Abstract: Historically, a secure water supply has been critical to a city’s survival. In Australia this reality has been heightened as the water storages of many of the country’s major urban centres drop to critically low levels leading to a water crisis. The use of recycled water has been proposed as one solution to this crisis. The experience of many recycled water projects around the world has demonstrated that community acceptance is critical to their success, especially projects which propose close personal use of recycled water, such as drinking or showering. This paper reports findings of a research project investigating public perceptions of recycled water at two commercial case study sites in Victoria: the Council House 2 Building of Melbourne City Council in Melbourne; and the Bendigo Bank Head Office in Bendigo. Both buildings will incorporate the use of recycled water for non-potable (non-drinking) uses such as toilet flushing and garden irrigation. An on-line survey was undertaken at each location prior to the use of recycled water commencing. The paper compares attitudes of respondents in the two locations, including: the perceived need to use recycled water; trust in the water authority; fairness in recycled water system implementation; perceived quality of the recycled water; satisfaction with the recycled water system; and information provision. Results indicate that there were significant differences in attitudes between locations. Results indicate the importance for governments and the water authority to gain and maintain trust of communities in order to ensure recycled water use acceptance.

Introduction
A secure supply of water is critical to a city’s survival. Water storage levels in many of Australia’s major urban areas are at record low levels, leading to a water crisis. This crisis is due to a number of factors including population growth, increasing demand for water, water use in excess of need, and climate change. Many solutions have been proposed to solve this crisis, ranging from those that require low human commitment, but high technological commitment such as desalination and recycling, to those that require high human commitment and low technological commitment such as demand management through water use restrictions (Hurlimann 2006). Demand management is typically the first step in water resource management, however its impact in the Australian context seems limited, as many cities still use water in excess of need despite being on water use restrictions (Hurlimann 2007d). Australians are amongst the highest consumers of water per capita in the world (World Resources Institute et al. 2005). Receiving more attention than demand management in Australia is the potential of water recycling to ease demand on potable (drinking) water supplies. Many levels of Australian government have set water recycling targets, for example in 2002 the Victorian Government set a target to recycle 20% of wastewater by 2010 (Victorian Government 2002). This policy has since been superseded by other water plans of the Victorian Government (2004; 2006) which set out various water recycling and alternate water supply scenarios such as mandating third pipe systems (residential systems that deliver both drinking water and recycled water for non-potable uses in separate pipes). These water plans have become quickly outdated due to the rapid onset of drought.

At present many regional areas of Australia are in a worse predicament for water than the major cities, and thus face more severe water shortages and restrictions to water use. For example as of June 2007, the State of Victoria’s regional urban centre of Bendigo had 4% capacity of water storages (dams) and was on stage 4a (of 4) water restrictions, while Melbourne – the capital city had 28.4% capacity of water storages (dams) full and was on stage 3 (of 4) water restrictions. The two Victorian commercial case studies used in this research provide a comparison of the capital city (Melbourne) and an urban regional centre (Bendigo). The case studies are the Council House 2 (CH2) building in Melbourne and the Bendigo Bank (BB) building in Bendigo, which will both incorporate recycled water use for non-potable (non-drinking) purposes. The details of each case study site are presented below.

Council House 2 (CH2)
The CH2 building is an environmentally innovative building of the City of Melbourne. In 2005 the Green Building Council of Australia awarded CH2 a ‘six green star rating’ which ‘represents world leadership in office building design’ (City of Melbourne 2007). A major intention of the CH2 building is efficient water use. In addition to water efficient fixtures and appliances, the design of the CH2 building includes a ‘sewer mine’. Sewage from the main sewer in Melbourne, along with sewage generated on site, will be treated to a standard suitable for all non-potable (non-drinking) uses and will
meet all Class A water criteria through a separate water supply system (Othman and Jayasuriya 2006). The recycled water will supply the CH2 cooling tower system, plant watering and toilet flushing needs and is also intended to be used for street cleaning and street tree watering within the central business district (CBD). The building construction was completed in November 2006 and was occupied soon after (540 staff capacity). Some delays in the recycled water system coming on line have been experienced, but recycled water use is expected to be fully operational by mid 2007. The CH2 survey was conducted in August 2006 – at that time Melbourne’s dam levels were at 47% of capacity.

**Bendigo Bank (BB)**

The BB Headquarters is an innovative building that is currently under construction in the Bendigo CBD, which is located 150km north west of Melbourne. It is anticipated that construction will be completed in stages with the first occupancy commencing at the end of 2007. The building will service 900 staff on completion. The building incorporates ecologically sustainable principles in its design and construction. It is estimated to save 51% of energy use, 1175t CO₂e/annum and around 17,000L of water per day (Sustainability Victoria 2006). Reducing reliance on reticulated water was a key design consideration for the building due to Bendigo’s drought-vulnerable water supply (Sustainability Victoria 2006). A wastewater treatment plant will treat both black and grey water, providing Class A water for use to flush toilets and irrigate gardens. The BB survey was conducted in February 2007 – at that time Bendigo’s dam levels were at 7.5% of capacity. A pipeline connecting Bendigo’s water supply system with the Waranga Western Channel (part of the Goulburn-Murray Water system) is currently under construction and is expected to be completed by August this year. If not, the region is sure to face the same fate as its neighbours such as Euroa who have run out of water completely and now rely on water tankers to supply their needs.

**Attitudes to recycled water use**

Recycled water use can reduce demand for potable water, thus it can make a potential contribution to easing the water crisis in Australia. Recycled water use can occur for many different purposes including industrial, agricultural and domestic. In Australia the use of recycled water is low but increasing. Currently 4% of total water use is recycled water (Australian Bureau of Statistics 2006). The majority of this is used in agriculture, thus the general Australian community have very little experience with recycled water use. Experience from around the world shows that support from local communities is critical to the success of recycled water projects. A number of projects around the world have failed due to a lack of local community support (Hurlimann and McKay 2004), however these have been predominantly projects which involved close personal use of recycled water such as drinking or showering with recycled water. Various studies have found that acceptance of recycled water use increases as the use of recycled water becomes increasingly less personal (Bruvold and Ward 1970; Marks et al. 2006; McKay and Hurlimann 2003). Given the relative lack of experience the Australian community has with recycled water use, projects should be carefully introduced to ensure the success of policy aims.

Across the world the major use of recycled water is for agricultural purposes. Increasingly common are third pipe systems or dual water supply systems. In Australia there are a number of well known third pipe systems including Rouse Hill and Newington in Sydney and Mawson Lakes in South Australia (Australian Academy of Technological Sciences and Engineering 2004). The use of recycled water in commercial buildings is currently limited, however is implemented widely in Japan. Research was conducted in Japan in 1999 with occupants of 125 commercial buildings using recycled water mainly for toilet flushing (Yamagata et al. 2002). Acceptance was strong, but problems with odour of the recycled water were reported. Use of recycled water in commercial areas is not yet occurring on a wide scale in Australia, but could provide the opportunity to save significant amounts of water. CH2 and the BB Head Office will be amongst the first commercial buildings to use recycled water in Australia.

Preliminary results from this study have indicated that for all uses of recycled water explored (drinking, showering, washing hands, clothes washing, cooling system, public fountains and water features, street cleaning, garden watering, and toilet flushing) there was no difference between locations (BB and CH2) with regards to happiness to use recycled water (Hurlimann 2007c) or perceived risk related to recycled water use (Hurlimann 2007b). This was contrary to anticipation that Bendigo respondents would be more willing to use recycled water because of the lower levels of water storage. Results indicated that it was not location but a respondent’s particular attitudes and perceptions that influence low risk perception and happiness to use recycled water for more personal uses (drinking, showering, washing hands and clothes washing) including: perceived need to use recycled water; being well informed about recycled water use; satisfaction with recycled water use; positive perceptions of
recycled water quality; perceived fairness in the system’s implementation; trust in the water authority; and a low perceived health risk related to recycled water use. These correspond to factors found to promote satisfaction with recycled water use in an urban Australian case study of recycled water use for non-potable purposes in Mawson Lakes South Australia (Hurlimann et al. In Press).

This paper explores whether these attitudes which were found to be important for fostering acceptance of recycled water use and lowering perceived risk, vary between locations. The paper also explores concerns respondents expressed with the future use of recycled water in the commercial context and information needs they expressed.

The role of trust has had limited exploration with regards to recycled water projects and community acceptance. Marks (2004) suggests trust in water service providers, and in technology play a pivotal role when risk is introduced to a traditionally, taken-for-granted service e.g. when the provision of recycled water is introduced for a use that would have traditionally been met by potable water. In a recent article on getting past the ‘Yuck Factor’ in recycled water projects, Christen (2005) believes that failure of recycled water projects often relates to some breach of the public trust in terms of the authority or utility’s behaviour or credibility. With a focus on US case studies, Christen notes that water recycling projects were side-lined in the past because of public opposition but projects are now being successfully implemented. Christen suggests that this is due to recent initiatives to involve stakeholders in the entire decision making process. More recently Hurlimann (2007a) has found a relationship between trust in the water authority and low perceived risk of close to personal uses of recycled water (see also Hurlimann and McKay 2004 for exploration of trust and recycled water use). This demonstrates the importance of trust to the successful implementation of recycled water projects.

Research Method

The results reported in this paper come from benchmark surveys of staff in both locations (CH2 and BB) prior to the new buildings’ occupation. Both surveys contained the same questions except for locational differences in the phrasing of questions (i.e. different names for the relevant water authorities) and three extra questions added to the Bendigo survey. Both surveys contained questions in the context of the new building and beyond surrounding the following issues: happiness/willingness to use recycled water for various uses, 2) risk perception of various recycled water uses, 3) attitude and perception statement ratings, 4) information needs and concerns 5) demographic issues. Employees of both organisations were invited to participate in the online survey through an organisation-wide email with a link to the survey site. The survey was open for one week at both locations. A reminder email was sent at both locations one day prior to the survey closing. The CH2 survey was conducted in August 2006. A total of 197 City of Melbourne employees responded to the survey out of an average of 690 employees who receive the email. This gave the CH2 study a response rate of 28.5% which was considered adequate for this study. The BB survey was conducted in February 2007. A total of 305 BB employees responded to the survey out of 750 employees located in Bendigo giving a response rate of 41% which was also considered adequate for this study.

This paper reports results regarding difference in attitude and perception statements between locations. Various attitude and perception statements (listed in Table 1) were measured on a 10-point scale of 1-10 where 1 = very strongly disagree and 10 = very strongly agree. Respondents were not obliged to respond to questions if they did not want to. Data was analysed using the Statistical Package for the Social Sciences (SPSS Inc 2006). Various statistical tests were undertaken including t-tests and Chi-square tests to analyse the results and establish if there were any significant differences between groups. Respondents were also asked if they had any concerns regarding the use of recycled water at the location, and if so were asked to list their concerns.

Table 1: Attitude and perception statements and associated variable labels

<table>
<thead>
<tr>
<th>Label / Variable</th>
<th>Statement / survey question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Need</td>
<td>‘We need to use recycled water for the future’s sake’</td>
</tr>
<tr>
<td>2) Information</td>
<td>‘I am well informed about recycled water use at &lt;location&gt;’</td>
</tr>
<tr>
<td>3) Satisfaction</td>
<td>‘I am satisfied with recycled water use as it will occur at &lt;location&gt;’</td>
</tr>
<tr>
<td>4) Quality</td>
<td>‘The recycled water which will be used in &lt;location&gt; is of a high quality’</td>
</tr>
<tr>
<td>5) Fairness</td>
<td>‘Recycled water use at &lt;location&gt; has been implemented in a fair manner’</td>
</tr>
<tr>
<td>6) Trust – Water Authority</td>
<td>‘I trust the water authority to ensure recycled water safety in &lt;location&gt;’</td>
</tr>
<tr>
<td>7) Trust – Council</td>
<td>‘I trust the Council to ensure recycled water safety in &lt;location&gt;’</td>
</tr>
<tr>
<td>8) Health risk</td>
<td>‘I am confident there are no health risks associated with recycled water use’</td>
</tr>
</tbody>
</table>
Results
Demographic details were analysed and compared for each location. For age and gender the respondents were comparable. For BB the mean age of respondents was 35.8 (sd = 10.1) and 56% of respondents were female. For the CH2 survey, the mean age of respondents was 37.5 (sd = 10.3) and 60% of respondents were female. A higher proportion of CH2 survey respondents had University degrees or higher (76%) compared to BB respondents (43%) (Chi-Square = 53.5, df = 1, sig. = 0.000).

Prior experience with recycled water use
Respondents in both case studies were asked ‘have you ever used recycled water before?’. A total of 35% of CH2 respondents and 64% of BB respondents said ‘yes’. A significantly greater number of BB respondents had used recycled water before than CH2 respondents (Chi square 41.72, df = 2, sig = 0.000). This may be due to the heightened water shortage in Bendigo and thus greater restrictions on the use of potable water. Prior experience of recycled water use was found to have a significant impact on reducing perceived risk of close to personal uses (drinking, showering, washing hands and clothes washing) of recycled water and increasing happiness to use recycled water at both locations (Hurlimann 2007b; Hurlimann 2007c).

Attitudes that influence recycled water acceptance
Respondents were asked to rate all the attitude and perception statements listed in Table 1 on a ten point scale. Mean ratings were calculated for each location, and t-tests were undertaken to establish whether there was a significant difference in ratings between locations. For 6 of the 8 variables there was a significant difference in mean ratings between locations, the results of which can be found in Table 2.

There was no difference in perceived need to use recycled water or perception of health risk related to use of recycled water between locations. It was anticipated that the BB respondents would perceive greater need to use recycled water given their greater water shortage. This result may indicate that living in an area with acute water shortage does not necessarily translate to an increase in perceived need to use recycled water. Perhaps this is related to perceptions that dam levels should never have got to such a low level.

Results displayed in Table 2 indicate that the BB respondents rated the variables information, satisfaction, quality and fairness significantly higher than the CH2 respondents. Thus the BB respondents perceived they were more well-informed about recycled water use, they were more satisfied with recycled water use as it was to occur in their workplace, were more confident that the recycled water was going to be of a high quality, and perceived the recycled water system had been implemented in a fair manner. This difference was not anticipated because at the time that both surveys were conducted, specific communication campaigns about the recycled water systems had not yet commenced at either location.

Table 2: Mean attitude and perception statement rating differences between locations*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Location</th>
<th>n</th>
<th>mean</th>
<th>sd**</th>
<th>t</th>
<th>Df</th>
<th>Sig (2 tailed)</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>CH2</td>
<td>196</td>
<td>5.75</td>
<td>7.00</td>
<td>2.5</td>
<td>5.75</td>
<td>499</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>BB</td>
<td>305</td>
<td>3.25</td>
<td>8.74</td>
<td>1.9</td>
<td>3.25</td>
<td>499</td>
<td>1.25</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>CH2</td>
<td>196</td>
<td>7.51</td>
<td>8.31</td>
<td>2.1</td>
<td>7.51</td>
<td>499</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>BB</td>
<td>305</td>
<td>9.00</td>
<td>8.74</td>
<td>2.1</td>
<td>9.00</td>
<td>499</td>
<td>0.80</td>
</tr>
<tr>
<td>Quality</td>
<td>CH2</td>
<td>197</td>
<td>7.49</td>
<td>8.00</td>
<td>2.4</td>
<td>7.49</td>
<td>497</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>BB</td>
<td>302</td>
<td>5.25</td>
<td>8.74</td>
<td>2.1</td>
<td>5.25</td>
<td>497</td>
<td>0.51</td>
</tr>
<tr>
<td>Fairness</td>
<td>CH2</td>
<td>194</td>
<td>7.22</td>
<td>8.07</td>
<td>2.3</td>
<td>7.22</td>
<td>495</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>BB</td>
<td>303</td>
<td>5.00</td>
<td>8.74</td>
<td>2.1</td>
<td>5.00</td>
<td>495</td>
<td>0.85</td>
</tr>
<tr>
<td>Trust – Water Authority</td>
<td>CH2</td>
<td>195</td>
<td>7.47</td>
<td>6.97</td>
<td>2.6</td>
<td>7.47</td>
<td>494</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>BB</td>
<td>301</td>
<td>6.61</td>
<td>6.74</td>
<td>2.6</td>
<td>6.61</td>
<td>494</td>
<td>0.50</td>
</tr>
<tr>
<td>Trust – Council</td>
<td>CH2</td>
<td>196</td>
<td>7.71</td>
<td>6.61</td>
<td>2.2</td>
<td>7.71</td>
<td>492</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>BB</td>
<td>298</td>
<td>6.61</td>
<td>6.74</td>
<td>2.6</td>
<td>6.61</td>
<td>492</td>
<td>1.11</td>
</tr>
</tbody>
</table>

* rating scale: 1 = very strongly disagree – 10 = very strongly agree
**sd = standard deviation, df = degrees of freedom, sig = significance

The CH2 respondents were significantly more trusting of the water authority and council to ensure recycled water safety. Perhaps this lower trust displayed by BB respondents could be attributed to the lower water storage levels and concern that the situation could have got to such a critical level. In an open ended section of the survey the following responses were made by BB respondents:
- “The lack of trust in Council and the water authority is more to do with their miss-handling of water resources in general and other planning issues for which vested interests come ahead of environmental concerns and the long term interests of the general public.”

- “Limited faith in the water authority – proven track record of failure”

Further investigation of trust in both contexts (Melbourne and Bendigo) would be beneficial.

**Concerns about recycled water use at CH2**

In both locations respondents were asked: ‘Do you have any concerns about recycled water use at <location>?’. Results are displayed in Table 3, and as can be seen, a greater percentage of CH2 respondents did have concerns with recycled water use. Chi square test established this difference was significant (Chi square = 12.51, 2df, sig = 0.01).

<table>
<thead>
<tr>
<th>Location</th>
<th>Yes n (% of respondents)</th>
<th>No n (% of respondents)</th>
<th>No response n (% of respondents)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH2</td>
<td>56 (28)</td>
<td>130 (66)</td>
<td>11 (6)</td>
</tr>
<tr>
<td>BB</td>
<td>63 (21)</td>
<td>237 (78)</td>
<td>5 (1)</td>
</tr>
</tbody>
</table>

Those who responded ‘yes’ (they did have concerns) were then asked ‘Please briefly outline your concerns’. In total 63 respondents (more than said ‘yes’) provided comment from CH2, and 68 respondents (more than said ‘yes’) provided comment from BB. However some of these comments related to support of the recycled water use rather than concern. Responses were categorized for summary. An overview of the three major category of responses can be found in Figure 1.

**Figure 1: Respondent concerns about recycled water use in the commercial case studies, a comparison of CH2 and BB respondents**

As can be seen from Figure 1 the main concerns for CH2 respondents related to technical and monitoring details, the perceived need for more information, and health risks. Many respondents commented on their concern for use of recycled water beyond that which will occur at CH2 such as drinking or washing hands. It can be seen from Figure 1 that technical / monitoring details were the biggest concern for BB respondents followed by health risks and more information. It is acknowledged that the communication plans had not yet begun at either location at time of survey. These results indicate the major concerns respondents had and thus would be advantageous to address in the communication plans at both locations and other locations around Australia.

There was provision at the end of each survey for respondents to make other comments. In total 42 CH2 respondents provided comments. On the whole these were very positive comments about the use of recycled water. Examples from CH2 include:

- “Brilliant initiative and I hope we can use this as a precedent for further use of recycled water in CoM”
“In the future recycled water will be the norm.”
“Council should be taking a lead role in promoting the recycling of water for drinking…this is a great first step, but we could go even further and the results of this survey may assist in that”

Examples from BB include:
- “There should be a lot more use of recycled water everywhere”
- “It is time Australians got over their fear of using recycled water. I drank it in Europe for many years and never had health problems as a result”
- “Living all my life in Melbourne but now living in Bendigo I now understand the issues regarding water conservation and re-use. I think the message now has to be conveyed to city dwellers perhaps for them to spend some time in drought stricken areas

**Information requests**

BB respondents were asked if they were interested in attending information sessions to learn more about the water recycling system in the new BB Head Office. In total 234 (77%) respondents said yes, 68 (22%) no and 3 (1%) did not respond. Respondents were also asked what type of information they would like made available regarding the recycled water use. A total of 177 responses were received. These comments were categorised, the results (major categories) can be found in Figure 2. As can be seen from Figure 2, the main information requests were for technical information about the treatment process (65) safety aspects (43) and details on use of recycled water (31). This gives suggested content of information sessions and a broader communication plan regarding recycled water use.

**Figure 2: Information requirements regarding recycled water as indicated by survey respondents**

![Figure 2: Information requirements regarding recycled water as indicated by survey respondents](image)

**Conclusions**

This paper has explored attitudinal differences between two locations (Melbourne the state’s capital city and the regional urban centre of Bendigo) regarding issues important to promoting acceptance of recycled water use. Interestingly this paper has found that there was a significant difference in attitudes between locations. Bendigo respondents perceived they were more well-informed about recycled water use at the building; were more satisfied with the imminent use of recycled water; perceived the recycled water to be of a higher quality; and perceived the recycled water use had been implemented in a fair manner. While it is acknowledged the surveys were both conducted prior to recycled water use and associated communication plans commencing this indicates that Bendigo Bank Limited had introduced the recycled water use in a more positive way than Melbourne City Council had. However, CH2 respondents had greater trust in the water authority and Council to ensure recycled water quality and safety. These results and other open ended comments from the survey indicate that the serious water shortage in Bendigo had impacted community trust in the water authority and Council. This may have interesting implications – as communities are more in need of...
the use of recycled water, their acceptance of its use may be decreased by their lowered trust in the water authority to achieve this in a safe manner – an attitude which may have been influenced by the fact that the community face this water scarce situation. This indicates that the need – acceptance – trust relationship is a complex but important one. The results indicate the importance for Councils, government and water authorities to gain and maintain community trust if water recycling projects are to be successful.

This paper has provided information regarding recycled water communication campaigns. Responses from BB respondents indicate that as future users of recycled water the most sought after information is technical information about the recycling process, followed by information regarding health and safety aspect, and details of the exact extent of recycled water use in the building.

Future research into factors underlying trust in the water authorities would be beneficial in particular in relation to total water management. Further research to monitor any change in attitude to use of recycled water over the long-term, in particular some time after the use of recycled water commences in both locations would also be beneficial.

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References