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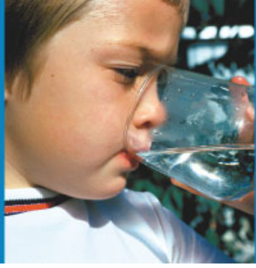

Water for a Healthy Country

Interpreting Householder Preferences to Evaluate Water Supply Systems

Stage 3

Zoe Leviston, Natasha B. Porter, Blair E. Nancarrow

CSIRO

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Executive Summary

This reports the results of Stage 3 in the development and investigation of an attitudinal model designed to measure perceived acceptability of a given water supply system and to understand the factors that govern the acceptability decision.

Concurrent with the growing need for Australian cities to boost their present water reserves, the community has displayed increasing interest in proposed sources of supplementary water supply. Public attitude has ranged from enthusiasm to concern, and in some cases unease has led to the rejection of a potential new water supply. While it is understood that the success of new supply systems is dependent on incorporating householder preferences and improving understanding within our communities, no research to date has attempted to examine acceptance of a new water supply system in a truly holistic manner.

This research program aimed to develop a model of community acceptance that is robust and consistent over different scales, source-points, end-uses and users of water supply systems. Further, for the model to be a valuable tool for decision-makers, a worthwhile amount of the variance in users' acceptability ratings would have to be accounted for by a relatively small number of factors.

In this report, a pre-refined model of community acceptance, incorporating a range of psycho-sociological variables, is tested using scenarios outlining three different potential water supply systems for the future at different scales. Three sample populations, taken from the metropolitan populations of Sydney, Brisbane and Melbourne respectively, were each administered a scenario, chosen on the basis of probable future water augmentation options for that city.

The scenario tested on the Sydney sample population concerned a 10-storey residential building with an onsite wastewater treatment plant. This system, under the general management of the body corporate, piped treated wastewater back to building residents for use on domestic garden areas and for toilet flushing. The scenario system tested on the Brisbane sample population captured stormwater from roofs in a 200-home neighbourhood, treated it and returned it to the regular water supply system. In this case the system was managed by Brisbane Water. The scenario system tested on the Melbourne sample population took wastewater from sewerage pipes and treated it at neighbourhood-level, privately run treatment plants. Treated water was pumped back in a separate pipe for use in domestic garden areas, for toilet flushing, and for local irrigation and industrial use.

The results of the study confirmed the model developed through previous stages of testing, with the predictor variables of risk, fairness, subjective assessment of the supply system, and perceived outcomes of the supply system all having strong relationships with acceptance of the supply system. Trust was also an important component through its relationship with risk. The model outputs for the three scenarios were extremely strong in their predictive power, predicting 63% of the variance in acceptability in the Sydney scenario, 78% in Brisbane and 68% in Melbourne.

Sydney respondents rated the acceptability of their scenario significantly higher than did Brisbane and Melbourne respondents. Sydney and Melbourne tended to rate cognitive outcomes such as responsibility and longevity more highly than Brisbane, while Brisbane rated emotive outcomes like the pleasantness and the cleanliness of the system more highly. Public versus private arrangements had significant effects on acceptability ratings, suggesting that the role of public agencies in the management of supply systems is critical.

The stability of the model in this phase of the research program supports the notion that a holistic measurement of people's acceptance can be used to assess alternative water supply systems at a variety of scales, and has the capacity to inform how best to tailor community acceptance strategies to a specific water supply system under proposal.

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1.0 INTRODUCTION

As current water supply systems in Australia come increasingly under stress, the need for supplementing supplies is at the forefront of Australian water utility planning and community expectations. In the past, the introduction and implementation of traditional water supply systems and source augmentation have been accompanied with little or no community involvement. Typically, water managers have assumed that supplementary supplies would be accepted by consumers due to demands for more water. Recently, however, the community has displayed increasing interest in proposed sources and has expressed concerns over the choice of some, and even rejected potential new supplies (Po *et al.* 2004).

While it is understood that the success of new technologies is dependent on incorporating householder preferences and improving understanding within our communities, no research to date has attempted to examine acceptance of a new water supply system in a holistic manner. The current study builds on the development of an attitudinal model designed to understand what factors are important to people when deciding whether a given water supply system is acceptable to them.

This report is concerned with the current stage of an ongoing research program that commenced in early 2004. In the initial stage of the program, a hypothetical attitudinal model was constructed based on what was known about community preferences in relation to water services. Figure 1 below outlines the hypothesised variables and their interrelationships.

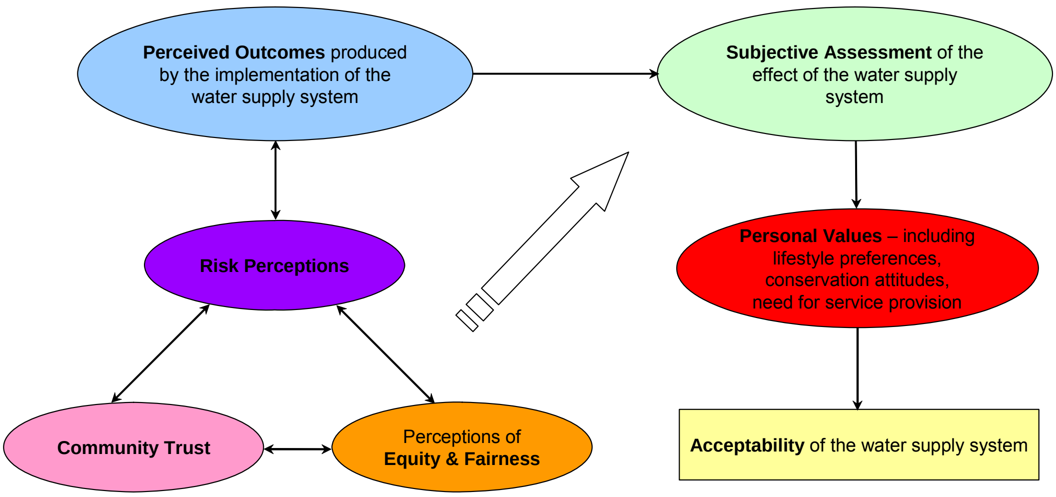

Figure 1. A hypothesised model of community acceptability of an urban water supply system

The variables in Figure 1 can be summarised as follows.

- **Community Trust.** Trust in the authorities to reliably provide good, safe and well-managed water.
- **Perceptions of Equity and Fairness.** Perceptions of fairness to specific groups of users as well as the overall fairness of the water supply system.
- **Risk Perception.** Perceptions of risks posed by the water supply system to self, family, city and the environment.
- **Perceived Outcomes.** Cognitive perceptions of outcomes relating to the sustainability, longevity, responsibility, certainty and appeal of the water supply system.
- **Subjective Assessment.** A weighted judgement of the overall risks of the water supply system versus its benefits.

- **Personal Values.** Values that relate to water consumption and attitudes to water, including lifestyle preferences, conservation attitudes, intergenerational equity, levels of service and garden recreation.
- **Acceptability.** A rating of the overall acceptability of the water supply system.

Prior to testing a focus group was held to better understand the community's outcome variables associated with a variety of water supply systems and to test some of the variable measures. The results of the focus group provided the basis for a survey questionnaire – designed to test the model.

1.1 Preliminary Assessment of the Model

The preliminary assessment of the model comprised two community surveys of householders in the Perth metropolitan area using two hypothetical future water supply systems: the recycling of treated wastewater (including toilet water) at the neighbourhood scale for use on domestic gardens and local parks; and drawing more water from the Yarragadee Aquifer in the south-west area of Western Australia to augment the Perth metropolitan water supply. Two different water supply systems were used to test whether the model was consistent over systems of varying nature.

Path analytic modelling was used to explore how well the hypothesised model fit with the collected data. The results are shown in Figure 2.

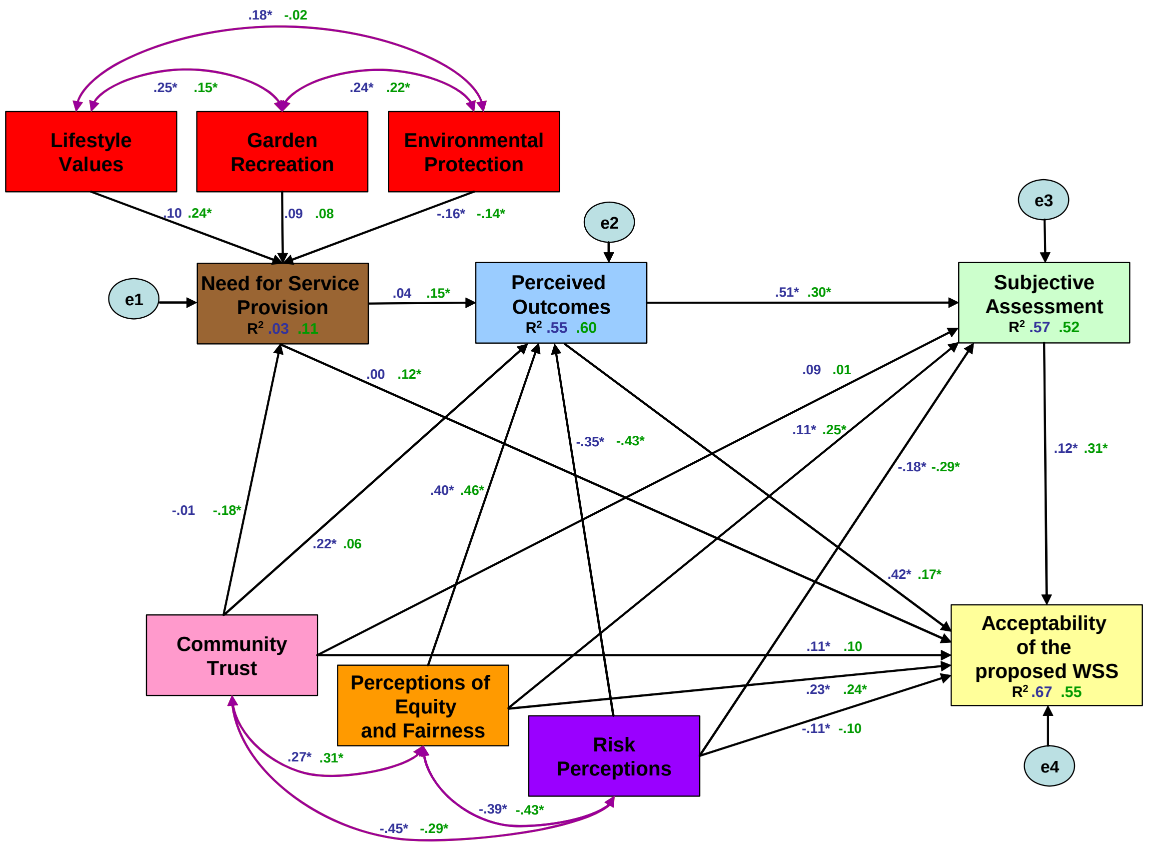

Figure 2. Model of community acceptability of an urban water supply system after preliminary assessment (Coefficients: Reuse Survey – Blue; Yarragadee Survey – Green; * indicates a significant relationship)

This preliminary investigation supported the inclusion of most of the hypothesised variables and causal relationships, and suggested a number of additional relationships. Personal values did not play as central a role as anticipated – of particular note is that, while the need for service provision impacted acceptability of the water supply system directly, its contribution was small and not critical to the predictive power of the model. Also, while the structure of the model was consistent between scenarios, the relationships between some of the key variables were indeed of different strengths, suggesting that the nature (ie. water source, treatment style and distribution) of the supply system may influence what is most important to people when deciding to accept or reject it (see Porter *et al.* 2005 for full details).

1.2 Secondary Assessment of the Model

Further testing of the model was conducted on the current Melbourne water supply system (Porter *et al.* 2005). The aim here was to test the consistency of the model over immediacy and familiarity – that is, to ascertain whether the same concepts were as important for informing acceptability for a water supply system that the individual was presently experiencing. A telephone survey was administered to 450 Melbourne householders using a questionnaire that had been refined in response to the preliminary assessment stage. Structural equation modelling[1] was used to explore the relationships between the variables. The results of this analysis can be seen in Figure 3 below.

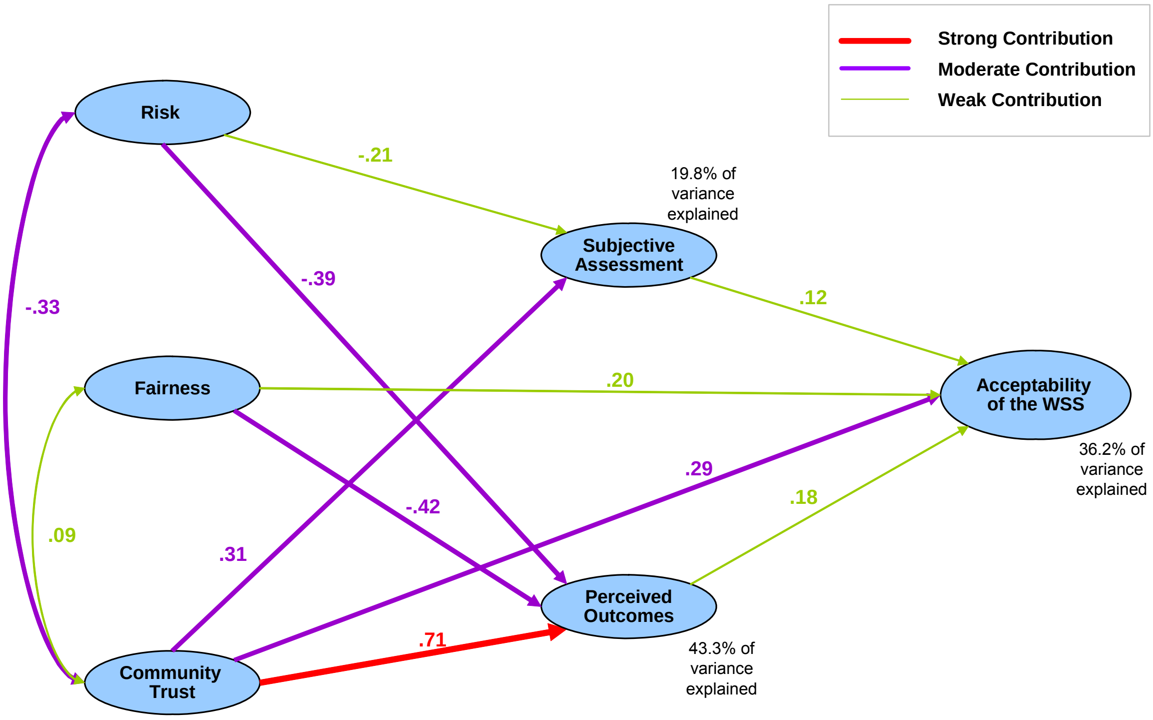

Figure 3. Current Melbourne water supply model

The final model for the Melbourne case study contained the majority of the initial variables. The main difference between this model and the one from the previous research stage (Figure 2) was the absence of the personal values and the need for service provision components. There are also differences in the strengths of some of the relationships, and in some cases their direction. For a detailed discussion see Porter *et al*. (2005).

[1] Structural equation modelling is a more sophisticated form of path analysis, as it allows for both latent and observed variables to be represented.

1.3 The Current Study

Three scenarios outlining three potential water supply systems for the future were developed for the current stage of model testing (Table 1).

These three scenarios were chosen, firstly, because they deal with smaller 'scales' of water supply systems than previous stages of the research (ie. one scenario is at the building envelope scale, while the other two scenarios are at a neighbourhood scale). Secondly, each scenario represents a realistic and probable future water augmentation option for their given cities, hence maximising the relevance of data on community acceptance levels to decision-making agencies.

The purpose then of the current stage of testing can be summarised as follows:

- to test the robustness and consistency of the model over different scales of water supply systems;
- to determine how much variance in acceptability ratings can be explained by the models' variables; and
- to establish community attitudes and acceptance levels in regards to the three scenarios tested.

Table 1 summarises the three water supply system scenarios used for the current stage of model testing.

Table 1. Summary of the three water supply system scenarios

Scenario Description	Testing Area	System Scale
"Sydney" scenario: The Sydney scenario concerned a 10-storey residential building. Wastewater created by the residents was piped to the basement where a treatment plant treated the wastewater on-site. The treated water was piped back, in a separate pipe, for use on the domestic garden areas surrounding the building and for toilet flushing. The day-to-day management of the system was the responsibility of the Body Corporate, who would contract a private company to operate and maintain the basement treatment plant and pipes.	Sydney Metropolitan	Building
"Brisbane" scenario: The Brisbane scenario involved capturing stormwater from all roofs in a 200-home neighbourhood, treating it and returning it to the regular water supply system. The system was managed by Brisbane Water.	Brisbane Metropolitan	Neighbourhood
"Melbourne" scenario: The Melbourne scenario involved taking wastewater from sewerage pipes and treating it at neighbourhood treatment plants - each plant treating the waste of roughly 200 homes. Once treated, the water was pumped back in a separate pipe for use in domestic garden areas, for toilet flushing, for the irrigation of surrounding public open space and for any industrial use as may be applicable. The system was managed by a private company.	Melbourne Metropolitan	Neighbourhood

2.0 METHODOLOGY

2.1 Experimental Design

Data was collected by means of three community surveys, conducted by telephone with householders in the metropolitan areas of Sydney, Brisbane and Melbourne. A sample size of 400 for each of the three questionnaires was required to enable structural equation modelling to be used for analysis.

2.2. Study Areas and Respondents

Suburbs in each of the three cities were stratified socio-economically (lower, medium and higher) based on average weekly family income figures.[2] For each city, ten suburbs were randomly selected from each of the lower and higher socio-economic groups and twenty suburbs were selected from the medium socio-economic group.

Tables 2 to 4 list the suburbs selected for each city under their corresponding socio-economic group.

Table 2. Sydney suburbs for each socio-economic category

Lower Socio-Economic	Medium Socio-Economic		Higher Socio-Economic
Bankstown	Bondi	Harbord	Baulkham Hills
Condell Park	Brookvale	Kirrawee	Bronte
Ermington	Carlingford	Leichhardt	Darlinghurst
Fairfield West	Cronulla	Macquarie Park	Drummoyne
Granville	Engadine	St Andrews	Grays Point
Macquarie Fields	Enmore	Stanhope Gardens	Northbridge
Pendle Hill	Epping	Ultimo	Paddington
Penrith	Erskine Park	Wareemba	Queens Park
St Marys	Five Dock	Werrington County	Roseville Chase
South Granville	Greystanes	Woodcroft	Seaforth

Table 3. Brisbane suburbs for each socio-economic category

Lower Socio-Economic	Medium Socio-Economic		Higher Socio-Economic
Annerley	Alderley	Marsden	Bardon
Brighton	Banyo	New Farm	Grange
Deagon	Camp Hill	Oxley	Jindalee
Durack	Carina	Red Hill	Middle Park
Inala	Corinda	Robertson	Newstead
Loganlea	Eight Mile Plain	Sherwood	Paddington
Mount Gravatt	Holland Park	St Lucia	Shailer Park
Rocklea	Holland Park West	Toowong	Westlake
Sandgate	Jamboree Heights	Wavell Heights	Wilston
Stafford	Kedron	Yeerongpilly	Wishart

[2] Source: Australian Bureau of Statistics, 2001 Census

Table 4. Melbourne suburbs for each socio-economic category

Lower Socio-Economic	Medium Socio-Economic		Higher Socio-Economic
Baxter	Balwyn	Keilor Downs	Albert Park
Broadmeadows	Belgrave South	Knoxfield	Brighton
Epping	Blackburn	Mont Albert North	Camberwell
Heidelberg Heights	Briar Hill	Narre Warren North	Canterbury
Jacana	Dingley Village	Northcote	Docklands
Oakleigh South	Fitzroy North	Notting Hill	Glen Iris
Seddon	Frankston South	Point Cook	Hawthorn East
Sunshine	Heathmont	Rowville	Malvern East
Wandin North	Hillside	Warrandyte	Port Melbourne
Werribee	Kallista	Williamstown	Surrey Hills

Respondents were randomly selected from the suburbs listed above. A sample of ten respondents from separate households aged eighteen years or over was required from each suburb. An effort was made to recruit an equal number of males and females. Interviewers were instructed to call each household a minimum of five times (at different times of the day and on different days) before they could dismiss it as a "no contact" household.

A total of 1205 respondents were recruited. Tables 5 and 6 below provide a summary of respondent composition.

Table 5. Number of respondents surveyed in each socio-economic area by city

	Sydney	Brisbane	Melbourne
Lower	101	102	100
Medium	201	201	201
Higher	100	99	100
TOTAL	*402*	*402*	*401*

Table 6. Number of respondents surveyed in each city by gender

	Sydney	Brisbane	Melbourne
Female	206	204	205
Male	196	198	196
TOTAL	*402*	*402*	*401*

2.3. Refusal Rates

The collective refusal rate for the three questionnaires was 65%. This comprised a refusal rate of 72% for Sydney, 61% for Brisbane and 67% for Melbourne. The table below provides a summary of refusals.

Table 7. Refusal details

Reason	Sydney	Brisbane	Melbourne
Too Busy	289	197	287
Not Interested	239	217	283
Limited English	136	55	121
Hung Up	72	70	55
Elderly	61	55	52
Unwell	25	23	13
TOTAL	*822*	*617*	*811*

2.4. The Questionnaire

The questionnaire consisted of items designed to measure each of the variables contained in the model outlined in Figure 3. Additional items measuring the concepts of environmental obligation and intergenerational equity were included, as results from the previous stage of research suggested that the concepts of long-term sustainability and fairness to future generations were central to people's outcome evaluations of the system. Affect-based outcomes were also included, to investigate whether emotional considerations (such as revulsion and disgust) played an important role in evaluation. Items measuring garden recreation were again included, as although not present in the model tested on a current water supply system, it had performed well in the preliminary assessment, where one of the scenarios involved reuse. Hence it was considered that the importance of garden recreation could be system specific.

Before the questionnaire was undertaken, the respondent was given an overview of the water supply system scenario. This overview outlined the sources of the water, the treatment processes involved and who would be responsible for the management of the system (this information is included as Appendices 1, 2 and 3, along with the additional information [Appendix 4] provided to the interviewers to assist with questions respondents may have asked).

3.0 RESULTS

Preliminary analyses were undertaken using correlation, analysis of variance (ANOVA), factor analysis and reliability analysis. Preliminary testing was followed by investigation of the causal relationships between the components of the model using the robust maximum likelihood estimation method in LISREL 8.72 (Joreskorg et al., 2000).

For the preliminary analyses, a significance level of $p < .01$ was applied. Differences referred to as "significant" in the results section refer to *statistical* significance. The number of respondents answering a question is denoted as "n" and/or as a percentage of the whole sample. For open-ended questions, up to three answers were recorded for each case (where a respondent was deemed to have stated multiple concepts).

The results are presented as three sections, in accordance with the three different water supply system scenarios tested. For ease of reference, the scenarios are referred to by their testing population (Sydney, Brisbane and Melbourne). Each of these sections consists of two parts: the Preliminary Analysis, which details the frequencies of each questionnaire item, significant differences between related items, and the construction and reliability of measurement scales; and the Structural Equation Modelling, which details the testing of the model using the relevant water supply system scenario.

3.1. Sydney

The scenario used on Sydney residents concerned a 10-storey residential building. Wastewater created by the residents was piped to the basement where a treatment plant treated the wastewater on-site. The treated water was piped back, in a separate pipe, for use on the domestic garden areas surrounding the building and for toilet flushing. The day-to-day management of the system was the responsibility of the Body Corporate, who would contract a private company to operate and maintain the basement treatment plant and pipes (see Appendix 1 for full details).

3.1.1 Preliminary Analysis

Perceived Outcomes

Respondents were asked a number of questions regarding potential outcomes of the proposed water supply system. A series of semantic differential scales was presented to respondents. Each scale consisted of an outcome differential (eg "Irresponsible / Responsible") which respondents were asked to rate using a seven-point scale. Higher numbers indicated more positive associations with the water supply system.

This section consisted of two components – a 'cognitive' component, devised as a result of focus group discussions in previous stages of research; and an 'affective' or emotional component. The cognitive component was designed to measure respondents' *beliefs* about the water supply system, while the affective component was concerned with respondents' *feelings* about the water supply system. While both components were recorded for the purposes of the preliminary analysis, only the cognitive component was used for the model (as discussed in the Section 3.1.2.).

Table 8. Respondents' outcome ratings of the water supply system

Component	Statement	Mean
Cognitive	**Responsibility** (n=402)	6.31
	Longevity (n=400)	6.06
	Sustainability (n=402)	5.98
	Certainty (n=401)	5.70
	Reliability (n=402)	5.65
Affective	**Okay-ness** (n=401)	5.91
	Healthiness (n=401)	5.71
	Safeness (n=402)	5.70
	Pleasantness (n=401)	5.69
	Cleanliness (n=402)	5.68

For the cognitive component, respondents rated *Responsibility* significantly higher than all other outcomes. *Certainty* and *Reliability* were rated significantly lower than other outcomes. For the affective component, respondents rated *Okay-ness* significantly higher than all other outcomes.

Risks and Benefits

Respondents were asked to rate, on a five-point scale, the possible risks posed by the water supply system to themselves, their families, the environment and the neighbourhood.

Table 9. Respondents' ratings of risks associated with the water supply system

	1 No risk at all (%)	2 (%)	3 Some risk (%)	4 (%)	5 Extreme risk (%)	Mean
To family (n=401)	28.7	23.2	38.8	6.0	3.5	**2.32**
Personally (n=402)	29.9	23.6	38.3	4.5	3.7	**2.29**
To neighbourhood (n=402)	46.5	25.4	20.9	3.5	3.7	**1.93**
To environment (n=402)	52.2	24.6	15.7	3.5	4.0	**1.82**

Risk personally and risk to family were rated as significantly greater than risk to the environment or neighbourhood. Risk to the environment was rated significantly lower than all other risk.

Respondents were then asked to rate the possible benefits posed by the water supply system.

Table 10. Respondents' ratings of benefits associated with the water supply system

	1 No benefit at all (%)	2 (%)	3 Some benefit (%)	4 (%)	5 Great benefit (%)	Mean
To environment (n=402)	1.7	2.5	14.7	17.7	63.4	**4.38**
To neighbourhood (n=402)	4.0	2.5	17.4	18.2	57.9	**4.24**
Personally (n=402)	5.5	2.5	24.6	16.4	51.0	**4.05**
To family (n=401)	5.2	3.5	24.2	16.5	50.6	**4.04**

Respondents rated the benefits to the environment significantly higher than to the other groups, while benefits personally and to family were rated significantly lower than the others.

Possibility of Something Going Wrong

Respondents were asked to rate the likelihood of something going wrong with the water supply system. Responses can be seen in the table below.

Table 11. Respondents' rating of the likelihood of something going wrong

Option	n (402)	%
1 - Not at all likely	43	10.7
2	107	26.6
3 - Neither	146	36.3
4	72	17.9
5 - Extremely likely	34	8.5
Mean = 2.87		

On average, respondents thought the possibility of something going wrong with the water supply system was neither likely nor unlikely.

Respondents were then asked how serious they thought it would be if something went wrong, and what level of control they thought the Body Corporate would have to stop something from going wrong with the water supply system. Responses can be seen in Tables 12 and 13.

Table 12. Respondents' rating of how serious something going wrong would be

Option	n (402)	%
1 - Not at all serious	63	15.7
2	75	18.7
3 - Neither	122	30.3
4	56	13.9
5 - Extremely serious	86	21.4
Mean = 3.07		

As can be seen in the table above, respondents on average thought that the seriousness of something going wrong would be neither serious nor not serious.

Table 13. Respondents' rating of how much control the Body Corporate would have over stopping something going wrong

Option	n (402)	%
1 - High level of control	111	27.6
2	50	12.4
3 - Some control	160	39.8
4	42	10.4
5 - No control at all	39	9.7
Mean = 2.62		

Just under 40% of respondents thought that the Body Corporate would have *some control* over something going wrong, while a further 28% thought that they would have a *high level of control*.

Perceived Expert Knowledge

Respondents were asked to rate on a five-point scale how much they thought the 'experts' (eg. scientists, water utilities) knew about issues associated with the water supply system.

Table 14. Respondents' rating of *experts'* knowledge of the water supply system

Option	n (402)	%
1 - No knowledge at all	13	3.2
2	11	2.7
3 - Some knowledge	87	21.6
4	71	17.7
5 - High level of knowledge	220	54.7
Mean = 4.18		

More than half the respondents (54.7%) thought that the 'experts' would have a *high level of knowledge* about the water supply system.

Subjective Assessment

After considering the previous questions concerning the potential benefits and risks of the proposed water supply system, respondents were asked whether they thought the benefits of the water supply system outweighed the problems, or the problems outweighed the benefits. They were asked to nominate which of the five statements in the table below they most agreed with.

Table 15. Respondents' subjective assessment of the water supply system

Option	n (402)	%
1 - The benefits easily outweigh the problems	103	25.6
2 - The benefits outweigh the problems	188	46.8
3 - The benefits and problems are equal	74	18.4
4 - The problems outweigh the benefits	26	6.5
5 -The problems easily outweigh the benefits	11	2.7
Mean = 2.14		

Over 70% of respondents answered that the benefits *outweigh* or *easily outweigh* the problems.

Perceptions of Equity and Fairness

Respondents were asked a series of questions to measure perceived equity and fairness of the water supply system. They were firstly asked to rate, on a five-point scale, how fair they thought the water supply system would be to a variety of users.

Table 16. Respondents' rating of how fair the water supply system is to a variety of users

	1 Less than fair (%)	2 (%)	3 Fair (%)	4 (%)	5 More than fair (%)	Mean
Sydney's future generations (n=402)	1.2	3.2	25.6	19.7	50.3	**4.14**
The Sydney environment (n=402)	0.7	4.0	35.1	18.2	42.0	**3.97**
Units with garden areas (n=402)	1.7	3.0	38.3	19.2	37.8	**3.88**
The neighbourhood environment (n=402)	2.0	4.7	38.5	19.2	35.6	**3.82**
Units with no children (n=402)	2.0	3.0	45.7	16.2	33.1	**3.75**
People neighbouring the building (n=402)	3.0	5.5	41.8	20.1	29.6	**3.68**
Units with children (n=402)	4.5	8.5	43.9	16.2	26.9	**3.52**
Units with no garden areas (n=401)	4.5	6.2	48.0	16.4	24.9	**3.51**

Respondents rated fairness to Sydney's future generations as significantly higher than for all other users. Interestingly, respondents rated the water supply system as significantly fairer to units with no children than to units with children, and as significantly fairer to units with garden areas than to units with no garden areas.

Having considered the potential users of the water supply system, respondents were then asked to rate how fair they thought the water supply system to be overall, and to provide reasons for their rating.

Table 17. Respondents' rating of how fair the water supply system is overall

Option	n (399)	%
1 - Less than fair	12	3.0
2	11	2.8
3 - Fair	154	38.6
4	75	18.8
5 - More than fair	147	36.8
Mean = 3.84		

Less than 6% of respondents rated the fairness of the water supply system below *fair*.

Of the variety of responses provided by the 222 respondents who rated the fairness higher than *fair* (4 or 5 on the scale), the main themes were: *saves water – including drinking water* (n=56); *helps the environment* (n=28); *everyone benefits from this* (n=22); *it is a long term solution* (n=16); *it will be using water that usually goes to waste*; *water is scarce*; and *solves the water crisis.*

A similar range of responses was recorded by those who rated the overall fairness as *fair* (3 on the scale – n=154). The main responses included: *saves water for drinking – including drinking water* (n=37); *helps the environment* (n=14); *everyone benefits from this* (n=14); *it is a long term solution*; *it doesn't disadvantage anyone*; *it is fair to all users*; and *water is scarce.*

Comments recorded by the 23 respondents who rated their overall fairness below *fair* (1 or 2 on the scale) included the following: *room for error*; *concerned the system will break down*; *economically unviable*; *needs more research*; *unhygienic*; *doesn't go far enough around Sydney*; and *it only affects residents of the building.*

Acceptability

The final question with direct reference to the particular water supply system scenario asked respondents to consider all aspects of the water supply system and rate on a five-point scale how acceptable they considered it to be. Respondents were also asked to provide reasons for their ratings.

Table 18. Respondents' rating of the acceptability of the water supply system

Option	n (402)	%
1 - Extremely unacceptable	9	2.2
2 - Unacceptable	15	3.7
3 - Neither	27	6.7
4 - Acceptable	186	46.3
5 - Extremely acceptable	165	41.0
Mean = 4.20		

The vast majority (87%) of respondents rated the water supply system as either *acceptable* or *extremely acceptable*, with 41% in the *extremely acceptable* category. The mean rating indicated that respondents generally felt that the water supply system was acceptable.

Respondents who felt the water supply system proposed for Sydney was *acceptable* or *extremely acceptable* (n=351) recorded a wide variety of reasons for their rating. The most common response was *it will save/conserve water (including drinking water) now and for future generations* (n=106). Other frequent comments included: *good idea* (n=31); *it will help the environment* (n=30); *there is no need to use potable water for the toilet/garden* (n=30); *I support recycling* (n=28); *it is okay as the water will not be used for drinking/personal use* (n=22); and *there doesn't appear to be any negative issues with the system* (n=20). Some respondents, while they rated the system as *acceptable* or *extremely acceptable* overall, did express a few conditions to their acceptance, such as *it would need to be maintained/managed properly* (n=19).

The few respondents who said they thought the system would be *neither acceptable nor unacceptable* (n=27) included comments such as *I would need more information* (n=11) and concerns with the system (n=8) including: *if it works okay and is maintained*; *possible health risks*; *worried about children playing in the garden*; *concerned that something may go wrong with the system*; *people are being used as guinea pigs*; and *costs are a concern.*[3]

A variety of responses were provided by those respondents who rated the water supply system as *unacceptable* or *extremely unacceptable* (n=24). The main responses concerned risks associated with the system - *risks to people (family, children, health)* (n=6) and *the risk of something going wrong with the system (breakdown of plant, tampering of plant, incorrect setup, contamination)* (n=9). Other reasons for rating the system as *unacceptable* or *extremely unacceptable* included: *don't like the idea of using toilet water* (n=5); *would be concerned about the monitoring*; *don't like the idea of recycled water*; *concerned about irresponsible users*; and *there are other sources of water to use*.

Respondents were then asked to consider a water supply system identical in all respects but that harvested water from bathrooms, laundries and kitchens and **not** from toilets. They were again asked to provide reasons for their rating.

Table 19. Respondents' rating of the acceptability of the water supply system, if the water for the system did not come from the toilets, but only bathrooms, laundries and kitchens

Option	**n (402)**	**%**
1 - Extremely unacceptable	2	0.5
2 - Unacceptable	8	2.0
3 - Neither	19	4.7
4 - Acceptable	114	28.4
5 - Extremely acceptable	259	64.4
Mean = 4.54		

The large majority (93%) of respondents rated this scenario as being either *acceptable* or *extremely acceptable*, with 65% in the *extremely acceptable* category. The mean rating (4.54) is significantly higher than the original acceptability rating, and indicated that under these conditions the water supply system was viewed as extremely acceptable.

The respondents who thought the water supply system proposed for Sydney was *acceptable* or *extremely acceptable* if it did not include toilet water (n=373), recorded a variety of reasons for their response. These ranged from feeling that it would not make much of a difference to their personal ratings of acceptance (*there would be no difference/still a good idea* (n=74); *I don't have a problem with including toilet water* (n=18); *it has to meet health standards either way*), to feelings that the system would be better without toilet water (*reduced health risks*, n=49; *less risk of contamination/problems*, n=25; *water/system is cleaner*, n=25; *I don't like the thought of toilet water being included*, n = 18; *easier to manage/maintain*; *would prefer it without toilet water*; *would be less serious if something did go wrong*; *reduces the cost of treatment*). Some respondents thought that the exclusion of toilet water from the system would reduce the effectiveness of the system (*less water will be*

[3] While the proposed water supply system for Sydney and for each of the other two scenarios was presented as cost neutral (respondents were told "all water in the future would cost more and this would cost you no more than any other water supply"), a number of respondents still had concerns regarding system costs.

recycled, n=10). As for the previous question, there were respondents who mentioned possible concerns (*it would need to be maintained/managed properly*, n=19; *if safety can be assured*, n=8; *worried about what's in the water*, n=6) even while viewing the system as *acceptable* or *extremely acceptable*.

Responses recorded by the 19 respondents who said they found the system *neither acceptable nor unacceptable* if no toilet water was included ranged from *no difference to having toilet water included*; *it would need to be maintained/managed properly*; *I would need more information/research done before deciding*; to *water from the laundry and kitchen contains detergents, pollutants, etc.* and *I support recycling.*

The main reasons given by those respondents rating the acceptability of a system that did not include toilet water as *unacceptable* or *extremely unacceptable* (n=10) surrounded the potential risks involves, for instance: *there is still a health risk*; *the system will eventually break down*; *don't trust the science*; and *there is still the potential for problems*. Other comments included: *it doesn't make any difference*; *don't like any form of recycled water*; and *should look for other solutions.*

Respondents were finally asked to consider a water supply system identical in all respects to the original but had Sydney Water maintaining and managing the system in place of the Body Corporate and their contracted private company.

Table 20. Respondents' rating of the acceptability of the water supply system if managed and maintained by Sydney Water rather than the Body Corporate and contracted private company

Option	n (400)	%
1 - Extremely unacceptable	13	3.3
2 - Unacceptable	32	8.0
3 - Neither	52	13.0
4 - Acceptable	128	31.8
5 - Extremely acceptable	175	43.8
Mean = 3.99		

The majority (76%) of respondents rated this scenario as being either *acceptable* or *extremely acceptable*, with 44% in the *extremely acceptable* category. The mean (3.99) is significantly lower than the original acceptability rating, and indicated that under these conditions respondents generally felt that the water supply system was acceptable.

Again, a wide range of comments was recorded by those respondents who thought the water supply system proposed for Sydney was *acceptable* or *extremely acceptable* under Sydney Water (n=303). Reasons given for Sydney Water being preferred as managers/maintainers of the system included that Sydney Water: *have experience/expertise in these areas* (n=57); *have more accountability* (n=13); *would monitor better*; *are more efficient, consistent, cheaper, safer, less risky; would maintain standards* and *has been around longer.* Other comments included: *no difference who manages/maintains the system* (n=55); *would prefer Sydney Water/Government department* (n=52); *would have more trust/faith in Sydney Water/Government department* (n=21); *private companies are motivated by profit* (n=24); *it doesn't matter who as long as it is maintained/managed properly* (n=18); and *private companies are not reliable, can take shortcuts, less honest, risky, not as diligent.*

The reasons respondents gave for rating the acceptability of the system as *neither acceptable nor unacceptable* (n=52) included both positive and negative comments regarding both Sydney Water and the Body Corporate/private company. For example: *Sydney Water has a poor track record, would be safer/have more control*; *Body Corporates are more conscientious*; and *private companies are motivated by greed.*

Of the comments made by respondents who felt the water supply system was *unacceptable* or *extremely unacceptable* (n=45), over one-third (37.3%) were directed at Sydney Water: *Sydney Water have a poor track record* (n=11); *I don't trust Sydney Water* (n=8); *Sydney Water would be over-worked and would cut corners*; and *Sydney Water are less accountable.* Other comments were similar to those recorded by the respondents in the previous two groups, such as: *the Body Corporate is directly affected so would be better, are more concerned with people's welfare, are more reliable*; and *it doesn't matter who as long as it is maintained/managed properly.*

Attitudinal Statements

Respondents were asked to rate on a five-point scale their agreement with a series of attitudinal statements designed to measure a number of the variables in the hypothesised model. Frequencies and mean ratings for these statements can be seen in the table below.

Table 21. Attitudinal Statements

Statement	**1** Strongly disagree (%)	**2** Disagree (%)	**3** Neither (%)	**4** Agree (%)	**5** Strongly agree (%)	**Mean**
Community Trust						
I have complete trust in the authorities to ensure I have good water quality (n=402)	3.7	15.7	19.4	53.2	8.0	**3.46**
I would have complete trust in any information about the safety of our water given to me by the various authorities (n=402)	2.7	17.4	24.9	49.8	5.2	**3.37**
I have complete trust in the authorities to manage our water responsibly (n=402)	8.7	27.1	23.6	37.4	3.2	**2.99**
Garden Recreation						
I enjoy sitting in a garden (n=402)	0.7	4.2	6.2	64.5	24.4	**4.07**
I enjoy having plants around the home (n=402)	0.2	6.2	6.2	65.3	22.1	**4.03**
Gardening is a valuable way to spend time (n=402)	3.0	17.4	14.7	48.2	16.7	**3.58**

Table 21. Attitudinal Statements (contd.)

Statement	1 Strongly disagree (%)	2 Disagree (%)	3 Neither (%)	4 Agree (%)	5 Strongly agree (%)	Mean
Gardening is a pleasant break from the household work and routine (n=400)	4.5	17.8	11.3	48.4	18.0	**3.58**
I get great satisfaction from gardening (n=401)	6.5	18.7	16.5	41.6	16.7	**3.43**
I don't like gardening (n=401)	18.3	49.4	10.0	17.0	5.3	**2.42**
Environmental Obligation						
I love doing things to help the environment (n=401)	0.0	2.2	11.0	62.6	24.2	**4.09**
The welfare of people must come before the environment (n=400)	2.3	24.0	39.4	28.5	5.8	**3.12**
I spend my leisure time doing things to help the environment (n=402)	2.7	34.6	30.3	28.9	3.5	**2.96**
The environment is a more important issue than education is (n=402)	7.2	41.8	41.3	8.5	1.2	**2.55**
Governments should spend more money on environment than they do on health (n=400)	7.8	46.0	37.4	7.8	1.0	**2.48**
Water Recreation						
A lush green home and neighbourhood environment is important to me (n=401)	0.7	13.0	16.2	56.9	13.2	**3.69**
I love taking long, hot showers (n=401)	6.0	40.6	14.5	28.4	10.5	**2.97**
I enjoy relaxing in a deep, hot bath (n=401)	11.5	46.2	10.7	25.4	6.2	**2.69**
I think an automatic dishwasher is a necessity of life (n=402)	24.1	47.1	7.7	16.9	4.2	**2.30**

Table 21. Attitudinal Statements (contd.)

Statement	1 Strongly disagree (%)	2 Disagree (%)	3 Neither (%)	4 Agree (%)	5 Strongly agree (%)	Mean
Intergenerational Equity						
The way we use water now is unfair on future generations (n=402)	1.0	13.9	14.2	53.2	17.7	**3.73**
What worries me most about water is that there won't be enough for future generations to use (n=402)	1.7	15.7	11.9	55.0	15.7	**3.67**
If we continue to use water the way we do now, there will be none left for future generations (n=402)	1.5	16.4	17.2	44.8	20.1	**3.66**
I worry about how my water use now will affect future generations (n=402)	1.2	18.9	12.4	55.1	12.4	**3.58**
It will be easier for future generations to use less water than it is for us to change now (n=402)	9.5	45.2	12.2	28.4	4.7	**2.74**

Factor analyses were performed on the above attitudinal items to yield scales with the highest reliability. Three scales were identified with sufficient reliability. Each scale was constructed by summing the agree/disagree scores of each scale-item. Descriptive labels were applied as follows.

Garden Recreation

The Garden Recreation scale had a Cronbach's alpha coefficient of .88 and consisted of six items. A scale score was calculated by summing the six attitudinal statements. Higher scores indicate a heavier emphasis placed on the garden as a means of recreating. The scale is summarised in the table below.

Table 22. Summary for Garden Recreation Scale

	n (397)
Minimum Score	6 (6)*
Maximum Score	30 (30)
Mean Score	22.24
Number of Items	6
Cronbach's α Coefficient	.88

* numbers in brackets represent possible minimum/maximum scores achievable

The mean score indicates that the respondents generally enjoyed their gardens.

Community Trust

This scale had a Cronbach's alpha of .80 and consisted of three items. Scores for this scale were calculated by summing responses to three attitudinal statements. Higher scores on this scale represent higher levels of community trust in the authorities to provide them with safe, good quality, well-managed water. The scale is summarised in the table below.

Table 23. Summary for Community Trust Scale

	n (402)
Minimum Score	3 (3)
Maximum Score	15 (15)
Mean Score	9.83
Number of Items	3
Cronbach's α Coefficient	.80

The mean indicates some trust in the authorities by the respondents.

Intergenerational Equity

The Intergenerational Equity scale, composed of four attitudinal statements, had a Cronbach's alpha of .79. Four statement-scores were summed together to calculate an overall score for each respondent, with higher scores indicating higher levels of agreement with intergenerational equity principles. The scale is summarised in the table below.

Table 24. Summary for Intergenerational Equity Scale

	n (402)
Minimum Score	4 (4)
Maximum Score	20 (20)
Mean Score	14.64
Number of Items	4
Cronbach's α Coefficient	.79

The mean indicates concern by the respondents in providing intergenerational equity.

Socio-Demographics

A number of socio-demographic questions were asked of respondents at the end of the questionnaire.

Awareness of Sydney's water issues
Respondents were asked to rate their awareness of water issues in Sydney. Their responses are shown in the table below.

Table 25. Awareness of Sydney's water issues

Option	n (401)	%
1 - Not at all aware	1	0.2
2 - Vaguely aware	14	3.5
3 - Somewhat aware	72	18.0
4 - Aware	134	33.4
5 - Very aware	180	44.9
Mean = 4.19		

The mean rating indicates that, in general, respondents considered themselves *aware* of water issues. In fact, just under 80% considered themselves either *aware* or *very aware*.

Household Unit

The following provides a breakdown of the unit of people living in the respondents' households.

Table 26. Household Unit

Household Unit	n (402)	%
Single adult < 65 years	39	9.7
Single adult > 65 years	19	4.7
Two adults - older person < 65	87	21.6
Two adults - older person > 65	44	10.9
Single adult - eldest child < 18	12	3.0
Single adult - eldest child > 18	7	1.7
Two adults - eldest child < 18	102	25.4
Two adults - eldest child > 18	39	9.7
Two adults - no children	34	8.5
More than two adults - eldest child < 18	11	2.7
More than two adults - eldest child > 18	8	2.0

Housing Type
The following table provides a breakdown of the type of dwelling the respondents were occupying.

Table 27. Details of respondents' dwellings

	n (402)	%
Detached	285	70.9
Semi-detached	24	6.0
Townhouse/villa	37	9.2
Unit/flat	56	13.9

Age
The following table provides a breakdown of respondents' age groups.

Table 28. Number of respondents in each age group

Age Group	n (402)	%
18 to 24 years	17	4.2
25 to 39 years	119	29.6
40 to 55 years	139	34.6
56 to 65 years	70	17.4
66 to 75 years	32	8.0
More than 75 years	25	6.2

Education
The following table provides a breakdown of respondents' highest completed level of education.

Table 29. Details of respondents' highest levels of formal education

Education	n (402)	%
All or some of primary school	1	0.2
All or some of secondary school	109	27.1
Partial trade or technical qualification	19	4.7
Trade or technical qualification	86	21.4
Partial university qualification	32	8.0
University qualification	155	38.6

Income
The table below provides a breakdown of respondents' gross household income.

Table 30. Details of respondents' gross household income

Gross Household Income	n (402)	%
< $22,000	37	9.2
$22,001 to $42,000	60	14.9
42,001 to $62,000	57	14.2
62,001 to $82,000	51	12.7
> $82,000	143	35.6
Don't know	20	5.0
Refused	34	8.5

3.1.2 Structural Equation Modelling

The following section details the testing of the model presented in Figure 3 using the Sydney water supply system scenario.

The structural equation model in Figure 4 was estimated using LISREL 8.72 software and Robust Maximum Likelihood estimation (Joreskog *et al*, 2000). Figure 4 shows the relationships between the latent variables (shown in the model as ellipses) and their respective indicators (shown in the model as rectangles). This reveals how well the indicators (eg risk to family: *riskfam*) measure the latent variables of interest (eg Risk). Coefficients on these paths can range from -1.0 (ie. a strong *negative* relationship between the latent variable and the indicator) to +1.0 (ie. a strong *positive* relationship between the latent variable and the indicator). Figure 4 shows that all indicators in the Sydney model have strong positive relationships with the latent variables they were hypothesised to measure.[4]

Figure 4 also shows the relationships between the independent variables and the dependent variable (ie Acceptability of the water supply system). The coefficients on these paths can also range from -1.0 (ie. a strong *negative* relationship between the predictor and Acceptability) to +1.0 (ie. a strong *positive* relationship between the predictor and Acceptability).

[4] It was necessary in the case of latent variables with only one indicator (Subjective Assessment and Acceptability of the water supply system) to fix these paths to a pre-specified value. Subjective Assessment was set to .8 while Acceptability was set to .9. This assumed reliability for Acceptance was higher than Subjective Assessment as it was judged that Acceptance was going to be the easier, or more straight-forward, question of the two to answer (the higher the ambiguity of a question, the lower its reliability is deemed to be).

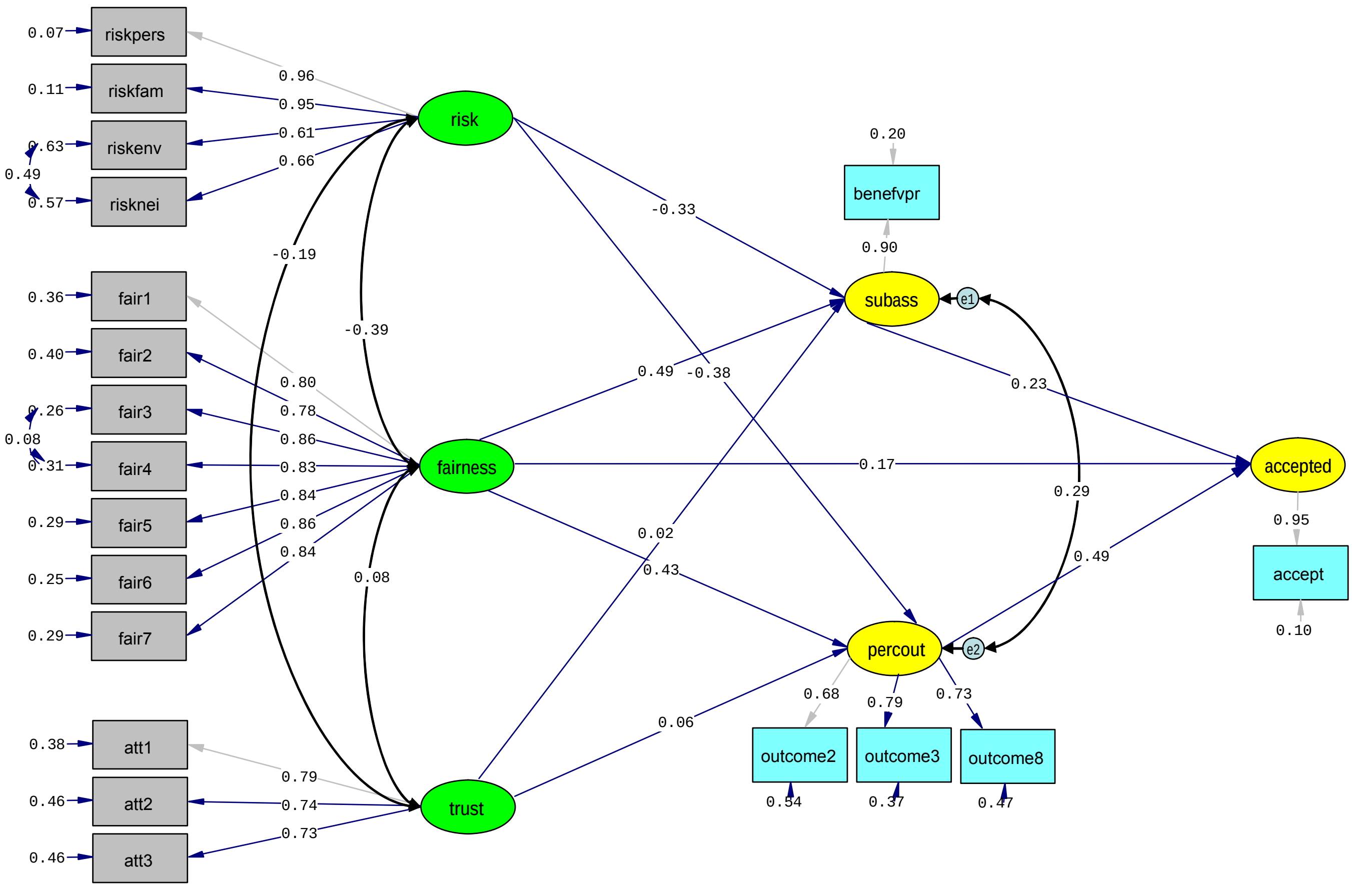

Figure 4. Estimated structural equation model with scale items for Sydney

Figure 5 below provides a simplified version of the structural equation model, and displays the strength and significance of pathways. Here, significant pathways are denoted by unbroken lines, with large effects shown as thick red arrows, moderate effects as thinner purple arrows, and weak effects as thin green arrows. Non-significant paths are denoted by broken lines.

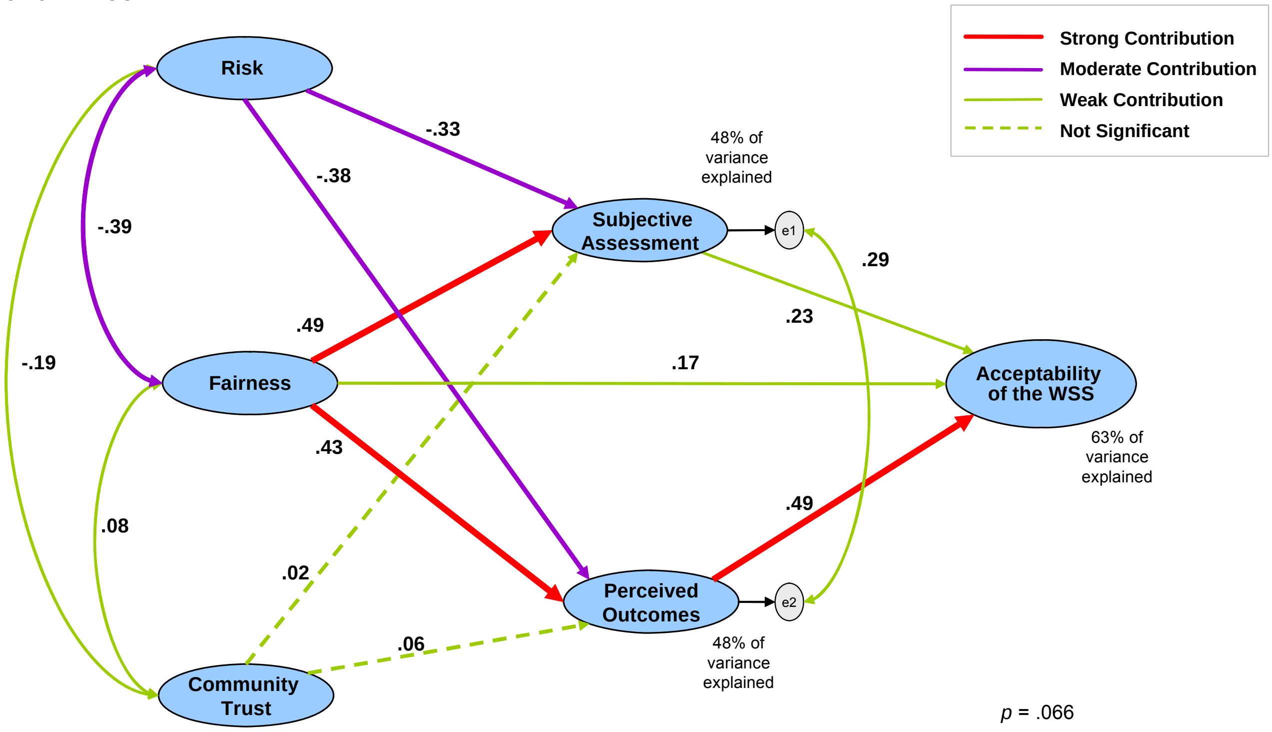

Figure 5. Simplified estimated structural equation model for Sydney

Figure 5 shows that four latent variables had significant relationships with Acceptability of the water supply system - Perceived Outcomes, Subjective Assessment, Fairness, and Risk (whose effect was indirect and mediated by both Subjective Assessment and Perceived Outcomes). Community Trust did not have a significant effect on Acceptability, however it was significantly correlated with both Fairness and Risk. Figures 4 and 5 suggest that the concept of Fairness is central to the model, with strong contributions to both Subjective Assessment and Perceived Outcomes. It also has a direct, though not as strong, contribution to overall Acceptability. Community Trust, on the other hand, gave no significant contributions, suggesting that the concept is not a major predictor of whether people will accept the water supply system, at least in this scenario.

The relationships between the dependent and independent variables in the final model can be summarised as follows:

- *Community Trust, Risk and Fairness*
  These three factors are interrelated in the model as indicated by the double-headed correlation arrows running between the three variables.
    - *Community Trust and Risk*
      Higher levels of trust in water authorities are associated with perceiving less risk in the water supply system.
    - *Community Trust and Fairness*
      Higher levels of trust in water authorities are associated with perceiving the system as fair.
    - *Risk and Fairness*
      Higher levels of perceived risk are associated with perceiving the system as unfair.

- *Risk*
  Greater perceived risk in the water supply system leads directly to:
    - a perception of less sustainable outcomes resulting from the water supply system; and
    - a subjective assessment that the problems of the water supply system outweigh the benefits.

  While Risk does not directly influence Acceptability, it indirectly influences it through its direct relationship with Perceived Outcomes and Subjective Assessment.

- *Fairness*
  A greater perception that the water supply system is fair and equitable leads directly to:
    - a perception of more sustainable outcomes resulting from the water supply system;
    - a subjective assessment that the benefits of the water supply system outweigh the problems; and
    - greater acceptability of the water supply system.

- *Subjective Assessment*
  The perception that the benefits of the water supply system outweigh its problems leads directly to:
    - greater acceptability of the water supply system.

- *Perceived Outcomes*
  The perception of more sustainable outcomes resulting from the water supply system leads directly to:
    - o greater acceptability of the water supply system.

The model accounted for 63% of the variance in acceptability ratings of the proposed water supply system, and its overall goodness-of-fit indices were satisfactory (see Table 31). The Satorra-Bentler Scaled Chi-Square was non-significant at the .05 level, indicating that there was not a significant difference between the hypothesised model (see Figure 3) and what the actual data suggested. As can be seen, the additional fit measures were also well within recommended values (Kline, 2005).

Table 31. Model fit indices for Sydney structural equation model

Fit Statistics	**Obtained Value**	**Recommended Value**
Chi-square (df)	164.90; df = 139; p > 0.05	*p* > .05
SRMR	.039	≤ .08
CFI	1.00	≥ .90
GFI	.95	≥ .90
RMSEA	.022	≤ .08

Finally, the model was run with the extra variables of Garden Recreation, Intergenerational Equity and the affective component of Perceived Outcomes included. While some significant relationships were found between these additional variables and other variables in the model, they did not (singularly or as a group) significantly improve the predictive power of the model or the model fit.

3.2. Brisbane

The Brisbane scenario involved capturing stormwater from all roofs in a 200-home neighbourhood, treating it and returning it to the regular water supply system. While the system was managed by Brisbane Water, householders were responsible for maintaining their roofs and gutters and no-one was allowed a private rainwater tank (see Appendix 2 for full details).

3.2.1 Preliminary Analysis

Perceived Outcomes

Respondents were asked a number of questions regarding potential outcomes of the proposed water supply system. A series of semantic differential scales was presented to respondents. Each scale consisted of an outcome differential (eg “Irresponsible / Responsible”) which respondents were asked to rate using a seven-point scale. Higher numbers indicated more positive associations with the water supply system.

Table 32. Respondents’ outcome ratings of the water supply system

Component	Statement	Mean
Cognitive	**Responsibility** (n=401)	5.84
	Longevity (n=402)	5.60
	Sustainability (n=400)	5.27
	Reliability (n=402)	5.22
	Certainty (n=402)	4.93
Affective	**Healthiness** (n=402)	5.89
	Okay-ness (n=401)	5.89
	Safeness (n=402)	5.79
	Cleanliness (n=402)	5.71
	Pleasantness (n=402)	5.65

Sustainability, Reliability and Certainty were all rated significantly lower than the other potential cognitive outcomes, while Healthiness and Okay-ness shared the top affective ranking.

Risks and Benefits

Respondents were asked to rate, on a five-point scale, the possible risks posed by the water supply system to themselves, their families, the environment and the neighbourhood.

Table 33. Respondents' ratings of risks associated with the water supply system

	1 No risk at all (%)	2 (%)	3 Some risk (%)	4 (%)	5 Extreme risk (%)	Mean
Personally (n=402)	31.6	21.1	38.9	4.7	3.7	**2.28**
To family (n=400)	31.8	21.5	38.1	4.8	3.8	**2.27**
To Brisbane as a whole (n=402)	49.0	20.4	22.6	5.0	3.0	**1.93**
To environment (n=402)	58.8	19.7	14.4	4.5	2.5	**1.72**

Risk personally and risk to family were rated as significantly greater than risk to the environment or Brisbane. Risk to the environment was rated as significantly lower than all other risks.

Table 34. Respondents' ratings of benefits associated with the water supply system

	1 No benefit at all (%)	2 (%)	3 Some benefit (%)	4 (%)	5 Great benefit (%)	Mean
To Brisbane as a whole (n=402)	3.7	4.0	18.2	21.6	52.5	**4.15**
To environment (n=402)	3.7	4.7	19.7	18.9	53.0	**4.13**
Personally (n=402)	7.2	6.7	26.4	19.4	40.3	**3.79**
To family (n=400)	7.0	7.0	26.8	19.3	39.9	**3.78**

Benefits to the environment and to Brisbane as a whole were rated as significantly greater than both personal benefit and benefit to one's family.

Possibility of Something Going Wrong

Respondents were asked to rate the likelihood of something going wrong with the water supply system. Responses can be seen in the table below.

Table 35. Respondents' rating of the likelihood of something going wrong

Option	**n (401)**	**%**
1 - Not at all likely	39	9.7
2	98	24.4
3 - Neither	146	36.4
4	87	21.7
5 - Extremely likely	31	7.7
Mean = 2.93		

On average, respondents thought the possibility of something going wrong with the water supply system was neither likely nor unlikely.

Respondents were then asked how serious they thought it would be if something went wrong, and what level of control they thought the authorities would have to stop something from going wrong with the water supply system. Responses can be seen in Tables 36 and 37.

Table 36. Respondents' rating of how serious something going wrong would be

Option	**n (401)**	%
1 - Not at all serious	35	8.7
2	86	21.4
3 - Neither	142	35.4
4	58	14.5
5 - Extremely serious	80	20.0
Mean = 3.15		

As can be seen in the table above, respondents on average thought that the seriousness of something going wrong would be neither serious nor not serious.

Table 37. Respondents' rating of how much control the authorities would have over stopping something going wrong

Option	n (402)	%
1 - High level of control	134	33.3
2	63	15.7
3 - Some control	145	36.1
4	38	9.5
5 - No control at all	22	5.5
Mean = 2.38		

While 36% of respondents thought that the authorities would have *some control* over something going wrong, a further 33% thought that they would have a *high level of control*.

Perceived Expert Knowledge

Respondents were asked to rate on a five-point scale how much they thought the 'experts' knew about issues associated with the water supply system.

Table 38. Respondents' rating of *experts*' knowledge of the water supply system

Option	n (401)	%
1 - No knowledge at all	11	2.7
2	21	5.2
3 - Some knowledge	136	33.9
4	84	20.9
5 - High level of knowledge	149	37.2
Mean = 3.85		

About one-third of respondents (37%) thought that the 'experts' would have a *high level of knowledge* about the water supply system, while another one-third (34%) thought they would have *some knowledge*. Only 3% of respondents thought the experts would have *no knowledge at all*.

Subjective Assessment

After considering a series of potential benefits and risks in the previous questions, respondents were asked whether they thought the benefits of the water supply system outweighed the problems, or the problems outweighed the benefits. They were asked to nominate which of the five statements in the table below they most agreed with.

Table 39. Respondents' subjective assessment of the water supply system

Option	**n (402)**	%
1 - The benefits easily outweigh the problems	85	21.1
2 - The benefits outweigh the problems	182	45.3
3 - The benefits and problems are equal	92	22.9
4 - The problems outweigh the benefits	25	6.2
5 -The problems easily outweigh the benefits	18	4.5
Mean = 2.28		

Two-thirds of respondents (66.4%) answered that the benefits *outweigh* or *easily outweigh* the problems.

Perceptions of Equity and Fairness

Respondents were asked a series of questions to measure perceived equity and fairness of the water supply system. They were firstly asked to rate, on a five-point scale, how fair they thought the water supply system would be to a variety of users.

Table 40. Respondents' rating of how fair the water supply system is to a variety of users

	1 Less than fair (%)	**2** (%)	**3** Fair (%)	**4** (%)	**5** More than fair (%)	**Mean**
Brisbane's future generations (n=402)	3.0	5.0	31.8	19.9	40.3	**3.90**
The Brisbane environment (n=402)	4.0	5.0	40.8	19.4	30.8	**3.68**
The neighbourhood environment (n=402)	3.5	4.7	45.3	17.4	29.1	**3.64**
Households on high income (n=401)	3.2	4.2	50.5	16.7	25.4	**3.57**
Households with no children (n=402)	4.5	5.2	53.5	16.2	20.6	**3.43**
Households with children (n=402)	5.0	6.2	53.9	15.7	19.2	**3.38**
Households on low income (n=401)	7.7	11.0	57.3	11.5	12.5	**3.10**

Respondents rated the water supply system as being most fair to Brisbane's future generations, relative to other users, and least fair to households on low incomes.

While respondents rated the system as being significantly fairer to households on high income than households on low income, there was no significant difference between households with children and those with no children.

Respondents were then asked to rate how fair they thought the water supply system to be overall, and to provide reasons for their rating.

Table 41. Respondents' rating of how fair the water supply system is overall

Option	**n (400)**	**%**
1 - Less than fair	15	3.8
2	22	5.5
3 – Fair	199	49.8
4	71	17.8
5 – More than fair	93	23.3
Mean = 3.51		

Only 9.3% of respondents rated the fairness of the water supply system below *fair*, while almost half (49.8%) rated it as *fair*.

When asked to explain why they rated overall fairness as they did, the most common responses given by those who rated fairness above *fair* (4 or 5 on the scale – n=164) were: *it saves water – including for the future* (n=47); *everyone benefits from the system* (n=26); *it is using water that usually goes to waste* (n=23); *good idea/scheme* (n=18); *it seems to be fair for everyone* (n=17); and *it helps the environment* (n=13).

Respondents who rated the proposed system as *fair* (3 on the scale – n=199) provided a wide range of comments, including: *everyone benefits* (n=32); *saves water – including for the future* (n=29); *it seems to be fair for everyone* (n=25); *good idea/scheme* (n=15); *it helps the environment* (n=12); and *it is using water that usually goes to waste* (n=11).

Respondents who rated the overall fairness below *fair* (1 or 2 on the scale – n = 37) provided comments such as: *costs are a concern* (n=10); *people should be allowed to have their own water tank*; *everyone should have a water tank*; *concerned about integrity in maintenance*; *there are better ways to save water*; and *there are too many risks.*

Acceptability

The final question with direct reference to the particular water supply system scenario asked respondents to consider all aspects of the water supply system and rate, on a five-point scale, how acceptable they considered it to be. Respondents were also asked to provide reasons for their rating.

Table 42. Respondents' rating of the acceptability of the water supply system

Option	n (402)	%
1 - Extremely unacceptable	21	5.2
2 - Unacceptable	26	6.5
3 - Neither	46	11.4
4 - Acceptable	181	45.0
5 - Extremely acceptable	128	31.8
Mean = 3.92		

Over two-thirds of respondents (76.8%) rated the water supply system as either *acceptable* or *extremely acceptable*.

Once again, a wide variety of responses were recorded by the respondents who rated the overall acceptability of the system proposed for Brisbane as *acceptable* or *extremely acceptable* (n=309). The main comments included: *saves water – including drinking water and water for future generations* (n=69); *good idea* (n=32); *it is harvesting water that normally goes to waste* (n=35); *we need to reuse water* (n=28); *it is a good way to recycle water* (n=17); *it is good for the environment*; *it would benefit all*; and *I don't have a problem with it.* Some of these respondents also expressed uncertainty about the system: *concerned about the integrity of maintenance*; *not sure if it is possible*; *not sure about the long term benefits*; *hard to police*; and *I won't have time to clean gutters.*

Common responses from the 46 respondents who rated the acceptability as *neither acceptable nor unacceptable* included: *I need more information* (n=9); *concerned about the integrity of maintenance*; *everyone should have the choice to install their own water tank*; *risk of contamination is high due to human error*; *it would be good quality water*; and *good for the environment.*

The 47 respondents who rated the system as *unacceptable* or *extremely unacceptable* recorded comments including: *everyone should have the choice to install their own water tank* (n=16); *cost is a concern*; *concerned about the integrity of maintenance*; *there are better ways to save water*; and *not happy that you cannot have your own private tank.*

Respondents were then asked to rate the acceptability of the water supply system under the condition of it being operated and maintained by a private company instead of Brisbane Water. Responses are recorded in the table below.

Table 43. Respondents' rating of the acceptability of the water supply system if it was operated and maintained by a private company instead of Brisbane Water

Option	n (399)	%
1 - Extremely unacceptable	64	16.0
2 - Unacceptable	112	28.1
3 - Neither	89	22.3
4 - Acceptable	109	27.3
5 - Extremely acceptable	25	6.3
Mean = 2.80		

Only one-third of respondents (33.6%) rated the system under this condition as being *acceptable* or *extremely acceptable*. The mean acceptability rating under this condition dropped significantly, from 3.92 to 2.80.

The most common response provided by those who had rated the acceptability of the water supply system under these conditions as *acceptable* or *extremely acceptable* (n=134) was *it makes no difference/there is no difference between the two* (n=37). While a number of respondents indicated that the reason they rated the acceptability as they did was because they would *prefer a private company* (n=14) or said that *private companies are more efficient/effective, will maintain the service, are okay if they are supervised by Brisbane Water,* the majority of the responses indicated that the remaining respondents would prefer to have Brisbane Water in the lead role. Comments here included: *I would prefer Brisbane Water/Government department* (n=22); *private companies will cost more/charge what they like*; *Brisbane Water should have the overseeing/supervising role*; *Brisbane Water have expertise with stormwater*; *Brisbane Water are safer*; and *all authorities need to be monitored.*

A variety of responses were recorded by those who said they felt the water supply system was *neither acceptable nor unacceptable* (n=89). The main response was, as earlier, *it makes no difference/there is no difference between the two* (n=25). Other comments ranged from *I would prefer Brisbane Water/Government department, private companies are profit driven/will cost more/charge what they like*, to *all authorities need to be monitored.*

For the respondents who felt that it was *unacceptable* or *extremely unacceptable* for the proposed water supply system to be operated and maintained by a private company rather than Brisbane Water (n=176), the main responses were as follows: *private companies are profit driven* (n=55); *private companies will cost more/charge what they like* (n=28); *I would prefer Brisbane Water/Government department* (n=28); *water services should be run by a public company/Government department* (n=16); and *I don't trust private companies* (n=10).

Attitudinal Statements

Respondents were asked to rate, on a five-point scale, their agreement with as series of attitudinal statements designed to measure a number of the variables in the hypothesised model. Frequencies and mean ratings for these statements can be seen in the table below.

Table 44. Attitudinal Statements

Statement	1 Strongly disagree (%)	2 Disagree (%)	3 Neither (%)	4 Agree (%)	5 Strongly agree (%)	Mean
Community Trust						
I have complete trust in the authorities to ensure I have good water quality (n=402)	2.0	13.4	18.4	57.2	9.0	**3.58**
I would have complete trust in any information about the safety of our water given to me by the various authorities (n=401)	2.2	19.2	22.4	51.2	5.0	**3.37**
I have complete trust in the authorities to manage our water responsibly (n=402)	4.5	23.1	24.6	44.1	3.7	**3.19**
Garden Recreation						
I enjoy having plants around the home (n=402)	1.2	3.2	9.5	63.0	23.1	**4.03**
I enjoy sitting in the garden (n=401)	0.7	6.7	11.0	64.1	17.5	**3.91**
Gardening is a valuable way to spend time (n=399)	4.0	16.0	15.8	50.2	14.0	**3.54**
Gardening is a pleasant break from the household work and routine (n=402)	5.2	20.1	12.4	47.6	14.7	**3.46**
I get great satisfaction from gardening (n=401)	7.0	23.9	11.2	43.2	14.7	**3.35**
I don't like gardening (n=400)	18.8	44.9	9.8	21.0	5.5	**2.50**
Environmental Obligation						
I love doing things to help the environment (n=402)	0.2	5.2	13.7	68.2	12.7	**3.88**

Table 44. Attitudinal Statements (contd.)

Statement	1 Strongly disagree (%)	2 Disagree (%)	3 Neither (%)	4 Agree (%)	5 Strongly agree (%)	Mean
The welfare of people must come before the environment (n=402)	6.0	21.1	40.0	28.4	4.5	**3.04**
I spend my leisure time doing things to help the environment (n=402)	4.2	41.6	24.4	27.6	2.2	**2.82**
The environment is a more important issue than education is (n=402)	7.5	44.7	39.1	7.7	1.0	**2.50**
Governments should spend more money on environment than they do on health (n=401)	6.7	47.1	38.2	6.5	1.5	**2.49**
Water Recreation						
A lush green home and neighbourhood environment is important to me (n=402)	1.5	16.2	19.7	49.9	11.7	**3.55**
I love taking long, hot showers (n=402)	8.7	50.6	13.9	21.1	5.7	**2.65**
I enjoy relaxing in a deep, hot bath (n=401)	15.5	53.3	9.5	17.0	4.7	**2.42**
I think an automatic dishwasher is a necessity of life (n=402)	26.1	48.8	6.2	15.2	3.7	**2.22**
Intergenerational Equity						
If we continue to use water the way we do now, there will be none left for future generations (n=402)	3.2	16.2	13.7	47.0	19.9	**3.64**
The way we use water now is unfair on future generations (n=401)	2.0	16.5	15.2	53.1	13.2	**3.59**
What worries me most about water is that there won't be enough for future generations to use (n=402)	1.7	19.4	13.2	52.3	13.4	**3.56**
I worry about how my water use now will affect future generations (n=402)	1.7	19.4	13.2	52.3	13.4	**3.36**
It will be easier for future generations to use less water than it is for us to change now (n=402)	10.0	48.2	10.2	29.4	2.2	**2.66**

Factor analyses were performed on the above attitudinal items to yield scales with the highest reliability. Three scales were identified with sufficient reliability. These scales contained the same items as those identified for Sydney. Each scale was constructed by summing the agree/disagree scores of each scale-item. Descriptive labels were applied as follows.

Garden Recreation

The Garden Recreation scale had a Cronbach's alpha coefficient of .87 and consisted of six items. A scale score was calculated by summing the six attitudinal statements. Higher scores indicate a heavier emphasis placed on the garden as a means of recreating. The scale is summarised in the table below.

Table 45. Summary for Garden Recreation Scale

	n (395)
Minimum Score	6 (6)
Maximum Score	30 (30)
Mean Score	21.83
Number of Items	6
Cronbach's α Coefficient	.87

The mean indicates that respondents generally enjoyed their gardens.

Community Trust

This scale had a Cronbach's alpha of .85 and consisted of three items. Scores for this scale were calculated by summing responses to three attitudinal statements. Higher scores on this scale represent higher levels of community trust in the authorities to provide them with safe, quality, well-managed water. This scale is summarised in the table below.

Table 46. Summary for Community Trust Scale

	n (401)
Minimum Score	3 (3)
Maximum Score	15 (15)
Mean Score	10.15
Number of Items	3
Cronbach's α Coefficient	.85

The mean indicates that respondents had some trust in the authorities.

Intergenerational Equity

The Intergenerational Equity scale, composed of four attitudinal statements, had a Cronbach's alpha of .78. Statements were summed together to calculate an overall score for each respondent, with higher scores indicating higher levels of agreement with intergenerational equity principles. The scale is summarised in the table below.

Table 47. Summary for Intergenerational Equity Scale

	n (401)
Minimum Score	4 (4)
Maximum Score	20 (20)
Mean Score	14.15
Number of Items	4
Cronbach's α Coefficient	.78

The mean indicates that respondents were concerned with the provision of intergenerational equity.

Socio-Demographics

A number of socio-demographic questions were asked of respondents at the end of the questionnaire.

Awareness of Brisbane's water issues
Respondents were asked to rate their awareness of water issues in Brisbane. Their responses are shown in the table below.

Table 48. Awareness of Brisbane's water issues

Option	n (399)	%
1 - Not at all aware	1	0.3
2 - Vaguely aware	11	2.8
3 - Somewhat aware	89	22.3
4 - Aware	134	33.6
5 - Very aware	164	41.1
Mean = 4.13		

The mean rating indicates that, in general, respondents considered themselves *aware* of water issues.

Household Unit
The following provides a breakdown of the unit of people living in the respondents' households.

Table 49. Household Unit

Household Unit	n (401)	%
Single adult < 65 years	44	11.0
Single adult > 65 years	37	9.2
Two adults - older person < 65	84	20.9
Two adults - older person > 65	49	12.2
Single adult - eldest child < 18	10	2.5
Single adult - eldest child > 18	6	1.5
Two adults - eldest child < 18	92	22.9
Two adults - eldest child > 18	17	4.2
Two adults - no children	36	9.0
More than two adults - eldest child < 18	20	5.0
More than two adults - eldest child > 18	6	1.5

Housing Type
The following table provides a breakdown of the type of dwelling the respondents were occupying.

Table 50. Details of respondents' dwellings

	n (402)	%
Detached	330	82.1
Semi-detached	2	0.5
Townhouse/villa	13	3.2
Unit/flat	57	14.2

Age
The following table provides a breakdown of respondents' age group.

Table 51. Number of respondents in each age group

Age Group	n (401)	%
18 to 24 years	25	6.2
25 to 39 years	106	26.4
40 to 55 years	123	30.7
56 to 65 years	63	15.7
66 to 75 years	63	15.7
More than 75 years	21	5.2

Education
The following table provides a breakdown of respondents' highest completed level of education.

Table 52. Details of respondents' highest levels of formal education

Education	n (402)	%
All or some of primary school	16	4.0
All or some of secondary school	114	28.4
Partial trade or technical qualification	10	2.5
Trade or technical qualification	65	16.2
Partial university qualification	28	7.0
University qualification	169	42.0

Income
The table below provides a breakdown of respondents' gross household income.

Table 53. Details of respondents' gross household income

Gross Household Income	n (402)	%
< $22,000	54	13.4
$22,001 to $42,000	69	17.2
42,001 to $62,000	60	14.9
62,001 to $82,000	63	15.7
> $82,000	99	24.6
Don't know	26	6.5
Refused	31	7.7

3.2.2 Structural Equation Modelling

This section details the testing of the model presented in Figure 3 using the Brisbane water supply system scenario.

As with Sydney, the structural equation model in Figure 6 was estimated using LISREL 8.72 software and Robust Maximum Likelihood Estimation.[5] Figure 6 shows that all indicators in the Brisbane model have strong positive relationships with the latent variables they were hypothesised to measure.

[5] Again, it was necessary to fix the paths for Subjective Assessment (.8) and Acceptability (.9) to pre-specified values.

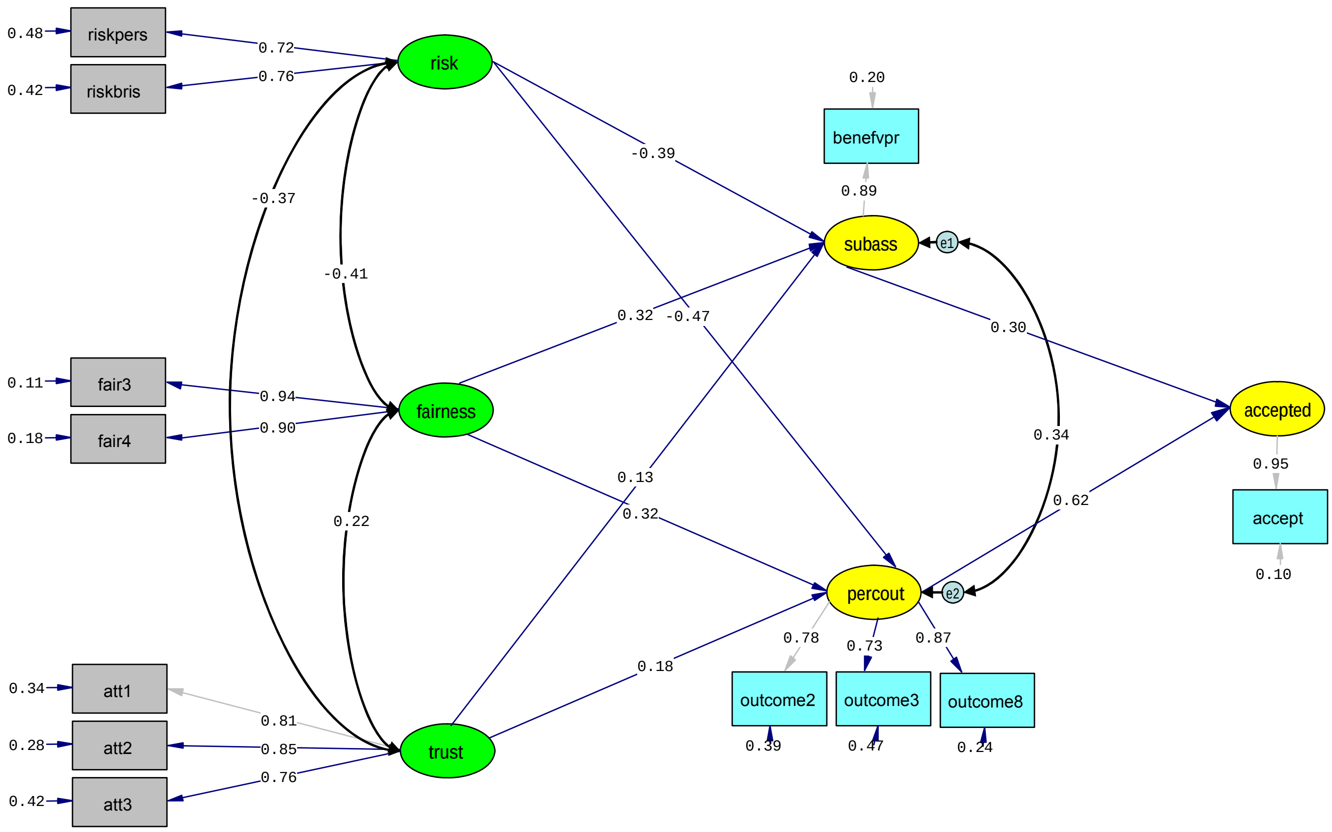

Figure 6. Estimated Structural Equation Model with Scale Items for Brisbane

Figure 7 below provides a simplified version of the structural equation model, and displays the strength and significance of pathways. Here, significant pathways are denoted by unbroken lines, with large effects shown as thick red arrows, moderate effects as thinner purple arrows, and weak effects as thin green arrows. Non-significant paths are denoted by broken lines.

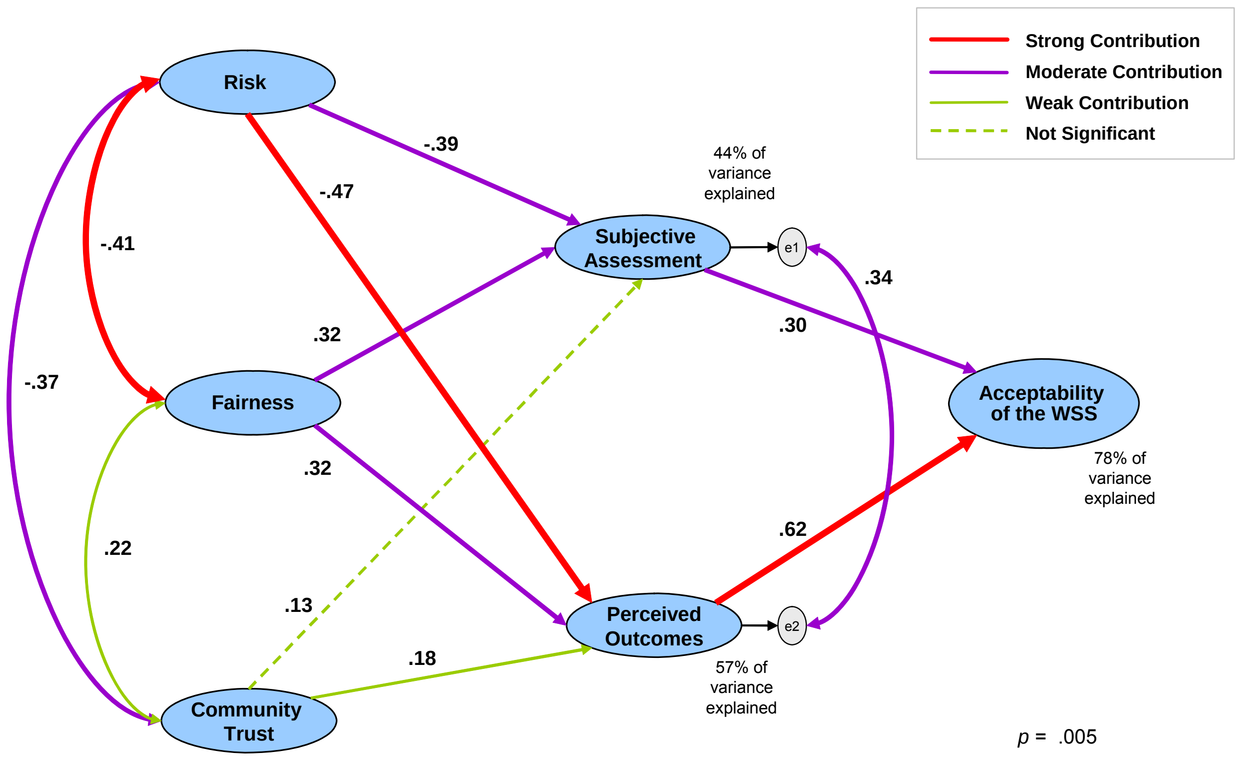

Figure 7. Simplified Estimated Structural Equation Model for Brisbane

Figure 7 shows that all five of the latent variables (Risk, Fairness, Community Trust, Subjective Assessment and Perceived Outcomes) had significant relationships with Acceptability of the water supply system. While the relationships of Subjective Assessment and Perceived Outcomes with Acceptability were direct, the contributions of Risk, Fairness and Community Trust were mediated. The Risk variable appears to be playing a strong part in this model, with a strong contribution to Perceived Outcomes, which in turn strongly contributes to Acceptability (.62).

The relationships between the dependent and independent variables in the final model can be summarised as follows:

- *Community Trust, Risk and Fairness*
  These three factors are interrelated in the model as indicated by the double-headed correlation arrows running between the three variables.
    - *Community Trust and Risk Perceptions*
      Higher levels of trust in water authorities are associated with perceiving less risk in the water supply system.
    - *Community Trust and Fairness*
      Higher levels of trust in water authorities are associated with perceiving the system as fair.
    - *Risk and Fairness*
      Higher levels of perceived risk are associated with perceiving the system as unfair.

- *Risk*
  Greater perceived risk in the water supply system leads directly to:
    - a perception of less sustainable outcomes resulting from the water supply system; and
    - a subjective assessment that the problems of the water supply system outweigh the benefits.

  While Risk does not directly influence Acceptability, it indirectly influences it through its direct relationship with Perceived Outcomes and Subjective Assessment.

- *Fairness*
  A greater perception that the water supply system is fair and equitable leads directly to:
    - a perception of more sustainable outcomes resulting from the water supply system; and
    - a subjective assessment that the benefits of the water supply system outweigh the problems.

  While Fairness does not directly influence Acceptability, it indirectly influences it through its direct relationship with Perceived Outcomes and Subjective Assessment.

- *Community Trust*
  A greater level of trust in water authorities leads directly to:
    - a perception of more sustainable outcomes resulting from the water supply system.

  While Trust does not directly influence Acceptability, it indirectly influences it through its direct relationship with Perceived Outcomes and Subjective Assessment.

- *Subjective Assessment*
  The perception that the benefits of a water supply system outweigh its problems leads directly to:
    - o greater acceptability of the water supply system.

- *Perceived Outcomes*
  The perception of more sustainable outcomes resulting from the water supply system leads directly to:
    - o greater acceptability of the water supply system.

The model accounted for 78% of the variance in acceptability ratings of the proposed water supply system, and its overall goodness-of-fit indices were satisfactory (see Table 54). The Satorra-Bentler Chi-Square was marginally significant at the .05 level indicating that the model could not reproduce the relationships among the indicators observed in the sample within a .05 level of significance. As the chi-square statistic is known to be upwardly bias in samples of 200 cases or more (Hair et al., 1995) a number of other goodness-of-fit measures are available to test the overall fit of the model. As can be seen in Table 54, these additional measures were well within recommended values.

Table 54. Model fit indices for Brisbane structural equation model

Fit Statistics	**Obtained Value**	**Recommended Value**
Chi-square (df)	72.32; df = 44; $p < 0.05$	$p > .05$
SRMR	.029	≤ .08
CFI	.99	≥ .90
GFI	.96	≥ .90
RMSEA	.041	≤ .08

Finally, the model was run with the extra variables of Garden Recreation, Intergenerational Equity and the affective component of Perceived Outcomes included. While some significant relationships were found between these additional variables and other variables in the model, they did not (singularly or as a group) significantly improve the predictive power of the model or the model fit.

3.3 Melbourne

The Melbourne scenario involved taking wastewater from sewerage pipes and treating it at neighbourhood treatment plants, each plant treating the waste of roughly 200 homes. Once treated, the water was pumped back in a separate pipe and used for domestic garden areas and for toilet flushing, as well as for industry and irrigating public open space. The system was managed by a private company (see Appendix 3 for full details).

3.3.1 Preliminary Analysis

Perceived Outcomes

Respondents were asked a number of questions regarding potential outcomes of the proposed water supply system. A series of semantic differential scales was presented to respondents. Each scale consisted of an outcome differential (eg "Irresponsible / Responsible") which respondents were asked to rate using a seven-point scale. Higher numbers indicated more positive associations with the water supply system.

Table 55. Respondents' outcome ratings of the water supply system

Component	Statement	Mean
Cognitive	**Responsibility** (n=401)	5.87
	Longevity (n=401)	5.75
	Sustainability (n=401)	5.65
	Reliability (n=401)	5.28
	Certainty (n=401)	4.93
Affective	**Safeness** (n=401)	5.34
	Cleanliness (n=401)	5.23
	Healthiness (n=399)	5.21
	Okay-ness (n=400)	5.11
	Pleasantness (n=401)	4.78

Respondents rated the outcomes of Responsibility, Sustainability and Longevity significantly higher than all other outcomes, while Certainty and Pleasantness were rated significantly lower than other outcomes.

Risks and Benefits

Respondents were asked to rate, on a five-point scale, the possible risks posed by the water supply system to themselves, their family, the environment and the neighbourhood.

Table 56. Respondents' ratings of risks associated with the water supply system

	1 No risk at all (%)	2 (%)	3 Some risk (%)	4 (%)	5 Extreme risk (%)	Mean
To family (n=399)	24.6	19.3	43.3	9.3	3.5	**2.48**
Personally (n=401)	25.7	20.7	42.4	8.7	2.5	**2.42**
To Melbourne as a whole (n=400)	38.6	21.8	29.5	8.3	1.8	**2.13**
To environment (n=400)	43.1	22.3	25.8	7.3	1.5	**2.02**

Respondents rated the risk to them personally and to their family as significantly higher than to the environment or Melbourne. Risk to the environment was rated significantly lower than the others.

Table 57. Respondents' ratings of benefits associated with the water supply system

	1 No benefit at all (%)	2 (%)	3 Some benefit (%)	4 (%)	5 Great benefit (%)	Mean
To environment (n=400)	3.0	3.2	21.2	18.5	54.1	**4.17**
To Melbourne as whole (n=400)	2.5	3.0	22.7	19.2	52.6	**4.16**
To family (n=400)	6.0	4.8	31.5	18.3	39.4	**3.81**
Personally (n=401)	6.5	5.0	30.4	18.5	39.6	**3.80**

Respondents rated the benefits of the water supply system to the environment and to Melbourne as a whole significantly higher than both the benefits for their family and for them personally.

Possibility of Something Going Wrong

Respondents were asked to rate the likelihood of something going wrong with the water supply system. Responses can be seen in the table below.

Table 58. Respondents' rating of the likelihood of something going wrong

Option	n (401)	%
1 - Not at all likely	28	7.0
2	92	22.9
3 - Neither	165	41.1
4	81	20.2
5 - Extremely likely	35	8.7
Mean = 3.01		

On average, respondents thought the possibility of something going wrong with the water supply system was neither likely nor unlikely.

Respondents were then asked how serious they thought it would be if something did go wrong, and what level of control they thought the authorities would have to stop something from going wrong with the water supply system. Responses can be seen in Tables 59 and 60.

Table 59. Respondents' rating of how serious something going wrong would be

Option	n (401)	%
1 - Not at all serious	29	7.2
2	72	18.0
3 - Neither	147	36.7
4	58	14.5
5 - Extremely serious	95	23.7
Mean = 3.29		

As can be seen in the table above, respondents on average thought that the seriousness of something going wrong would be neither serious nor not serious.

Table 60. Respondents' rating of how much control the authorities would have over stopping something going wrong

Option	n (401)	%
1 - High level of control	147	36.7
2	50	12.5
3 - Some control	132	32.9
4	39	9.7
5 - No control at all	33	8.2
Mean = 2.40		

While 32.9% of respondents thought that the authorities would have *some control* over something going wrong, a further 36.7% thought that they would have a *high level of control*.

Perceived Expert Knowledge

Respondents were asked to rate on a five-point scale how much they thought the 'experts' knew about issues associated with the water supply system.

Table 61. Respondents' rating of *experts'* knowledge of the water supply system

Option	n (401)	%
1 - No knowledge at all	5	1.2
2	9	2.2
3 - Some knowledge	113	28.2
4	89	22.2
5 - High level of knowledge	185	46.1
Mean = 4.10		

Nearly half the respondents (46.1%) thought that the 'experts' would have a *high level of knowledge* about the water supply system. Only 1.2% of respondents thought the experts would have *no knowledge at all*.

Subjective Assessment

After considering a series of potential benefits and risks, respondents were asked whether they thought the benefits of the water supply system outweighed the problems, or the problems outweighed the benefits. They were asked to nominate which of the five statements in the table below they most agreed with.

Table 62. Respondents' subjective assessment of the water supply system

Option	n (401)	%
1 - The benefits easily outweigh the problems	86	21.4
2 - The benefits outweigh the problems	169	42.1
3 - The benefits and problems are equal	104	25.9
4 - The problems outweigh the benefits	31	7.7
5 -The problems easily outweigh the benefits	11	2.7
Mean = 2.28		

Nearly two-thirds of respondents (63.5%) answered that the benefits *outweigh* or *easily outweigh* the problems. A further one-quarter (25.9%) answered that the benefits and risks were equal.

Perceptions of Equity and Fairness

Respondents were asked a series of questions to measure perceived equity and fairness of the water supply system. They were firstly asked to rate, on a five-point scale, how fair they thought the water supply system would be to a variety of users.

Table 63. Respondents' rating of how fair the water supply system is to a variety of users

	1 Less than fair (%)	2 (%)	3 Fair (%)	4 (%)	5 More than fair (%)	Mean
Households with garden areas (n=398)	2.0	2.0	44.0	15.1	36.9	**3.83**
The Melbourne environment (n=398)	2.8	3.5	37.9	19.3	36.4	**3.83**
The neighbourhood environment (n=398)	4.8	5.0	38.9	18.6	32.7	**3.69**
Households on high income (n=388)	3.4	5.4	47.9	15.7	27.6	**3.59**
Households with no children (n=397)	3.5	4.8	50.9	15.4	25.4	**3.54**
Households on low income (n=389)	6.7	9.8	50.6	11.8	21.1	**3.31**
Households with children (n=397)	7.3	10.3	48.4	12.3	21.7	**3.31**
Households with no garden areas (n=397)	7.8	13.1	44.6	13.6	20.9	**3.27**

Respondents rated the water supply system as significantly fairer to households with garden areas and to the Melbourne environment than to the other users. The system was rated as significantly fairer for households on high incomes than households on low incomes, and as significantly fairer for households with no children than for those with children.

Respondents were then asked to rate how fair they thought the water supply system to be overall, and to provide reasons for their rating.

Table 64. Respondents' rating of how fair the current water supply system is overall

Option	n (398)	%
1 - Less than fair	13	3.3
2	25	6.3
3 - Fair	192	48.2
4	76	19.1
5 - More than fair	92	23.1
Mean = 3.53		

Only 9.6% of respondents rated the fairness of the water supply system below *fair*, while almost half (48.2%) rated it as *fair*.

For the group of respondents who rated the overall fairness of the water supply system proposed for Melbourne higher than *fair* (4 or 5 on the scale – n=168), the most common reasons given were: *it saves water – including drinking water* (n=55); *no group is disadvantaged* (n=30); *we need to reuse/recycle water* (n=21); *it benefits all* (n=17); *good idea* (n=15); and *it helps the environment* (n=13).

A similar range of responses was recorded by those respondents who rated overall fairness of the water supply system as *fair* (3 on the scale – n=192). The main responses were: *it saves water – including drinking water* (n=40); *no group is disadvantaged* (n=40); *it helps the environment* (n=18); *concerned about the cost* (n=15); *it benefits all* (n=12); and *we need to reuse/recycle water* (n=12).

The responses given by those who rated the system below *fair* (1 or 2 on the scale – n=38) included a range of concerns: *concerned about the cost* (n=8)*, health risks, smell, noise, extra infrastructure needed, bacteria/contamination* and *about being privately run*. Other comments included: *it saves water*; *it should be available to everyone*; *it is not equitable*; and *I don't have confidence in the scheme.*

Acceptability

The final question with direct reference to the particular water supply system scenario asked respondents to consider all aspects of the water supply system and rate, on a five-point scale, how acceptable they considered it to be. Respondents were also asked to provide reasons for their rating.

Table 65. Respondents' rating of the acceptability of the water supply system

Option	n (401)	%
1 - Extremely unacceptable	16	4.0
2 - Unacceptable	31	7.7
3 - Neither	31	7.7
4 - Acceptable	198	49.4
5 - Extremely acceptable	125	31.2
Mean = 3.96		

Over 80% of respondents rated the water supply system as either *acceptable* or *extremely acceptable*.

A variety of comments were provided by the 323 respondents who rated the proposed water supply system for Melbourne as *acceptable* or *extremely acceptable*. The most common responses included: *it saves water – including drinking water* (n=86); *we need to reuse/save water* (n=47); *good idea* (n=40); *it helps the environment* (n=32); *it is a benefit to gardens and gardeners* (n=27); and *we don't need drinking water to flush toilets/water gardens* (n=21).

The responses recorded by those who felt the water supply system was *neither acceptable nor unacceptable* (n=31) ranged from *concerned about the noise* through *I need more information* to *good idea.*

For those who rated the proposed system as *unacceptable* or *extremely unacceptable* (n=47), comments included: *concerned about the smell* (n=9); *there are health risks/safety issues*; *concerned with the system being privately run*; *there will be a huge problem if the system breaks down*; *I wouldn't like to live near the plant*; and *I don't like the idea.*

Respondents were then asked to rate the acceptability of the water supply system under the condition of it being operated and maintained by Melbourne Water instead of a private company.

Table 66. Respondents' rating of the acceptability of the water supply system if managed and maintained by Melbourne Water

Option	n (398)	%
1 - Extremely unacceptable	7	1.8
2 - Unacceptable	17	4.3
3 - Neither	60	15.1
4 - Acceptable	137	34.4
5 - Extremely acceptable	177	44.5
Mean = 4.16		

Almost half the respondents (44.5%) found the water supply system under this condition to be *extremely acceptable*. The mean acceptability rating under this condition rises from 3.96 to 4.16 – a statistically significant amount, indicating a preference for public management over private management.

The main reason given by those respondents who rated the acceptability of the water supply system as *acceptable* or *extremely acceptable* if Melbourne Water was to operate and maintain the treatment plants instead of a private company (n=314) was *I would prefer Melbourne Water or other water agencies* (n=98). Other comments included: *it makes no difference to me who operates and maintains it* (n=54); *private companies are profit driven* (n=51); *I have trust/confidence in Melbourne Water/Government department* (n=31); *Melbourne Water has experience* (n=22); *Melbourne Water are more accountable* (n=19); and *it should only be run by Melbourne Water/Government department* (n=19).

Of the 60 respondents who rated the water supply system as *neither acceptable nor unacceptable*, over half stated that *it makes no different who runs it* (n=35). Other comments included: *I would prefer Melbourne Water/other water agency*; *Melbourne Water have knowledge/expertise*; and *concerned about the cost.*

For those who felt that the proposed water supply system under these conditions was *unacceptable* or *extremely unacceptable* (n=24), the reasons given included: *it makes no difference who runs it*; *I would prefer a private company*; and *I would prefer Melbourne Water/other water agency.*

Attitudinal Statements

Respondents were asked to rate, on a five-point scale, their agreement with as series of attitudinal statements designed to measure a number of the variables in the hypothesised model. Frequencies and mean ratings for these statements can be seen in the table below.

Table 67. Attitudinal Statements

Statement	1 Strongly disagree (%)	2 Disagree (%)	3 Neither (%)	4 Agree (%)	5 Strongly agree (%)	Mean
Community Trust						
I have complete trust in the authorities to ensure I have good water quality (n=401)	2.2	9.0	17.5	59.8	11.5	**3.69**
I would have complete trust in any information about the safety of our water given to me by the various authorities (n=401)	3.0	14.7	25.4	49.9	7.0	**3.43**
I have complete trust in the authorities to manage our water responsibly (n=401)	3.5	18.0	29.4	45.9	3.2	**3.27**
Garden Recreation						
I enjoy sitting in a garden (n=400)	0.0	3.5	3.0	62.2	31.3	**4.21**
I enjoy having plants around the home (n=400)	0.3	1.8	5.3	66.8	25.8	**4.16**
Gardening is a valuable way to spend time (n=401)	1.5	14.2	11.7	51.4	21.2	**3.77**
Gardening is a pleasant break from the household work and routine (n=401)	2.2	14.7	11.2	48.0	23.9	**3.77**
I get great satisfaction from gardening (n=401)	4.0	16.5	12.7	39.9	26.9	**3.69**
I don't like gardening (n=398)	25.4	44.4	9.8	13.6	6.8	**2.32**
Environmental Obligation						
I love doing things to help the environment (n=401)	0.0	3.0	9.0	62.6	25.4	**4.10**

Table 67. Attitudinal Statements (contd.)

Statement	1 Strongly disagree (%)	2 Disagree (%)	3 Neither (%)	4 Agree (%)	5 Strongly agree (%)	Mean
The welfare of people must come before the environment (n=398)	3.8	23.4	42.9	25.1	4.8	**3.04**
I spend my leisure time doing things to help the environment (n=401)	3.0	35.5	26.9	30.9	3.7	**2.97**
Governments should spend more money on environment than they do on health (n=400)	4.5	47.4	39.8	7.0	1.3	**2.53**
The environment is a more important issue than education is (n=399)	5.8	45.3	41.6	6.3	1.0	**2.51**
Water Recreation						
A lush green home and neighbourhood environment is important to me (n=400)	1.8	17.0	15.5	52.9	12.8	**3.58**
I love taking long, hot showers (n=400)	10.0	39.6	11.3	29.3	9.8	**2.89**
I enjoy relaxing in a deep, hot bath (n=398)	13.1	46.4	9.8	23.9	6.8	**2.65**
I think an automatic dishwasher is a necessity of life (n=401)	24.0	41.1	8.7	19.7	6.5	**2.44**
Intergenerational Equity						
The way we use water now is unfair on future generations (n=400)	0.8	17.8	11.3	53.1	17.0	**3.68**
What worries me most about water is that there won't be enough for future generations to use (n=401)	1.0	16.5	14.7	53.8	14.0	**3.63**
If we continue to use water the way we do now, there will be none left for future generations (n=400)	2.3	20.3	14.8	43.1	19.5	**3.58**
I worry about how my water use now will affect future generations (n=399)	1.3	22.8	11.0	53.1	11.8	**3.51**
It will be easier for future generations to use less water than it is for us to change now (n=401)	14.0	42.9	13.0	26.9	3.2	**2.63**

Factor analyses were performed on the above attitudinal items to yield scales with the highest reliability. Three scales were identified with sufficient reliability. Scales contained the same items as those identified for Sydney and Brisbane. Each scale was constructed by summing the agree/disagree scores of each scale-item. Descriptive labels were applied as follows.

Garden Recreation

The Garden Recreation scale had a Cronbach's alpha coefficient of .88 and consisted of six items. A scale score was calculated by summing the six attitudinal statement-scores. Higher scores indicate a heavier emphasis placed on the garden as a means of recreating. The scale is summarised in the table below.

Table 68. Summary for Garden Recreation Scale

	n (396)
Minimum Score	9 (6)
Maximum Score	30 (30)
Mean Score	23.24
Number of Items	6
Cronbach's α Coefficient	.88

The mean indicates that respondents enjoyed their gardens.

Community Trust

This scale had a Cronbach's alpha of .81 and consisted of three items. Scores for this scale were calculated by summing responses to three attitudinal statements. Higher scores on this scale represent higher levels of community trust in the authorities to provide them with safe, quality, well-managed water. This scale is summarised in the table below.

Table 69. Summary for Community Trust Scale

	n (401)
Minimum Score	3 (3)
Maximum Score	15 (15)
Mean Score	10.40
Number of Items	3
Cronbach's α Coefficient	.81

The mean indicates that respondents had some trust in the authorities.

Intergenerational Equity

The Intergenerational Equity scale, composed of four attitudinal statements, had a Cronbach's alpha of .79. Statement-scores were summed together to calculate an overall score for each respondent, with higher scores indicating higher levels of agreement with intergenerational equity principles. The scale is summarised in the table below.

Table 70. Summary for Intergenerational Equity Scale

	n (398)
Minimum Score	4 (4)
Maximum Score	20 (20)
Mean Score	14.40
Number of Items	4
Cronbach's α Coefficient	.79

The mean indicates that respondents were concerned about the provision of intergenerational equity.

Socio-Demographics

A number of socio-demographic questions were asked of respondents at the end of the questionnaire.

Awareness of Melbourne's water issues

Respondents were asked to rate their awareness of water issues in Melbourne. Their responses are shown in the table below.

Table 71. Awareness of Melbourne's water issues

Option	**n (400)**	**%**
1 - Not at all aware	0	0.0
2 - Vaguely aware	18	4.5
3 - Somewhat aware	89	22.3
4 - Aware	141	35.3
5 - Very aware	152	38.0
Mean = 4.07		

The mean rating indicates that, in general, respondents considered themselves *aware* of water issues.

Household Unit

The following provides a breakdown of the unit of people living in the respondents' households.

Table 72. Household Unit

Household Unit	n (399)	%
Single adult < 65 years	23	5.8
Single adult > 65 years	30	7.5
Two adults - older person < 65	87	21.8
Two adults - older person > 65	46	11.5
Single adult - eldest child < 18	10	2.5
Single adult - eldest child > 18	5	1.3
Two adults - eldest child < 18	118	29.6
Two adults - eldest child > 18	39	9.8
Two adults - no children	30	7.5
More than two adults - eldest child < 18	9	2.3
More than two adults - eldest child > 18	2	0.5

Housing Type

The following table provides a breakdown of the type of dwelling the respondents were occupying.

Table 73. Details of respondents' dwellings

	n (401)	%
Detached	342	85.3
Semi-detached	8	2.0
Townhouse/villa	15	3.7
Unit/flat	36	9.0

Age
The following table provides a breakdown of respondents' age group.

Table 74. Number of respondents in each age group

Age Group	n (401)	%
18 to 24 years	13	3.2
25 to 39 years	107	26.7
40 to 55 years	139	34.7
56 to 65 years	65	16.2
66 to 75 years	46	11.5
More than 75 years	31	7.7

Education
The following table provides a breakdown of respondents' highest completed level of education.

Table 75. Details of respondents' highest levels of formal education

Education	n (399)	%
All or some of primary school	9	2.3
All or some of secondary school	95	23.8
Partial trade or technical qualification	4	1.0
Trade or technical qualification	78	19.5
Partial university qualification	31	7.8
University qualification	182	45.6

Income
The table below provides a breakdown of respondents' gross household income.

Table 76. Details of respondents' gross household income

Gross Household Income	**n (400)**	**%**
< $22,000	41	10.3
$22,001 to $42,000	48	12.0
42,001 to $62,000	65	16.3
62,001 to $82,000	62	15.5
> $82,000	123	30.8
Don't know	26	6.5
Refused	35	8.8

3.3.2 Structural Equation Modelling

This section details the testing of the model presented in Figure 3 using the Melbourne water supply system scenario.

Again, the structural equation model in Figure 8 was estimated using LISREL 8.72 software and Robust Maximum Likelihood Estimation.[6] Figure 8 shows that all indicators in the Melbourne model have strong positive relationships with the latent variables they were hypothesised to measure.

[6] As with Sydney and Brisbane, it was necessary to fix the paths for Subjective Assessment (.8) and Acceptability (.9) to pre-specified values. It should be noted here that a sensitivity analysis run on the Melbourne scenario found that the assumption of fixing the Subjective Assessment variable's reliability affected the significance of the path from Perceived Outcomes to Acceptance. That is, Perceived Outcomes becomes non-significant when the reliability of Subjective Assessment is fixed to .7 or below.

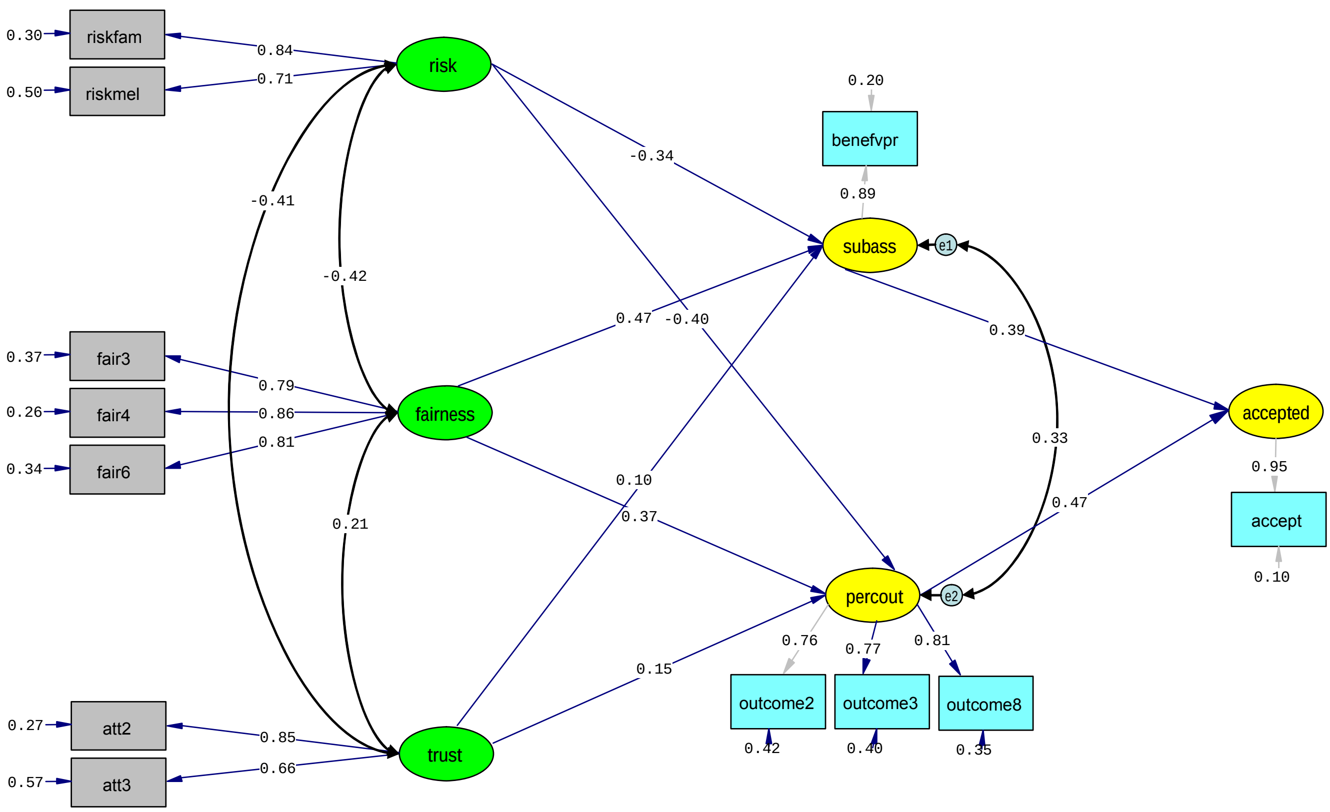

Figure 8. Estimated Structural Equation Model with Scale Items for Melbourne

Figure 9 below provides a simplified version of the structural equation model, and displays the strength and significance of pathways. Here, significant pathways are denoted by unbroken lines, with large effects shown as thick red arrows, moderate effects as thinner purple arrows, and weak effects as thin green arrows. Non-significant paths are denoted by broken lines.

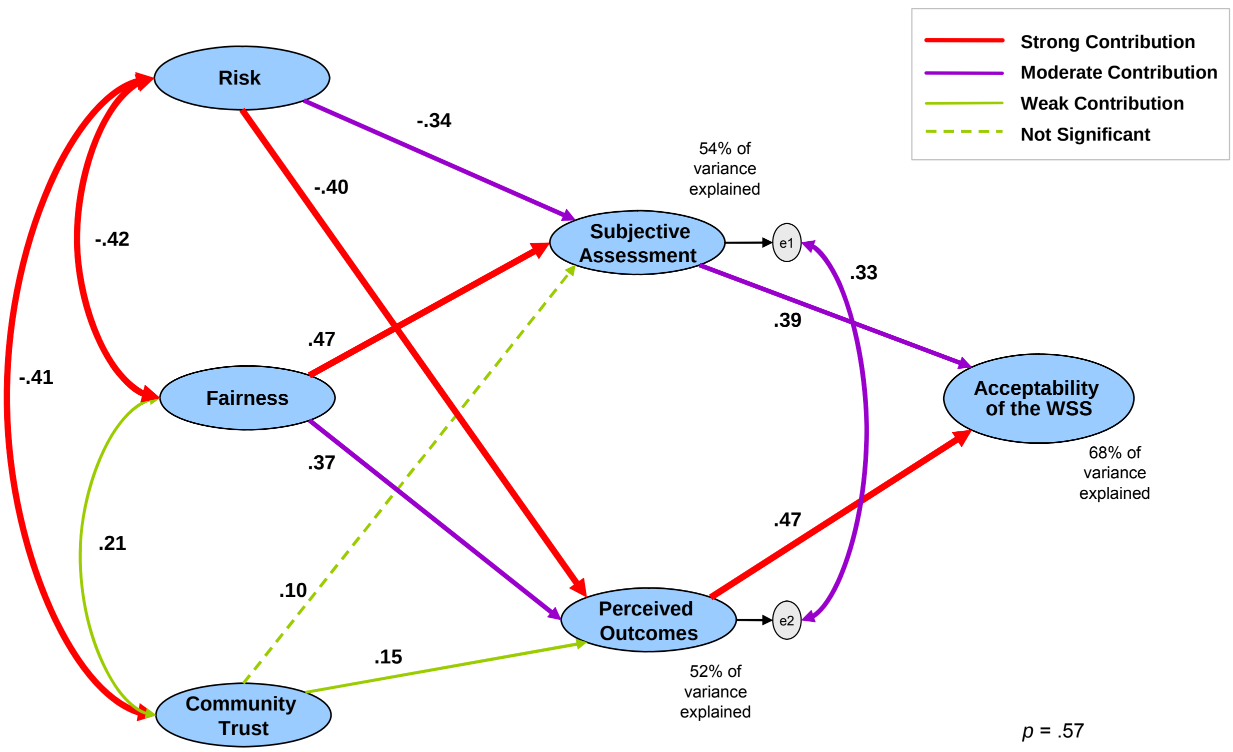

Figure 9. Estimated Structural Equation Model for Melbourne

Figure 9 shows that all five of the latent variables (Risk, Fairness, Community Trust, Subjective Assessment and Perceived Outcomes) had significant relationships (either directly or indirectly) with Acceptability of the water supply system. While the relationships of Subjective Assessment and Perceived Outcomes with Acceptability were direct, the contributions of Risk, Fairness and Community Trust were mediated. From the Figure above, Risk and Fairness play a central role in predicting acceptability, as does Perceived Outcomes. Again, Community Trust is significant only through perceived outcomes, and its correlations with Risk and Fairness.

The relationships between the dependent and independent variables in the final model can be summarised as follows:

- *Community Trust, Risk and Fairness*
  These three factors are interrelated in the model as indicated by the double-headed correlation arrows running between the three variables.
  - *Community Trust and Risk Perceptions*
    Higher levels of trust in water authorities are associated with perceiving less risk in the water supply system.
  - *Community Trust and Fairness*
    Higher levels of trust in water authorities are associated with perceiving the system as fair.
  - *Risk and Fairness*
    Higher levels of perceived risk are associated with perceiving the system as unfair.

- *Risk*
  Greater perceived risk in the water supply system leads directly to:
  - a perception of less sustainable outcomes resulting from the water supply system; and
  - a subjective assessment that the problems of the water supply system outweigh the benefits.

  While Risk does not directly influence Acceptability, it indirectly influences it through its direct relationship with Perceived Outcomes and Subjective Assessment.

- *Fairness*
  A greater perception that the water supply system is fair and equitable leads directly to:
  - a perception of more sustainable outcomes resulting from the water supply system; and
  - a subjective assessment that the benefits of the water supply system outweigh the problems.

  While Fairness does not directly influence Acceptability, it indirectly influences it through its direct relationship with Perceived Outcomes and Subjective Assessment.

- *Community Trust*
  A greater level of trust in water authorities leads directly to:
  - a perception of more sustainable outcomes resulting from the water supply system.

  While Trust does not directly influence Acceptability, it indirectly influences it through its direct relationship with Perceived Outcomes and Subjective Assessment.

- *Subjective Assessment*
  The perception that the benefits of a water supply system outweigh its problems leads directly to:
    - o greater acceptability of the water supply system.

- *Perceived Outcomes*
  The perception of more sustainable outcomes resulting from the water supply system leads directly to:
    - o greater acceptability of the water supply system.

The model accounted for 68% of the variance in acceptability ratings of the proposed water supply system, and its overall goodness-of-fit indices were satisfactory (see Table 77). The Satorra-Bentler Chi-Square was non-significant at the .05 level, indicating that there was not a significant difference between the hypothesised model (Figure 3) and what the actual data suggested. As can be seen in Table 77, the additional fit measures were also well within recommended values.

Table 77. Model fit indices for Melbourne structural equation model

Fit Statistics	Obtained Value	Recommended Value
Chi-square (df)	41.76; df = 44; p >.05	*p* > .05
SRMR	.023	≤ .08
CFI	1.00	≥ .90
GFI	.98	≥ .90
RMSEA	.0	≤ .08

Finally, the model was run with the extra variables of Garden Recreation, Intergenerational Equity and the affective component of Perceived Outcomes included. While some significant relationships were found between these additional variables and other variables in the model, they did not (singularly or as a group) significantly improve the predictive power of the model or the model fit.

3.4. Socio-demographics

A number of one-way between-groups analyses of variance were performed to explore the impact of socio-demographic variables on some of the key model components. Respondents were grouped according to a number of demographic criteria: income, age, household unit, education, water issues awareness and housing type. These groups were then tested for significant variations in the way they rated Risk, Fairness, Trust, Perceived Outcomes, Subjective Assessment and Acceptability.

Sydney

No significant differences were found between socio-demographic groups for Risk, Fairness, Trust, Perceived Outcomes, Subjective Assessment or Acceptability.

Brisbane

No significant differences were found between socio-demographic groups for Risk, Fairness, Trust, Perceived Outcomes, Subjective Assessment or Acceptability.

Melbourne

No significant differences were found between socio-demographic groups for Fairness, Trust, Perceived Outcomes or Acceptability.

Those who considered themselves “very aware” of water issues in Melbourne rated the risk of the proposed system significantly lower than all other groups.

Those whose lowest level of education was a university qualification gave a significantly more positive subjective assessment of the proposed scheme than both those whose highest level of education was a partial trade or technical qualification and those with all or some of secondary school.

The lack of socio-demographic influences over respondents’ ratings of the key model components suggests that, for Sydney and Brisbane, results could be extrapolated to the whole of city populations, regardless of the representativeness of the sample populations here. For Melbourne, a demographic examination suggests that the education level of the sample population generally exceeded that of the whole of city population (46% of respondents reported having a University qualification). Hence, it is possible that the frequency scores for the subjective assessment of the Melbourne scenario were upwardly influenced. It is important to restate, however, that no significant link was found between education levels and the overall acceptability of the proposed water supply system.

4.0 DISCUSSION

4.1. Testing the robustness and consistency of the model

To test the robustness and consistency of the model over different scales of water supply systems, structural equation modelling was performed separately on the three different scenarios. To aid discussion, the final models are presented together below.

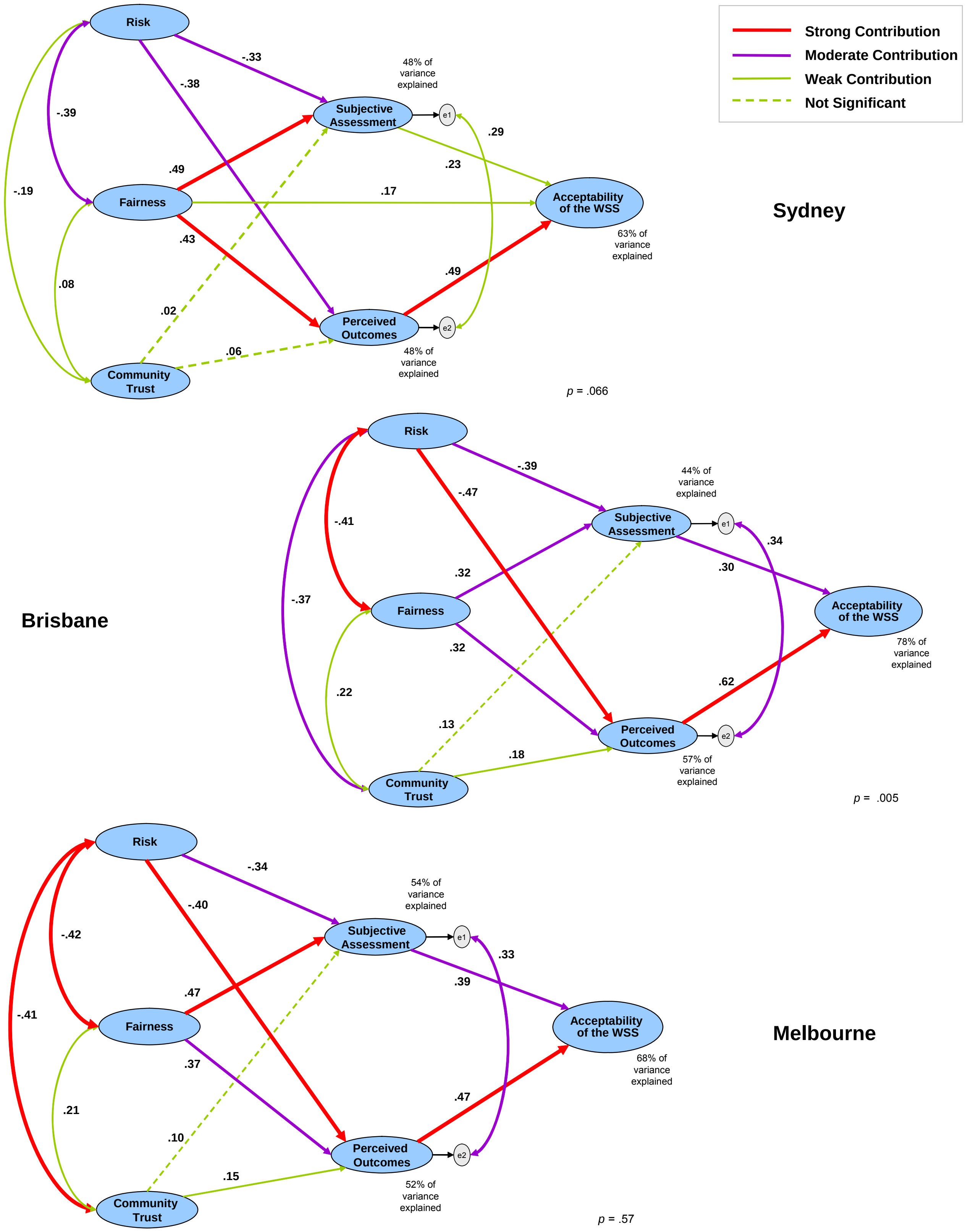

Figure 10. Models for Sydney, Brisbane and Melbourne

The results of our analysis confirmed the model developed through previous stages of testing. With the exception of trust, all four predictor variables had significant and, in many cases, strong relationships (either directly, indirectly or both directly and indirectly) with acceptance. The model fit statistics for the three scenarios indicated that this model is indeed applicable across different scales of water supply systems (as well as across different metropolitan populations, and for different styles of water augmentation).

With regards to consistency, all three models shared the same basic structure. However, the outputs were clearly not identical. For instance, risk appeared to be a stronger contributor in Melbourne and Brisbane than it was in Sydney, while in Sydney, fairness played a more central role than it did in either Melbourne or Brisbane. It seemed that, for Sydney, fairness was to some extent replacing the role of risk. This may be due to the small scale (building size) of the Sydney scenario, where the effects of fairness and equity are more immediate or apparent than at a neighbourhood scale where fairness impacts may be more diffuse. Similarly, scale may be a contributing factor to risk, if the controlling factors governing a neighbourhood-scale system are seen as more vulnerable due to its larger size. This supposition was supported by the respondents' perceptions of the level of control the authorities would have to stop something going wrong with the system. The perceived level of control in the Sydney scenario, a small-scale system, was significantly higher than for both Brisbane and Melbourne.

While trust still had significant relationships in all the models, it was weaker than anticipated and certainly not as influential as the other predictors, particularly in Sydney. There are several possible explanations for this. In both the Sydney and Melbourne scenarios, the supply system is privately run, while trust in authorities to provide good, safe and well-managed water was measured in general terms (that is, not with relation to the specific managing body identified in the scenario). Therefore, for these two privately run scenarios we might not expect trust to impact acceptance levels greatly, and indeed, could argue that a high level of trust in the "authorities" may be correlated with a low level of trust in the private sector. The implications for these scenarios therefore would be that a relationship between trust in the authorities and acceptance of a privately run water supply system would be close to zero, or even negative. Perhaps not surprisingly then, trust performed best in Brisbane – a publicly managed scenario, although admittedly the relationships were not radically stronger here. This may be due to the nature of the supply system. For example, trust is not as critical for uses such as toilet-flushing and garden-watering, or for stormwater as it might be for other combinations of uses and sources of water. Scale may also have an impact. For instance, perhaps in Sydney, where trust is the least critical, respondents believe that the influence of Sydney Water would be minimal over something as small-scale as a basement treatment plant, whereas Melbourne Water or Brisbane Water might be perceived as having greater 'watch body' duties over their larger-scale systems. Whether the scenario was presented as publicly or privately managed (as mentioned earlier here), or the immediacy of the scenario (eg. trust was a critical component of the model when tested on a current water supply system – see Figure 3) may all impact on the strength of contribution of trust to the models.

Much of trust's real importance then, appears to lie in its relationship with risk. While no causality is inferred in the current model (ie. trust is not said to be the cause of risk, or vice versa; they are simply said to be related), it could be reasonably argued that higher levels of trust *precede* and *predict* greater perceptions of risk, which then goes on to reduce acceptance. The idea that those that trust an organisation tend to find its risk estimates more credible and its policies and proposals more acceptable is supported by the risk management literature (Poortinga & Pidgeon, 2003; Slovic, 1993).

4.2. Predicting the amount of variance in acceptability ratings

A commonality of the three model outputs was their strong predictive power. In the Sydney scenario, the model predicted 63% of the variance in acceptability, in Brisbane 78% and in Melbourne 68%. These are impressively high figures for a model that attempts to predict people's decision-making. It also represents a marked improvement from the 36% predictive power of our hypothesised model (see Figure 3). This increase can be attributed to, firstly, improvements made to measurement items throughout the research stages. Secondly, testing the model on vivid *future* water supply scenarios is preferable in the sense that it is easier for a respondent to consider it more holistically (eg. how it makes them feel, do they think it's risky, is it fair and so on) than a current water supply system, where the entirety of a respondent's answers risks bias by recent experiences with one part of the system (eg. over billing, burst water mains).

4.3. Community attitudes towards the three test scenarios

The results of the preliminary analysis provided a number of interesting insights, with several points of difference between the different water supply system scenarios. In the area of perceived outcomes of the water supply system, while Sydney and Melbourne tended to rate cognitive outcomes (such as Responsibility and Longevity) more highly than emotive outcomes (such as Pleasantness and Cleanliness), the reverse was true for Brisbane. This is consistent with previous research pointing to a 'yuck factor' (an affective or emotional concept) associated with wastewater – the source of the water in the Melbourne and Sydney scenarios (Melbourne Water, 1998). However, the acceptance ratings for these schemes also suggest that the seemingly unpalatable connotations of reusing wastewater are countered to a large extent by the cognitive perceptions of what such a system will deliver – long-term, sustainable water supplies.

The water supply systems in Sydney and Melbourne were rated as fairer to household units with garden areas than to those without garden areas. This goes against the supposition of a perceived hazard with using treated wastewater on domestic garden areas, where incidental human contact with the water is higher than, for instance, when the water is used to irrigate public open space. This suggests that, more important than any contact risk considerations in people's assessment of fairness, is the idea that people with gardens will have access to water that they otherwise would not have had. At the same time however, both these scenarios were rated as being significantly fairer to those with no children than to those with children, suggesting that any perceived danger of contamination from garden use may be associated more specifically with children (as supported by the risk literature).

When it came to actual acceptance of the schemes, there was a significant difference in acceptability ratings between the Sydney scenario and the other two scenarios, with Sydney respondents rating the acceptability of their proposed water supply system significantly higher than Brisbane and Melbourne did theirs. There was no significant difference between the Melbourne and Brisbane scenarios. By far the largest change in acceptance ratings under different circumstances occurred when respondents rated their acceptance of the scheme under private management. The mean of acceptance fell markedly for Brisbane under this circumstance, suggesting that the role of public agencies in the management of supply systems is a critical one – either to the Brisbane population, or in a supply system of this particular nature, or both.[7]

[7] The magnitude of difference in the ratings for Brisbane in particular may also be attributable to the emphasis of the question. Brisbane respondents were told at the beginning of the questionnaire that the system was publicly run, and were later asked specifically to rate the system under private management, thereby prompting respondents to focus on this particular aspect of the scheme. In the case of Melbourne and Sydney, the public/private ordering of the initial and modified scenario was reversed, meaning the initial high levels of acceptance may have masked the effects of any increases in acceptance under the revised (from private to public) conditions.

5.0 CONCLUSION

The stability of the model in this research supports the notion that this holistic measurement of people's acceptance can be used to assess alternative water supply systems at a variety of scales. This model was useful in showing similarities and differences in what households thought about three alternative water supply systems. Furthermore, it is expected that by detecting and understanding the differences in emphasis on the individual components of the model it also has the power to inform us how to tailor community acceptance strategies to a specific water supply system under proposal. This could be achieved in practice by the development of a specific tool (perhaps consisting of a questionnaire with implementation and analytical instructions) designed for the decision-making agency (such as the water utility, planners or developers) to use in water sensitive urban design.

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APPENDIX 1

Respondent information regarding the water supply system
Scenario 1 – Sydney

There are many ways to make sure Sydney has enough water for the future, but we need to know what people think about them. I am going to read some information about one idea that planners have. It will take less than a minute, but I'd like you to listen carefully. You may ask questions at the end if you'd like to know more.

I'd like you to think about a building of about 10 storeys high that contains about 60 housing units of different sizes. There is an area of garden around the building. All residents can enjoy and use this common garden area. Water is originally supplied to the building from the mains supply system operated by Sydney Water.

Wastewater would then be collected from all the units in the building. Water from all the bathrooms, kitchens, laundries and toilets would be piped to a treatment plant ***in the basement of the building****. There the wastewater would be treated to a standard set by the Health Department. There would be no noise or smell from this basement treatment plant.*

The treated wastewater would then be piped back to each housing unit through a separate pipe where it would be used to flush the toilets. It would also be piped to the garden taps where the gardens would be watered with this treated wastewater. The garden taps would be labelled to say they contain treated wastewater. They would be coloured purple, and would have removable handles.

The Body Corporate, which is made up of all the owners of the housing units in the building, would contract a private company to operate and maintain the basement treatment plant and the pipes. This would be inspected once a year by Sydney Water.

I now want you to imagine that you live in this building with this water supply system. Please assume that all water in the future would cost more and this would cost you no more than any other water supply.

Is there anything else you'd like to know before I ask you some questions?

APPENDIX 2

Respondent information regarding the water supply system
Scenario 2 – Brisbane

There are many ways to make sure Brisbane has enough water for the future, but we need to know what people think about them. I am going to read some information about one idea that planners have. It will take less than a minute, but I'd like you to listen carefully. You may ask questions at the end if you'd like to know more.

At the moment, much of the water from rain in Brisbane goes to waste, and flows off roofs and roads, down gutters, and is piped to rivers and creeks. One way to supply water in the future is to collect rain-water from people's roofs and reuse it.

When it rains, water would be collected from neighbourhood roofs and piped to a nearby large underground storage tank, probably under the road at an intersection. Each neighbourhood would have about 10 underground storage tanks, each collecting rainwater from about 20 houses – about 200 houses in total.

The rainwater would then flow to a neighbourhood treatment plant. The treatment plant would treat the rain water to Australian Drinking Water Standards. This treated rainwater would then be mixed with the regular water supply, and then piped to people's houses for normal use. That is, it would be used for drinking, cooking, bathing and showering, washing, toilet flushing, gardens and so on. The mix of the water coming into the houses would usually be about half regular water and half treated rainwater. The amount of rain water would be more at times of heavy rain.

It would be the home-owner's responsibility to make sure that their roofs and gutters were cleared, cleaned and maintained. The neighbourhood pipes, storage tanks and treatment plants would be operated and maintained by Brisbane Water. No households would be allowed to have their own private rainwater tanks.

I now want you to imagine that your neighbourhood was chosen for one of these water supply systems. Please assume that all water in the future will cost more, and this will cost you no more than anywhere else in Brisbane.

Is there anything else you'd like to know before I ask you some questions?

APPENDIX 3

Respondent information regarding the water supply system
Scenario 3 – Melbourne

There are many ways to make sure Melbourne has enough water for the future, but we need to know what people think about them. I am going to read some information about one idea that planners have. It will take less than a minute, but I'd like you to listen carefully. You may ask questions at the end if you'd like to know more.

As you probably know, recycling of water is being considered for a range of different uses in the future. One way being considered is to take wastewater directly from the sewerage pipes at different places around Melbourne and treat it in neighbourhood treatment plants to be reused in those neighbourhoods.

The treatment plants would treat the sewerage water to a standard required by the Health Department. The water would then be pumped back to households in special pipes to use for flushing toilets and for watering gardens. It would also be used to water local parks, and golf courses, and for use by any local industries. Garden taps would be labelled to say they contain treated wastewater. They would also be coloured purple, and would have removable handles.

The neighbourhood treatment plants would serve about 200 houses, so there would be about 2 or 3 in each suburb. Each treatment plant would be about the size of a house. Some would be underground, but others would be above-ground. There would sometimes be a slight noise or smell from the treatment plants, but not often.

The treatment plants would be owned, maintained and operated by private companies, and not by the government or the water utilities.

This water supply system would not be in all suburbs, but only where it would be financially viable, such as in suburbs with lots of parkland, sporting ovals, or places with industries.

I now want you to imagine that you live in one of these suburbs with this water supply system. Please assume that all water in the future will cost more, and this will cost you no more than any other water supply.

Is there anything else you'd like to know before I ask you some questions?

APPENDIX 4

Additional information for Interviewers regarding the proposed water supply system

Multi Unit Development - Sydney

(INTERVIEWERS' INFORMATION)
Water Cultures – Stage 3, Nov/Dec 2005

TREATMENT AND HEALTH DEPARTMENT STANDARDS

The department in charge of setting standards for recycled wastewater in New South Wales is NSW Health (referred to in the questionnaire as "the Health Department).

CURRENT GUIDELINES

Current NSW guidelines for the use of recycled water in multi-unit and commercial premises are being developed but have yet to be released. The following are interim guidelines, and give an idea of some of the key points the completed guidelines will include. The interim guidelines state the following about the treatment of recycled water…

- The treatment should be capable of achieving the required final water quality and include a disinfection step. It is also suggested that if primary disinfection other than chlorination is used then additional chlorination be carried out
- The treatment process should undergo 'validation'. Results consistent with compliance values should be produced for a minimum of three months before supply is commenced. During this validation period, the treated wastewater should be discharged to sewer.
- Routine monitoring programs should be conducted
- Samples should be collected at the point of entry of recycled water to the distribution system. Appropriately trained personnel should collect all samples. A laboratory accredited for the specified tests by an independent body acceptable to NSW Health (such as the National Association of Testing Authorities (NATA) or equivalent) should carry out all analyses. On-line monitoring equipment should be calibrated weekly (or as per manufacturer's instructions).

The treatment system should also contain:

- On-line monitoring of turbidity, pH and disinfection efficiency of water leaving the plant.
- An alarm system to notify appropriate responsible persons if turbidity, pH or disinfection targets are not met.
- Automatic bypass of the supply system and return to sewer when readings do not satisfy compliance values.
- Suitable back-up to ensure a constant supply of water is available.
- Appropriate backflow prevention devices and any other requirements of the local water utility.
- Use of a pressure differential between potable and non-potable pipes
- Compliance with any other plumbing requirements for recycled water outlined in the most recent edition *New South Wales Code of Practice: Plumbing and Drainage*.
- Consideration of odour, noise and access issues.

Management and maintenance of the system

- The person or organisation responsible for the on-going management and maintenance of the system should be identified before the system is approved and detailed in the management plan.
- A management plan should be developed and documented. The plan should include details of the treatment process, routine sampling program, maintenance, emergency contact numbers, system failure procedures, auditing procedures to detect cross-connections and contingency plans for the management of sewage and water requirements in the event of system failure.
- An independent qualified plumber should conduct an inspection of the internal plumbing for the presence of cross-connections, before the occupation of the building and following any plumbing modifications.
- A suitably qualified person should carry out maintenance of the plant at least every six months.

What the water must NOT be used for

- Drinking, cooking or kitchen purposes
- Swimming pools
- Baths, showers, hand basins or personal washing
- Water contact recreation (eg playing under sprinklers)
- Irrigation of crops for human consumption without processing or cooking

Information and education

All residents and visitors will be made aware of the use of recycled water within the building and the permissible uses. This process will include informing all new tenants prior to moving into the building.
Contractors carrying out work on the building will also be made aware of the presence of recycled water and the need to ensure there are no cross connections with the potable water supply.
Appropriate warning signs will be erected on tap outlets.

Potable Rain Water - Brisbane

(INTERVIEWERS' INFORMATION)

Water Cultures – Stage 3, Nov/Dec 2005

Who is Brisbane Water?

Brisbane Water is a commercialised business unit of the Brisbane City Council. They provide water and wastewater services to Brisbane residents.

Australian Drinking Water Standards

The Australian Drinking Water Standards were developed by the National Health and Medical Research Council.

The Scientific Analytical Services is in charge of testing Brisbane water samples each year. They are a National Association of Testing Authorities (NATA) accredited facility for chemical and biological analyses and sampling of water, wastewater, soil and air.

Neighbourhood Treatment Plants

The treatment plant would be fitted with online monitoring devices designed to detect changes in water quality standard. In cases where it is detected that water quality drops below required standards, the treated water would cease to be pumped into the mains water supply until the problem had been resolved.

The plants would be about the size of a garden shed. There would be very little noise or odour coming from them.

Maintenance of Roofs and Gutters

It would be the owner's responsibility to maintain their roofs and gutters to a reasonable standard. This would be the case for rental properties too (that is, it would be the owner's responsibility, not the tenant's). The gutters would not have to be spotless, but free enough of debris so that all rainwater run-off can be harvested.

How would this be checked? Brisbane Water would carry out random inspections from time to time, or in response to reports, to check whether roofs and gutters were being maintained to a reasonable standard. In cases where roofs/gutters were not being maintained, Brisbane Water would request the home-owner to clear their roof/gutter. If the owner failed to do so after an allocated period of time, then Brisbane Water could impose a fine upon the home owner.

Water Tanks

No new private water tanks would be allowed to be installed for people whose houses were part of this supply system, however a householder would **not** be forced to remove an **existing** private water tank. Where there was an existing private water tank, that household would not be included as part of the water harvesting network in this water supply scheme.

Information and Communication

Standard information packs would be provided to all home owners in the area regarding the system's infrastructure, treatment processes, and the requirements of the home owner to maintain their roofs and gutters, and what constituted a "reasonable standard" of maintenance.

Recycled Water - Melbourne

(INTERVIEWERS' INFORMATION)

Water Cultures – Stage 3, Nov/Dec 2005

Neighbourhood Treatment Plant

<u>Location</u>: Neighbourhood Treatment Plants would be located close to where the treated water would be used most, usually near parkland or industry. However, as there would be one treatment plant per 200 houses, some houses will unavoidably be within close proximity of one.

<u>Above-ground or below-ground</u>: It may not always be possible (or desirable) to place the treatment plant below ground, as under-ground installation would be more costly, or could be restricted by the physical environment.

Health Authority Standards

The Health Authority in charge of setting standards for the treated water would be the Department of Human Services and the EPA. The standard would conform to existing guidelines for *Environmental Management: Use of Reclaimed Water*, developed by the Department of Human Services and the EPA to make sure that recycled wastewater is used appropriately. When developing these guidelines, health staff reviewed similar guidelines overseas and interstate, as well as medical literature. Workshops with reuse experts and other stakeholders were also held.

The Victorian guidelines comply with the national conditions for the use of recycled wastewater set by the National Health and Medical Research Council (NHMRC). They are also consistent with the US standards and the international requirements for the use of recycled water set by the World Health Organisation (WHO).

The guidelines outline four classes of recycled water that represent the minimum standards of biological treatment and pathogen reduction for defined categories of use. In this case, Class A, the highest level of treatment, would need to be reached. Approved uses of Class A water include:

- residential garden watering
- closed system toilet flushing
- process/cooling water for industry
- fire protection stores and reticulation systems
- irrigation of municipal parks and sportsgrounds
- water for contained wetlands or ornamental ponds
- food crops that are consumed raw or sold to consumers uncooked or processed

How do you ensure no mix up with drinking water?

Before the recycling scheme came on line, it would have to be ensured that the system was designed in such a way as to prevent cross-connection between reclaimed water pipes and drinking water pipes. This would be achieved through following Australian Standards (AS) for *National Plumbing and Drainage*.

The following checklist would need to be completed:

- Connection of the reclaimed water system into the potable supply system is not permitted.
- Install reclaimed water distribution systems in accordance with AS/NZS 3500 *National Plumbing and Drainage Code - Parts 1.2 and 2.2.*
- Identify all piping and conduits in accordance with AS 1345 *Identification of the Contents of Piping, Conduits and Ducts.*

- Ensure above-ground distribution systems are not laid closer than 100 millimetres from potable water pipes, and below ground distribution systems are not laid closer than 300 millimetres from potable water pipes.
- Ensure above-ground and buried facilities and water hose tap outlets in areas of public access are distinctively colour-coded (deep purple) and/or marked with the words: WARNING: RECLAIMED WATER — NOT FOR DRINKING.
- Install an approved registered air gap or backflow prevention device meeting the requirements of AS 3500 - AS/NZS 3500-1.2 where potable water is supplied into the reclaimed water system as make-up water.
- Identify distribution systems in accordance with AS 1319 *Safety Signs for the Occupational Environment.*
- Design reclaimed water irrigation piping systems in accordance with AS 2698.2 *Plastic Pipes and Fittings for Irrigation and Rural Applications*.
- Implement a field test and maintenance program of back flow prevention devices in accordance with AS 2845.3 *1993 Water Supply – Backflow Prevention devices. Field Testing and Maintenance*.
- Implement an inspection program for non-potable supply systems to residential areas in accordance with *National Plumbing and Drainage Code - Part 1.2.*
- Ensure that environmentally acceptable provisions are made for the cleaning and disinfection of the distribution pipe work to control biological solids and bacterial re-growth.

Monitoring

A monitoring program would be put in place in accordance with the EPA guidelines for monitoring the use of recycled wastewater for residential use. This would include the following:

Monitoring levels of:

- pH, BOD, SS, *E.coli*, weekly
- Turbidity and disinfection efficacy (eg chlorine) - continuously
- Disinfection daily
- Nitrogen and phosphorous

The treatment system would also need the following:

- An Environment improvement plan
- Appropriate signage in accordance with AS 1319 – Safety Signs
- Monitoring and auditing programs

The following checklist would need to be completed:

- Undertake the monitoring of reclaimed water in accordance with parameters and frequencies listed above.
- Cease supply if non-compliance triggers for Class A reclaimed water are exceeded.
- Undertake repeat sampling and testing immediately if the microbiological results exceed notification limits, and take appropriate action.
- Regularly inspect the treatment and disinfection systems in accordance with the frequencies above.
- Obtain, preserve and analyse samples of reclaimed water in accordance with the *Guide to the Sampling and Analysis of Waters, Wastewaters, Soils and Wastes* (EPA Victoria, 1999, Publication 441).
- Keep records of all monitoring results and analyses to demonstrate compliance with the Guidelines.
- Record and keep details of all inspection and maintenance programs on site.
- Ensure soil and groundwater monitoring reports include an evaluation of quality against the appropriate environmental criteria and trend analyses.
- Ensure the supplier of reclaimed water notifies the user of any non-compliance problems.
- Ensure the user of reclaimed water notifies the supplier of any non-compliance problems.
- Submit supplier and user emergency or incident reports (non-compliance with the objectives) in writing to the appropriate regulatory agency immediately.
- Submit annual reports to EPA Victoria detailing which reuse schemes are being supplied with reclaimed water.