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# What affects public acceptance of recycled and desalinated water?

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# What affects public acceptance of recycled and desalinated water?

## **Abstract**

This paper identifies factors that are associated with higher levels of public acceptance for recycled and desalinated water. For the first time, a wide range of hypothesized factors, both of socio-demographic and psychographic nature, are included simultaneously. The key results, based on a survey study of about 3000 respondents are that: (1) drivers of the stated likelihood of using desalinated water differ somewhat from drivers of the stated likelihood of using recycled water; (2) positive perceptions of, and knowledge about, the respective water source are key drivers for the stated likelihood of usage; and (3) awareness of water scarcity, as well as prior experience with using water from alternative sources, increases the stated likelihood of use. Practical recommendations for public policy makers, such as key messages to be communicated to the public, are derived.

## **Keywords**

desalinated, public, water, acceptance, affects, recycled

## **Disciplines**

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# 1                   **What effects public acceptance of recycled and desalinated water?**

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## 31                   **Abstract**

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36                  range of hypothesized factors, both of socio-demographic and  
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43                  prior experience in using water from alternative sources, increases the stated  
44                  likelihood of use. Practical recommendations for public policy makers, such  
45                  as key messages to be communicated to the public, are derived.



48 **1. Introduction**

49

50 Many countries endure water supplies that are insufficient to meet their present and  
51 future demands. Escalating pressure from increased population, along with the  
52 uncertainty of water supply conditions due to climate change, amounts to a burgeoning  
53 water crisis. While technologies are available to alleviate water shortage, many countries  
54 have experienced public resistance to the adoption of much needed water augmentation  
55 projects. To address the world's water crisis it is essential that engineers and social  
56 scientists work together. Engineers can provide the best, safest and most energy-efficient  
57 solutions to augment water supplies, whereas social scientists can facilitate better  
58 understanding of the reasons for public resistance to the adoption of water from  
59 alternative sources. Social scientists can also suggest ways in which public policy makers  
60 may be able to increase acceptance of alternative water sources and find solutions which  
61 are most acceptable for the community. The present study represents a social science  
62 contribution to this field.

63

64 To date a significant amount of empirical work has been conducted to investigate the  
65 level of stated public acceptance for recycled water - Bruvold and Ward (1970); Bruvold  
66 (1972); Kasperson et al. (1974); Sims and Baumann (1974); Stone and Kahle (1974);  
67 Olson, Henning, Marshack and Rigby, (1979); Bruvold, Olsen and Rigby, (1981);  
68 Milliken and Lohman (1985); and Po, Kaercher and Nancarrow, (2004). Recently, similar  
69 studies have been conducted in the context of desalinated water: Dolnicar and Schäfer  
70 (2006); Dolnicar and Schäfer (2009); and Dolnicar and Hurlimann (2010). Each of these  
71 studies has provided an interesting snapshot of the public's sentiments toward alternative  
72 water sources at the time of survey. Additionally, a number of other studies identified  
73 correlates of high acceptance levels - Hanke and Athanasiou (1970); Gallup (1973);  
74 Kasperson et al. (1974); Sims and Baumann (1974); Johnson (1979); Olson et al. (1979);  
75 Alhumoud, Behbehani and Abdullah, (2003); and Hurlimann and McKay (2004).  
76 However to date, limited studies have attempted to include a comprehensive set of  
77 potential explanatory variables, and to simultaneously test the effect they have on the  
78 acceptance levels of water from alternative sources.

79

80 The aim of this paper is to fill this gap, both for recycled and desalinated water.  
81 Specifically, we investigate which of the hypothesized personal characteristics are in fact  
82 associated with higher or lower levels of acceptance of recycled and desalinated water.  
83 Testing is conducted simultaneously for a wide range of independent variables, thus  
84 avoiding the over-interpretation of single factors. From the empirical findings we derive  
85 key insights and recommendations for public policy makers.

86

87 **2. Literature review**

88

89 Since the 1970's a significant body of knowledge has developed around the topic of  
90 public acceptance of recycled water, providing useful information about general  
91 acceptance levels for various uses of recycled water. Most studies investigating public  
92 acceptance of recycled water come to the same conclusion – that people are very open to  
93 using recycled water for uses with low personal contact, such as watering trees and

94 shrubs in their garden, but are reluctant to adopt recycled water for uses with high  
95 personal contact, such as drinking or bathing one's baby. Although it could be argued that  
96 recycled water has now been used for many decades, recent studies have shown that the  
97 same pattern is still valid – Marks, Martin and Zadoroznyj, (2006); Dolnicar and Schäfer  
98 (2006); Hurlimann (2006); and Hurlimann (2007). For example, Dolnicar and Hurlimann  
99 (2010) found that 92% of Australian respondents would use recycled water for garden  
100 watering, but only 36% for drinking.

101

102 Despite the significant research attention that public acceptance of recycled water has  
103 attracted, very little social science research has focused on water from other alternative  
104 sources. Only recently have comparative studies of acceptance across different kinds of  
105 water been undertaken, such as Dolnicar and Schäfer (2006), and Dolnicar and Schäfer  
106 (2009). Both conclude that people – in this case the Australian population – clearly  
107 discriminate between recycled and desalinated water. Desalinated water was preferred  
108 over recycled water for close-to-body uses such as drinking (49% compared to 20%  
109 acceptance respectively). Recycled water was preferred over desalinated water, however,  
110 for some uses with little body contact, for example, for watering gardens (89% compared  
111 to 68% acceptance respectively). Respondents understood that water recycling is more  
112 environmentally friendly than desalination which, in turn, was perceived by respondents  
113 as less risky from a public health perspective.

114

115 More recently, Dolnicar and Hurlimann (2010) conducted a similar comparison, finding  
116 that Australians now generally prefer desalinated water: 53% were willing to drink it (as  
117 compared to only 36% who were willing to drink recycled water) and 84% were willing  
118 to water their garden with it (compared to 86% who were willing to water their garden  
119 with recycled water). It is likely that developments since the 2006 study have  
120 significantly impacted people's perceptions. Most importantly, Australians in a  
121 Queensland country town, Toowoomba, voted against the development of a water  
122 recycling plant. Public opposition led by the community group 'Citizens Against  
123 Drinking Sewage' dominated national media (for a detailed case study see Hurlimann &  
124 Dolnicar, 2010). Possibly as a consequence of the Toowoomba case, many Australian  
125 state governments have chosen desalination as the preferred path, thus communicating to  
126 the public the benefits of this alternative method of securing Australia's water for the  
127 future. It is likely that these developments have led to the shift in public perception  
128 observed between the 2006 and the 2009 studies.

129

130 While a significant amount of survey research has been conducted to ask respondents  
131 directly about their willingness to use different kinds of water from alternative sources,  
132 only a small amount of work has attempted to identify which personal characteristics are  
133 associated with a high or low level of acceptance towards alternative water sources. An  
134 overview of these studies is provided in Table 1. As can be seen, key explanatory factors  
135 include trust (in the water provider or public policy makers); knowledge and information;  
136 past experience with alternative water sources; and perception of risk. Demographic  
137 variables have been explored, but consensus on the nature of the association is low,  
138 particularly for age.

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[TABLE 1 HERE]

The main limitation of this body of work is that most studies investigate factors hypothesised to be associated with acceptance of water from alternative sources in isolation from one another, thus risking that the association is over-interpreted. The possible interaction effects of multiple factors have mostly been ignored to date. To the authors' knowledge only one study, Po et al. (2005), attempted this in the context of the general public's acceptance of indirect potable reuse of wastewater. Statements of intended use were found to be significantly related to positive attitudes towards indirect potable reuse, which, in turn, were influenced by a number of factors: subjective norms, emotions, trust in the authorities, risk perceptions (negative), sense of obligation to protect the environment, and their perceived control over the source of their drinking water. However, this study focused mainly on complex psychological constructs which are hard to assess and are thus of limited value to public policy makers who need to be able to easily target certain segments of the population with educational messages about water from alternative sources.

### 3. Methodology

#### 3.1. *Fieldwork administration*

Data was collected online in January 2009 using an Australian permission-based research-only internet panel. 13,884 invitations were sent out to panel members. The final total sample size amounted to 3094 respondents (a 22% response rate); 1495 of the respondents were representative of the Australian public. Representativeness was ensured by using a quota sampling procedure. This is achieved by online fieldwork companies who send out invitations to a large group of panel members representative of the population and then monitoring, for all quota criteria, frequency of responses. Toward the end of the process it may be that some respondents wanting to participate in the survey are rejected because they do not qualify as the kind of respondents still required to ensure representativeness. Quotas were set for gender, age, state and education level. Census data from the Australian Bureau of Statistics was used to specify the quota requirements numerically.

Note, however, that the present study does not require the sample to be representative because we are interested in assessing which factors effect public acceptance of recycled and desalinated water. It is more important to ensure that there is sufficient variety in those variables which are hypothesized to play a role. This is ensured by the way the sample was drawn.

The remaining 1599 were collected from specific locations which differ in their local water situations (Adelaide, Sydney, Brisbane, Melbourne, Perth, Darwin, The Mallee and Toowoomba).

185 The online data collection allowed controlling for non-response. The questionnaire  
186 administration ensured that respondents could not proceed without having completed all  
187 questions on a page. As a consequence, missing values due to oversight or unwillingness  
188 to answer, as experienced in paper-and-pencil data collections, were not a factor.

189

### 190 3.2. *Questionnaire*

191

192 Respondents were asked to answer a number of questions which related to their  
193 behaviour, attitudes and socio-demographic characteristics. They are discussed below  
194 under the headings of *Dependent Variables* and *Independent Variables*, reflecting the  
195 hypothesised relationship in the model.

196

#### 197 3.2.1. *Dependent Variables*

198

199 Stated likelihood of using recycled / desalinated water is the dependent variable in this  
200 model. One such variable was computed for recycled water, one for desalinated water.  
201 The variables aim to measure the attitude of the respondents towards recycled and  
202 desalinated water by determining the likelihood of using this kind of water for different  
203 purposes. The final value of the stated likelihood of using recycled / desalinated water is  
204 computed as the sum of 10 items, each of which represents one particular water use. The  
205 10 alternative uses were: watering the garden (flowers, trees, shrubs), washing clothes /  
206 doing laundry, cooking, showering / taking a bath, drinking, brushing teeth, toilet  
207 flushing, cleaning (the house, windows, driveways), watering the garden (vegetables,  
208 herbs to be eaten raw), and washing the car.

209

210 In order to ensure that the data would not be biased by respondents who differed in their  
211 understanding of what recycled / desalinated water meant, each were provided with the  
212 following definitions before they were asked to state the likelihood of use: “*For the*  
213 *following questions we will use the term ‘recycled water’ to describe ‘purified*  
214 *wastewater or sewage,’ and we will use the term ‘desalinated water’ to describe ‘purified*  
215 *seawater,’ and we will assume that both recycled and desalinated water are treated to*  
216 *the same level of water quality.”*

217

218 For each item the respondents had to place a cross on a line. The endpoints were assigned  
219 the values 1 and 100 and all intermediate values were equidistantly determined.

220 Respondents also had the option not to answer a question by ticking a box labelled *not*  
221 *applicable*. However, since no information was available for such items, the summated  
222 score cannot be determined. For each item of the *likelihood to use recycled water*  
223 variable, between 0.7% and 5.9% of the questions were answered *not applicable*. The  
224 average of *not applicable* answers for each item was 2.3%, with 11.6% of respondents  
225 answering *not applicable* to at least one of the items measuring this variable. For the  
226 *likelihood to use desalinated water* variable the situation was similar, with between 0.8%  
227 and 5.7% of the answers being *not applicable*, with an average of 2.2% for each item.  
228 Respondents who had chosen *not applicable* in any part of the survey were removed,  
229 leading to an exclusion of 12.9% of the respondents, a method which was preferred to  
230 that of coding each answer as zero. Substituting zero for these answers would suggest



231 that the respondents do not use any kind of water for certain purposes, however, this  
232 would distort the data to suggest a positive attitude towards recycled and/or desalinated  
233 water. The final sample size therefore was 2694 which leads to a precision level under  
234 the worst care scenario (for binary questions with maximum variance and a confidence  
235 level of 95%) of 2%. A comparison of the state distribution as well as the size of the city  
236 distribution between the retained and excluded respondents indicated no significant  
237 differences (state:  $\chi^2 = 11.3$ ,  $df = 7$ ,  $p\text{-value} = 0.13$ ; size:  $\chi^2 = 8.7$ ,  $df = 10$ ,  $p\text{-value} =$   
238  $0.56$ ). Thus the composition of the sample with respect to location and size of city was  
239 not significantly altered by the omission.

240

241

242

### 243 3.2.2. *Independent Variables*

244

245 The following independent variables were included in the model:

246

247 Environmental attitudes were measured using the New Ecological Paradigm (NEP) scale  
248 designed by Dunlap, Van Liere, Mertig and Jones (2000), which – according to Bragg  
249 (1996) – is the most widely used instrument for measuring environmental attitudes. The  
250 scale consists of 15 items covering five dimensions: reality of limits to growth, anti-  
251 anthropocentrism, fragility of nature’s balance, rejection of exemptionalism, and  
252 possibility of ecocrisis. Respondents were offered five answer options to indicate their  
253 level of agreement. The item labels with corresponding scores were *Strongly agree* (2),  
254 *Mildly agree* (1), *Unsure* (0), *Mildly disagree* (-1) and *Strongly disagree* (-2). Item-level  
255 responses were added to the total NEP score.

256

257 Environmental concern was measured using the items developed by Berenguer, Corraliza  
258 and Martin (2005) for general environmental concern. A sample item is: *To what extent*  
259 *are you concerned about the situation of the environment in general?* Respondents were  
260 asked to record their answer using a five-point agreement scale identical to the scale used  
261 for the environmental attitudes. The values of the six concern items were added to form  
262 the overall value for environmental concern.

263

264 Altruism was measured using Clark, Kotchen and Moore’s (2003) nine item altruism  
265 scale, which is based on Schwartz’s (1970, 1977) norm-activation model. Three items  
266 measure personal norms, three measure awareness of consequences, and three measure  
267 ascription of responsibility. Respondents expressed their beliefs on a five-point  
268 agreement scale identical to the scale used for the environmental attitudes. The total  
269 altruism value was computed as the sum over all nine altruism items.

270

271 Moral obligation to behave in an environmentally friendly way has been shown to be a  
272 good predictor of pro-environmental behaviour. For example, Berenguer et al. (2005)  
273 find moral obligation to be the best predictor of pro-environmental behaviour. Dolnicar  
274 and Leisch (2008) found moral obligation to be a useful segmentation base to identify  
275 subgroups of the population with distinctively different levels of pro-environmental  
276 behaviour. We used the following wording for the single item measure: *Do you consider*

277 *yourself morally obliged to carry out environmentally friendly behaviours?* Respondents  
278 had to respond by ticking either *Yes* (1) or *No* (0).  
279

280 Pro-environmental behaviour was a summated value across respondents' answers to the  
281 following question: *You will now see a list of behaviours. Please indicate how frequently*  
282 *you carried out each of these behaviours at home in the last year?* Response options were  
283 *Always* (4), *Often* (3), *Rarely* (1) and *Never* (0) and *Not applicable* (0). A total of thirty  
284 behaviours were included.  
285

286 Active involvement in searching for information about water was measured using a single  
287 item measure by asking respondents: *How much effort have you made this year to look*  
288 *for information on water-related issues (water recycling, desalination, water*  
289 *conservation, rain water etc.)?* Respondents had four response options: *Absolutely no*  
290 *effort* (0), *A small effort* (1), *A big effort* (2) and *A huge effort* (3).  
291

292 Previous use of recycled / desalinated water was measured using a single item measure,  
293 worded as follows: *Have you ever used recycled water / desalinated water?* Answer  
294 options were *Yes* (1) and *No* (0).  
295

296 Experience with water restrictions was measured by asking respondents *Have you ever*  
297 *experienced water restrictions?* Answer options were *Yes* (1) and *No* (0).  
298

299 Perception of being limited by water restrictions was measured asking *To what extent do*  
300 *you feel limited by water restrictions?* Answer options were *Not at all* (0), *Slightly* (1)  
301 and *Strongly* (2). For analysis we used a collapsed variable with the categories *Not at all*  
302 (0) and *Slightly / Strongly* (1).  
303

304 Attitude towards water conservation consisted of the sum over nine items about water  
305 conservation which were developed specifically for this study based on results from the  
306 qualitative fieldwork stage. One example is: *Water conservation is necessary because of*  
307 *water scarcity.* Response options were *I agree* (1) and *I disagree* (-1).  
308

309 Water conservation behaviour was also computed as a sum over 17 items indicating  
310 different means of water conservation behaviour, such as *I make sure that taps do not*  
311 *drip.* Answer options were *Yes* (1) and *No* (0).  
312

313 Extent of influence of other people on people's water-related behaviour and attitudes was  
314 computed as the sum over 14 items which listed different social sources of influence, for  
315 example, friends, partner, the media. Answer options were *Yes* (1) and *No* (0) for each  
316 listed social source.  
317

318 Knowledge about recycled and desalinated water, as well as perceptions of recycled and  
319 desalinated water, respectively, were measured with knowledge and perception items  
320 developed by Dolnicar and Schäfer (2006). The sum across all items was used to arrive at  
321 separate overall measures of knowledge about recycled and desalinated water. Note that  
322 the knowledge and perception questions were asked before the definition of recycled and

323 desalinated water was provided and respondents were asked to state their likelihood of  
324 use. Once respondents were provided with the definition and the statement that both  
325 recycled and desalinated water were treated to the same level of water quality,  
326 respondents were not able to click back anymore. This was done to ensure they would not  
327 retrospectively change their answers to the perceptions and knowledge questions.  
328

329 Finally, a number of socio-demographic questions were asked covering age, gender,  
330 education, size of city, feeling of belonging to the region, importance of religion, media  
331 use and whether or not respondents had read something about recycled or desalinated  
332 water recently.  
333

334 These variables were chosen because they emerged as predictive in a number of studies  
335 trying to explain pro-environmental behaviour of different kinds, namely pro-  
336 environmental behaviour in general (Berenguer et al., 2005), intentions to undertake pro-  
337 environmental behaviour (Cordano, Welcomer & Scherer, 2003) as well as specific kinds  
338 of pro-environmental behaviour such as subscribing to green electricity programs (Clark  
339 et al., 2003), willingness to pay for species protection (Kotchen & Reiling, 2000), for  
340 environmentally sound products (Laroche, Bergeron and Barbaro-Forleo, 2001) and  
341 environmental protection in general (Stern, Dietz and Kalof, 1993). We deliberately  
342 included a wide range of criteria which were found to be associated with pro-  
343 environmental behaviour more generally because we felt that limiting our selection of  
344 variables to those studied in water-related research may lead to the omission of key  
345 factors.  
346

347

#### 348 4. Analysis

349

350

351 The numeric independent variables (such as environmental attitudes, environmental  
352 concern or altruism) were standardized to have comparable coefficient estimates. For  
353 variables with answers *Yes* or *No* the baseline category are the *No* answers, which are  
354 therefore included in the intercept, and the estimated coefficient indicates the change in  
355 likelihood if this question was answered with *Yes*.  
356

357 All of the proposed independent variables are assumed to be correlated with the  
358 likelihood of using recycled or desalinated water and hence, might be used to predict this  
359 likelihood. Separate multivariate linear regression models were fitted for the two  
360 dependent variables. Variables which are specific to recycling water - such as experience  
361 with recycling water or the perception of recycled water - were only employed in the  
362 regression, using the likelihood to use recycled water as the dependent variable; the same  
363 approach was taken for desalinated water. Variable selection was made using stepwise  
364 forward selection by adding the variable with the smallest p-value and utilising the F-test  
365 to compare the model with this variable added against the model without this variable  
366 added. Candidates for terms which could be added in the model were all variables and all  
367 pair wise interactions between the variables already included in the model. The selection  
368 process was stopped when all p-values were larger than 0.05. Variables which are not

369 included in the final model therefore do not significantly increase the explained variance  
370 if added to the model. The final model is analysed with respect to: (1) the variables  
371 included; and (2) the estimated coefficients for each of the variables.

372

## 373 5. Results

374

375 The empirical distributions for both dependent variables are provided in Figure 1. Both  
376 dependent variables range from 10 to 1000, because each respondent provided responses  
377 for 10 items, each of which was assessed on a 100 point scale. Overall, public acceptance  
378 for desalinated water is higher, supporting the results of previous studies as discussed in  
379 Section 2.

380

381

382 [FIGURE 1 HERE]

383

384

### 385 5.1. *Explaining the Likelihood of Use of Recycled Water*

386

387 Results for recycled water are provided in Table 2. The table gives the parameter  
388 estimates together with the standard errors and the p-values of the corresponding *t*-tests.  
389 For numeric variables, negative estimates indicate that an increase in the variable leads to  
390 a decrease in the likelihood of using recycled water; for categorical variables, the  
391 likelihood of using recycled water is decreased compared to the base level of the variable  
392 which is accounted for in the intercept. The order of estimates is in the sequence each  
393 entered the model. The  $R^2$  value of 0.398 indicates that the model was able to account for  
394 a substantial amount of the variance. Nine factors hypothesized to increase the level of  
395 likelihood that respondents would use recycled water are significant: (1) previous  
396 experience with water restrictions; (2) not feeling limited by water restrictions; (3) greater  
397 knowledge about recycled water; (4) more positive perceptions of recycled water; (5) a  
398 high extent of other people influencing one's water-related behaviours; (6) pro-  
399 environmental attitudes; (7) older age (note that the underlying model is assuming a  
400 linear relationship, so the regression results indicate that higher age is associated  
401 significantly with a higher stated likelihood of using recycled water); (8) religion not  
402 being an important life factor; and (9) watching State (non-commercial) TV channels.  
403 This information contained in the Estimate column in Table 2 provides information about  
404 how sensitive the dependent variable (likelihood of use of recycled water) is to each of  
405 the factors in the regression model. This number is interpreted as follows: if the  
406 independent variable is increased by one unit the dependent variable increases with  
407 Estimate units, i.e., if the Estimate is negative the dependent variable decreases. The  
408 Standard Error indicates the precision of the Estimate, i.e, the 95% confidence interval  
409 for the estimate is approximately given by Estimate  $\pm 2$  Standard Error.

410

411 For ease of interpretation we also provide a graph with standardized estimates in Figure  
412 2. In this graph all factors that positively affect the likelihood of use plot to the right of  
413 the vertical axis and all factors with negative effects plot to the left. The length of each  
414 bar indicates the extent of the effect.

415

416 In addition to the individual effects, there are significant interaction effects between  
417 variables. Between two numeric variables this indicates that their combined effect is  
418 different from their separate effects. For example, the interaction effect between higher  
419 knowledge and the greater influence of others is negative, indicating that while these two  
420 variables separately have a positive effect on the likelihood of using recycled water, the  
421 effect levels off if both are increased. This observation also holds for the combination of  
422 more positive perception and the greater influence of others. For the combination of a  
423 numeric and a categorical variable, this can be interpreted as different slopes for the  
424 different levels of the categorical variable. The fitted model implies that the higher the  
425 influence of others, and the more positive the attitudes towards the environment, the  
426 better is the attitude towards recycled water. However, this effect is strongest for those  
427 who do not watch TV, followed by respondents preferring State TV channels.

428

429 The fact that not feeling limited by water restrictions increases the stated likelihood of  
430 using recycled water appears counter-intuitive at first. A proposed explanation is that  
431 people with higher pro-environmental attitudes have more understanding for the need for  
432 water restrictions and are therefore more tolerant of them. Consequently, this would lead  
433 them to express less frustration about water restrictions.

434

435 [TABLE 2 AND FIGURE 2 HERE]

436

437

## 438 *5.2. Explaining the Likelihood of Use of Desalinated Water*

439

440 Results for desalinated water are presented in Table 3 and in Figure 3. The number of  
441 variables contributing significantly to the stated likelihood of using desalinated water  
442 across a range of household uses is higher than it is for recycled water, with ten  
443 explanatory variables being significant. The explained variance of the model, which is  
444 equal to 31.2%, is slightly lower than that for the recycled water model.

445

446 The overlap between the results for recycled water and desalinated water is great, with  
447 eight explanatory variables having the same significant influence for the likelihood of  
448 using either water source. Watching TV is the only explanatory variable which is  
449 significant for the likelihood of using recycled water, but not significant for desalinated  
450 water use.

451

452 Additional variables which significantly influence the likelihood of using desalinated  
453 water are the previous use of desalinated water and the respondent's attitude towards  
454 conservation, where previous use and the higher valuation of conservation both increase  
455 the likelihood of use. The interaction effects of two numeric variables compensating their  
456 effect is observed for positive perception and attitude towards conservation, positive  
457 perception and the influence of others, knowledge and attitude towards conservation, as  
458 well as for environmental attitudes and age. By contrast, for age and the influence of  
459 others, the combined effect is even more emphasized. The influence of positive attitudes  
460 towards the environment on the likelihood of using desalinated water is smaller for

461 respondents who have previously used desalinated water and who have experienced  
462 water restrictions in the past. Furthermore, the influence of positive perceptions of  
463 desalinated water is enforced if respondents perceive themselves as limited by water  
464 restrictions. Religion only impacts on the use of desalinated water if respondents have  
465 used this type of water before.

466  
467 One possible explanation for the finding that positive environmental attitudes increase the  
468 likelihood of using desalinated water, is that the knowledge level about desalination  
469 within the Australian population is relatively low (Dolnicar & Hurlimann, 2009). The  
470 environmental disadvantages of water desalination are not commonly understood, which  
471 may lead to (uninformed) support for desalinated water from people generally concerned  
472 about the environment. If people have previous experience with the use of desalinated  
473 water they are likely to know more about the negative environmental impacts of  
474 desalination and therefore become more reluctant to embrace it. These findings and  
475 explanation are in line with previous findings that people opposed to desalinated water  
476 are often opposed for environmental reasons (Dolnicar & Schäfer, 2009).

477

478

479 [TABLE 3 AND FIGURE 3 HERE]

480

481

## 482 6. Discussion and Conclusions

483

484 The following key findings emerged from the study: First, some of the factors identified  
485 previously as being associated with higher levels of public acceptance of recycled water  
486 (e.g., gender and education) do not appear to be the main drivers, but may possibly be  
487 correlated with them. Our results provide support for previous research which has found  
488 favourable attitudes to recycled water use from:

489 (1) older respondents (Hurlimann, 2007a; and Dolnicar & Schäfer, 2009); and

490 (2) knowledge (Lohman & Milliken, 1985; Flack & Greenberg, 1987; Jeffrey &  
491 Jefferson, 2003; Tsagarakis & Georgantzis, 2003; and Hurlimann, Hemphill, McKay &  
492 Geursen, 2008).

493 Our results also provide evidence for the impact of environmental attitudes, positive  
494 perceptions of recycled water, the influence of other people, religion, experience of water  
495 restrictions, the perception of being limited by water restrictions, and watching State TV  
496 channels, on the stated likelihood of using recycled water. We believe that the predictive  
497 value of watching State TV may be due to the fact that State TV (non-commercial)  
498 channels have a number of current affairs programs and news shows which provide in-  
499 depth analyses on the topics covered. With respect to recycled water, for example, they  
500 not only discuss people's fear of health risks, they also provide information about the  
501 environmental advantages of recycled water. We think that it is this additional insight  
502 which is associated with the increased stated likelihood of use.

503 Second, drivers of the stated likelihood of using desalinated water were found to be  
504 similar to those for recycled water. Only watching State TV channels did not emerge as

505 an influential factor. In addition, respondents who have previously used desalinated water  
506 and who indicated a positive attitude towards conservation, were reportedly more likely  
507 to use desalinated water than those who have not. The fact that people in Australia know  
508 relatively little about desalinated water and how it is produced seems to work in favour of  
509 acceptance because the negative environmental effects are not commonly known. But the  
510 perception in terms of public health is more positive than for recycled water (for  
511 example, 38% perceive recycled water as “disgusting” but only 25% perceive desalinated  
512 water as such; 48% perceive recycled water as not tasting good, whereas only 41% feel  
513 the same way towards desalinated water).

514

515 These findings have significant practical implications, particularly for public campaigns  
516 designed to promote the use of desalinated and/or recycled water. Too much information  
517 regarding desalinated water may have the effect of decreasing public acceptance due to  
518 the environmental concerns usage might raise. In the case of recycled water it is likely  
519 that public campaigns will potentially increase public acceptance and usage since public  
520 perceptions play a major role in acceptance.

521

522 Key drivers for the acceptance of both water sources are the possession of positive  
523 perceptions about alternative water sources, and the extent to which other people might  
524 influence a person’s decisions about alternative water sources. Positive messages about  
525 recycled and/or desalinated water, particularly from personal communication channels  
526 such as family, friends and colleagues, are important to the uptake of these water sources.  
527 Since knowledge was a significant influencing factor for both water sources, it follows  
528 that public information and marketing have a major contribution to make in the context of  
529 introducing water from alternative sources. Marketing strategies that make water from  
530 alternative sources a positive conversation topic may be particularly valuable.

531

532 Finally, previous experience with water restrictions, in addition to previous experience  
533 with these water sources, evidently increases the likelihood of use. Again, this is key  
534 information for public policy makers as it informs the nature of the communication  
535 message that is likely to be effective. In this particular instance it has to be concluded that  
536 messages emphasizing the real problem of water scarcity, maybe showing examples of  
537 current water scarcity in the near geographical proximity of where people live, will have  
538 a higher likelihood of positively impacting acceptance.

539 These findings have important practical implications as they provide guidance to water  
540 providers and public policy makers about interventions that are likely to increase public  
541 acceptance of water augmentation projects, especially information and communication  
542 campaigns:

- 543 1. It is essential that people understand that water from alternative sources is not an  
544 option, but a necessity; and
- 545 2. Suggesting non-threatening ways for people to be able to experience recycled and  
546 desalinated water may be a useful strategy to increase public acceptance and  
547 usage. Non-threatening ways include voluntary opportunities, such as tasting  
548 recycled and desalinated water, filling public swimming pools with recycled and  
549 desalinated water. These techniques are likely to be far more effective than public

550 announcements stating that recycled or desalinated water would be added to water  
551 supplied to households. Such announcements have proven to be very threatening  
552 and have resulted in public rejection of water augmentation schemes in the past  
553 (Hurlimann & Dolnicar, 2010).

554 The above findings support a barely enacted recommendation made more than three  
555 decades ago by Baumann and Kasperson (1974), namely, to “put the reclaimed water in  
556 an attractive setting and invite the public to look at it, sniff it, picnic around it, fish in it,  
557 and swim in it” (p. 670).

558 This study is limited in three ways, providing opportunities for future researchers to  
559 further extend our understanding of why the public rejects or accepts water from  
560 alternative sources. First, this study was conducted in Australia only. Although it could  
561 be argued that the drivers for resisting acceptance are universal, there is some evidence  
562 that critical events in the history of certain Australian locations - such as the Toowoomba  
563 referendum - are likely to have an impact on results. Secondly, this study did not include  
564 a comprehensive list of every factor that can be expected to effect people’s acceptance of  
565 water from alternative sources. In future work it would be valuable to include measures  
566 for trust, risk perception, health concerns, or perceptions of quality, and include those  
567 into the model as independent variables. Finally, respondents were not asked about  
568 frequency or volume of water use for different purposes, which could be used to assess  
569 the extent to which dam water could easily be substituted with water from augmented  
570 sources without raising public health or environmental concerns among the population.  
571 Such a study, or studies, would be of great value in future, especially in countries which  
572 do not currently use water from augmented sources and where, as a consequence, the  
573 population may be reluctant to accept large scale water augmentation projects.

574  
575

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577

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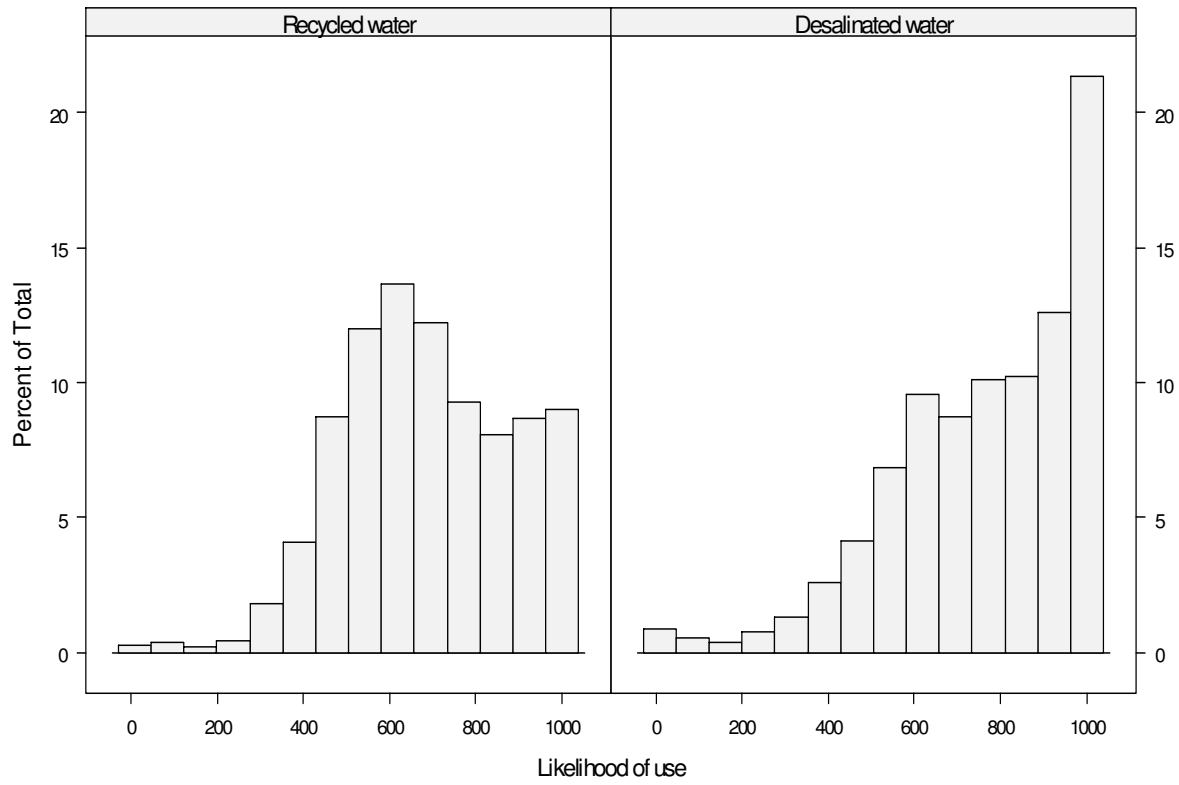
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*Table 1: Factors found to influence community acceptance of recycled water*

<b>Factor positively influencing attitudes to recycled water</b>	<b>Study</b>
Attitudes and experiences	
Trust in authorities associated with recycled water use	Lohman and Milliken (1985) Jeffrey and Jefferson (2003) Hurlimann and McKay (2004) Po et al. (2005) Hurlimann (2007b) Hurlimann (2007c)
Knowledge / Information	Lohman and Milliken (1985) Flack and Greenberg (1987) Jeffrey and Jefferson (2003) Tsagarakis and Georgantzis (2003) Hurlimann et al. (2008)
Risk perception (negative)	Po et al. (2005) Hurlimann (2008) Hurlimann et al. (2008)
Past experience with alternative water source	Sims and Baumann (1974) Olson et al. (1979) Lohman and Milliken (1985) Flack and Greenberg (1987) Dishman et al. (1989) Hurlimann (2007a)
Health concern (negative)	Olson et al. (1979) Dishman et al. (1989) Marks et al. (2006) Baggett et al. (2006)
Perception of good water quality	Higgins et al. (2002) Po et al. (2005) Baggett et al. (2006) Hurlimann et al. (2008)
Demographic variables	
Age – older  Age – younger	Hurlimann (2007a) Dolnicar and Schäfer (2009) Stone and Kahle (1974) Lohman and Milliken (1985) McKay and Hurlimann (2003)
Gender – being male	Baumann and Kasperson (1974) Lohman and Milliken (1985) Tsagarakis et al. (2007) Hurlimann (2007a) Nancarrow et al. (2008) Dolnicar and Schäfer (2009)
Education level – having a higher education degree	Bruvold (1972) Stone and Kahle (1974) Flack and Greenberg (1987) Lohman and Milliken (1985) Alhumoud et al. (2003) Menegaki et al. (2006) Hurlimann (2007a) Dolnicar and Schäfer (2009) Robinson et al. (2005)

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Figure 1: Empirical distribution of the dependent variables  
(Stated likelihood of using recycled / desalinated water)



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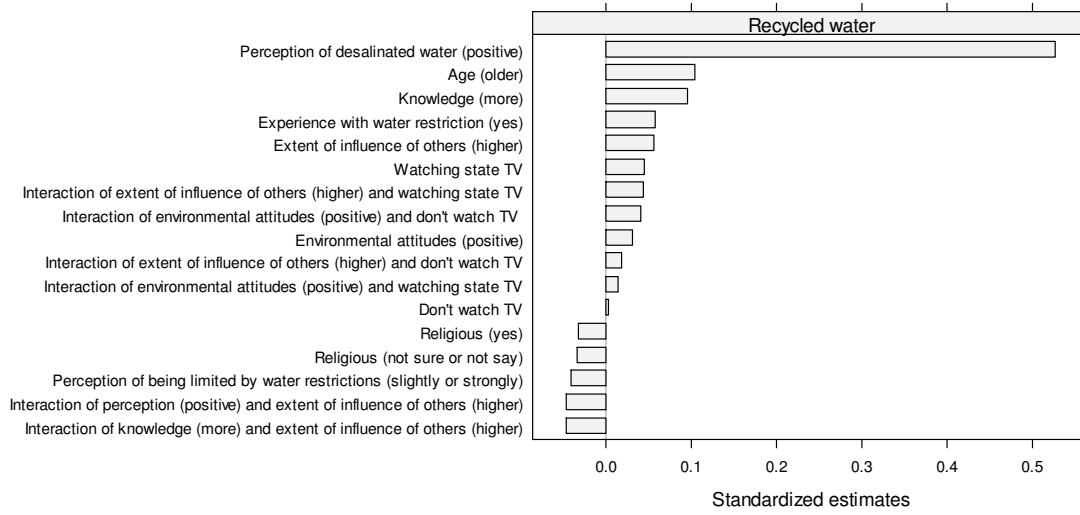
*Table 2: Regression Coefficients – Recycled water*

	Estimate	Std. Error	P-value
Intercept	666.81	10.53	< 0.001
Perception of recycled water (positive)	102.05	3.07	< 0.001
Knowledge (more)	18.57	3.06	< 0.001
Age (older)	20.13	3.11	< 0.001
Extent of influence of others (higher)	10.90	3.54	0.002
Environmental attitudes (positive)	5.89	3.53	0.095
Experience with water restriction			
– Yes	39.22	11.85	< 0.001
Feeling limited by water restrictions			
– Slightly or strongly	-17.18	7.24	0.018
TV (commercial)			
– State	20.22	7.25	0.005
– Don't watch	5.18	29.98	0.863
Religious			
– Yes	-14.48	6.88	0.035
– Not sure or not say	-17.53	8.13	0.031
Interactions			
Knowledge (more) : Extent of influence of others (higher)	-8.28	2.84	0.004
Perception (positive) : Extent of influence of others (higher)	-9.00	3.12	0.004
Extent of influence of others (higher) : TV (Commercial)			
– State	17.86	7.20	0.013
– Don't watch	36.43	32.53	0.263
Environmental attitudes (positive) : TV (commercial)			
– State	5.25	6.89	0.447
– Don't watch	61.92	24.06	0.010

734  $R^2 = 0.398$

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Figure 2: Standardized Regression Coefficients for Recycled Water



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*Table 3: Regression Coefficients – Desalinated water*

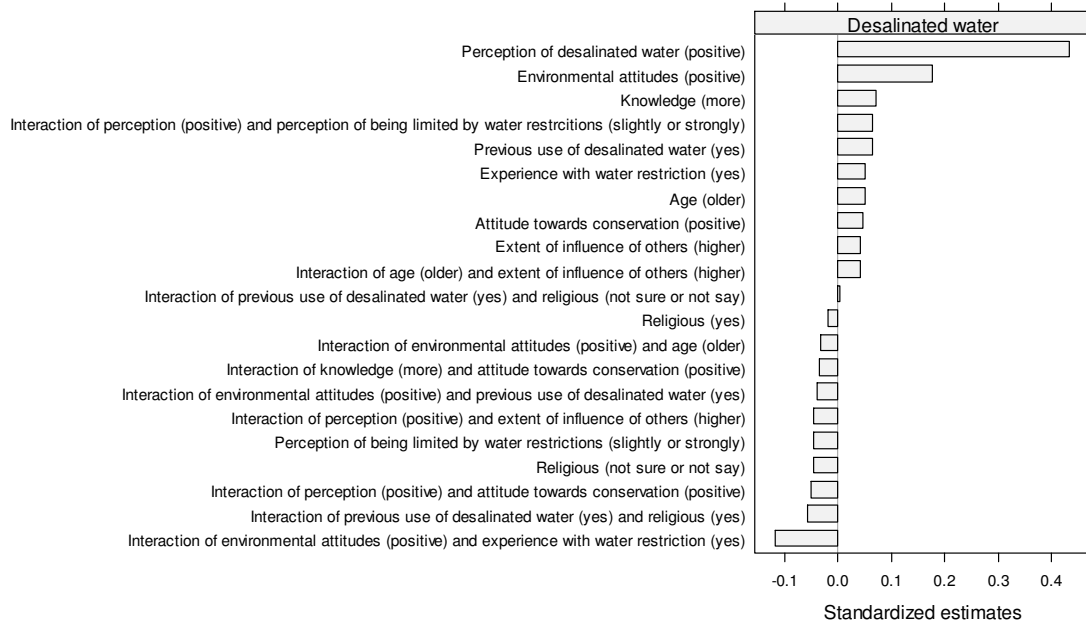
	Estimate	Std. Error	P-value
Intercept	752.39	12.55	< 0.001
Perception of desalinated water (positive)	92.87	6.68	< 0.001
Knowledge (more)	15.18	3.53	< 0.001
Attitude towards conservation (positive)	9.89	3.80	0.009
Environmental attitudes (positive)	38.09	12.07	0.002
Previous use of desalinated water			
– Yes	38.67	13.12	0.003
Age (older)	10.81	3.70	0.004
Religious			
– Yes	-8.60	8.72	0.324
– Not sure or not say	-26.54	10.29	0.010
Extent of influence of others (higher)	9.29	3.67	0.012
Experience with water restriction			
– Yes	38.85	14.08	0.006
Feeling limited by water restrictions			
– Slightly or strongly	-21.07	8.50	0.013
Interactions			
Perception (positive) : Attitude towards conservation (positive)	-10.77	3.51	0.002
Perception (positive) : Extent of influence of others (higher)	-9.09	3.40	0.008
Knowledge (more) : Attitude towards conservation (positive)	-7.19	3.37	0.033
Age (older) : Extent of influence of others (higher)	9.33	3.66	0.011
Environmental attitudes (positive) : Age (older)	-7.02	3.56	0.049
Previous use of desalinated water (yes) : Religious			
– Yes	-60.88	22.60	0.007
– Not sure or not say	4.56	27.23	0.867
Environmental attitudes (positive) : Previous use of desalinated water (yes)	-21.24	9.51	0.026
Environmental attitudes (positive) : Experience with water restrictions (yes)	-26.61	12.49	0.033
Perception (positive): Feeling limited by water restrictions (slightly or strongly)	16.28	7.71	0.035

742  $R^2 = 0.312$



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Figure 3: Standardized Regression Coefficients for Desalinated Water



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