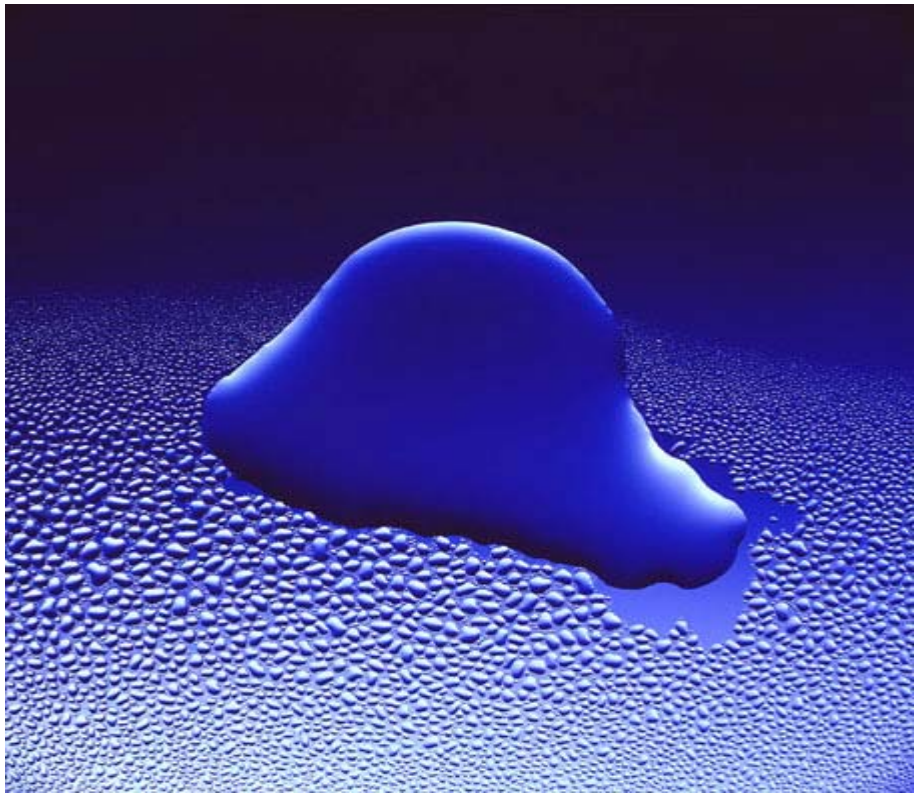
Australian Water Conservation and Reuse Research Program

Literature review of factors influencing public perceptions of water reuse



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Description: Water is remarkably photogenic. This image was created using the amazing ability of water to transmit, disperse and reflect light in ever changing patterns of colour

Photographer: Willem van Aken

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1.0 INTRODUCTION

With increasing pressures on water resources, the concept of beneficial use of treated wastewater has rapidly become an imperative for water agencies around the world. Water reclamation, recycling and reuse are now recognised as key components of water and wastewater management. Along with the technology advances in wastewater treatment, the opportunities for water reuse have never been greater. The benefits of using recycled water include protection of water resources, prevention of coastal pollution, recovery of nutrients for agriculture, augmentation of river flow, savings in wastewater treatment, enhancing groundwater recharge, and sustainability of water resource management (Angelakis & Bontoux, 2001). However, given these benefits, water reuse should not be treated simply as a means to an end but should be implemented in conjunction with other water conservation measures.

Australia is one of the driest inhabited continents on earth. The national water consumption rates are now generally considered to be unsustainable, with about a quarter of Australia's surface water management areas either approaching or exceeding sustainable extraction limits (Australian Bureau of Statistics, 2002). The development of water reuse schemes in Australia has been generally slow in comparison to some other countries. It is only in the past few years that the Australian water agencies have begun to shift their focus of water management to a total water cycle approach. This has led to the development of strategies to reduce the overall amount of wastewater discharged to the ocean and rivers.

The factors that have been cited as driving forces behind the introduction of water reuse in Australia are summarised as follows (Higgins et al., 2002; Stenekes et al., 2001; National Water Quality Management Strategy, 2000).

- Drought and prediction of possible further droughts from climate change.
- Meeting the needs of a growing population.
- Demand from the general community to have greener water strategies and water conservation.
- Increased urbanisation of Australia's towns and cities.
- Increased industrial and agricultural needs.
- To allow conservation of higher quality water for suitable uses.
- Heightened awareness of the potential benefits of using recycled water in the agricultural industry.
- More advanced wastewater treatment processes.
- Reforms from the Coalition of Australian Governments (COAG) which have pushed government departments to seek further research on the public health and environmental risks of water recycling.

The central aim of this report is to provide a summary of existing international and Australian literature and experience on water reuse research, particularly in determining factors that may affect public perception of water reuse. It is important to note here that this literature review focuses mainly on wastewater reuse because this type of reuse has been better researched and often elicits greater public concerns. Therefore, the term 'recycled water' in this report is referring to treated wastewater. By definition, treated wastewater is wastewater originating from municipal, industrial or agricultural activities that has been treated to a quality suitable for reuse. Where appropriate, other water reuse sources will be mentioned specifically – for example, greywater, stormwater and rainwater harvesting. This report will also utilise the terms *direct* and *indirect reuse* (either potable or non-potable). Direct reuse refers to a pipe-

to-pipe scheme where recycled water is distributed directly from the wastewater treatment plant to a water distribution system. Indirect reuse refers to a system where recycled water is mixed with surface water or groundwater before being reused. In addition, the term *water reuse*, instead of *water recycling* is used in the report as the former places more emphasis on the beneficial use of recycled water. Water recycling is used only in relation to particular reuse projects.

2.0 WATER REUSE INIATIATVES IN AUSTRALIA & OVERSEAS

Successful direct and indirect reuse projects have been implemented in many different countries, such as Singapore, Israel, Namibia, the United States (US), Australia and many European countries. The development of these reuse projects has often been driven by the need to overcome water shortages.

The first direct potable reuse was introduced at Windhoek, Namibia in 1968, whilst indirect potable reuse systems were in place in the US (e.g. California) 30 years ago. Successful indirect potable reuse projects that have been implemented in the US include those at the Water Factory 21 in California, Fred Harvey Water Reclamation Facility, located in El Paso, Texas and the Upper Occoquan Sewerage Authority Water Recycling Project in North Virginia. Technical information on these projects was abundant but no information was found on any community surveys conducted, public education or involvement programs. Some researchers noted this as being the norm of public involvement in decision-making processes at the time (D'Angelo Report, 1998; Wegner-Gwidt, 1998; Recycled Water Task Force, 2003). The reuse projects were introduced at a time when the public trusted the experts or governments to make the right decision and they therefore did not usually participate in or challenge project decisions. With no major incidents, these projects were trusted by the community and have continued without controversy.

Given there are numerous examples of failed water reuse projects, there is now a growing awareness amongst water resource professionals of the need to include the public in their decision making processes. The next section provides examples of successful and unsuccessful water reuse projects.[1] Evidence of the reuse project's success or failure is also provided in the section. Note that most successful reuse projects were for non-potable purposes only. Potable reuse projects have often encountered strong community opposition, with very few exceptions (e.g. the Singapore NEWater project). However there is a range of social factors that apply to all reuse projects, regardless of whether for potable use or otherwise. The degree to which each factor may be an issue in community consideration may change according to the use, but all need to be included in the discussion. For this reason, little distinction is made between different uses of recycled water within this review.

2.1 Successful Projects

2.1.1 Water reuse projects in Australia

The reuse projects that have been implemented in Australia are often carried out on a small scale basis and are generally designed for non-potable purposes, such as landscape irrigation, agricultural or horticultural irrigation, industrial water recycling, residential garden irrigation and toilet flushing. To date, only a few social studies have been conducted in relation to these reuse schemes.

[1] The authors acknowledge that many other reuse projects nationally and internationally can be included here as examples. The final selection of examples is based on the detail of the social information most readily available in the literature and the apparent successful or unsuccessful implementation of the projects.

Examples of reuse projects can be found in every state of Australia. The largest residential dual reticulation wastewater reuse scheme can be found in the Rouse Hill development area, Sydney. Since 2001, residents in the development have been supplied with recycled water for toilet flushing, garden watering and fire fighting (Sydney Water, 2001). This initiative resulted from an agreement between landholders and the New South Wales government to pursue the concept of integrated water cycle management. Its aim was to reduce the export of sediment and nutrients to the Hawkesbury/Nepean River System (Williams, 1997).

Sydney Water conducted two separate studies to understand the views of the Rouse Hill community on recycled water *before* and *after* commissioning the scheme (Sydney Water 2000, 2001). Most residents surveyed were aware of the scheme when they took up residence in the area. However, there was an uncertainty amongst some of the residents as to whether human waste was being recycled or not, and what was actually involved in the treatment of the recycled water. Residents were generally aware of the appropriate designated use of the recycled water (e.g. garden irrigation) and had used the water accordingly. They regarded the dual water scheme with a sense of pride. They were a few concerns, although many felt they had no choice when taking up residence in the area (Sydney Water, 2001).

Another well-known reuse project, also in Sydney was the Water Reclamation and Management Scheme at Homebush Bay, the site of the Sydney 2000 Olympics. Wastewater generated from the Olympic venue facilities and Newington village was collected, treated and reused for non-potable purposes (Olympic Co-Ordination Authority, 2003). The water was used for toilet flushing, watering lawns, gardens and parks around the Olympic venues and facilities and at the Newington Village.

Other residential non-potable water reuse schemes include New Haven and Mawson Lakes in South Australia. Marks et al. (2002a) conducted a study looking at resident experiences and perceptions with water reuse in both areas along with two other dual reticulation sites in Florida, US. They found that residents in New Haven had a good knowledge of the source of water used for recycling in their area, unlike residents in Mawson Lakes.[2] They also reported that, although the majority of their New Haven respondents indicated no concerns over their water system, all had experienced some problems with their recycled water quality for toilet flushing. These concerns were mainly related to the odour, colour and/or turbidity of the recycled water.

In addition, examples of greywater, stormwater and/or rainwater reuse schemes can be found in Figtree Place (Newcastle), Lynbrook Estate and Inkerman Oasis (Melbourne). However, there is little or no socially-based information associated with the schemes.

The development of reuse schemes for agricultural or horticultural and industrial irrigation has been more rapid than those for household purposes. However, the amount of social research conducted to understand consumers and retailers' perception in relation to these schemes is minimal.

The largest horticultural reuse scheme in Australia can be found at Bolivar, South Australia. This project, commonly known as the Virginia Pipeline Scheme, is expected to supply over 20 billion litres of irrigation water a year to market gardens (SA Water Corporation, 2002). More than 120 market gardens had contracted to join the irrigation scheme in 2002. Associated with this scheme was a preliminary analysis of stakeholder perceptions of risks in

[2] The dual distribution system at Mawson Lakes was not on-line at the time of study (Marks et al., 2002a).

relation to the scheme. The analysis was carried out so that appropriate plans could be made to deal with possible consumer reaction to the scheme (Warren, 1999). The public concerns over the scheme were identified in the analysis and these were: (1) the source and quality of the water used; (2) the effect of using recycled water to irrigate edible food crops and; (3) possible negative environmental impacts of the aquifer recharge technique and the overall scheme itself to the region. The analysis concluded that the likelihood of major public concerns to emerge as a result of the scheme was relatively low. Therefore, a public information campaign was not conducted. The analysis further concluded that any potential negative consequences resulting from the scheme would significantly impact on the regional industries (Warren, 1999). The scheme was formally launched in October 1999.

In Queensland, the Eli Creek Irrigation Project at Hervey Bay was created to reduce the need for an ocean outfall due to population growth (Heron, 1998). The idea of redirecting wastewater inland for irrigation was first mooted in 1991 due to concerns over the use of the water (Focus, 2000). One sugar cane farmer later took the initiative to irrigate with the recycled water and a few years later the farm won the district productivity award for the most sugar cane per hectare. Subsequently, the project was launched in February 1998 and recycled water was provided to local cane farmers for irrigation. The program has now been extended to include reuse of the local stormwater and recycled water is now used for irrigating crops, pasture, tea tree plantations, sporting fields, a golf course and a turf farm.

In Perth, Western Australia, a trial has begun to convert the irrigation systems of McGillivray Sporting Complex from bore water to treated wastewater. The community living close to the sporting complex as well as the complex users were informed about the project and were invited to raise any queries. To date, no concerns have been reported (Harry Lee, personal communication, December 9, 2003). It is expected that the system will officially begin early in January 2004.

2.1.2 Water reuse projects in California, US

California is a pioneer water recycling State in the US with over 230 reuse projects operating at the time of this review. The majority of the projects were for non-potable reuse purposes and only four projects were for indirect potable uses (Recycled Water Task Force, 2003). An overview of different reuse projects in California is presented on the websites of the Bureau of Reclamation (http://www.usbr.gov/main/library), Department of Water Resources California (http://wwwdpla.water.ca.gov/sd/recycling/so_cal_reclaim&reuse.html), and the Water Reuse Association (http://www.waterreuse.org). Following are two examples of successful reuse projects in California.

The Irvine Ranch Water Recycling Program is said to be one of the longest and most successful multi-use recycling projects in California (Redwood City, 2003). Irvine Ranch Water District (IRWD) imports 50% of its water to meet the district irrigation and domestic requirement. In order to reduce the dependency on this imported water, IRWD first introduced recycled water to the local agricultural sector in 1967 (D'Angelo Report, 1998). Recycled water has since been widely used in the district for the irrigation of local crops, golf courses, parks, school grounds, greenbelts, street medians, freeway landscaping, other industrial uses and even commercial toilet flushing. The IRWD has also supplied individual homeowners, through a dual distribution system, recycled water for non-potable uses (Holliman, 1998). Currently, recycled water supplies about 15% of the annual water needs of the District (Young et al., 1998).

The success of the Irvine Ranch Water Recycling Program can be credited to their commitment to inform and educate the local community about efficient water use and reuse, thus creating a greater awareness of the water shortage issues. Every member of the community was told about the value of water by the IRWD *for decades* (Young et al., 1998). Water reuse was promoted to the public as a means of protecting the environment, saving money and energy, and providing a drought resistant supply (D'Angelo Report, 1998). Intensive water conservation programs combining public tours, in-school education, outreach and community education programs were fully utilised to promote water reuse.

Another successful water recycling project in California was the Monterey County Water Recycling Project. This project was designed to minimise seawater intrusion into the local groundwater aquifers by using recycled water for irrigation rather than groundwater (Sheikh et al., 1999). Currently, over 53 billion litres of recycled water is produced for irrigation of high quality food crops, such as artichokes, lettuce, cauliflower, celery, and strawberries.

The success of the project is credited to years of careful planning with great emphasis on public involvement. It took *almost 20 years of planning* before the project was fully operational in 1998 (Recycled Water Task Force, 2003). In the early planning stage, public discussion with the local growers suggested a field study was needed to look at the safety and marketability of produce irrigated with recycled water. A five-year health study was consequently conducted and the results showed that produce irrigated with recycled water was safe to consume (Sheikh et al., 1998). The market study also returned a positive note for the project (Sheikh et al., 1998). Buyers, shippers and other intermediaries were accepting of recycled water for their irrigation needs, providing that the practice was endorsed by regulatory agencies and that their competitors and the media would not target them with negative publicity. More importantly, the labelling of the products as being irrigated with recycled water was not required since the water had been treated to the acceptable standard.

Overall, support for this project was well received from different groups in the County (Recycled Water Task Force, 2003). The environmental community and local people endorsed the project for reducing wastewater discharge to the Monterey Bay Sanctuary. The support by the agricultural industry was obtained by actively involving the growers in the health study and providing safe, reliable and inexpensive water for irrigation. However, two years before the project was due to start, concerned growers formed a committee to express their concerns about the project design and operation (Recycled Water Task Force, 2003). The County took these concerns seriously and subsequently a supplemental food safety study was conducted to investigate potential pathogen growth in the irrigation water. The study again failed to find any pathogens and thus the project commenced (Sheikh et al., 1999). To assure growers of the plant's operating safety, the County provided continual information, both directly to them, and via the Monterey Regional Water Pollution Control Agency – the agency which manages the reuse scheme website.

The project was said to have a strong support at the community level because of the extensive educational programs introduced (Recycled Water Task Force, 2003). These programs involved using school presentations, tours to treatment plants, project exhibitions at local community events, and providing pamphlets to consumers with their water bills outlining the project.

2.1.3 Singapore NEWater project

To understand the indirect potable reuse project that was implemented in Singapore in early 2003, it is important to understand the circumstances surrounding its conception. Singapore

is a small, wealthy island that depends heavily on its neighbouring countries for their natural resources, including water. In fact, half of the country's water supply is imported from Malaysia (Seah, 2002). This dependency has long been regarded by the government and the people of Singapore as a highly sensitive issue. The recent disputes between Malaysia and Singapore over the price of water have further threatened Singapore's future water supply and consequently the country has had to seek alternatives for its water supply (Kyodo News International, 2003).

The recycled water project, commonly known in Singapore as NEWater, was seen as a strategic option as it reuses the available water and it is cheaper than other options such as desalinated water. In 2001, NEWater was introduced to the industries for non-potable applications such as wafer fabrication processes and cooling towers. The scheme has since been extended to include indirect potable uses for the public. Currently, about nine million litres of highly treated wastewater is mixed with the reservoir water before it undergoes the conventional water treatment (Collins, 2003). This figure represents about 1% of the daily water consumption by the country and it is expected to increase to 2.5% (about 45 million litres) by 2011.

To raise people's awareness of NEWater, Singapore's Public Utilities Board (PUB) launched intensive education campaigns, using a documentary feature film, media exposure, information briefings at community centres and schools, and a NEWater visitor centre (Collins, 2003). In relation to the quality of NEWater, the PUB reassured the public by citing that there had been no ill-health impacts to US citizens who had consumed recycled water throughout the past 20 years. The government supported a two-year study by a panel of local and international experts to look at the different aspects of introducing NEWater to supplement the country's drinking water supply. The study concluded that the quality of NEWater was well within standards specified by the World Health Organisation and the US Environmental Protection Agency and that it was considered to be safe for potable uses (PUB, 2002). Using the study results, PUB promoted NEWater as cleaner than their tap water in terms of colour, clarity, organic substances and bacteria count (http://www.pub.gov.sg/NEWater). The government also distributed 1.5 million bottles of NEWater for the public to see and try for themselves (Kyodo News International, 2003).

A few newspaper articles indicated signs of public hesitation to using the NEWater (see Seah, 2002; Kyodo News International, 2003). Two leading newspapers in Singapore further reported their studies which found the majority of respondents did not feel comfortable with drinking the water (Seah, 2002). Some respondents even considered paying more for imported water rather than having to drink NEWater (Seah, 2002). These findings are, however, in contrast to an independent poll by Forbes Research (Kyodo News International, 2003) which the government cited. The poll indicated that 82% of people surveyed were prepared to drink the NEWater directly and 16% were prepared to drink it indirectly through mixing with reservoir water. With little public controversy, NEWater was introduced in February 2003. The government hopes to use NEWater to meet 20% of the country's needs by 2015 (Collins, 2003).

2.2 Controversial Reuse Projects

2.2.1 San Diego water repurification project

The downfall of the city of San Diego's water repurification project probably took the many agencies involved by surprise. At the 1997 Beneficial Reuse of Water and Biosolids Conference, Katz and Tennyson, the public relations agents for the project, described it as having all the main ingredients for success. In the following year, the project was illustrated

as having very successful public information and outreach programs in a publication produced by the Water Environment Federation (WEF) and the American Water Works Association (AWWA) (D'Angelo Report, 1998).

The idea of introducing recycled water as a supplement to the city of San Diego's drinking water supply was conceived during the 1991-92 drought (D'Angelo Report, 1998). The project proposed mixing the recycled water with imported freshwater in reservoirs. After a year's detention, this water would go through the conventional water treatment process before being piped to domestic homes. The project was introduced to the community as means of protecting the city from possible future droughts.

The San Diego City Council and the San Diego County Water Authority understood the importance of public acceptance and therefore embarked on a comprehensive research project to better understand the public willingness to use recycled water and to identify potential issues that needed to be addressed (Katz & Tennyson, 1997). The research was collected from public opinion research, focus groups, and individual interviews with community leaders and policy makers.

In a telephone survey of more than 300 San Diego residents, participants expressed a significant level of interest and concern about water supply, quality and treatment options (Katz & Tennyson, 1997). A high number of respondents also indicated support for the use of recycled water and preferred the term 'purified water' to reclaimed or recycled water. The research also found the participants to be supportive of using repurified water for drinking, washing and cooking once it was fully explained to them.

Furthermore, focus groups and one-to-one interviews with community leaders also indicated favourable results when the concept was explained (Katz & Tennyson, 1997). To further assure San Diego residents, the Authority and the Council submitted their water repurification project proposal to the scrutiny of an Independent Advisory Panel and a citizens' review committee which later concluded that recycled water was an acceptable option, and it would provide a much needed source for the region (Wegner-Gwidt, 1998). Additional public outreach work was also undertaken, these included brochures and related fact sheets, video presentations about the project, feature stories in newspapers, and other media outlets, and a telephone enquiry line.

Despite the strong support from a wide variety of community organisations, the project became entangled in political campaigns which eventually caused the whole project to be halted. The campaigns claimed that the city intended to take wastewater from affluent communities to distribute as drinking water to those less affluent, and health dangers from the project were specifically highlighted (Recycled Water Task Force, 2003). The State Department of Health Services subsequently called a hearing for the project. Hundreds of worried residents turned up to the hearing after seeing advertised posters covered with the slogan "Toilet to Tap" (Recycled Water Task Force, 2003). In the end, the project was put on indefinite hold by the San Diego City Council (US Bureau of Reclamation, 2000).

2.2.2 San Gabriel Valley groundwater recharge project

Similar to the San Diego water repurification project, the San Gabriel Valley Groundwater Recharge project was conceived during a period of drought in the region (D'Angelo Report, 1998). It was designed to use tertiary-treated recycled water to replenish the local aquifer. The project met significant opposition before its conception with newspaper advertisements and mailers questioning the safety and feasibility of the project.

In an attempt to win public acceptance, the project started to form alliances with groups that supported the project (Recycled Water Task Force, 2003). Public tours and meetings were also organised to inform the public about the project, how the water was treated and the safety measures in place to address public health concerns. However, just weeks before the project's hearing of the environmental review process, a citizens group, Citizens for Clean Water took out several full page newspaper advertisements declaring the project as "Toilet to Tap"; that the project was unnecessary and the potential health risks associated with drinking reclaimed water – however small – were unacceptable and bore too many risks for the environment and the people (Stenekes et al., 2001; Logan, 1996).

Another challenge to the project was the legal confrontation by a local brewery Miller Brewing Co., who alleged that the project posed serious environmental problems and might pollute their water supply. Subsequently a lawsuit was lodged to block the project (Wegner-Gwidt, 1998). As a result of these proceedings, the project was eventually downsized by 40 percent and was moved further away from the brewery. The Miller Brewing Co. has since agreed to support the smaller project which has now moved forward through planning, design and environmental permitting processes (Upper San Gabriel Valley Municipal Water District, 2003). Although the project has been delayed a few times, it has survived through the confrontations due to strong support from sections of the community and reputable organisations such as the California WateReuse Organisation, Los Angeles County Medical Association, Heal the Bay, the Sierra Club, and US House of Representatives member Esteban E. Torres (Wegner-Gwidt, 1998).

2.2.3 Other controversial projects in the US and Australia

A number of other recycled water projects in the US such as the California's Bay Area Water Recycling Program, and City of Los Angeles Department of Water and Power's East Valley Water Reclamation Project were also redesigned to overcome the so-called "yuck factor" or were delayed because of public opposition (Bay Area Monitor, 1999; Timko, 2002). Similarly, two further indirect potable reuse projects involving surface water augmentation (one in California and one in Florida) have been postponed indefinitely because of public or political pressure, or health concerns (Crook, 1999). Finally, a headline in a local paper that dubbed the Dublin County's Clean Water Revival Project in California as "Toilet to Tap" halted the whole project. This groundwater replenishment project was proposed to augment the local water supply, to reduce salt levels in existing groundwater and the need for wastewater discharge to San Francisco Bay. With the strong support from the local environmental groups however, the county resorted to using the very high quality water for landscape irrigation instead.

In Australia, few attempts from the local authorities to introduce potable reuse projects have been met with strong community resistance. In their article, Gibson and Apostolidis (2001) noted that a medium-sized local government in Australia was defeated at election for investigating a possible reuse scheme. Along Australia's Sunshine Coast, consideration by the Maroochy and Caloundra councils to augment dwindling domestic water supplies with recycled water was modified after strong opposition from the local community. Community action groups used media releases to warn the community about the potential shrinking and deforming of male sexual organs because of gender-bending hormones in wastewater (Lamble, 1998). An internet website was also established by one residents action group, the Rivermouth Action Group to spread news of the reuse proposal citing the feared ill effects of using recycled water in the US, and how the proposal would be the first of its kind, reusing infectious hospital, abattoir and industrial waste for potable purposes (http://www.rag.org.au).

The argument against the proposal was intensified due to a perceived lack of community involvement and consultation in the events leading up to the implementation of the proposal (Stenekes et al., 2001). The Rivermouth Action Group stated that the local council had supported the proposal without consulting the local community.

3.0 RESEARCH ON PUBLIC PERCEPTIONS OF REUSE

The first planned use of recycled water for drinking started as far back as the 1950s. However, it was not until twenty years later that researchers started to look into public perceptions and acceptance of water reuse. Most of these studies were conducted in the US and were limited in their scope, in generally aiming to increase public acceptance using applied behavioural methods (eg. incentives). Indeed, the early approach to implementing water reuse projects often viewed public acceptance as the principal 'obstacle' to implementing any recycling projects. Subsequently the research following this view was limited to finding ways to persuade people to accept recycled water. As an example, Dishman et al., (1989) mentioned that *"...the issue of public acceptance could kill the (reuse) proposal. In view of this very possible scenario, a strategy (based on applied behavioural analysis and social marketing) should be developed to deal with public unwillingness to drink reclaimed water (p.158)*".

It is now generally accepted that social marketing or persuasion is ineffective in influencing people to use recycled water. Public perceptions and acceptance of water reuse are now recognised as the main ingredients of success for any reuse project. Despite this, no research has investigated the different factors that influence public perceptions of water reuse and how these factors mediate people's decision-making processes. The need for social research into water reuse in Australia has not been realised until recent years. Social studies conducted so far have mainly been initiated by water agencies considering the possibility of using recycled water.

4.0 ACCEPTANCE OF WATER REUSE IN AUSTRALIA

The successful implementation of any reuse projects hinge on public acceptance. As a concept for water management, water reuse is indeed widely accepted by the Australian community. In Western Australia, a recent focus group held by the Water Corporation of Western Australia (WA) (2003) indicated that people rated the idea of using recycled water very positively. The same findings were obtained in Melbourne Water (1998) and Sydney Water (1999) studies on community perceptions of water reuse.

However, the widespread acceptance for water reuse in the Australian community does not automatically assume that any reuse projects will be readily accepted by the community. Numerous reuse projects overseas have failed in the past despite receiving favourable support initially from the potential users. Californians are said to be very accepting of recycled water use (Recycled Water Task Force, 2003), but as shown in Section 2.2, many reuse projects have failed to win public acceptance. The general community often saw the logic in the move towards using recycled water, but felt that they themselves could not use the water. This view is again shared by the focus groups participants in discussions held separately by Melbourne Water (1998), Water Corporation of WA (2003) and ARCWIS[3] (Kaercher et al., 2003).

[3] Australian Research Centre for Water in Society (ARCWIS), CSIRO Land and Water.

Why is it that people can see the logic in using recycled water but remain reluctant to use it? The following provides a summary of different factors in the literature that may influence the behavioural acceptability of a reuse scheme to the general community.

- Disgust or "Yuck" factor;
- Perceptions of risk associated with using recycled water;
- The specific uses of recycled water;
- The sources of water to be recycled;
- The issue of choice;
- Trust and knowledge;
- Attitudes toward the environment;
- Environmental justice issues;
- The cost of recycled water; and
- Socio-demographic factors.

4.1 Disgust or "Yuck" Factor

The "yuck" factor, or disgust in psychological terms, as a barrier to water reuse has been cited in the literature since the beginning of public attitudes studies towards reuse back in the 1970s. However, no studies have been conducted to examine how this factor exerts its influence on people's perceptions of water reuse.

On many occasions, the general community openly acknowledged there was a psychological barrier when it came to using recycled water (Melbourne Water, 1998; Kaercher et al., 2003). This psychological barrier appears to be the disgust emotion derived from the thought of using recycled water. Some people reported that they were caught up in their own mental imagery associated with raw sewage and could not move beyond it (Melbourne Water, 1998). This is well described by one participant in the Melbourne Water (1998) focus group. "*I guess it is a mental image. Brown solids to clear liquids" (p.28).* Even some participants who reported a willingness to use recycled water for all purposes, including drinking, admitted that they would prefer to drink bottled water or pass their household drinking water through a filter. *"You would just have to depend on it, but there is obviously a psychological barrier as well. I think most people would want to refilter it as well to just get over that" (Melbourne Water, 1998, p.30).*

The disgust emotion is defined as the emotional discomfort generated from close contact with certain unpleasant stimuli (Angyal, 1941). Objects that can commonly elicit disgust reactions from people include excrement, urine, saliva and mud. A disgust reaction in using recycled water is likely to be generated from people's perceived 'dirtiness' of the water and their fear of contagions or personal contamination from using the water. In support of this, an early reuse study in Australia by Hamilton and Greenfield (1991) indicated that the psychological rejection of potable reuse as *filthy* and *unclean* accounted for the majority of respondents who totally rejected the reuse scheme. From the perception of filthy and unclean, the disgust reaction was generated and served to tip the balance, motivating people to stay away from using recycled water in order to prevent illness and disease.

The relationship between one's perception of contamination and avoidant behaviour has been demonstrated in past research (see Rozin et al., 1986). For this reason, projects that have investigated introducing recycled water have avoided using any terms that relate to treated wastewater. In Singapore, recycled water was called NEWater and in San Diego it was repurified water. The term "recycled water" was said to leave too much to people's

imagination and other terms such as 'repurified water' were therefore preferred (Leovy, 1997).

How, then, do people associate recycled water and the emotion of disgust? One possible mode, discussed in the psychology literature is through the law of contagion (Rozin & Fallon, 1987). This law suggests that a neutral object may acquire disgusting properties from another object through brief contact (e.g. hair in the soup). So regardless of the fact that recycled water has been treated to highest standards, people may still perceive the water to be disgusting because it has been in contact with disgusting stimuli, in this case human wastes. Research in the past has successfully measured people's disgust sensitivity to predict the probability of avoidance in the presence of unpleasant stimuli (e.g. Woody & Tolin, 2002). The large scale community survey research by Sydney Water (1999) had indicated that individual perception of disgust was a good predictor of his or her support for various uses of recycled water. Syme and Nancarrow (forthcoming) suggested future studies may utilise this measurement to examine the relationship between disgust sensitivity and opposition to using recycled water.

4.2 Perceptions of Risk Associated with Using Recycled Water

Another important factor that influences public acceptance is the perceived risk of using recycled water. In the context of water reuse, the risk perception is often related to public health issues from using the water. Focus group participants consistently reported concerns about the safety of using recycled water, considering the potential lethality of pathogens in the water and the unknown impact of chemicals used to treat the water (Melbourne Water, 1998; Sydney Water, 2002b; Kaercher et al., 2003). The majority of respondents (89%) in a study conducted by Jeffrey and Jefferson (2002) in the United Kingdom agreed with the statement *'I have no objection to water recycling as long as safety is guaranteed'*. Also, when respondents in the Sydney Water study (1999) were asked what they thought of the disadvantages of using recycled water, the most commonly mentioned statements were related to health concerns – such as *potential for health problems*, *would have to be proved safe*, and *health risks if used for cooking or drinking*. Concerns about the safety of using recycled water on children were especially pronounced. Ninety-two percent of respondents in the Sydney Water study (1999) agreed or strongly agreed with the statement *"people will worry about the safety of recycled for their children."*

Why do the public perceive such a risk in using recycled water despite constant assurances from experts and the authorities that the water is more highly treated than scheme water? From the general risk literature, it is evident that risk perceptions are different between the experts and lay people. The public tends to capture a broader conception of risk, incorporating attributes such as uncertainty, dread, catastrophic potential, controllability, and equity into their risk equation (Slovic, 1998). The experts, on the other hand, define risk in terms of event probabilities and treat subjective factors as "accidental" dimensions of risk. These "accidental" dimensions of risk may however play an important role in forming people's attitudes towards a risky situation. For example, the experts may consider that a one in a million risk of getting sick from drinking recycled water was acceptable whilst this risk may be completely unacceptable to the public, as that one case could be them or their child. Is there then, an acceptable risk to the community when it comes to using recycled water? Interestingly, the Sydney Water study (1999) found that just over half of the participants (59%) agreed or strongly agreed with the statement *"no one can guarantee the safety of recycled water."*

From the general risk literature, Frewer et al. (1998) stated that people used their social and moral values, otherwise known as *outrage factors*, to evaluate situations, especially if they are poorly defined. Based on the outrage factors, it could be proposed that people may perceive the use of recycled water to be too risky because (1) the use of this water source is not natural; (2) it may be harmful to people; (3) there might be unknown future consequences; (4) their decision to use the water may be irreversible; and (5) that the quality and safety of the water is not within their control.

It is important to note here that many risk studies have been conducted to examine possible global factor structures of risk characteristics that formed individual risk perceptions to different hazards. The results have so far been inconclusive. In contrast, many studies have indicated that people do not use the same underlying frames of reference when making judgements of risky situations (e.g. Beckwith, 1996; Syme & Bishop, 1992). Beckwith (1996) further contended that people might use different judgement strategies to determine the acceptability of risky decisions. For example, two persons may perceive the same level of risk in using recycled water but disagree as to the acceptability of such use. In her study, Beckwith (1996) found that people who supported the introduction of a risk were more willing to consider the individual and societal benefits of the risk as part of their decision making strategy. Those who opposed did not seem to factor these benefits into their thinking. Knowledge of the judgement strategies people use is therefore crucial in reuse research so that effective risk communication strategies can be tailored to complement the decision strategies adopted by different people. No research has, however, been conducted to examine this important aspect.

Finally, since the use of recycled water is considered risky, people are inclined to avoid using the water in order to reduce the potential of regret (i.e. anticipated regret). Empirical evidence has shown that anticipated regret is an important determinant of people's behavioural choices (e.g. Bakker et al., 1997; Zeelenberg & Beattie, 1997). People often prefer the existing service and known experience rather than a new innovation because the potential of feeling regret and disappointment is lower.

4.3 The Specific Uses of Recycled Water

The disgust emotion and risk perceptions in using recycled water can further explain the research results which have consistently shown that the way recycled water is used affects people's perceptions and acceptance of the water. Specifically, the closer the recycled water is to human contact or ingestion, the more people are opposed to using the water. Table 1, on the next page, shows the opposition research cited in Bruvold (1988) and studies by ARCWIS (2002), and Sydney Water (1999).

As a summary of Table 1, non-potable water reuse for golf courses, parks, and industries were well accepted by the community. For irrigated agriculture, it was generally accepted. Although it is not clearly shown in the table, other research showed that the acceptability of using recycled water was high on crops either not directly consumed by humans (ie. livestock forage crops) or food crops that must be peeled or washed prior to human consumption (eg. oranges, sweet corns) (D'Angelo Report, 1998). In comparison to other uses, recycled water use inside the home was less preferred.

Table 1. The percentage of respondents who were opposed to specific uses of recycled water from different studies.

	ARCWIS (2002) N=665 %	Sydney Water (1999) N=900 %	Lohman & Milliken (1985)* N=403 %	Milliken & Lohman (1983)* N=399 %	Bruvold (1981)* N=140 %	Olson et al. (1979)* N=244 %	Kasperon et al. (1974)* N=400 %	Stone & Kahle (1974)* N=1000 %	Bruvold (1972)* N=972 %
Drinking	74	69	67	63	58	54	44	46	56
Cooking at home	-	62	55	55	-	52	42	38	55
Bathing at home	52	43	38	40	-	37	-	22	37
Washing clothes	30	22	30	24	-	19	15	-	23
Home toilet flushing	4	4	4	3	-	7	-	5	23
Swimming	-	-	-	-	-	25	15	20	24
Irrigation on dairy pastures	-	-	-	-	-	15	-	-	14
Irrigation of vegetable crops	-	-	9	7	21	15	16	-	14
Vineyard irrigation	-	-	-	-	-	15	-	-	13
Orchard irrigation	-	-	-	-	-	10	-	-	10
Hay or alfalfa irrigation	-	-	-	-	-	8	-	9	8
Home lawn/garden irrigation	4	3	3	1	5	6	-	6	3
Irrigation of recreation parks	-	3	-	-	4	5	-	-	3
Golf course irrigation	2	-	-	-	4	3	2	5	2

*cited in Bruvold (1988) – these studies were conducted in the US.

It is important to note that the consistency of the findings is not only limited to quantitative research. The focus groups conducted by Melbourne Water (1998), Water Corporation of WA (2003) and ARCWIS (Kaercher et al., 2003) also indicated that the acceptability of water reuse decreased substantially as the use moved from public areas to inside the home, and from toilet flushing, laundry, bathroom and kitchen uses to drinking. The consistency of the findings has become the basis for the initiation of new reuse projects (Bruvold, 1988). That is, introducing recycled water on low or non-human contact uses and gradually moving closer along the contact continuum.

In an attempt to validate the consistent findings, Bruvold (1988) conducted a different study using salient options which specifically described how and when the recycled water was to be used in the respondents' community. He argued, past studies on reuse had all been based on the general options questions where respondents were not given information about the outcome of the reuse. The results of his study indeed produced different results to the past studies: degree of contact was not related to how favourable people perceived a specific reuse option to be. In his study, participants were found to favour reuse options that conserved water, enhanced health and reduced treatment and distribution costs. Bruvold (1988) therefore proposed two major factors that influenced public perception to reuse: (1) degree of human contact, and (2) the five factors (i.e. health, environment, treatment, distribution, and conservation). He asserted that the first factor only took greater effect when people were asked about general reuse options. When salient reuse options were used, the second factor had greater impact on people's perceptions. To date, no empirical research has been conducted to examine the effects of the combination of these five factors on people's willingness to use recycled water.

4.4 The Sources of Water to be Recycled

The source of water to be recycled, or 'use history' of the water, was also found to affect the acceptability of recycled water (Jeffrey, 2002; Nancarrow et al., 2002; Kaercher et al., 2003). Specifically the reuse of greywater or treated wastewater from one's own household was more acceptable than water obtained from other public or secondary sources (Jeffrey, 2002; Nancarrow et al., 2002). This finding can be associated with the disgust emotion in using recycled water. People may perceive using their own waste to be less 'disgusting' than other people's. In contrast to this, participants in the ARCWIS focus group (Kaercher et al., 2003) indicated a preference towards a more public source of recycled water. In the preliminary study, the participants indicated preferences towards reusing greywater from their neighbourhood rather than their own household. They also preferred using treated wastewater from the whole city, rather than their own neighbourhood.

Further examination of these studies revealed that the differences man be attributed to two underlying factors: (1) the perceived quality of the recycled water and (2) the perceived control over the quality of recycled water received. In the Jeffrey (2002) and Nancarrow et al. (2002) studies, participants were reassured of the safety of the recycled water quality regardless of their source. In fact, when given a chance to comment on their acceptability of a particular water source, participants in the Nancarrow et al.'s (2002) study consistently mentioned that they could accept the source if it was safe and treated to appropriate health standards. Meanwhile, participants in Jeffrey's study were told that the greywater quality had been assured by the two institutions that they trusted. In the preliminary ARCWIS (Kaercher et al., 2003) study, participants were reticent about the consistency of treatment of the recycled water. They did not feel they themselves had the ability to manage and monitor an on-site greywater treatment system. Similar concerns were expressed by participants in the

Sydney Water (2002a) about having an on-site sewage treatment system. With neighbourhood wastewater treatment plants, people felt with many in operation, the risks of failure increased significantly (Kaercher et al., 2003). As a result, the quality of the water might be compromised. The city-wide wastewater treatment plant was therefore preferred.

Studies have also found that the acceptability of recycled water is dependent upon the type of water to be recycled (ARCWIS, 2002; Nancarrow et al., 2002; Kaercher et al., 2003). Rainwater harvesting from one's household roof was considered to be more acceptable than grey water and wastewater reuse. Reusing greywater was on the other hand more acceptable than treated wastewater. Similarly, in the Sydney Water (2002b) study, the majority of participants were keen on the idea of using rainwater tanks. Rainwater tanks were seen as a logical way to augment water supply. The tanks appealed to people partly due to the perception of them being an Australian tradition. However, people realised rainwater tanks could only be a secondary water source due to the lack of the water reliability in times of drought. In addition, Nancarrow et al. studies (2002, 2003) found aquifer recharge of recycled water to be less acceptable than using grey water for home gardens and wastewater for parks and gardens. Even within the same water source, different levels of treatment can also affect how well the recycled water is accepted. The greywater used for toilet flushing, as part of the Millennium Dome recycling scheme in the United Kingdom had to be treated to potable standards after receiving high public and media attention (Diaper et al., 2001). Focus group participants often queried the levels of recycled water treatment before they could decide upon the different uses of recycled water (e.g. Kaercher et al., 2003).

4.5 The Issue of Choice

The issue of choice is also an important determinant to the public acceptance of water reuse. In places where there were water shortage issues, people were reported to readily accept water reuse because of the heightened awareness of the need to conserve water (Dishman et al., 1989). Rebhun (as cited in Dishman et al., 1989) reported that in Israel, it had not been necessary to convince the public of the need for water reuse as everyone was aware of the country's water shortage problem. In instances where an alternative water source is available, people question the need for reuse. Indeed, when the option of water reuse was discussed, the Melbourne Water focus group participants (1998) stated that there had to be a genuine need for using recycled water. It should only be considered if other solutions were impractical and economically unfeasible. This finding is also cited in Bruvold & Crook (1981).

It is important to note here that the heightened need for other water sources does not necessarily warrant public acceptance of water reuse. The San Gabriel Valley Groundwater recharge project, mentioned earlier, is an example of a failed project despite being conceived during the 1987-92 droughts. It is therefore important to understand the mediators of the relationship between awareness of water shortage issues and acceptance of reuse. Issues such as trust in governance and administration may be crucial as shown below.

4.6 Trust in the Authorities and Scientific Knowledge

Trust in the authorities to provide safe recycled water, and in the scientific investigations and technologies could play a crucial role in determining public acceptance of water reuse. Trust in the Water Corporation of WA to provide safe recycled water was said, by the different focus group participants to be the main reason they would be willing to use recycled water (e.g. Kaercher et al., 2003). In other research, trust in the Water Authorities has been found to be the main indicator of how acceptable people perceived the quality of their drinking water to be (Syme and Williams, 1993; Porter et al., 2000, 2002).

Scientists from universities or the CSIRO are most trusted by the community to provide information about recycled water (Sydney Water, 1999). No detailed research has been found to examine the characteristics of institutions that people trust when dealing with the provision of information, treatment and monitoring of the recycled water quality. Nevertheless, preliminary research has found that participants trusted the Water Corporation of WA to provide recycled water to the community as it had been established for many years, had a good safety record, and its intention was not monetarily or politically driven (Kaercher et al., 2003). These characteristics are similar to those found in a food risk perception study by Frewer et al. (1996). For communicating food-related hazards, people trusted institutions that they perceived to be truthful, trustworthy, responsible, accurate, concerned with public welfare, factual and had a good track record. Despite public trust in certain institutions to set and monitor the quality of recycled water, Jeffrey and Jefferson (2002) found that people may remain unwilling to use recycled water for higher risk applications. They found that people often relied on their impressions of the water quality (mainly water turbidity and the content of suspended solids) to decide whether they could accept using recycled water.

Overall, the relationship between trust in the authorities and attitudes towards policies has been consistent in the general empirical investigations. Many studies in the US have shown that lack of trust in the US Department of Energy as an important predictor of perceived risk and risk acceptability. However, the relationship between trust and attitudes towards policies was often found to be either weak or moderate (Bord & O'Connor, 1992; Biel & Dahlstrand, 1995). In the siting of a local high level nuclear waste repository, Drottz-Sjoberg (as cited in Sjoberg, 2001) found that people trusted agencies to make decisions that protected public safety, but they still might oppose a siting proposal. Sjoberg (2001) contended that trust can be defined in a specific or a more general sense. In his study, he found that specific trust was a more powerful construct than general trust for explaining risk perceptions. Specifically, the trust in the limits of knowledge, or belief in the likelihood that an unknown effect might occur, was found to be the most important predictor of people's risk perceptions and their related attitudes.

Future research is therefore needed to understand the role of trust in people's decision making processes to either accept or reject the use of recycled water, and how people perceive the limits of scientific knowledge in the field of water reuse. Given the current context, lack of trust in technology could negatively impact on the acceptability of water reuse. This lack of trust was the reason most frequently noted by people who were in opposition to using recycled water for agriculture, watering parks or drinking (Sydney Water, 1999).

4.7 Attitudes towards the Environment

Finally, attitudes toward the environment may also play a crucial role in people's acceptance of using recycled water. Jeffrey (2002) found that people who had undertaken water conservation measures in their homes were more prepared to reuse greywater for toilet flushing from different sources. Residents living in the Mawson Lakes area in South Australia, where a dual water supply scheme was proposed, also agreed that the potential to do something positive for the environment had motivated them to live in the greenfields development (Hurlimann & McKay, 2002). Residents in Australia and Florida who had recycled water delivered to their home for toilet flushing and garden irrigation expressed a high level of awareness of the conservation of natural water resources through water reuse (Marks et al., 2002a).

Although the residents considered the high levels of environmental benefits from using recycled water in studies by Hurlimann and McKay (2002) and Marks et al. (2002a), this reason did not appear to be the main driver in their decisions to live in the dual supply developments. Residents in Hurlimann and McKay (2002) study ranked the 'environmental sustainability' and 'the dual pipe system' as the fifth and second least important factors (given 12 possibilities) in their choices to live in the development. None of the twenty households interviewed by Marks (2002b) nominated recycled water as a reason for choosing to live at Mawson Lakes. The environment and technology were ranked sixteenth and fourteenth respectively in the eighteen reasons nominated by the participants.

Reviews of general conservation literature indicate a need to focus on more specific attitudes, rather than general attitudes towards the environment, to explain conservation behaviour. It was suggested that people might have strong environmental values but chose to express these values in different contexts. From this perspective, some people are therefore more likely to respond to issues related to wildlife conservation whilst others may respond more readily to issues of water conservation. In support of this, Vining & Ebreo (1992) showed that in a kerbside recycling program, both participants and non-participants expressed positive attitudes towards the environment but were different in their endorsement of specific recycling attitudes (e.g. personal or social norms). People who participated in the recycling program felt a stronger personal obligation to recycle and they also perceived greater social pressure to recycle. Similarly, the Sydney Water (1999) study reported that people who supported the need to conserve water and use recycled water for almost all purposes (except cooking and drinking) tended to be those who believed strongly about the importance of environmental issues and their ability to make a difference.

Following the above findings, the implementation of water reuse projects may encounter difficulties if individual community members do not see themselves as being responsible for the water issues, or do not have the ability to deal with water issues. The preliminary research by ARCWIS (Kaercher et al., 2003) found that these attitudes were present amongst the focus group participants. The participants perceived the community and the Government as being responsible for Perth's water shortage issue, and they both had the ability to deal with Perth's water future. Overall, they did not perceive themselves personally to be as responsible or that they alone had the ability to deal with Perth's water future. Research is needed to examine the influences of specific environmental attitudes to the acceptance of water reuse.

4.8 Environmental Justice Issues

The environmental justice issues can also influence how people perceive the acceptability of the reuse projects. One of the strong opponents of the San Diego Repurification project, Herman Collins, stated that his opposition to the project was due to the perceived injustice to the low and medium income communities as they were deemed the major recipients of recycled water (Recycled Water Task Force, 2003). This information was promoted by a politician and it resulted in strong community resentment and subsequently the demise of the project. The perceived fairness in the decision making process is also important. The Maroochy and Caloundra councils failed to initiate the reuse project because the lead up process was seen to be unfair by some community groups. As mentioned earlier, the Rivermouth Action Group stated that they were not consulted and involved at the conception of the project.

No reference was found in the literature regarding the siting of treatment plants and opposition to reuse projects. This aspect should however be considered seriously for the

potential negative impact on community "sense of place". Aesthethic concerns over neighbourhood treatment plants have been expressed by participants in Sydney Water (2002b) and ARCWIS (Kaercher et al., 2003) focus groups. People expressed little opposition to having either estate-or neighbourhood-based treatment plants, but expected the treatment plants to be located away from main residential areas. The idea of having on-site sewage treatments system was completely rejected for fear of unpleansant smells and contamination (Sydney Water, 2002b).

In addition, there is a perception amongst community members that they should not be targeted for water reuse initiatives. Any water reuse projects should start with big water users such as industries before domestic householders. The comparative amount of water that could be saved from householders was said to be minimal (Kaercher et al., 2003).

4.9 Cost of Recycled Water

Cost consideration has been suggested in the National Water Quality Management Strategy (NWQMS) as an important determinant for community acceptance. People generally expect to pay less for using recycled water as it is considered to be of lower quality. In a survey of residents who were living in a dual supply development, Marks et al. (2002a) found that the majority of people expected to pay less for using recycled water because of the water quality and restrictions on people's use of this resource. Some residents thought the lower price was necessary to encourage acceptance and investments in the up-front costs. This was also indicated by the focus group participants (e.g. Kaercher et al., 2003). As an incentive to encourage industrial reuse, Gagliardo (2003) further asserted the need to show the potential users economic advantages in recycled water.

4.10 Socio-demographic Factors

Finally, some demographic factors have been identified in reuse studies to be influential in public perception of water reuse. For example, McKay & Hurlimann (2003) predicted that the greatest opposition to water reuse schemes would be from people aged 50 years and over. As a result, they recommended education and information campaigns to target this specific age group. Some surveys in California and Colorado (cited in Hartley, 2003) further indicated that "older" women tended to be less supportive of potable water reuse and hazardous waste siting. In contrast, Jeffrey (2002) found no significant variation in the public support of greywater reuse across gender, age or socio-economic groups. Sydney Water (1999) study indicated differences in the responses of participants from different genders, levels of education, place of residence, and language spoken. No discernible differences were, however, found in the respondents from different age groups. In the early potable reuse research in Australia by Hamilton and Greenfield (1991), it was suggested that without prior exposure to negative reuse information, a person who had a higher level of education, was male and had no aversion to change, was more likely to accept potable reuse. There was no significant global relationship between age, gender and income in either acceptance or rejection of potable reuse across the different study locations.

These inconsistent findings may in turn suggest that demographic factors alone were not able to explain the individual differences in the perceptions and acceptance of water reuse. Research in the area of risk perceptions suggested that 80-90% of the variation in risk perceptions across individuals results resulted from attitudinal and contextual factors other than demographics (Savage, 1993).

5.0 MODELLING OF FACTORS INFLUENCING PUBLIC ACCEPTANCE

An attempt was made recently by Syme and Nancarrow (forthcoming) to use Ajzen's theory of planned behaviour to model the different factors that would influence people's willingness to use recycled water for horticultural purposes (See Figure 1 for details of Ajzen (2001) model).

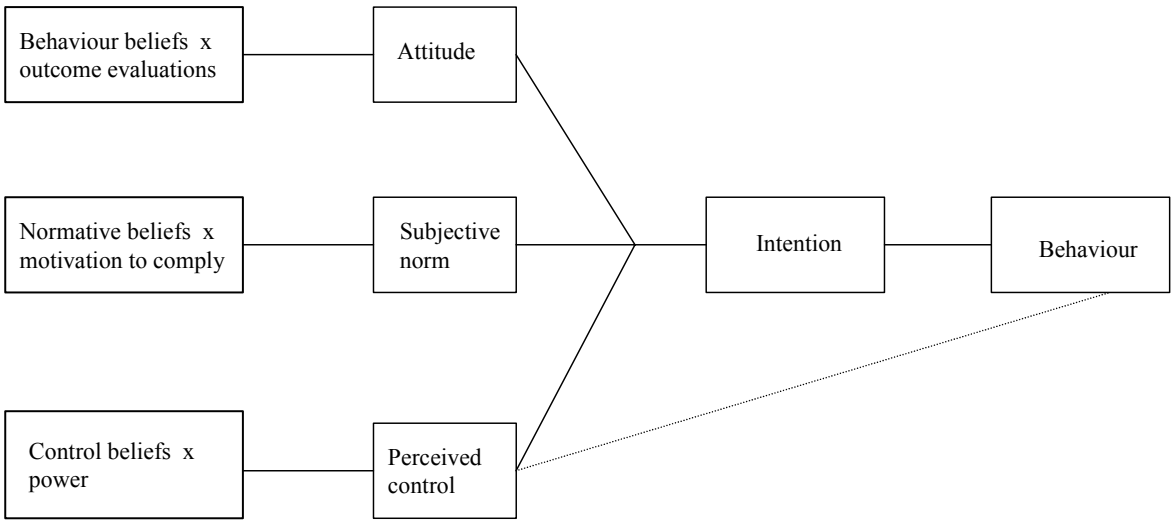

Figure 1. Ajzen (2001) theory of planned behaviour

The application of Ajzen's theory of planned behaviour specifically to water reuse proposes that people's willingness to use recycled water (i.e. *behavioural intention*) is dependent on: (1) their attitudes towards using the water; (2) their perception of what their significant others think about using recycled water (i.e. *subjective norm*) and; (3) their perceived ease or difficulty in using recycled water (i.e. *perceived control*). Their attitudes towards water reuse are in turn determined by their beliefs about the outcomes of using recycled water and their evaluation of the expected outcomes (ie. *behavioural beliefs* and *outcome evaluation*). The same principles underlie their *subjective norm* and *perceived control* over the use of recycled water. Syme and Nancarrow (forthcoming) acknowledged that Ajzen's theory tended to focus on the cognitive aspects of the attitudes and stressed the importance of including other factors in the model. They incorporated some of the factors mentioned earlier in their theoretical modelling and these are listed below.

1. Trust in the authorities and scientific findings and knowledge of issues related to recycled water.
2. The issue of choice: the benefits of using the recycled water outweighed all other options.
3. Emotional variables such as disgust.
4. Anticipated regret.
5. Risk perceptions of using recycled water.

Overall, the approach of using Ajzen's model in water reuse allows the differing factors to be mapped along with their possible influences on people's willingness to use recycled water. This model has been applied successfully in understanding conservation behaviours (e.g. water conservation) and has also been used to formulate successful conservation programs over the past decades.

6.0 STRATEGIES FOR IMPLEMENTING NEW PROJECTS

The strategies for implementing water reuse projects have evolved substantially to meet dynamic social requirements and expectations. The traditional approach of implementing water reuse by means of a "decide, announce and defence" policy has now been commonly acknowledged as ineffective. The strategy by means of extensive public education and outreach programs after the project's conception is also shown to be inadequate. Many reuse projects following this strategy have failed (e.g. San Diego Water Repurification Project). Countries which managed to implement reuse projects using this strategy tend to be more authoritarian in their governmental system (e.g. Singapore).

The new strategy proposed for implementing water reuse projects is to involve the community prior to the conception of any reuse projects (Recycled Water Task Force, 2003). This strategy is now recognised as the most essential component for obtaining long-term public support. San Diego County may have introduced a comprehensive public outreach program but the project failed to include the public at the planning stage. The opponents of the project utilised this to protest against the project, citing that the public was left out of the information loop. Some opponents even created damaging stories about the project to create public unease (Wegner-Gwidt, 1998). Early public involvement is therefore crucial to the success of any reuse projects. It provides the opportunity to engage the public and to understand their views on the issue.

Community empowerment is the key to this early public involvement process. The public should be empowered to make an informed choice about their water supply options, thus encouraging them to take part in the water supply solution. Different water supply options can be presented and discussed with the community along with the advantages and disadvantages of each option. Every issue raised by the community should then be considered in the planning of the project. This process, although time consuming, provides an opportunity for informing the public and allowing any misconceptions people may have about their water supply to be clarified.

The community involvement process should *never* be used to sell or persuade the public to use recycled water. The authorities involved, and the process used to engage the community, have to be honest and transparent. Accurate and complete information on water issues should be updated and available to the public, media and educators, on a continual basis.

Information provision has been shown to reduce people's concerns about reuse, especially the perceived safety of the projects (e.g. Marks et al., 2002a). Risk communication needs to be an integral part of this information provision process. Alhakami and Slovic (1994) suggested that changing the perception of benefits associated with a new technology might also alter the perceived risk of adopting the technology. Specifically, if benefits associated with a technology are high, the technology is often seen as low risk and visa versa. Another part in the risk communication is to heighten people's awareness of water issues by providing information about successful reuse projects. This aims to increase people's exposure to reuse experiences and therefore reduces perceived risks.

Currently no formal standard framework has been established to build successful and ethical public involvement programs for water reuse. In the US, the community involvement processes were integrated as part of the legal requirements to initiate new reuse projects. However, these legal requirements were found to be inadequate in their involvement of the public. In Australia, it is recommended that public involvement programs be included in the

implementation phase of water reuse projects (NWQMS, 2002), although no legal requirement exists for introducing the programs. A more concerted public participation process is needed to ensure that the public is involved in the decision making phase.

From the water recycling literature, only two articles were found at the time of this review which briefly discussed building community participation programs.

Wegner-Gwidt (1998, p. 1448) recommended the following eight critical steps for successful community support programs.

1. Being upfront and proactive.
2. Developing a basic information campaign.
3. Working with local media.
4. Using credible third party testimony.
5. Showing successful projects elsewhere.
6. Being visible and creative.
7. Increasing public awareness.
8. Using demonstration projects.

Recently in the US, Hartley (2003) established a framework consisting of five principles to assist water agencies to constructively engage the public on contentious reuse issues. The primary aim of the principles was to build and maintain public confidence and trust. These five principles were: (1) *manage information for all*; (2) *maintain individual motivation and demonstrate organisational commitment*; (3) *promote communication and public dialog*; (4) *ensure fair and sound decision making and decisions* and; (5) *build and maintain trust (Hartley, 2003, p.3-2)*. The author emphasised that these principles were not a standard checklist of 'to-dos' to establish public trust. Instead, the application of these principles had to be tailored to the context of a reuse decision using diagnostic questions and analytical techniques.

An alternative approach in the initiation of reuse projects could utilise social psychological theory of equity, justice and fairness which have been successfully applied by social justice scientists in the evaluation of ecological and water allocation policies (Syme & Nancarrow, 2001; Syme et al., 2000; Syme et al., 1999). Many qualitative and quantitative research projects have shown that justice concerns are highly salient in the decision making processes. In particular, procedural justice studies have found that community and stakeholder support for developments does not depend only on the possible impacts on their well-being, but also on their perceptions of the decision making processes (e.g. Lind & Tyler, 1988). Specifically, people are more likely to accept decisions from the authorities if they thought the process had been 'fair' and unbiased. This implies designing processes that do not just "bring the community" with the planner, but which also develop a genuine partnership with the community.

Regardless of the approaches adopted by the water agencies, it seems that understanding community values and concerns, and establishing a genuine partnership with the community are most essential in the formulation of any reuse policy.

7.0 A SUMMARY OF REQUIRED RESEARCH

Although the importance of community acceptance for a successful reuse program is widely acknowledged, there is an obvious lack of social research in understanding the basis of public perceptions of water reuse and the psychological factors governing their decision making processes. The following lists the areas for further investigations that have been identified in this review.

- Understanding of judgement strategies used by people to make their decisions to accept or reject using recycled water.
- Identification of different factors that influence people's risk perceptions in using recycled water.
- Investigation of the role of trust in the authorities and the limits of scientific knowledge in people's decision making processes to either accept or reject the use of recycled water.
- Examination of the different ways and situations where factors such as health, environment, treatment, distribution and conservation issues can impact on people's willingness to use recycled water.
- Examination of people's sensitivity in regard to the disgust emotion or "yuck" factor and the probability of avoiding recycled water.
- Understanding of why different sources and uses of recycled water can influence people's decisions to accept recycled water.
- Understanding of how perceived economic advantages in using recycled water can facilitate people's decisions to use recycled water.
- Identification of possible environmental justice issues which can affect people's willingness to use recycled water.
- Examination of the effectiveness of using Ajzen's model of Planned Behaviour in understanding factors that influence people's willingness to use recycled water.

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