from an IPR system for showering holds at the same or higher percentage as the previous willingness to drink results. This suggests a real interest by the public to consider this use. Once ingestion is proposed, however, confidence falls by around 20% for the cooking

application in each city, and by around another 10% when drinking is considered. Canberra residents indicate the highest level of trust in IPR, but opinion is still polarised.

Non potable uses

Given the historically high levels of support for recycling water for non potable purposes, this section gives the Australian city results in some detail to confirm and to clarify the trend. The following table lists the percentages in favour of using recycled water for a range of public/municipal uses (Table 3).

Table 3 Percentages in favour of public uses of recycled water

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
Flushing toilets	94.9	93.3	96.6	89.6	95.4	95.5	96.9
Commercial laundry	81.4	74.9	82.4	74.0	80.5	75.3	79.7
Golf, parks, gardens	97.8	98.6	97.2	94.7	96.4	95.8	96.9
School yards, play fields	90.7	89.4	90.7	86.4	88.6	86.0	86.9
Dairy, beef, sheep pasture	82.3	83.2	84.1	80.5	74.8	79.2	75.0
Vegetable, fruit crops	76.1	72.1	73.1	74.4	69.3	73.3	68.0
Vineyards	83.2	79.5	80.5	79.4	72.5	78.6	76.2

The more favoured public uses are for the irrigation of golf courses, parks and gardens and the flushing of toilets in public buildings. There is little variation between the cities for these two types of applications, with Hobart being only slightly less in favour than the other populations. A slight fall in support is evident in each case for the irrigation of school yards and playing fields. Concern for health risks and the safety of children may contribute to this more subdued response. An overall lower level of support, although still high, is found for using recycled water for clothes washing in commercial laundries. Similar percentages who strongly favour/favour emerge for irrigation within the food chain for producing meat, vegetables and wine. The pattern of acceptance that emerges in this table confirms previous findings, that the more removed recycled water is from personal contact, the more acceptable it becomes.

After considering public uses, respondents were asked if they were willing to use the water in their own homes. The results are detailed in Table 4.

Table 4 Willingness to recycle water for a range of applications in the home (percent)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
Toilet flushing							
Without hesitation	76.7	74.1	87.0	73.8	77.9	78.1	80.8
Some qualifications	21.1	23.4	10.8	22.8	19.3	19.0	16.9
Garden irrigation							
Without hesitation	81.7	84.2	86.2	80.3	79.6	81.4	81.7
Some qualifications	14.9	13.6	11.8	16.3	17.6	12.1	15.2
Hand watering							
Without hesitation	80.2	85.5	86.2	79.8	77.7	78.8	81.0
Some qualifications	14.8	11.6	11.9	16.3	18.0	12.0	15.4
Car washing							
Without hesitation	76.2	76.2	81.4	71.2	73.7	68.6	77.7
Some qualifications	13.3	13.9	12.0	14.9	15.2	12.8	12.9
Washing machine							
Without hesitation	37.9	35.2	45.0	39.1	38.1	37.9	41.4
Some qualifications	36.5	33.8	35.8	28.0	39.5	32.9	31.8
Hand washing clothes							
Without hesitation	32.5	31.0	39.4	33.1	34.1	38.2	37.2
Some qualifications	37.0	35.2	37.1	28.6	36.9	27.8	29.3

An overall observation of the results in Table 4 is that the public are not responding according to the not-in-my-backyard (NIMBY) syndrome. With the exception of laundry uses, well over two-thirds of each sample are willing to use the water without hesitation. Over 90% are willing (without hesitation and with some qualifications) to use recycled water in their home for toilet flushing and in the garden for irrigation systems and hand watering. This latter result also lays to rest generalisations that the public are more opposed to the water when bodily contact is suggested. The same can be said for car washing, where contact would be made, because from 80% to over 90% also support this use. Once personal applications are proposed, however, support is withdrawn to some extent, and fairly consistently across all cities. Residents in Canberra, closely followed by Melburnians, are the most willing to try the water in washing machines and for hand washing of clothes. The levels of willingness for washing machines are important as this is one area where water savings can be made in units and townhouses without gardens. Also, the inclusion of recycling water in the laundry in dwellings with standard sized blocks would be particularly beneficial in winter, or in wet weather, when the water is not required for garden irrigation.

Because 'third pipe' water recycling systems are only considered for new housing developments in Australia, we asked respondents how willing they would be to use recycled water from a regional treatment plant for outdoor uses only. This is similar to the practice in Florida, which allows retrofitting to established houses for garden irrigation. The results are shown in Table 5.

Table 5 Willingness to use recycled water for garden irrigation, retrofitted to existing residential properties from a regional treatment plant (percent)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
<i>n</i> =	357	354	354	354	349	350	353
Without hesitation	69.2	66.7	75.1	69.5	55.0	74.3	65.4
Some qualifications	26.9	29.7	22.0	26.8	37.2	20.0	30.9
Not willing	3.9	3.7	2.8	3.7	7.7	5.7	3.7
Total percentage	100	100	100	100	100	100	100

The total willing (without hesitation and with some qualifications) reaches over 90% for each city (Table 5).

Next, respondents were asked to assume they were in the market for a new home and whether they would be willing to buy into one that provided recycled water for toilet flushing and garden irrigation, with rainwater for all other uses. The proposed alternative water sources for the Pimpama Coomera region in Queensland and the Aurora housing initiative in Victoria include the use of rainwater and recycled water. Levels of willingness for this scenario are given in Table 6.

Table 6 Willingness to buy into a housing development featuring recycled water for toilet flushing, garden watering and rainwater for all other applications (percent)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
<i>n</i> =	355	350	356	355	349	356	352
Without hesitation	76.6	80.0	78.9	75.8	75.1	80.6	75.9
Some qualifications	20.6	16.3	18.8	21.1	22.9	14.9	20.5
Not willing	2.8	3.7	2.2	3.1	2.0	4.5	3.7
Total percentage	100	100	100	100	100	100	100

Willingness levels are higher still for the scenario of buying into homes that provide recycled water and rainwater, with the totals rising from 95% across all cities (Table 6). Again, the results are consistent.

Water recyclers

Taking this enquiry a step further, the confidence of householders who already recycle water for most of these applications was investigated. The results suggest that recycling is socially acceptable, and sustainable since these recyclers had from one year (Mawson Lakes) to five years' experience (Sydney sites) at the time of the survey. Table 7 details the results for the current uses and for the hypothetical laundry applications.

Table 7 Confidence of water recyclers in a range of household applications (percent)

<i>Confidence level:</i>	Mawson Lakes		Newington		Rouse Hill area	
	Great	Moderate	Great	Moderate	Great	Moderate
Existing applications:						
Toilet flushing	77.3	18.1	88.2	10.6	88.7	7.9
Garden irrigation	74.0	22.3	81.8	16.6	86.0	10.7
Hand watering	69.9	25.8	79.0	17.5	86.0	10.9
Car washing	57.8	27.1	79.8	15.4	76.0	15.2
Hypothetical applications:						
Washing machine	11.7	24.1	24.6	32.5	20.6	22.7
Hand washing clothes	7.4	22.2	17.8	31.6	15.0	24.5

These results (Table 7) demonstrate that householders who have experience of recycling water through a 'third pipe' system have great confidence in using the water for the applications they are familiar with. The cumulated result (great plus moderate confidence) mirrors that for the city populations (over 90% at each site) with respect to flushing toilets, and watering gardens through an irrigation system or by hand. The same high level is found for car washing at Newington and in the Rouse Hill area, with slightly less confidence at Mawson Lakes, possibly due to the South Australian Environmental Protection Agency policy that discourages the practice in order to curb catchment pollution caused by detergents.

The experience of recycling water has not lead to a ready acceptance of the hypothetical laundry application. Only the residents at Newington show a degree of interest (on or just over half the sample). This may be due to the higher density of the development (fewer gardens) that lends itself to considering more indoor applications for recycled water.

Willingness to use greywater

The future of greywater units is uncertain. Generally, authorities (local councils, environmental and human health authorities) have been reluctant to actively encourage their use. They require regular maintenance to ensure proper filtration occurs. This issue was not included in the question put to respondents, which stated that:

Individual greywater units can treat used water from the laundry and shower for household garden watering and toilet flushing. How willing would you be to have this type of unit installed?

The levels of willingness shown in Table 8 range from a combined total willingness for Melbourne of 90% through to 98% for Sydney householders.

Table 8 Willingness to use greywater for non potable uses (percent)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
<i>n=</i>	358	354	354	355	351	357	357
Without hesitation	67.6	58.5	70.1	60.3	53.0	65.0	63.0
Some qualifications	29.6	37.0	26.8	35.8	37.3	28.3	35.0
Not willing	2.8	4.5	3.1	3.9	9.7	6.7	2.0
Total percentage	100	100	100	100	100	100	100

Stormwater

This alternative source of water is already being used in community scale, residential recycling as reported above for Newington and Mawson Lakes where a mix of stormwater and recycled water is reticulated. Respondents were asked:

Stormwater, that is, water drained from streets and other areas, can be treated for recycling. How willing would you be to use it for toilet flushing and garden watering?

The results for 'willing without hesitation' listed in Table 9 indicate strong support for using stormwater.

Table 9 Willingness to use treated stormwater for toilet flushing and (percent)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
<i>n=</i>	358	356	357	358	351	356	358
Without hesitation	88.8	83.1	88.0	82.7	80.3	85.4	86.0
Some qualifications	8.7	13.5	10.1	12.0	14.5	10.1	12.3
Not willing	2.5	3.4	2.0	5.3	5.1	4.5	1.7
Total percentage	100	100	100	100	100	100	100

Potable uses of "drinking water quality" stormwater were also queried. The results shown in Table 10 illustrate the marked fall in support for this source when ingestion is suggested.

Table 10 Willingness to use drinking water quality stormwater for all household uses (percent)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
<i>n=</i>	355	358	352	352	350	358	352
Without hesitation	24.8	25.1	30.1	17.3	26.0	26.0	26.4
Some qualifications	52.4	48.9	53.1	49.7	45.4	54.2	48.0
Not willing	22.8	26.0	16.8	33.0	28.6	19.8	25.6
Total percentage	100	100	100	100	100	100	100

To compare results for potable uses of stormwater with water from an IPR system, respondents also considered how confident they were in the applications listed in Table 11.

Table 11 Confidence to use drinking water quality stormwater for showering, cooking and drinking (percentage great plus moderate confidence)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
<i>n=</i>	357	354	356	354	356	355	357
Showering	84.8	81.3	84.6	76.0	79.8	84.2	82.5
Cooking	59.6	58.9	70.7	51.3	51.6	62.8	56.0
Drinking	43.4	50.3	62.6	43.3	44.4	49.6	45.5

The results for potable uses of stormwater and recycled water clearly follow a similar pattern and do not vary significantly (Table 2 compared to Table 11).

Desalination

As mentioned in the introduction, desalination of seawater is a topical issue. Within time limitations, an attempt was made to place this source of water in the context of environmental and economic impacts:

Seawater can be used. Desalination removes the salt and has been an expensive option that uses a lot of energy, but is becoming more economical. If desalinated water became available how willing would you be to use it in the same way as you use the current mains/drinking water

Table 12 Willingness to use water from desalinated seawater (percent)

	Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
<i>n=</i>	355	355	350	352	353	355	353
Without hesitation	57.2	60.0	54.6	43.2	43.3	58.9	52.1
Some qualifications	36.3	33.0	36.3	48.9	45.9	34.1	40.8
Not willing	6.5	7.0	9.1	8.0	10.8	7.0	7.1
Total percentage	100	100	100	100	100	100	100

It is noted that the strongest measure of willingness (without hesitation) in Table 12, doubles that for IPR shown in Table 1. This observation applies to each city. Total willingness to use the water (Table 12) settled around 90%, similar to most non potable uses of alternative sources of water.

Reasons for hesitation or concern

An open-ended question sought responses to the main reason for hesitating or being opposed to alternative sources of water. Opportunities were given after each scenario initially but time limitations for the telephone survey pruned these down. The final column in Table 13 (combined five options) includes greywater; both potable and non potable stormwater; recycled water for the garden only; and recycled water for toilet flushing and garden watering in new homes with rainwater supplied for all other uses, including drinking. Comments on greywater and stormwater by the first set of respondents (n=572) are included separately (2nd and 3rd column, Table 13) to illustrate the weight given by householders on cost when the onsite greywater system is considered, and health risk in relation to stormwater.

The code ‘trust factors’ describes issues that were qualified (e.g. “if I could trial it first”; “if I could trust the managers”; “if it could be maintained properly”; “chemicals in the treatment process”) and suggest opportunities where discussion and further information may address these reasons for hesitation or concern.

Table 13 Coded reasons for hesitation or concern: alternative scenarios (percent)

	Non potable uses			Potable uses		Combined 5 Options
	Domestic n=	Greywater	Stormwater	IPR	Desalination	
Cost	1861	155	55	2012	1172	1719
Health risk	2.4	49.2	16.8	1.0	14.2	4.1
Water source	25.3	19.1	59.4	33.4	11.6	38.3
Trust factors	14.4	3.7	6.8	23.0	9.0	23.5
Water quality	28.4	19.1	5.1	24.4	23.1	13.5
Environment, alternatives, not necessary/not applicable	24.7	4.6	9.8	14.7	17.7	16.8
Total	4.8	4.2	2.2	3.5	24.4	3.9
	100	100	100	100	100.0	100

For domestic non potable recycled water (as listed in the first section of the results in Table 4), trust factors, health risk and water quality are foremost in people’s minds. The largest response related to IPR (n=2012) and health risk is articulated as the main problem with the transformation of effluent to drinking water. The water source and trust factors also shape hesitation or rejection. Of note, is that the quality of the water is of much less importance.

Awareness of water recycling

Finally, levels of awareness are included to situate the public’s familiarity with these technologies.

Urban Australians have little experience or awareness of public uses, such as recycling on golf courses, agriculture and other public uses (shown in Table 3). In five cities, a slightly higher proportion have heard of IPR, and this may have increased due to the media attention given to the concept more recently. The ‘unplanned’ evidence of IPR – where effluent is discharged upstream of some urban populations - is more known to populations in Adelaide and Canberra, but still represents less than half these samples.

Table 14 Awareness of water recycling (percent)

		Adelaide	Brisbane	Canberra	Hobart	Melbourne	Perth	Sydney
Experienced	n=	347	349	351	352	338	347	348
public uses	%	35.2	28.7	30.5	32.7	21.0	23.1	19.5
Head of IPR	n=	357	357	356	349	354	356	355
concept	%	30.8	37.0	42.7	29.8	28.5	34.0	41.7
Though about	n=	356	357	355	355	353	355	357
unplanned IPR	%	44.9	31.1	45.6	24.5	32.0	25.9	31.4

Discussion and conclusion

One clear outcome of this research is that there is overwhelming evidence of public support for a number of initiatives to aid water security in cities. Other important findings - the awareness levels and reasons for hesitation or concern - highlight issues that may be addressed through more targeted, but open and frank communication between responsible authorities and their communities.

There appears to be almost complete public approval for implementing public and municipal forms of recycling water (Table 4), as well as a range of non potable household uses. Therefore, provided that clear information is given, and that there are opportunities for initial and ongoing dialogue between providers and consumers on public health and other concerns (as detailed in Table 13), these applications could soon become standard features - the norm - of water supply. For established homes, there is sufficient enthusiasm for retrofitting existing properties to merit more attention to instances where this may be practical. The experience in Wagga has been most successful and can be refined for other locations if cost and infrastructure can be justified in partnership with relevant communities that may value survival of gardens over the inconvenience and cost of putting pipes down roads.

In relation to IPR, these findings confirm a trend of public opposition to this measure, illustrating that the Toowoomba community is not alone in its unwillingness to embrace the proposal. Strong leadership – as shown by the Mayor of Toowoomba, and now by the Queensland and ACT governments - may, therefore, not be necessary nor sufficient to win public approval. More likely, a process of public engagement that allows debate amongst the various interests, professions and concerned groups that comprise any particular community would be more effective in coming up with options that are socially and economically acceptable, and sustainable, in the long term. Of interest, is the relatively low proportion of city populations that nominate water quality as their main concern in relation to IPR. This suggests that an emphasis on 'purity' may only appeal to a similar proportion of populations. Rather than technical claims, people may be placing greater importance on the embedded cultural and social fact of keeping the two systems separate within a defined geographical area, so that pollutants flow away from rather than into the body.

Further research is required on intentions to use these various sources of water, thoroughly canvassing reasons for and against these different options within communities. Such social research should engage people in a fair appraisal of all matters in relation to treatment, benefits, issues and challenges that can be identified for each proposal. This is particularly the case for potable quality water - desalination and IPR (recycled water or stormwater) - which require a lot of energy to remove salinity and to treat the polluted source water to drinking-water standard. In the meantime, there is much to support a range of initiatives to supplement city drinking water supplies.

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