National Research FLAGSHIPS

CSIRO

Structuring Dimensions of Risk: Technical and Community Perceptions of Risk in the Reuse of Wastewater for Irrigation and Indirect Potable Supply

Alison L. Browne, Zoe Leviston, Murni Po Greenhill,
Blair E. Nancarrow, David I. Tucker & Natasha B. Porter

December 2007

www.csiro.au

PREMIER'S WATER FOUNDATION

Enquiries should be addressed to:
Australian Research Centre for Water in Society
CSIRO Land and Water
Private Bag No 5
WEMBLEY WA 6913
Ph: +61 8 9333 6265 Fax: +61 8 9383 7193
E-mail: arcwis-enquiries@csiro.au

Copyright and Disclaimer

Important Disclaimer

Cover Photograph:

Description: Aerial view of Groundwater Lake in the suburbs of Perth, WA. 1975.

Photographer: Willem van Aken

ACKNOWLEDGEMENTS

This research was undertaken as part of the Premier's Water Foundation, an initiative of the Western Australian Government's State Water Strategy. The Grantee appreciates the assistance provided by the Premier's Water Foundation. It was also supported by the CSIRO Water for a Healthy Country Flagship Program and Water Corporation of Western Australia.

We would like to acknowledge the following project staff for assisting with the development and administration of the research design and methodology: Alexandra Fry, Peta Dzidic, Sengmanichanh Somchanmavong and Sarah Nicol. We would also like to thank all the participants in the initial focus groups and the Q-Method workshops.

ACRONYMS, ABBREVIATIONS & DEFINITIONS

HORT – Horticultural Irrigation

MAR – Managed Aquifer Recharge

POS – Public Open Space

PWF – Premier's Water Foundation

WA – Western Australia

Q-Methodology (also known as Q-Method) – Is a systematic methodology that can be used to reveal the distinct, personal and subjective combination of factors that underlie and influence peoples' decision making processes.

Q-Method Concourse/Concourse – a set of interconnected claims and statements that reflect the breadth of the themes and topics identified above.

Q-Statements (also known as Q-Sample) – Are a reduced set of statements from the initial concourse that is established by eliminating repetitive statements, and incorporating the widest possible number of themes in the final Q-Statement set.

Q-Sort – The compiled Q-Method scenario, conditions of instruction and statement sets that participants are asked to complete.

CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

This report describes current results of the Managed Aquifer Recharge (MAR) research program designed to systematically investigate major factors governing people's behavioural intentions to use or reject recycled wastewater when the water's use involves different degrees of personal contact.

Investigations into the scientific and community requirements of MAR are presently the focus of a major, multi-disciplinary study being funded under the Western Australian Premier's Water Foundation. The social science contribution reported here investigates the role of risk perception relating to indirect potable reuse, horticultural irrigation, and the watering of public open spaces. Stage One of the MAR program conceptualised a behavioural model designed to identify the key psycho-sociological variables predicting people's intention to support or reject an indirect potable MAR scheme. A major theme to emerge from this stage was the prominence and diversity of risk perceptions associated with the scheme amongst the community. Also of interest is the contribution of risk perception in determining people's decision-making in support or in protest of an indirect potable MAR scheme. An emergent theme of risk perceptions is the differences between the community's perception of risk and the technical perception of risk. Other important issues involve the association between trust in agencies, different types of risk and the supposed 'emotional-rational' dichotomy.

This report contains the results and interpretations of Stage Two of the MAR social research program. The research program involved initial scoping focus groups, workshops and interviews with both technical experts working in the MAR field and general community members. While exploratory in nature, the content of the activities were structured upon the findings from Stage One of the research program and informed by theoretical considerations. In response to the scoping activities, a Q-Method research methodology was implemented. This research methodology engaged an innovative technique to explore, in greater detail, (i) community perceptions of risk for different fit-for-purpose uses, (ii) professional perceptions of risk, and (iii) professional perceptions of *community* perceptions of risk.

Q-Method was employed to explore the different structures of perceived risk, and also the relationship of these different risks (e.g., systems, environmental, personal health risks) in relation to other concepts such as trust, disgust, and emotion/affect. Other factors emerged through the scoping phase that were analysed to assist in developing the Q-Method. Factors included (i)unknown risks, (ii)uncertainties, (iii) perceptions of management of MAR and other water supplies, (iv) relative/competitive risk, (v) choice, (vi) tolerability and resignation to risk, (vii) political risk factors, (viii) population health risks, (ix) intergenerational issues, (x) aesthetics, (xi) financial risks,(xii) perceptions of scientific and community responses to risk, (xiii)alternative futures, and (xiv)broader societal issues.

Q-sorts relating to indirect potable water, horticultural irrigation and public open space MAR schemes were administered to community members from the northern suburbs of Perth[1], while technical stakeholders and water professionals completed an indirect potable water MAR scheme Q-sort. Technical and professional groups were also required to complete the indirect potable water Q-sort from their perspective of a 'typical' community member. The analysis supported previous ARCWIS research that the specific fit-for-purpose use of the water informs the decision-making framework. That is, different typologies of decision-making emerged for each of the different fit-for-purpose uses, indicating that people use different criteria on which to base their decisions for each water use activity. An analysis of the community Q-sorts revealed a high level of heterogeneity. This was in contrast to the technical perceptions of community, which revealed a much higher level of homogeneity in perceived community opinion.

[1] The proposed indirect potable MAR scheme will principally supply the northern suburbs of Perth

The results have several implications for the implementation and management of schemes, including the importance of dealing with unknown risks, the importance of communicating MAR contextually amongst other water augmentation options, and formulating community inclusion to support the complexity of their perspective beyond the yuck factor. Q-method itself presents as a valuable tool for understanding and tracking community opinion over time. As more information becomes available to the community, and as different issues come to the fore, a barometer of changing risk perceptions may be a valuable informant for implementation and community involvement strategies.

1.0 INTRODUCTION

Reusing wastewater that would otherwise be discharged to an outfall has now become an integral part of policy for Australia's water resource management. One reuse scheme under consideration involves the infiltration of treated wastewater into drinking water aquifers. This reuse method, commonly known as Managed Aquifer Recharge (MAR) or groundwater replenishment as it is publicly referred to, is considered by the Water Corporation of Western Australia to have major potential to secure Perth drinking water supplies into the future. It is thought that MAR could also assist in maintaining the environmental sustainability of the aquifer Perth relies on for much of its drinking water supply. The technical viability of using MAR in Perth is currently being explored and discussed within the scientific and wider communities. Trials involving MAR for both non-potable and indirect potable uses are occurring increasingly in urban Perth and in regional areas. It is the focus of a major, multi-disciplinary study being funded under the Western Australian Premier's Water Foundation. The work reported here is one aspect of those investigations.

While advancements in treatment processes have broadened the range of potential uses and sources of recycled water, the successful implementation of any reuse scheme hinges on public acceptance. As an option for responsible water resource management, water reuse is widely promoted by the Australian community. Nation-wide and interstate research has generally found people to be accepting of water reuse as a concept (e.g. Kaercher, Po & Nancarrow 2003; Marks, Martin & Zadoroznyi 2006; Melbourne Water 1998; Sydney Water 1999; Water Corporation 2003). However, reactions from people when it comes to actually using the water are frequently quite different, as has been shown in the 2006 referendum in Toowoomba, Queensland. Water recycling is seen to be a logical and necessary inclusion in the range of water resource management options, but communities frequently feel a reluctance to use the water where close personal contact occurs. Until recently little has been known of how people make their decisions to accept different water recycling schemes for a range of different uses. What was apparent was that many technically sound reuse schemes around the world have failed because communities have rejected them, often at the eleventh hour (Po, Kaercher & Nancarrow 2004).

Worldwide, there has been little in the way of systematic programs of social investigation to identify the factors that might influence public perceptions or mediate their decision-making about reuse schemes. This report describes the most recent work in the MAR program that has been designed to systematically investigate the major factors governing people's behavioural intentions to use or reject recycled water in schemes where the water's use involves close personal contact (e.g., drinking, bathing, food preparation) as well as when it is used for less personal contact (watering public open space, crop irrigation etc).

1.1 Previous Research by ARCWIS

Po, Kaercher and Nancarrow (2004) identified a number of factors that influence the acceptance of water reuse in Australia. Further studies have focused upon predicting community behaviour in relation to wastewater reuse and the role of these factors (e.g., Leviston, Nancarrow, Tucker & Porter 2006; Po et al. 2005). Based on previous research, issues such as (i) disgust or the 'yuck factor', (ii) perceptions of risk associated with using recycled wastewater, (iii) specific uses and sources of water to be recycled, (iv) choice, (v) trust in authorities and scientific knowledge, (vi) attitudes towards the environment and environmental justice issues, (vii) cost, and (viii) socio-demographic factors have been hypothesised as influential factors when exploring risk in relation to MAR with recycled wastewater.

Leviston et al's (2006) report showed that although half of the respondents to a community survey responded that they would drink water provided by an MAR scheme in Perth, large percentages of respondents scored

only moderately when asked in more detail of their 'intended behaviour' toward the scheme. This community survey highlighted that different types of perceived risk (health risk and systems risk) significantly contribute to predicting 'intended behaviour' (Leviston et al. 2006). However, correlations between risk, trust, emotion, fairness and subjective norm[2] suggest that the relationship between risk and 'intended behaviour' is best understood in the context of their relationship with other variables. To aid the understanding of the role of emotion, trust and risk perceptions, and how these 'factors' interact to influence peoples' intended and actual behaviours, an initial set of research questions emerged:

- What is the community's idea of acceptable levels of risk?
- Is the community's idea of acceptable level of risk compatible with what the scientific community deems acceptable?
- What is it exactly that people want to be reassured of?
- How is risk perception associated with trust?
- What is the role of environmental risk in people's decision making?
- If a scheme was created where only a selection of the population was affected, how would that shape considerations of fairness?
- Are there links between environment, health and systems risks and sustainability?

The objective of the current study was to adopt a research methodology that facilitated the further exploration and refinement of findings from previous stages of research, and to establish an understanding of the structure of these different risk and other dimensions for people when making decisions about MAR for a range of fit-for-purpose uses.

2.0 THE CURRENT STUDY

The current study aims to further expand on issues that shape community attitude, decision making and behaviour towards water reuse. Previous research by ARCWIS and exploratory focus groups and interviews with both technical experts and members from the general community has shown that these issues are complex, amorphous and do not have an easily definable structure that could be used to provide clear outcomes. To allow the complexity of these perspectives to be maintained while uncovering any patterns in the way people were structuring their decision making around the indirect potable supply, a Q-Methodology (also known as Q-Method or Q-Sort) approach was implemented. Continuing on from previous research by ARCWIS, the study explores in greater detail the main characteristics of risk and perceived risk around MAR schemes for different fit-for-purpose uses, from both the perspective of the technical experts and the general community.

[2] Subjective norm is the influence of the views and opinions held by people the respondent considers important.

2.1 Study Objectives

The specific objectives of the current study are as follows:

- To understand the different components of risk and the importance of each component in decision making around MAR;
- To explore the structure of factors that underlie different decision making processes for people when making decisions for different MAR scenarios;
- To ascertain the importance of risk relative to other factors (a quasi-confirmatory objective following on from Stage 1);
- To explore the differences and similarities of dimensions of decision making between general community and technical expert stakeholders;
- To explore the perceptions of technical expert stakeholders about the way community constructs risk associated with recycled wastewater.
- To explore the implications for planning, implementation and management based on the dimensions that emerge from Q-Method.

3.0 RISK

While in its early stages, the multidimensionality of risk and its importance in understanding attitudes and decision making in regards to water issues is coming under increasing focus. For instance, in a study designed to understand the role of consumer risk perception in water use planning, Baggett, Jeffrey and Jefferson (2006) found the most pressing risk issues for domestic consumers revolved around health, economic, ecological and monitoring concerns.

The difference between actual risk and perceived risk is an important distinction when exploring community and technical perspectives to risk, and the discourse of risk around MAR. Perceived risk refers to subjective evaluations of risk inherent in a given situation. Broadly, it applies to any process with potentially negative consequences, or any hazard that is publicly perceived and discussed as a risk (Bayerische 1993). Slovic (1987) has suggested that risk perceptions may vary between experts and lay citizens. The perceptions of risk by experts are often based around the number of lives at stake and the probability of harm, with subjective factors being treated as ‘accidental’ dimensions of risk (Po et al. 2004; Slovic 1987). Lay citizens, it is suggested, focus on a more complex set of considerations (Slovic 1987). Risk perceptions can be described in terms of dread risk (e.g., perceived lack of control, perceived catastrophic potential, feelings of dread), and unknown risk (e.g., hazard judged as unobservable, new, unknown, delayed in producing harmful impacts) (Slovic 1987).

The distinction between risk perceptions however may not be as clear as the binary distinction between perceptions of risk as dread or as unknowns. Frewer (1999) also warned that risk perceptions should not be used as sole explanatory devices for understanding perspectives on emerging technologies.

The inclusion of ethical concerns, trust/distrust (e.g., in regulators, information providers, scientific institutions) and perceptions of social exclusion from (risk) management, also can be used in order to understand reactions, responses and resistance to 'new' technologies (Frewer 1999). This complex relationship of risk with other factors has been captured in previous research by ARCWIS (Leviston et al. 2006).

Perceptions of risk may also include the distinction between personal and impersonal risks, and the relevance of the risk to people. Although it has not been explored directly in relation to MAR, in the health communication literature the difference between direct personal threats versus impersonal threats not seen as posing a direct personal threat has been explored (Kahlor et al. 2006). In summarising much of this literature, Kahlor et al (2006, p. 166) suggested that "… research on health communication has shown that perceived personal relevance is a powerful predictor of individuals' use of health related messages"(cf. Biek, Wood & Chaiken 1996; Liberman & Chaiken 1992; Markova & Power 1992; Stockdale, Dockrell & Wells 1989).

Keeney and von Winterfeldt (1986) called for the incorporation of the personal relevance of risk in risk communication literature. That is, there is a need to reduce the reliance on quantifiable risk characteristics in favour of qualitative characteristics that are meaningful for people including the lay community (Keeney & von Winterfeldt 1986; Kahlor et al. 2006). Kahlor et al (2006, p. 167) have suggested that "the primary distinction that differentiates impersonal risks from more personal risks is the focus on something other than personal safety – oftentimes, that focus is on values or distinct others…. The more immediate perceived impacts are on groups of people or geographic entities rather than the individual". Campbell (2006) has described these features as objective, subjective and relative risk in relation to the harm component (or actual risk).

Developing understanding of the types of risks that may be perceived, and their relationship with actual risks in MAR from recycled water involves disassembling and reconnecting a wide range of personal and impersonal (or societal) worldviews about a range of risks and other factors. The purpose of using Q-Method to explore complex relationships is to develop understandings of broad attitudinal and emotional frames through which people view, judge and make decisions about MAR for a range of different fit-for-purpose usage options (Peters, Burraston & Mertz 2004).

4.0 USING Q-METHOD TO EXPLORE THE DIMENSIONS OF MAR AND RISK

Q-Methodology has been used in a number of disciplines such as community and social psychology, political sciences, ecological economics, and human/cultural geography to analyse the structure of discourse (Eden, Donaldson & Walker 2005; Previte, Pini & Haslam-McKenzie 2007; Robbins & Krueger 2000; Stephenson 1953; Swedeen 2006). In a number of these fields Q-Methodology has been extended to explore topic areas such as public perceptions and risk, sustainability, environmental policy including forest and ocean management and climate change, and nuclear technologies (Barry & Proops 1999; Niemeyer, Petts & Hobson 2005; Simmons and Walker 1999; Swedeen 2006; Tuler, Webler & Finson 2005; Webler, Tuler & Krueger 2001; Webler & Tuler 2006). The power of Q-Method lies in revealing patterns of relationships between factors that are unexplained by current hypotheses about certain issues in science domains, and can be effectively integrated to inform public policy processes (Robbins & Krueger 2000; Schofield 2002; Steelman & Maguire 1999).

While Q-Method is an approach that is gaining a relatively solid foothold in 'sustainability sciences', it has yet to be used in exploring recycled water in any research or policy setting. Given its utility in other complex settings of sustainability and environmental policy, and the issues to be explored in this second stage of the project, it is a practical methodology with which to explore the complex interactions of risk and other factors in MAR, and their policy implications.

Q-Method is an approach that facilitates the exploration of issues and statements around a particular topic and the range of viewpoints shared by a particular group of participants (Previte et al. 2007). The methodology involves participants sorting through statements as instructed (e.g., extent to which a participant agrees/disagrees with a statement, or in the case of this research how like/unlike a statement is to their point of view). The statements are chosen to capture the range of issues that are often presented around a particular discourse or topic (McKeown & Thomas 1988; Previte et al. 2007; Simmons & Walker 1999). The statements in the this research program have been derived from past research and archival analysis, policy and media analysis, interviews, focus groups, semi-structured interviews and surveys.

Q-Method is also an approach that highlights subjectivity in people's decision making processes. It can be used to explore linkages between subjective understandings and peoples' specific actions or inaction (Robbins & Krueger 2000). When administered to a larger sample, it can be used to capture a range of viewpoints favoured, shared or disparate between particular groups of participants (Previte et al. 2007). Q-Method captures the subjective experiences of people (and their personal points of view) around a certain issue, and the patterns between these factors across individual people, rather than the patterns between people across a range of variables as in other survey methods (Robbins & Krueger 2000). The current application of Q-Method aims to both reveal the subjectivity of people's decision making, as well as capture the range of viewpoints across technical and lay stakeholders. Q-Method maintains the factors that influence people's decision making during statistical analyses which allows an exploration of each participant's 'subjective' response (Robbins & Krueger 2000).

As Q-Method can be used to explore both the subjectivity of decision making and the shared or disparate viewpoints between different groups of participants, it is a useful methodology for exploring the differences and similarities in community and technical perspectives of risk for MAR. For example, community is often treated as a 'space' between states and markets - an idealised and homogenous community that is dichotomous to experts and often viewed nostalgically by policy and scientific stakeholders (Rose 1999; Shofield 2002). As Shofield (2002, p.679) suggests "it is generally assumed that (i) community exists as a pre-given area of social life; (ii) this domain is a fixed, homogenous space; and (iii) it can be conceived of as a realm beyond the immediate control of the state" . However, what Shofield (2002, p.663) adds is that there is a "different way of thinking about community", other than analysing social relationships between members of the lay community and experts as entrenched opposites. Analysing assumed opposition and difference could reduce the understanding of the range of possible responses to a proposed MAR scheme, as a choice between competing alternatives in which stakeholders can only be 'for' or 'against' the scheme (Shofield 2002). For example, constructing the community as a group distinct from expert professionals may result in a failure to see 'pockets' of community who may think similarly to 'experts'. Composing the community as a homogenous group may also mean that the diversity of accepting, uncertain, ambivalent or rejecting opinions may not be captured, with strong implication for policy and communication strategies. Q-Methodology is an approach that can be used to explore the similarities, differences, and points of disjuncture within and between community and expert professional groups.

There may be various conditions for tolerability and acceptability of the scheme for both technical experts and community stakeholders. Understanding heterogeneity of opinion and perspectives means that specifically targeted strategies can be put into place to more effectively address the wide range of potential responses to a MAR scheme being implemented for a range of different fit-for-purpose uses by both technical and community stakeholders. This process of comparing groups of peoples' perspectives, that is,

getting the respondent to think about how another type of person would organise the statements, has also been used by Eden et. al (2005).

Preserving the subjective factors and patterns of decision making may pick up the subtle nuances in the relationships between trust, risk, emotion and other issues when it comes to MAR for drinking water purposes. Q-Method should reveal the distinct, personal and subjective combination of factors that underlie and influence peoples' decision making processes. Understanding the range of issues that influence perspectives of MAR is highly complex, and is influenced by a range of issues that extend from the personal and emotive, to the societal. The advantage of using Q-Method as a methodology to assess perceptions of risk in recycled water is that it reflects the highly complex structuring of opinions, judgements and understandings of risk (Robbins & Krueger 2000; Simmons & Walker 1999; Stainton-Rogers 1998). Q-Method is a non-reductive technique that opens up multiplicity, complexity, tension and inconsistencies in a certain issue domain (Previte et al. 2007). Using Q-Method to build upon the findings from Stage One of the research program and the scoping phase of Stage Two has facilitated the exploration of the broad range of individual, cultural, social and historical issues that influence perceptions of risk of recycled water.

5.0 METHODOLOGY

This section details the steps taken in the present study to develop and administer Q-Sort – rankings by participants of a set of statements formulated as part of Q-Method. As this is a methodology new to the setting of recycled wastewater, a detailed account of the method is included to assist with interpretation and analysis in the later sections of this report. Table 1 indicates phases leading to Q-Sort application.

Table 1. Summary of the Q-Methodology process

Stage	**Details**
Scoping & Q-Method development phase	Literature review
	Community focus group
	Follow-up interviews with community participants
	Technical focus groups
	Archival data collection (incl. ARCWIS research, media and other sources)
	Development of concourse, Q-Sample and scenarios
Q-Sort Administration	Technical experts & general community

5.1 Scoping & Q-Method Development Phase

The scoping phase was designed to develop the following:

i) an understanding of the underlying themes and topic areas (this is called the discourse) about the use of recycled wastewater for indirect potable supply for a range of fit-for-purpose uses; and

ii) a set of interconnected claims and statements that reflect the breadth of the themes and topics identified above (this set of statements is called the concourse).[3]

The topic areas (discourse) in the study relates to people's perceptions about using recycled wastewater from a MAR scheme for a variety of purposes, as well as issues of trust, different forms and types of risk, and the role of emotion in relation to community and technical professionals. ARCWIS research has previously explored risk, as detailed at the beginning of this report. The study has been informed by other research exploring other issues involved in recycled wastewater in the public domain (e.g. Turner, 2006), to develop an understanding of the current range of issues and ideas being used to explore the use of recycled wastewater.

The development of a concourse for a Q-Method study involves capturing a range of statements that reflect the broadest possible combination of issues surrounding a particular topic. The concourse can be derived by 'naturalistic' methodologies, with statements largely derived from 'ready made'[4] sources and the research process itself (Previte et al. 2007; Simmons & Walker 1999). The concourse sources can also be 'quasi-naturalistic' in that they are derived from sources that are external to the study, such as from other research programs or other stages of research.

The concourse of statements for the current study was developed as a 'hybrid' (McKeown & Thomas 1988) made up of 'naturalistic', 'quasi-naturalistic' and 'ready made' items. In particular, it was developed from previous ARCWIS studies, community and technical focus groups, individual unstructured and semi-structured interviews, literature reviews, media and other sources of public comment. The aim of developing and refining this concourse was to capture a broadly representative and diverse set of statements which reflected the whole issue 'domain' and perspectives on MAR (Watts & Stenner 2005; Previte et al. 2007).

During the concourse development, the research team built up a statement set which identified different assertions on the topic from each of these 'data' areas[5]. Although we relied on previous research to guide the structuring and development of the concourse and the statements, a number of the categories and themes used emerged from the data. The scoping activities revealed many issues, beyond ideas of perceptions of risk captured in our previous research, that appear to influence both technical and community acceptance or resistance to using recycled wastewater through various MAR schemes. It was decided that it was important to include these in the present study to enhance understandings of the way risk and risk perceptions operate, amongst other influential factors.

[3] In Q-Method, the concourse refers to "the flow of communicability surrounding any topic" in "the ordinary conversation, commentary, and discourse of every day life" Brown (1993).
[4] 'Ready made' (naturalistic) sources include letters to the editor, newspaper and magazine reports, interviews, editorial positions and other private and public communications and media.
[5] A concourse is complete when no more diversity of opinion is uncovered through further interviews or other forms of data collection; that is, when saturation is reached

5.2 Structure of Concourse for MAR – Risk Concepts and Themes

The final concourse for the MAR Q-Method included the following:

- different elements of risk:
    - unknown risks/uncertainties;
    - system failure risk;
    - relative/competitive risk;
    - political risk;
    - personal health risk;
    - population health risk;
    - intergenerational issues and risk;
    - financial risk;
    - environmental risk;
    - perceptions of scientific and community responses to risk;
    - chemical/toxicological risk;
    - voluntary versus imposed risk; and
    - tolerability and resignation to risk.
- emotion – the 'yuck factor';
- trust;
- time in aquifer;
- aesthetics and water quality;
- geographical location and fairness;
- fairness (general);
- alternative futures;
- perception of abundant supply;
- societal issues; and
- management (including scientific, policy and infrastructure management/knowledge)

Although a lot of the themes and concepts that emerged in the development of this concourse are termed 'risk', the research team acknowledged the difference between 'actual' risk, and people's risk perceptions. Considerations of the differences between risk and risk perceptions, and impersonal and personal risk, also informed the development of the themes and concepts for the Q-Method concourse. The following sections contain overviews of the main risk concepts and theme categories that were developed as a part of this study. Appendix 3 lists statements for themes and categories for the public open space and horticultural irrigation, and indirect potable supply.

5.2.1 Unknown Risks and Uncertainties

Risk can be unknown and uncertain – in terms of the uncertainty of the predicted risky event actually occurring, and through disagreement amongst experts about the uncertainties (Blowers 1997). Uncertainty is classified in several ways, such as (i) general situational uncertainty, (ii)legal-moral uncertainty, (iii)social uncertainty, (iv) institutional uncertainty, and (v)uncertainties determined by rights and interests of property and privacy (Funtowicz and Ravetz 1990). 'Unknown risks and uncertainties' emerged from both the literature and the data derived during the scoping phase. Unknown risks and uncertainties involve future-oriented perceptions of potential risky events, (i) perception of what is actually unknown, (ii) what is not scientifically known, and (iii) emergence of knowledge that could reveal more risks in the future. Studies have suggested that people do not use the same or global frames of reference to judge risky or uncertain situations (Beckwith 1996; Syme & Bishop 1992). Unknown risks and uncertainties theme attempts to capture the research that explores subjective risks in the face of conflicting scientific information, and the uncertain status of scientific information (Cameron 2005; Thalmann & Wiedemann 2006).

5.2.2 Systems Failure Risk – Mismanagement/Monitoring

Systems failure risk as a category includes human aspects of management and monitoring that could contribute to systems breaking down. Different levels and layers of systems failure emerged from the technical scoping workshops. For example, systems failure could include issues of governance, technological systems, individual negligence and failure, regulatory issues, or the impact of scientific uncertainties of systems risk.

5.2.3 Relative/Competitive Risk – Risk Compared to Other Risks/Water Sources

Relative and competitive risk emerged as a theme by capturing the way people talked about the risks of MAR *relative* to other risks. Risks were related to current supplies of water, and in other areas of everyday life.

5.2.4 Political Risk – Risk to Political Domain, Community Backlash

The theme of political risk emerged as a means to express the way in which political interests could compromise the implementation of the scheme or effectiveness in running of the system.

5.2.5 Population Health Risk; Intergenerational Issues; Personal Health Risk – Family Health, Personal Cumulative Risk

Three themes characterise a broader discourse surrounding MAR that in particular is concerned with health risks. Personal health risk includes issues such as family health, individual risks and issues, personal cumulative health issues, and the influence of population health issues on personal life. Research has shown that women tend to talk about, and prioritise health risk associated with recycled wastewater and MAR (Bord & O'Connor 1997) and appear to be less accepting of water supply schemes involving wastewater (Leviston et al. 2006). These findings suggest different people have different vulnerabilities in risk perceptions (Adger, 2000; Bord & O'Connor 1997). Population risk involves perspectives on the risks to population health such

as the impact on reproductive health and fertility. Intergenerational issues include the risks posed to both current and future generations of children and young people.[6]

5.2.6 Financial Risk

Financial risk is constructed of statements that capture the economic characteristics and risks of the MAR scheme identified during the scoping phase.

5.2.7 Environmental Risk

Significant concern about risks to the environment through the various MAR scenarios arose during discussions in technical and community scoping workshops. Risks *to* the natural environment or aquifer were questioned as described in other studies by Böhm and Pfister (2000).

5.2.8 Perceptions of Scientific and Community Responses to Risk

Peters, Burraston and Mertz (2004) have suggested that risk perceptions are largely emotional, and that these emotions are linked to people's judgements and assessments of technologies and communications about those technologies. Subjective risk and emotion appears to be an important factor, particularly in the face of the uncertainty of science (Cameron 2005; Thalmann & Wiedemann 2006). Thalmann and Wiedemann (2006) discussed this in terms of technology debates and the uncertainty of scientific knowledge and emotional discussions between stakeholders. They found that beliefs influenced judgements and highly emotive information polarised beliefs and risk appraisals. Perceptions of scientific and community responses to risk and beliefs about 'the other' people involved in making decisions around MAR did appear to polarize the perceptions of others' risk appraisals. The inclusion of this category is to trial how perceptions of other responses to MAR influence thinking and decision making.

5.2.9 Chemical and Toxicological Risk

Chemical and toxicological risk was developed from detailed discussions in technical and community scoping workshops which revealed an array of concerns. Although presented in 'layperson' terms, the category contains statements about (i) faith in filtration and treatment, (ii) common statement from community about not being able to account for what is in the waste stream, and (iii) perceived scientific knowledge gap about the long-term build up and consequences of the mixing of different chemical compounds and organic pollutants.

5.2.10 Voluntary versus Imposed Risk

This category emerged as community members reflected upon the difference between risks taken as a choice or a voluntary action, and imposed or involuntary risks. The category also included a *perception* of choice even with imposed risk.

[6] Although intergenerational issues, it could be argued, include more than just the impacts on children and young people, the discussion about intergenerational issues in the scoping phases

5.2.11 Tolerability and Resignation to Risk

Tolerability and resignation as a risk category reflects a number of comments by participants, particularly from community focus groups, about levels of tolerability of certain risks associated with recycled wastewater and MAR. Tolerability and resignation reflects concerns and perceptions of limited water supply and impacts on personal lifestyle. Also expressed was a sense of lack of control over outcomes of the scheme and perceptions regarding the salience or strength of the debate. Concerns were over the newness as a social issue, and opinions that water reuse may be tolerated in the future once it becomes more familiar or is proven to be 'safe'. The category also reflects theoretical concepts about tolerability of risk, where risk is broken into three categories, (i) a broadly acceptable region, (ii)a zone where risk needs to be considered carefully, and (iii) an unacceptable region (Blowers 1997; Simmons & Walker 1999).

5.2.12 Emotion – The Yuck Factor

Much of the available literature captures people's sensitivity and disgust, particularly when actions involve ingestion of 'disgusting' materials (e.g., Charash & McKay 2002). Disgust is often linked to the principles of contamination (Charash & McKay 2002; Marzillier & Davey 2004), and is described as a defensive emotion (Charash & McKay 2002). The stigma of wastewater exists as an emotive/cognitive feature that can influence decision making, despite expert based reassurances of its safety.

5.2.13 Trust

Trust includes trust in government regulators and operators and science, as well as elements of individual trust and trust in systems to 'mediate' risk (e.g., Leviston et al. 2006; Sjoberg 2001). It is also a dynamic and fluid property of relationships between people in the public and private sectors (Kjoernes et al. 2006). General trust is a belief that other people can be relied on, and this type of trust involves risk and vulnerability which is important when familiarity is low (Luhman 1988, 1998). General confidence, on the other hand, involves the conviction that everything is under control, uncertainty is low, and is based on high levels of familiarity (Luhman 1988). This distinction may be important in the context of MAR as there are varying levels of familiarity with the system, science and policy between and within technical and community groups. It is also important to reflect that objects of trust are persons, but confidence can be in anything, including systems. (Luhman 1988; Hamilton & Sherman 1996; Marks & Zadoroznyj 2005; McDonnell 1997). As faith and trust (or lack of) are cited as the most common reason for not accepting indirect potable recycling it is an important issue to explore, particularly its relationship to risk (Stenekes et al. 2006).

5.2.14 Wastewater - Time in Aquifer

This refers to the concept that, over time, treated wastewater diffusing into the aquifer will osmotically acquire the properties of residual aquifer waters. This perspective may originate from technical considerations (i.e., based on biochemical properties and rate of dispersion), or may have more intuitive underpinnings basis. For instance, it has been suggested that introducing extra processes between the source of wastewater and the tap, such as passing the wastewater through wetlands or injecting it into aquifers, facilitates people's ability to ignore perceptions of contamination associated with a particular source (Dingfelder 2004). This has been supported by research finding that intended behaviour toward wastewater schemes less positive once the aquifer (as a receiving/intervention body) is removed (Leviston et al. 2006).

5.2.15 Aesthetics

Aesthetics is simply a concern about the aesthetic quality of water produced by a MAR scheme, such as the smell and taste, and visual impressions. There are different aesthetic qualities and requirements for drinking water and irrigation which are reflected in the statements.

5.2.16 Geographical Location and Fairness

Geographical fairness relates to issues where schemes impact disparately on a given community. In this instance, only those living in areas where scheme water is supplied by the particular underground aquifers will be affected – recycled wastewater will be piped to only *their* houses, used to water *their* local parks and gardens and so on. That one section of the community could benefit from a more sustainable water supply at the (perceived) expense of the other generates issues of fairness and distributive justice. Focus group discussions highlighted that issues of geographical fairness not only play a part in the 'selfish' direction (the 'why should I do it if they don't have to?' sense) but also in a more altruistic, cohesive sense (the 'we should be all in this together' sense).

5.2.17 Fairness – in general

Fairness highlights an issue that is commonly raised by community stakeholders i.e., - that polluters and industrial and commercial users of water should use recycled water before it is used for other purposes (such as drinking).

5.2.18 Alternative Futures

When considering the risks associated with MAR, many people often cite examples of alternative water futures that are more acceptable to them than recycled wastewater. This sense of alternative can be defined at two levels i) technical/ technological/ government based changes and processes, and ii) personal responsibility and choice at a personal level.

5.2.19 Perceptions of Abundant Supply

Perceptions of abundant supply as a category attempts to capture people who believe that water management is appropriate in Western Australia, and who may not perceive there to be a 'water crisis'. Perceptions of abundance also reflect issues emerging from scoping activities concerning the possible introduction of an alternative water supply which may encourage greater water usage in the community.

5.2.20 Societal Issues

Societal issues as a category captures peoples' reflections on national and international level issues influencing people's perceptions of recycled wastewater schemes such as indirect potable supply. The theme highlights, for example, the comparison of the use of recycled wastewater at an international level, and the extent to which the participants see this issue as a fundamental community and societal debate.

5.2.21 Management – Scientific, Policy and Infrastructure Management/Knowledge

The 'management' component of the concourse is comprised of scientific information, government policy, infrastructural management and knowledge to reduce or prevent risks. Legal and legislative frameworks, and harm reduction/minimisation are included in this theme.

5.3 Q-Method Administration

The final phase involved the development of a Q-Sample and the set of Q-Statements. The initial concourse started at 584 statements which were reduced to 62 statements for the final list. The initial list of statements was decreased by eliminating repetitive statements, and incorporating the widest possible number of themes in the final Q-Statement set. Appendix 3 contains the final Q-Sample for each of the different 'usage scenarios'. This research activity also involved the refinement of research questions thereby acting as a set of conditions or instruction for the Q-Method process (Previte et. al. 2007). This involved piloting the statements, scenarios and procedure and making suitable amendments to experimental materials.

Q-Method is sued with smaller sample size as the method is not concerned with generalisability of results sample size is often between 30-40 sorters (Addams 2000). In fact Previte et al. (2007, p.139) have suggested that "a larger number of participants can be problematic, because they negate the complexities and fine distinctions which are essential features of qualitative techniques". In order to apply a separate analysis using community and technical groups, sampling of approximately 30 people from each sub group was sufficient.

5.3.1 Community Workshops

Participants were selected from a range of northern Perth suburbs whose drinking water is supplied by the aquifer to be replenished by the treated wastewater. A random selection of participants were invited from the participating suburbs to attend five community workshops, detailed in Table 2.

Table 2. Suburbs chosen for the community workshops

Workshops location	**Suburbs selected**
Connolly	Connolly, Edgewater & Heathridge
Bayswater	Bayswater, Inglewood & Bedford
Warwick	Hamersley, Carine & Greenwood
CSIRO (two sessions)	Jolimont, Floreat, Innaloo & Wembley

5.3.2 Technical Workshops

Participants were chosen who (i) attended the technical scoping focus groups, and (ii) those who did not attend the focus group when originally contacted but expressed a willingness to be involved in future stages of the research. The sample for the technical Q-Method included participants from CSIRO, Water Corporation, University of Western Australia, Department of Water, Department of Health, and Department of Environment. A number of staff from ARCWIS were also included in the technical expert sample, in the capacity of social technical professionals working in the area of recycled wastewater and risk. The inclusion of ARCWIS staff in the technical sample is a methodologically consistent with Q-Method, as researchers themselves can be included as a subject for the Q-Method study along with other participants (Dryzek 1990; Swedeen 2006). Inclusion also facilitated a process of self-reflection by the researchers in observing their own opinions and analysing their own results and interpretations of them in the context of Q-Method.

5.3.3 Workshop Procedure

Community members were asked to complete a Q-Sort relating to a drinking water scenario and either a public open space *or* a horticultural irrigation scenario. Technical professionals were asked to complete a drinking water scenario Q-Sort and drinking water Q-Sort from the perspective of a community member. Table 3 provides a breakdown of administered Q-sorts. It was decided not to include a third sort, for example a community perspectives of a technical sort, was not conducted to prevent participant fatigue.

Table 3. Number of participants performing Q-Sort for each condition of instruction

Scenarios	**Community**	**Technical**
Drinking	37 (all)	20 (all)
POS	19	-
Horticulture	17	-
Perspective of Community Drinking Water Sort (Technical Experts)	-	14

Participants were given a specific scenario for MAR (e.g., for drinking, public open space irrigation, or horticultural irrigation), which included a common condition of instruction (Appendix 1 & 2). The condition of instruction was a simple request to sort the statement cards according to statements most representative of their viewpoint (+5) and most unrepresentative of their viewpoint (-5) (McKeown & Thomas 1988; Robbins & Krueger 2000). Participants were presented with the scenario and procedures (Appendix 2). As they read through the cards, they were asked to sort the statements into three piles of cards, (i) most like their point of view, (ii) most unlike their point of view, and (iii) cards they felt uncertain about or neutral towards (Tuler et al. 2005). They were then asked to place the cards on the board according to whether the statements were unrepresentative or representative of their viewpoints (-5 to +5), as set out in Figure 1.

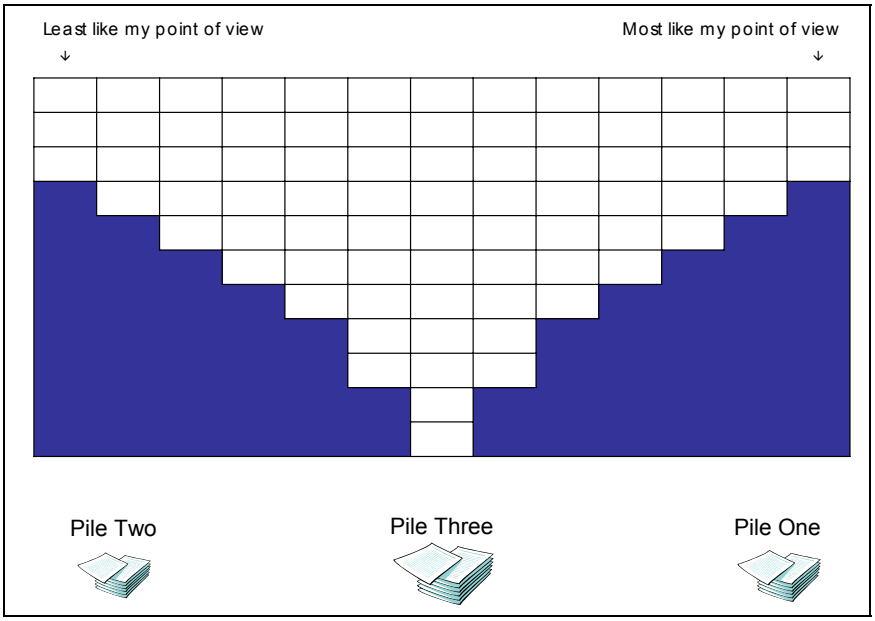


Figure 1. Q-sort board

Most Q-Methodology studies use a forced normal distribution approach, although some Q-studies do give people the top line only and allow them to sort as many statements in each column as they desire (Eden et al. 2005). A forced normal distribution does not dramatically impact on the results of the research when contrasted with a free distribution (Nieymeyer, Petts & Hobson 2005). However, a forced normal distribution was chosen for this study to ensure participants thought carefully about the relative ranking of statements that represented their positioning (Nieymeyer et al. 2005). Table 4 shows the Sorting Scheme Distribution used for this study.

Table 4. Q-Methodology sorting scheme distribution

Statement Rank	-5	-4	-3	-2	-1	0	1	2	3	4	5
Number of Statements	3	4	5	6	8	10	8	6	5	4	3

Previous research has shown that it is useful to check the representativeness of the statements in the sample by asking each subject undertaking the Q-Sort whether they could think of additional elements that weren't included in the Q-Statements set (Tuler, Webler & Finson 2005). Participants were asked to record details of how they made their decisions, any statements that they had problems with, and any other comments (e.g., new statements that would more effectively capture their point of view) on a feedback form. These feedback forms were used to assist the brief interviewing process at the end of each Q-Sort scenario.

In addition to Q-Sort, participants completed a brief questionnaire asking them about their behavioural intentions regarding MAR water for various fit-for-purpose uses.

6.0 RESULTS

PQ Method software (a freeware package available on the internet) was used for the analysis of the results (Previte et al. 2007; Schmolck 2002). This software is available from http://www.lrz-muenchen.de/~schmolck/qmethod/downpqx.htm . SPSS was also explored as a potential tool for analysis, however it was decided for the purposes of this research that it did not contain enough analytic features to address the research questions (Brown, 1996). Factor analyses of the Q-Sort data allowed the identification of patterns across individuals. Each factor consists of individuals who will have similarly sorted the statement items, and hold a generally similar discursive position (Previte et al. 2007). It should be noted that all statements could be of importance to a person but, as individuals were directed to differentiate between the statements, they represent relative rather than absolute rankings. Hence, care needs to be taken in the interpretation of the data to ensure that this is understood reflected in the analysis. For this study a 'Principle Components Analysis' with 'Varimax Rotation' was chosen as no prior assumptions or hypotheses were made of the data. Brown (1980) recommends researchers run from a seven-factor to two-factor solution before accepting a final solution (Previte et. al. 2007), as conducted in this study.

In this section, the abbreviation "S" refers to the Q-Sort statement number for that scenario. For example, for the Public Open Space scenario, "S16" refers to the statement "I don't have a problem with MAR". Each statement is paired with its positioning on the Q-Sort board, or 'factor array'. For example, (S12 = +5) indicates that item 12 is ranked in the +5 position (*most like my point of view*) in the factor array Q-Sort of Factor 1. Full lists of these statements and their respective ranking for each factor can be found in Appendix 3.

Tables 5 and 6 in the following two pages provide visual representations of factors emerged for all Q-sorts performed for different water recycling scenarios. Table 5 sumnarises the results from different community Q-sort recycling scenarios. Table 6 compares the technical and community Q-sort indirect potable scenario and technical presceptions of the communities Q-sort for that scenario.

Table 5. Summary of findings of community Q-sort for three recycling scenarios

Irrigation of Public Open Space – Community's sort (n=19)

Factor 1 (n=8) *25% Variance* **CONFIDENT**	**Factor 2** (n=4) *14% Variance* **SCEPTICAL**	**Factor 3** (n=4) *14% Variance* **DOUBTFUL**	**Factor 4** (n=2) *10% Variance* **RECONCILED**	
∗Accepting ∗Belief in accountability of government ∗Confident in science, technology and governing systems ∗No health concerns	∗Not accepting ∗Sceptical of science, technology and governing systems ∗Personal risk concerns ∗Risk to aquifer & surrounding environment ∗Future uncertainty ∗Reduce water use ∗Requires community debate	∗Accepting ∗Confidence in scientists ∗Concerned about system failure ∗Risk to aquifer ∗Concerned about energy use ∗Preference for green POS ∗Resigned to it happening	∗Accepting ∗Lesser call for strong regulation ∗Belief in science and technology ∗Concerned about system failure ∗Can't wait for whole of community acceptance ∗Resigned to it happening	

Irrigation of Horticulture – Community's sort (n=17)

Factor 1 (n=6) 28% Variance **CONFIDENT**	**Factor 2** (n=4) 13% Variance **DOUBTFUL**	**Factor 3** (n=2) 13% Variance **NO WORRIES**	**Factor 4** (n=2) 10% Variance **SUSPICIOUS**	
∗Accepting ∗Confident in accountability of government ∗Confident in science ∗No health concerns ∗Requires strict regulation	∗Unsure ∗Lacks confidence in accountability of government ∗Doubts that science or money could manage risks ∗Strong health concerns ∗Future uncertainty	∗Accepting ∗Confident in science ∗Confident in system operation ∗Confident that risks can be overcome ∗No environmental risks	∗Accepting? ∗Distrust of science and authorities ∗Requires safe/safer source options ∗Concerned about energy use	

Indirect Potable Reuse: MAR - Community's sort (n=37)

Factor 1 (n=17) 23% Variance **CONFIDENT**	**Factor 2** (n=7) 13% Variance **SCEPTICAL**	**Factor 3** (n=3) 7% Variance **PESSIMISTIC**	**Factor 4** (n=3) 7% Variance **SUSPICIOUS**	**Factor 5** (n=3) 7% Variance **TRUSTING**
∗Accepting ∗Belief in accountability of government ∗Requires strict regulation ∗Confident in science ∗No health concerns ∗Pragmatic – replenish the aquifer; need for the source; lacks emotion	∗Not accepting ∗Sceptical of science, technology and governing systems ∗Requires safe/safer source options ∗Future uncertainty ∗Reduce water use ∗Requires community input and debate	∗Accepting/unsure ∗Lacks confidence in accountability of government ∗Strong health concerns ∗Risk to aquifer ∗Doubt about alternative sources ∗Lacks confidence in community decision making	∗Unsure ∗Belief in accountability of government ∗Requires strict regulation ∗Faith in scientific fact ∗Concerned about system failure ∗Concerned about "gender bending" chemicals ∗Not concerned about *long term* health effects	∗Accepting ∗Indifferent to need for strict regulation ∗Confident in science ∗Rejection of system failure ∗Belief that risks can be overcome with sufficient funding ∗Emotive about drinking the water ∗Faith in community knowledge

Table 6. Comparison between technicians' and community's Q-sort for indirect potable scenario and the technicians' perceptions of the community's Q-sort for that scenario

Indirect Potable Reuse: MAR - Community's sort (n=37)

Factor 1 (n=17) 23% Variance **CONFIDENT**	**Factor 2** (n=7) 13% Variance **SCEPTICAL**	**Factor 3** (n=3) 7% Variance **PESSIMISTIC**	**Factor 4** (n=3) 7% Variance **SUSPICIOUS**	**Factor 5** (n=3) 7% Variance **TRUSTING**
∗Accepting ∗Belief in accountability of government ∗Requires strict regulation ∗Confident in science ∗No health concerns ∗Pragmatic – replenish the aquifer; need for the source; lacks emotion	∗Not accepting ∗Sceptical of science, technology and governing systems ∗Requires safe/safer source options ∗Future uncertainty ∗Reduce water use ∗Requires community input and debate	∗Accepting/unsure ∗Lacks confidence in accountability of government ∗Strong health concerns ∗Risk to aquifer ∗Doubt about alternative sources ∗Lacks confidence in community decision making	∗Unsure ∗Belief in accountability of government ∗Requires strict regulation ∗Faith in scientific fact ∗Concerned about system failure ∗Concerned about "gender bending" chemicals ∗Not concerned about *long term* health effects	∗Accepting ∗Indifferent to need for strict regulation ∗Confident in science ∗Rejection of system failure ∗Belief that risks can be overcome with sufficient funding ∗Emotive about drinking the water ∗Faith in community knowledge

Indirect Potable Reuse: MAR - Technicians' sort (n=20)

Factor 1 (n=10) 27% Variance **CONFIDENT**	**Factor 2** (n=5) 18% Variance **SCEPTICAL**	**Factor 3** (n=1) 10% Variance **DEFIANT**	**Factor 4** (n=2) 10% Variance **DOUBTFUL**	
∗Accepting ∗Confident in science, knowledge and governing authorities ∗Requires strict regulation ∗Belief that risks can be overcome with sufficient funding ∗No health concerns ∗Pragmatic – replenish aquifer; need for the source; lacks emotion	∗Not accepting/ unsure ∗Sceptical of science, technology and governing systems ∗Strong health concerns ∗Future uncertainty ∗Risk to aquifer ∗Faith in community knowledge and need for debate	∗Not Accepting ∗Distrust of science and governing authorities ∗No health concerns ∗Risk to aquifer ∗Concerned about energy use ∗Reduce water use ∗Pay more for water ∗Address population growth ∗Emotive about drinking water	∗Unsure ∗Belief in accountability of government ∗Requires strict regulation ∗Little confidence in science, technology and knowledge ∗Mild health concerns ∗Concerned about aquifer environment ∗Can't wait for whole of community acceptance ∗Lacks confidence in community decision making	

Indirect Potable Reuse: MAR - Technicians' perception of community's sort (n=14)

Factor 1 (n=11) 45% Variance **CHALLENGING**	**Factor 2** (n=3) 19% Variance **RESISTANT**			
∗Not Accepting ∗Requires strict regulation ∗Distrust of scientists ∗Doubts that science or money could manage risks ∗Concerned about system failure ∗Strong health concerns ∗Future uncertainty ∗Emotive about drinking water ∗Time to wait for whole of community acceptance	∗Unsure ∗Belief in accountability of government ∗Requires strict regulation ∗Trust in scientists and experts ∗Money can't manage risks ∗Strong health concerns ∗Can't pay too much to get acceptable treatment ∗Not concerned about energy use ∗Emotive about drinking water ∗Put up with anxiety of running out of water			

6.1 Public Open Space Results

For the 19 participants who completed the public open space Q-Sort, the analysis revealed four factors (See Table 5 for a visual representation of these factors). One participant did not load onto any factor. Table 1 in Appendix 3 indicates the rankings that each statement had for each factor (referred to as a factor array). The most independent (or dissimilar) factors for the public open space scenario were Factors 1 and 2 (r = -0.036). Factors 3 and 4 were 52 percent and 44 percent similar to Factor 1. Correlations between factors are presented in Table 7. There were only three statements that did not distinguish between any pair of factors for the POS scenario (these are also known as 'consensus statements'). The non-distinguishing statements were statement 10 regarding possible human/mechanical errors, and statement 37 about the community not having the required expertise to make decisions. Both of these statements were ranked relatively neutrally for all factors (that is, they were statements not generally strongly like or dislike people's view). The statement about wanting other areas to use recycled water first (S26) was ranked mostly unlike ones point of view for all factors.

Table 7. Correlations between public open space factors.

	1	2	3	4
1	1.000	-0.036	0.515	0.440
2		1.000	0.199	0.078
3			1.000	0.410
4				1.000

The following sections are written narratives informed by the Q-Analysis. They describe the particular perspectives and characteristics represented by each factor for the POS scenario.

POS Factor 1: Confident

Accepting, Governance Focused, Strongly Not Health Driven

Eight of the 19 participants that completed the POS scenario loaded on Factor 1. This factor explained 25 percent of the variance. This typology reflects people who are mostly accepting of the scheme, are focussed on governance and legal arrangements, and have a strong belief, trust and confidence in scientific process, governance and technology. The typology is characterised by health concerns being strongly unlike their points of view.

The perspective represented by this factor is one of strong legal and legislative concern (S15 = +5) and belief that political interests and processes could compromise the scheme (S18 = +4). This perspective is not likely to agree with the statement that Western Australia is managing its wastewater well enough not to need recycled wastewater (S53 = -4), and does not agree that their life is so busy that they will just tolerate it (S44 = -4). This factor holds an overall acceptance of MAR (S16 = +4), and strongly disagrees with the statement that they would not play sport on grounds that had been watered with recycled wastewater (S62 = -5).

This perspective is further characterised by a strong belief in the accountability of government bodies over privatised systems (S7 = +5), a relatively strong trust in authorities (S8 = +3), knowledge about water testing (S13 = +3), that scientists will know how different chemicals will react (S41 = -3), and a faith in the filtration process (S39 = +4).

Health concerns were strongly *unlike* this factor's point of view.[7] Most unlike this groups point of view are concerns about effects of MAR water on unborn babies and children (S23 = -5) and outbreaks of diseases and illnesses (S20 = +4). Milder, but still unlike points of view about health include concern about chemical or toxin build up (S21 = -3), concern about the risk of infection from sporting grounds (S57 = -3), and anxiety over the uncertainty of what could go wrong (S2 = -3).

This group are not overly concerned about water aesthetics (S24 = -5) and focus instead on the accessibility of public open space that has been watered by MAR water (S45 = +3).They are not overly concerned about it being used elsewhere first (S26 = -4). They are also considerate of the current use and impact on the aquifer (S32 = +5), that it should be used to preserve local amenities such as wetlands (S58 = +4), and consider that water that had been in the aquifer becomes groundwater anyway (S9 = +3). Interestingly, although this group considered environmental issues such as replacing the water used from underground aquifers and using the water to preserve local amenities, the consideration of the environmental impact on the aquifer was neutral (S31 = 0), as well as mildly unconcerned about the impact on wildlife (S60 = -3). Therefore, the consideration of the environment for this factor seems to be more from a pragmatic perspective, rather than a deep ecological/conservationist consideration and concern. All of the eight people who loaded on this factor said 'yes' to using recycled wastewater to irrigate public open space in the questionnaire.

POS Factor 2: Sceptical

Focused on Environment, Behaviour Change and Governance

Of the four people (out of 19) that loaded on this factor (14% variance explained by this factor), two people said yes to using recycled water for POS, one was unsure and one said no. This perspective is strongly characterised by 'having a problem' with MAR (S16 = -5, S38 = -4). Despite this factor not believing Western Australia is managing its water well enough not to need recycled wastewater (53 = -5), there is a strong focus on the need for behaviour change to reduce water use (S48 = +5), and that we have the technology and finances as a developed country to *not* use recycled wastewater (S54 = +4). This perspective also considers MAR an important public issue that requires further community debate (S55 = +3) and that it is no small risk relative to other risks in people's everyday lives (S17 = -4). At a personal level, it is the uncertainty of what could go wrong that is troubling (S2 = +3). Those who hold this perspective are not likely to tolerate the scheme if they are told it is safe or they don't like it (S43 = -3; S44 = -5). There is also a mild concern about the health effects of the scheme (S19 = +3), although the specific health statements themselves are relatively neutral (ranging from 0 to +2).

There is a strong concern for the environmental impacts of the scheme (S31 = +5). Although there is a belief that the water should be used for wetland regeneration (S5= +4), there is a mild concern about the effects of this usage on birds and other wildlife (S60 = +3). They do not consider that once the water was in the aquifer it became groundwater (S9 = -3). Aesthetic considerations are not a significant concern (S24 = -2, S25 = -3).

[7] That is, many of the health based questions strongly loaded across the most unlike point of view columns of the Q-Distribution.

Trust and faith in the political and governance systems and actual technological and scientific systems that govern the scheme is relatively low. This group does not trust the media at all as a source of information (S5 = -4), does not think there is enough knowledge around about water testing (S13 = -4), and does not believe that it wouldn't go ahead unless the authorities thought it was safe (S8 = -3). There is concern about systems' processes such as breakdowns (S12 = +4), a strong belief in the need for strict legal and legislative requirements (S15 = +5) and importance placed on the reduction of industrial emissions before it enters the waste stream (S14 = +4). Despite these issues, this perspective would be mildly reassured if a group of independent experts declared the water safe (S4 = +3).

POS Factor 3: Doubtful

Accepting, Risks Focused on Aquifer Environment, 'Other' Focussed

Four participants out of the 19 that completed this scenario loaded on Factor 3. The variance explained by this factor was 14%. A significant focus of this factor is the concern for the aquifer (S31 = +5) and the environment. There is a concern over the risk of contamination to the aquifer (S11 = +4), and a strong belief in the utility of wastewater for environmental reasons. An example of this environmental utility perspective is that we should be replenishing the water we are using from the aquifer (S32 = +3), and water should be used to preserve local amenities (S58 = +5). However, despite the concern for the various environmental impacts for the aquifer, there is not a concern about the energy intensity of the MAR process (S33 = -5), and only a mild negative concern for wildlife (S60 = -2).

Like Factor 2, there is a strong perspective that the media cannot be trusted as a source of information (S5 = -4) and, as for Factor 1 and 2, a strong belief in the need for strict legal and legislative requirements (S15 = +4). This factor also considers as unlike their point of view several societal, alternative options and perceptions of abundant supply issues. These include disagreeing that our position as a developed country means that we don't need recycled wastewater (S54 = -5), that those who pollute/use should use the water first (S27 = -3), that water is too cheap (S50 = -3), that population issues are the key to water management (S51 = -3), and not agreeing that Western Australia manages its water well enough (S53 = -4).

Aesthetics issues such as staining (S25 = -4) and fears of build up of toxins in their bodies (S21 = -3) are most unlike this perspectives' point of view. However, other aesthetics statements and health statements are ranked relatively neutrally (-2 to +2).

There appears to be a belief that the government should be looking for the safest water options available (S30 = +3), and that there is not a risk in paying too much to get the water treated to a level that the community is happy with (S29 = -5). This perspective strongly believes that when it comes to decision making about MAR, that scientists base their decisions on fact and the community bases its decision on feeling (S34 = +4). This may relate to the high support for the statement that they accept the scheme but they think it will be difficult to convince others (S38 = +4). Other expressions of this support for the scheme come from lack of concern about children or themselves playing sport on grounds that had been watered with recycled wastewater (S61 = -3; S62 = -4), and that they would prefer to have public open space available that had been watered with recycled wastewater (S45 = +5). There is also a mild resignation to the feeling that the scheme would occur anyway, despite how they personally felt about it (S47 = +3). Of the four people who loaded on this factor, all said yes to using recycled water for POS watering.

POS Factor 4: Reconciled

Confidence in Scientific Process and Knowledge

For the two participants that loaded on this factor, there is no concern about aesthetics (S24 = -3; S25 = -4), or the impacts of using public open space that has been watered with recycled wastewater (S57 = -3; S61 =

-4; S62 = -4). This factor considers societal issues such as there being other sources of water that are better than recycled wastewater for Western Australia (S49 = -5), that water is too cheap (S50 = -3), that Western Australia managing its water well enough (S53 = -5) and that our position as a developed country means that we do not need recycled wastewater (S54 = -5) to be strongly unlike their point of view. There is also a strong feeling that there is not time to wait until the whole community is happy with the decision before the scheme is implemented (S36 = +5). Other community related statements which define this perspective include a belief that scientists base their decision making on fact and community on feeling (S34 = +3), and that there is a financial risk of paying too much to get the water to an accepted standard (S29 = +3).

There is a relatively strong degree of trust and confidence in scientific processes and knowledge surrounding the scheme (S3 = -3; S6 = +4; S13 = +4; S41 = -4). This group is concerned, however, about issues such as systems breakdown (S11 = +4; S12 = +3) and industrial management (S14 = +4). They do not think that government bodies would be more accountable (S7 = -3), however they would be reassured by an independent body of experts (S4 = +4).

There is a strong agreement with the use of recycled wastewater for wetland regeneration (S59 = +5), although there is little focus put on other environmental considerations. This perspective also holds a mild belief that the injected water becomes groundwater anyway after a period of time (S9 = +3). This factor explained 10% of the variance for this scenario. Both participants who loaded on this factor said yes to using MAR water for POS watering.

6.2 Horticulture Results

For the 17 participants who completed the horticulture Q-Sort, the analysis revealed four factors. Three participants failed to load adequately on a factor. Table 2 in Appendix 3 indicates the rankings that each statement had on each factor (See Table 5 for a visual reporesentation of these factors). The two factors that were most distinct from one another were factors 3 and 4 (r = 0.058), while the most similarity existed between factors 1 and 3 (r = 0.507). Inter-factor correlations can be seen in Table 8.

Table 8. Correlations between horticulture factors.

	1	**2**	**3**	**4**
1	1.000	-0.098	0.507	0.072
2		1.000	-0.131	0.372
3			1.000	0.058
4				1.000

Horticulture Factor 1: Confident

Governance Focused, Accepting, Strongly Not Health Driven

Six of the 17 participants fell on this factor, which explained 28% of the variance. All of the participants who loaded on this factor said yes to eating fruit and vegetables that had been grown with recycled wastewater. This factor is characterised by unconcernedness with health risks. Issues pertaining to health rate strongly in the negative (S21, S23, S24, S25 = -4).

There is general acceptance of the scheme (S16 = 4) that appears to hang on legal, legislative and political considerations. There is a strong view that government would be more accountable than private companies in delivering such a scheme (S7 = 5), that there needs to be strict legal and legislative requirements in place (S15 = 5), and that political interests could compromise the scheme (S18 = 5).

There is a perception that there is inadequate management of water resources currently (S57 = -5) and that this situation is something that we cannot afford to ignore (S58 = -5). There is also a view that, given water is already being taken from the aquifer, it makes sense to replenish it in some fashion (S34 = 4). There is also a reasonably strong faith in the filtration and treatment process (S41 = 3).

While this factor is generally supportive of the scheme, there is also an acknowledgement that there needs to be a focus on behaviour change and reducing water use (S51 = 4) as well as the opinion that governments will have a hard time convincing others to support the scheme (S40 = 3).

Other concepts that further distinguish this factor include a perceived contradiction regarding concern over this scheme when many people buy imported produce that could be treated with wastewater and chemicals Australia prohibits the use of (S60). There is also greater agreement that much of the controversy stems from the concept being new (S49). People on this factor also have relatively more trust in scientists than the other factors (S6). Overall, this factor has many similarities with Factor 1 for the Public Open Space scenario.

Horticulture Factor 2: Doubtful

Health Driven, Ambivalence, Distrustful

This factor explained 13% of the variance, with four of the 17 participants loading on this factor. While there are apparent misgivings about the scheme (S16 = -3), based on responses from the questionnaire, two of the participants who loaded on this factor said that they would eat fruit/vegetables grown with recycled wastewater (one specifying it would depend on the filtration), with two participants indicating that they were unsure. This perspective is typified by a less accepting attitude towards MAR. It is characterised by perceived health risks that cannot be adequately overcome. Many health risk considerations are rated highly by participants on this factor, including the possibility of the outbreak of diseases (S20 = 5), a concern with the build-up of toxins and chemical in the body (S21 = 5) and the effects of the water on unborn babies (S24 = 4).

There appears to be a strong distrust in media and government, with participants on this factor rating as extremely unlike their point of view that they could trust the media and information and messages about the scheme (S5 = -5), and rating the accountability of government bodies over private bodies

similarly (S7 = -5). There is also strong scepticism that money (S30 = -4), technology (S58 = -5; S41 = -4), or population control (S54 = -5) will be an effective means of overcoming the risks involved.

Horticulture Factor 3: No Worries

Accepting, Confidence in Science and System Processes

Two of the 17 participants fell on this factor, explaining 13% of the variance. It is characterised by high levels of acceptance in the scheme. There is strong agreement that they have no problem with the scheme (S16 = 5) and would eat fruit and vegetables grown with recycled water (S62 = 4). Both participants who loaded on this factor indicated in the questionnaire that they would eat fruit/vegetables grown with recycled water.

The perspective is also characterised by strong disagreement with the possibilities of environmental harm and system breakdowns. Specifically, they consider as very much unlike their points of view that the aquifer could possibly become contaminated as a result of the scheme (S11 = -4) and that something could go wrong with the scheme such as a system breakdown (S12 = -5). There is also a belief that the water's odour will not be affected (S26 = -5)

By contrast, there is great agreement that enough knowledge exists about water testing, and that disease minimisation and harm reduction for MAR will not be a problem (S13 = 5). Similarly, if enough money is put into it, any risks associated with MAR can be overcome (S30 = 4). There is also a high level of faith in the filtration process (S41 = 4). This factor is also distinguished from the others by a greater agreement that, in the face of everyday risks, any risks associated with MAR are too small to worry about (S17 = 3). There is also much less concern that political processes could compromise the scheme (S18 = -2) relative to other factors.

Horticulture Factor 4: Suspicious

Ambivalence, Distrust in Scientific and Political Processes, Emphasis on Alternative Options

Two of the 17 participants fell on this factor, with 10% of the variance explained. This factor, as for Factor 2, is characterised by a certain amount of ambivalence towards the scheme. While there are strong misgivings about the scheme itself (S16 = -4), there is also an apparent willingness to eat fruit and vegetables grown with recycled wastewater (S62 = 2). This is supported by both participants who loaded on this factor answering yes to eating fruit/vegetables that had been watered using recycled water.

The misgivings in the scheme appear to stem from a distrust in and scepticism in the motives of authorities and 'experts'. There is strong dissent with ideas of trusting scientists to communicate whether the water is safe or not (S6 = -5), and that authorities would not let it go ahead unless it really was safe (S 8 = -4). There is also a belief that political interests and processes could compromise the scheme (S 18 = 4).

While this distrust exists, there is a view that something definitely needs to happen. While there is a belief that Western Australia is not currently managing its water resources sustainably (S57 = -5), there is also a concern that the MAR process will be too energy intensive (S35 = 4) and that other solutions would be a better source of water (S52 = 5). There is an attitude that governments should be

looking for water options that are the safest rather than the cheapest (S32 = 5) and that there needs to be a strong focus on behaviour change and reducing water use instead (S51 = 5).

6.3 Indirect Potable Water Results

6.3.1 Community Perspective

There were numerous factors (in excess of eight) of statistical significance for the community indirect potable drinking water scenario (Eigenvalues >1). This was pared down to five factors for the following reasons. Firstly, by consolidating to five factors, each factor had multiple cases (or people) loading onto it. Secondly, the amount of variance explained by the sixth factor (and subsequent factors) was viewed as not large enough to warrant inclusion. Thirdly, limiting the analysis to five factors provided more suitable conceptual distinction between the factors. All of these are considered appropriate rationales for factor extraction and exclusion (Adams, 2000).

Thirty-two of the 37 participants' sorts loaded on one of these five factors, while five participants did not load significantly onto any factor.[8] This reduced number of factors and the number of other significant, one person factors, particularly compared to the four clear factors that emerged for POS and HORT, shows that for the drinking scenario, there is something occurring beyond the factors that is not captured in this current research [9] (See Table 5 for a visual reporesentation of these scenarios). Nevertheless, the percentage of explained variance by the five factors is 57%. Of this variance explained, Factors 1 and 2 provide the bulk of it, explaining 23% and 13% respectively.

Table 9 shows the correlations between each of the factors. The most independent Factors are 2 and 4 (r = 0.056), while the most similarity existed between Factors 1 and 5 (r = 0.313).

Table 9. Correlations between community indirect potable water factors.

	1	**2**	**3**	**4**	**5**
1	1.000	-0.237	0.125	0.143	0.313
2		1.000	0.208	0.056	-0.170
3			1.000	-0.001	0.171
4				1.000	0.039
5					1.000

There were three 'consensus statements' between the factors – Q-Statements whose ratings did not differ significantly from factor to factor. All three statements (S19, S31, S36) were rated relatively neutrally. The areas of consensus (or neutrality) are the suggestion that political interests or processes could compromise the scheme, that we run the risk of paying too much to get the water at a standard the community will accept and concerns that the MAR process will be too energy intensive.

[8] This is able to be explained theoretically, and it is common for people not to load on any factor (Webler et al., 2001).

[9] The distinctions between the clarity of factors for POS/horticulture versus drinking water will be discussed in detail in the next section.

Community Indirect Potable Water Factor 1: Confident

Accepting, Governance-Focussed, Appeased Health Concerns

This factor is characterised by relatively high levels of acceptance, a focus on responsible management and a marked lack of health concern. Fourteen of the 17 participants who loaded on this factor answered yes to drinking Indirect Potable water on the questionnaire, with two unsure and one answering no. This factor explained 23% of the variance.

People in this factor generally do not have a problem with MAR (S16 = 3), backed by a view that sufficient knowledge of water testing, disease minimisation and harm reduction exists for the viability of such a scheme (S13 = 4). They also cite that other countries have been drinking recycled water for years with no adverse effects (S60 = 5). Health is important to them as a salient decision point, but they feel that the health risks associated with this scheme have been overcome. There is little concern with potential health effects of drinking recycled water (S20 = -4), worry about the effects of so called 'gender bending' chemicals (S24 = -5), or of the effects of the water on unborn babies (S26 = -4).

There is an attitude that water is not currently being managed in a sustainable way (S59 = -5) and that as we are already drawing water from the aquifer we should be replenishing it (S34 = 4). There is also a moderately strong view that if the water is clean enough to drink, it will be clean enough for the environment (S35 = 3) and that once the wastewater has been in the aquifer for a number of years it becomes similar to groundwater (S9 = 3).

People in this factor generally think that there need to be strong legislative and legal processes put in place to oversee such a scheme (S15 = 5) and that government bodies would be more accountable than privatised companies when it came to the scheme (S7 = 4). There is also a belief that reducing industrial emissions to the wastewater stream should be a main management priority (S14 =5). Finally, the emotive element of drinking recycled wastewater is actively downplayed, with objection to the statement – "the thought of drinking sewage disgusts me" (S45 = -5).

Community Indirect Potable Water Factor 2: Sceptical

Not Accepting, Unknown Risk, Alternative Option, Inclusion of Community

This factor is characterised by a rejection of the scheme, scepticism of the current scientific knowledge available, and a focus on alternative water augmentation options. Five of the seven participants who loaded on this factor said no to drinking recycled water from an MAR scheme with 2 indicating they were unsure. Factor 2 explains 13% of the variance. Those in this perspective perceive problems with MAR (S16 = -5), are unsettled by the uncertainty of what could go wrong with the scheme (S2 = 4), and don't feel that there is adequate information and knowledge about water testing currently (S13 = -5). They certainly don't feel they can trust the media to provide them with accurate information (S5 = -4). There is also a lack of faith in filtration (S42 = -4).

This typology is characterised by a belief that government should be looking at water augmentation options that are the safest, not the cheapest (S32 = 4), and that, as a developed country, we have the technology and the finances to forgo the option of using recycled wastewater as an indirect potable water source (S61 = 5).

There is a view that MAR needs the approval of the entire community, even if that takes some time (S39 = -4) and that it is a fundamental public issue that needs more community debate before a

decision is made (S62 = 4). There is rejection of the notion that their lives are too busy to tolerate the scheme even if they didn't like it (S49 = -5) or that it can be accepted at face value that it is safe and so consume it on that basis (S48 = -4).

Despite their misgivings about the scheme, they are not overly focused on personal health issues, with low to moderate agreement with the threat of a range of adverse health consequences (S21 = 2, S22 = 1, S23 = 1). There is however a strong belief that there are better sources and options for water augmentation (S54 = 5) and that there needs to be a focus on behaviour change and reducing water use in the first place (S53 = 5).

Community Indirect Potable Water Factor 3: Pessimistic

Ambivalence, Health Concerned, Environment Concerned, Futures Focused

Two of the participants on this factor indicated they would drink recycled wastewater, with the other indicating that they were unsure. This factor explained 7% of the variance. This typology is primarily defined by its negative outlook, and could be hypothesised that it reflects a somewhat 'global' pessimistic worldview. There is little agreement with any of the statements, except for those that capture negative issues and concepts. Many of the statements that are most like or unlike this factor's point of view are contradictory, creating ambivalence in perspective.

The people loading on this factor disagree that government bodies would be more accountable (S7 = -3), distrust the media (S5 = -5) and believe that the community doesn't have the required expertise to make an informed decision (S40 = 4). They are worried about water-borne diseases we don't know about yet (S1 = 4), and their biggest concern is health effects of drinking the recycled water (S20 = 5). This health concern is most strongly characterised by the build up of chemicals and toxins (S22 = 4).

They are concerned about contamination of the aquifer (S11 = 5), do not consider that wastewater will eventually become the same as other aquifer water (S9 = -5), and are concerned with industrial emissions entering the wastewater stream (S14 = 5).

The people loading on this typology typically do not think Western Australia is managing its water well (S59 = -5) and would rather drink recycled water than live with the anxiety of running out of water to drink (S50 = 4). There is also a scepticism that there are better water augmentation options available (S54 = -4) and disagreement that being a rich and developed nation does not mean we shouldn't have to drink recycled wastewater (S62 = -5).

Community Indirect Potable Water Factor 4: Suspicious

Ambivalence, System Risk Focus

This factor appears to be typified by mixed feelings towards the MAR scheme. One of the participants who loaded on this factor said they would not drink recycled wastewater, with the other participant indicating they were unsure. Factor 4 explains 7% of the variance. While there is a strong rejection of the statement "I don't have a problem with MAR" (S16 = -5), there is also strong affinity with "I support it, but you will have a hard time convincing others" (S41 = 5). This is supported by the view

that scientists make their decisions based on fact, while the community make theirs based on emotion (S37 = 4).

This typology has an emphasis on system risks; there is strong affinity with the concept that a big risk of the scheme is the potential contamination of the aquifer (S11 = 4), which stems largely from a concern about the risk of breakdown or something not working properly (S12 = 5). There is a strong opinion that the scheme needs to be run in accordance with strict legislative and legal requirements (S15 = 5).

Those of this perspective also seem to be in two minds about personal health effects. They are not concerned about the future generations (S24 = -4) or unknown health effects (S1 = -5), however, they seem to make an exception for the possible effects of 'gender-bending' chemicals (S24 = 4).

Community Indirect Potable Water Factor 5: Trusting

Acceptance, Trust, 'Techno-Faith'

This factor is characterised by overwhelming acceptance of the scheme, trust in the science behind it and a downplaying of perceived risks. It explains 7% of the variance with the two participants who loaded on this factor saying yes to drinking recycled water, while one participant indicated 'no'.

From a personal viewpoint, they have no problem with the scheme themselves (S16 = 5). This is emphasised by a strong objection to the suggestion that they would be unhappy to have to drink it if others didn't have to (S28 = -5).

Trust in scientists (S6 = 4), faith in filtration (S42 = 5), a belief that there is enough knowledge about water testing (S13 = 5), discounting the risk of human and mechanical error (S10 = -5) and the potential for the aquifer to become contaminated (S11 = -4) strongly characterise this typology. From this trust in science, knowledge, process and technology there is a belief that if the water is clean enough to drink it will be clean enough for the environment (S35 = 4). Following from this is the opinion that you can overcome any risk if you spend enough money on it (S30 = 4).

People belonging to this factor typically view themselves as 'rational thinkers', and strongly object to the stereotypes of members of the community as lacking in knowledge and emotional. This is displayed through a strong objection to the idea that people don't really know what comes out of their taps now, so what's the difference (S18 = -4), and a disagreement with the idea that scientists base their decisions on facts, and the community on feelings (S37 = -4).

There is a relatively high rating of the statement regarding disgust at the thought of drinking sewage (S45 = 4). This may be because those who are generally accepting of the scheme hold a strong belief that the technological process separates the derived product from its source, in effect making MAR water fundamentally different from sewage.[10]

[10] This is supported by post-sort interviews for this group. Interestingly, this is in contrast to a number of people who we interviewed in the scoping phase of Stage 2 who strongly emphasised the lack of separation between sewage and the derived MAR water.

6.3.2 Technical Perspective

The analysis of the Technical Drinking Water Sort revealed four factors (see Table 15 Appendix 3 for factor loadings for each of the statements). Factor 1 accounted for 27% of the explained variance, with 10 out of the 20 technical participants loading on this factor. Eight of these technical participants on Factor 1 answered 'yes' in the questionnaire for drinking recycled wastewater, with two of them indicating they were 'unsure'. Factor 2, accounting for 18% of the variance, had five participants loaded onto it, with one saying 'yes', two saying 'no' and two being 'unsure' as to whether they would drink recycled water. Factor 3 had only one technical participant loaded on it, however, it explained 10% of the variance. It was also theoretically distinct from the other factors so was retained for the purpose of this analysis. This person suggested in the questionnaire that they would not drink recycled water. Factor 4 also explained 10% of the variance, and had two out of the 20 technical participants loading on the factor. One of these participants said 'yes' to drinking recycled water, the other participant said 'no'. The inter-correlations in Table 10 between each of the factors for the Technical Drinking Water sort were fairly low. Most of the statements that achieved 'consensus' amongst the four factors that emerged from the technical perspectives of drinking water sort, fall in the neutral range (S28, S32, S38, S51, S52, S54, S61; see Appendix 3 Table 15). The only statement that all factors placed like the community's point of view was the trust of the media for information and messages about MAR (S5).

Table 10. Correlations between technical indirect potable water factors.

	1	**2**	**3**	**4**
1	1.000	-0.240	-0.133	0.268
2		1.000	0.149	0.216
3			1.000	0.091
4				1.000

Technical Indirect Potable Water Factor 1: Confident

Accepting, Trusting of Science and Process, Strongly Not Health Focused, Perceived Community/Technical Divide

This perspective is characterised by 'not having a problem with MAR' (S16=4), as it was proposed in this scenario, and it appears they prefer this option of using recycled wastewater over a scheme where the water is stored separately from other drinking water supplies (S57=-5). This acceptance of the scheme is also captured in how the disgust and emotion aspects are most unlike this perspectives' point of view (S45 = -5). Strongly unlike this factors' perspective are worries about water borne diseases (S1 = -4), concerns about diseases/illnesses (S21 = -3), build up of chemicals (S22 = -3), the impact on unborn babies (S26 = -3), uncertainty (S2 = -3), and trust in the media (S5 = -4). They are also strong in their belief that MAR would not influence aesthetics of the water (S27 = -5), and that those who pollute/use the water should not have to use the water first (S29 = -3). This perspective is characterised by a strong community discourse, with a belief that scientists base decisions on fact and community base their decisions on feeling (S37 = 4), and that there will be difficulties in convincing others of the scheme (41 =1).

Environmental consideration is focused around the need to replace water that was being used from the underground aquifers (S34 = 4), and that once the wastewater has been in the aquifer for a number of years it becomes groundwater (S9 = 5).

The perspective is further characterised by a relatively strong sense of trust in science (S6 = 3) and current knowledge (S13 = 3), a trust in management and authorities (S8 = 4) and a sense of reassurance by a system that has an independent body (S4 = 3). They identify the need for there to be strict legal and legislative requirements (S15 = 5), and believe that by putting enough money into MAR that almost any problem can be overcome (S30 = 3). There is a focus on the 'governance' issues of water in Western Australia, with this perspective strongly regarding that water is too cheap and should cost more (S55 = 5), and strongly unlike their point of view that recycling wastewater will encourage people to use more water (S58 = -4). This group disagrees that Western Australia is managing its water well enough not to need recycled wastewater (S59 = -4).

Technical Indirect Potable Water Factor 2: Sceptical

Lack of Trust/Faith/Confidence in Science, Process and Technology, Strongly Health Concerned, Community Focused

The perspective captured by Factor 2 is characterised by a lack of trust in science (S6 = -3) and authorities (S8 = -3), the accuracy of scientific processes given historical examples (S3 = 4), the belief that it's extremely unlikely that scientists will know how different chemicals react together (S44 = 4), would not be reassured if there was an independent body of experts (S4 = -3), and does not trust the media as a source of information (S5 = -5). There is also a strong belief that political interests could compromise the scheme (S19 = 5). The uncertainty of what could go wrong (S2 = 4), concern about human and mechanical errors (S10 = 3), and concerns about breakdowns (S12 = 4) are also strong features of this perspective. Similarly, safety of the scheme is not reassured through international examples (S60 = -3). This is also characterised by a lack of faith in filtration (S42 = -4), and a lack of agreement that any problem can be overcome by putting enough money into MAR (S30 = -5).

A strong health focus characterises this perspective, with it being one of their biggest concerns (S20 = 5). Of these health concerns outbreaks of diseases and other illnesses (S21 = 3) and how it might affect generations to come (S25 = 3) are the biggest considerations. A concern for the environmental impact on the aquifer is also a relatively strong part of this perspective (S11 = 3).

This factor also has strong opinions regarding the 'community' statements, and a strong belief that it is a fundamental public issue that needs more community debate (S62 = 5). For example, they disagree that the community do not have the required information or expertise to make decisions (S40 = -4), and that the community base their decision on feeling and that scientists base their decisions on facts (S37 = -4). There is also strong disagreement with the viewpoint that people can just switch to bottled water if people are not happy with the scheme (S46 = -5).

Technical Indirect Potable Water Factor 3: Defiant

Strongly Not Health Focused, Environmentally Concerned, Lack of Trust/Faith

Although one person loading onto this factor, on observations of the pattern of responses it was decided that differences between this and other factors were significant, and of interest at a theoretical level. For example, although similar to Factor 1 in that he/she is strongly not health focused, it differs in that this factor reports a lack of trust and a strong environmental concern. This perspective focuses on specific health issues as strongly unlike this point of view (S23-S26). It is also strongly unlike this point of view that political interests could compromise the scheme (S19 = -5). Mildly unlike this point of view is a sense of reassurance if there was an independent body of experts (S4 = -3), trust in scientists to assure the water was safe (S6 = -3), that it wouldn't go ahead unless the authorities thought it was safe (S8 = -3), that people don't know what comes out of their tap now (S18 = -3) and that scientists base their decision making on fact and communities on feeling (S37 = -3). Strongly like this perspective are that MAR will be too energy intensive (S36 = 4), and that those who pollute and use it most should have to use the water first (S29 = 4). Mildly like this perspective is concern for the environmental impact on, or contamination of, the aquifer (S11 = 3; S33 = 3), running the risk of paying too much for an acceptable level of treatment (S31 = 3) and reducing industrial emissions (S14=3).

Technical Indirect Potable Water Factor 4: Doubtful

Environment Focused, Mildly Health Concerned, Lack of Faith/Trust/Confidence in Science, Process and Technology

This perspective is characterised by quite a strong environmental focus, with consideration of the risks of contamination and environmental impact on the aquifer (S11 = 4; S33 = 5), and the view that the water should be replaced in the aquifers we are already using (S34 = 4). This group does not think that if the water is clean enough for humans it would be clean enough for the environment (S35 = -4). However, the environmental consideration appears to be mostly for the aquifer environment itself as they are not overly concerned about the energy intensity of the MAR process (S36 = -3). There is a mild health concern about the impact of the water on reproductive health (S23 = 3), although this does not extend to a concern about how it may effect generations to come (S25 = -3).

There appears to be relatively little confidence in the scientific, management and technological systems surrounding MAR by the people loading on this factor. This is captured in concerns about breakdowns (S12 = 3), lack of faith in scientific knowledge and processes (S6 = -3; S13 = 4; S44 = 4), and a lack of faith in filtration (S42 = -5). There are very low level of trust in the media as a source of information (S5 = -5). They would, however, be reassured if there was a panel of independent experts (S4 = 5), and they consider government bodies more accountable than private companies (S7 = 3). As part of this management, there is a strong opinion regarding the need for legal and legislative requirements (S15 = 5) and the need to reduce industrial emissions (S14 = 3). It is not thought, however, that money could overcome almost every problem to do with MAR (S30 = -4).

This perspective does have a strong connection with societal and community issues, and does not think that Western Australia is managing its water well enough (S59 = -5). They do not think that population growth is the real issue (S56 = -4), or that using recycled water would encourage greater water use (S58 = -4). This perspective is characterised by an 'anti-community' involvement sentiment, with a belief that there is not enough time to wait until the whole community accepts the scheme (S39 = 3),

and that the community do not have the required expertise or information to make that decision anyway (S40 = 4).

6.4 Technical Results – Perception of Community Sort (Indirect Potable Water)

Two factors emerged from the Technical Perceptions of Community Drinking Water Sort. All expert participants loaded on a factor (social-technical sorts were excluded due to working with the community Q-Sorts and having an awareness of the way the actual community were sorting their answers). The first factor, explaining 45% of the variance, had 11 people loading on it. The second factor, explaining 19% of the variance, had three people loading on it, with one participant loading on it 'negatively'.[11]

Although the two factors were only moderately correlated (r = 0.475), half of the statements (n = 31) in the Q-Sample for this scenario were consensus statements. These statements ranged from those that were ranked strongly like the community's point of view to unlike their point of view. Many of the strong 'positive' statements that gained consensus were the health related statements (S20, S23, S24, S25, S26, S28). The strongly 'negative' statement that gained consensus was the financial investment relative to reducing risk (S30). Mildly unlike point of view statements were about tolerability and resignation to risk (S48, S50), emotion (S45), problems with filtration (S42), relative risk (S18), and trust of the media (S5). Statements considered neutral by consensus included systems failure (S11, S12) and management issues (S13, S14), compromising potential of political interests (S19), fairness issues (S28, S29), financial risk (S32), perceptions of community response (S37, S40, S41), chemical and toxicological risk (S43, S44), voluntary versus imposed risk (S47) and alternative futures/perceptions of abundant supply (S53, S54, S56, S58).

Table 6 (pg. 26) captures the comparison between the technical and community perceptions for the indirect potable scenario and technical perceptions of a community's person Q-sort for this scenario.

Technical Perceptions of Community Factor 1: Challenging

Perception of Community as Not Accepting, Health Focused, Lacking Trust and Confidence

The perspective of the community by those who loaded on this factor is characterised by a lack of acceptance of MAR (S16 = -5), and a belief that the community would be relatively disgusted by it (S45 = 3). The people that load on this factor also disagree that the community *would not* find it to be a small risk relative to other risks (S17 = -5). There is also a very strong perception of a focus on health concerns (S20 = 5; S21 = 4; S22 = 5; S23 = 4; S24 = 3; S25 = 4; S26 = 3), and also a perception of a lack of trust in science (S6 = -4) and media (S5 = -3) for information about the scheme's safety. There is a moderately strong perception that the community would require strict legal/legislative

[11] In Q-Method, a negative loading indicates that a person has structured their responses in a mirror-imaged way to the other people who loaded on this factor, as people who load on a factor negatively hold opposite views to the others loaded on that factor (Addams 2000).

requirements (S15 = 3). This is combined with a perceived lack of faith in filtration (S42 = -4), the possibility of human and mechanical error (S10 = 3), and community concern regarding the uncertainties of the scheme (S1 = 5; S2 = 4). There is also a perception that community would not just get used to drinking it if they were told it was safe (S48 = -3), and that there would be a lack of acceptance of other sources of water (such as bottled water) by community (S46 = -5).

There is a perception that the community would not accept that sufficient financial contributions would overcome any risk (S30 = -4), nor that there is not sufficient time to wait until the community was happy with it (S39 = -4). Also, there is a perception that the community disagrees that water is too cheap and should cost more (S55 = -3).

Technical Perceptions of Community Factor 2: Resistant

Perception of Community as Health Focused, Reassured by Science and Government/Independent Process, Focused on Societal Issues

Factors 1 and 2, as indicated by the correlations, were not dissimilar. The main point of similarity with Factor 1 was that health concerns are a strong feature of the perspective (S20 = 4; S23 = 5; S24 = 4; S25 = 3; S26 = 4). Where the factors differ is that this factor perceives community to be reassured by science and governance. This is reflected in relation to perceptions of trust about the safety of the scheme by scientists (S6 = 3), government (S7 = 3), independent bodies of experts (S4 = 4), and a stronger perception that legal and legislative requirements would be important for the community (S15 = 5). Despite the greater sense of trust captured from the perceptions in this factor, there is also a perception that the community would not just get used to drinking it if they were told it was safe (S48 = -3), and that they would not be more happy to drink recycled water than run out of water to drink (S50 = -4). The people who loaded on this factor do not agree with the notion that, as scientists cannot agree on many things, the community should not be expected to (S38 = -3).

The factor is also characterised by a range of other social and ‘perception of community’ issues such as the focus on not believing that the controversy of MAR is due to the fact it is a new issue (S51 = -5), a belief that the community would support that water is too cheap and should cost more (S55 = 3), lack of support for the real issue being population growth (S56 = -3), lack of support that Western Australia is not managing its water well enough (S59 = -5) and also that the community disagrees with the idea that as a developed country we have the technology and finances to not have recycled water (S61 = -3). There is also the perception that the community is not concerned with it being too energy intensive (S36 = -4).

There is also a greater emphasis on the financial aspects of risk, with the same perception as Factor 1 that the community would not accept that sufficient financial contributions would overcome any risk (S30 = -4). However a strongly ‘unlike the communities point of view’ ranking was about paying too much to get the water treated to a level that the community is happy with (S31 = -5). Also, there is the perception that the community would be unhappy if there was uneven distribution of the MAR water, where some people would have to drink it and others didn’t (S28 = 3). The people who loaded on this factor are more likely to suggest that the community would not be concerned about smell or taste of the MAR water (S27 = -3), but similarly suggest that the thought of drinking sewerage disgusts the community (S45 = 4).

There was also one person who loaded negatively on this factor. That suggests that this participant uses similar frameworks for constructing their opinion of community to those in Factor 2 – just in a mirrored or reversed way.

6.5 Combined Analysis - Community, Technical Results for Indirect Potable Water

To further explore the differences between the expert and lay perspective, a combined analysis was run on all community, technical participants' Q-Sorts for indirect potable water.

For the 57 participants who sorted the drinking water scenario, from their own perspective, the analysis revealed six factors. Table 5 in Appendix 3 indicates the ranking that each statement has in each factor. Forty-six of the 57 participants' sorts load on one of these six factors (summarised in Table 11), while 11 participants did not load significantly onto any factor. The percentage of explained variance by the six factors is 58%. Solutions with additional factors were tested for, but they added little additional explanation and were considered not to be of statistical or theoretical interest.

Table 11. Number of individuals from each group who loaded significantly on each of the seven factors (1 – 6) and the number who loaded on no factor at all

GROUP	N	Number of Factors						No Factor
		1	2	3	4	5	6	
Community	37	13 (35%)	8 (22%)	1 (3%)	3 (8%)	1 (3%)	1 (3%)	10 (27%)
Technical	20	10 (50%)	6 (30%)	2 (10%)	1 (5%)	0 (0%)	0 (0%)	1 (5%)
TOTAL	57	23 (40%)	14 (25%)	3 (5%)	4 (7%)	1 (2%)	1 (2%)	11 (19%)
Variance Explained		21%	15%	7%	6%	4%	5%	

The percentage of respondents accounted for the first factor, 40%, is high. Similarly, the second factor accounts for a further 25%. While a greater percentage of technical people than community people loaded on the first factor, it was the most frequent factor for both these groups, suggesting a relative level of homogeny between them.

While there are some subtle differences, Factor 1 is analogous with Community Indirect Potable Water Factor 1 – *Accepting, Governance-Focussed, Appeased Health Concerns*, while Factor 2 is analogous with Community Indirect Potable Water Factor 2 - *Not Accepting, Unknown Risk, Alternative Option, Inclusion of Community*.

7.0 DISCUSSION AND INTERPRETATION

Using Q-Methodology to understand technical and community aspects of risk in relation to recycled wastewater through MAR has facilitated an understanding of the range of viewpoints that are disparate, favoured or shared between groups. The study has highlighted subjective and meaningful aspects of people's decision making and consideration of risk around this issue. Emergent typologies reflected a detailed understanding of the elements of risk that were currently considered by participants. Although factors and descriptions are generalisations or a 'typical' way of thinking that summarises the people who load on a similar factor the results cannot be extrapolated or generalised to the wider community (Brown 1996). Typologies that emerge from Q-Method are specific to study participants and may alter if Q-Method is administered to groups at a later time, or to another set of participants. However, this did not limit the research study. Q-Methodology does not allow for specificity in terms of frequency of attitudes and generalisablility of opinions (to a wider population), however, the methodology provided knowledge of characteristic features and dimensions of risk in relation to different uses of MAR in this Western Australian context (Previte et al. 2007). Repetition over a longitudinally based study may assist in revealing the changing nature of features and dimensions of risk as implementation of the scheme in a Western Australian occurs. Given that Q-Method captures 'real-time' patterns and features of risk, Q-Method could be a useful tool to assist in the clear dialogue between expert and community members about the features and dimensions of risk throughout the different stages of this investigation and research process, and communicating stakeholder differences in risk.

Factors that emerged for the POS, horticulture, community/technical indirect potable water and the technical perceptions of community drinking water Q-Sorts revealed a myriad of typologies according to fit-for-purpose usage. They were appropriate to the 'current water context' in Western Australia, particularly in relation to MAR. The typologies that have emerged from this study, taken cautiously, give rise to interesting reflections on planning implications and formation of future stages of research in relation to risk and recycled water. This section contains an interpretation of the typologies and discusses planning implications and recommendations for the implementation of MAR for a range of uses within Western Australia.

7.1 Understanding the 'Transition' of Community Risk Perceptions Across Fit-For-Purpose Usage Scenarios

Past research on recycled wastewater for different fit-for-purpose scenarios such as POS and horticultural irrigation, and indirect potable use, indicated people's acceptance of recycled wastewater depended on proximity of human contact and ingestion (e.g., Po et al. 2005). This study revealed a 'transition' and fluidity of risk perceptions relative to the closeness of the suggested use of the water to ingestion and personal contact. Patterns of factors emerging from three Q-Sort scenarios completed by the community revealed complex patterns of decision making for each of the differing fit-for-purpose uses. While previous research has highlighted this 'continuum' or 'transition' of acceptance- relative to usage, Q-Method research has made inroads into explaining acceptance, ambiguity of perspectives and complexity of community opinion on this continuum.

The POS scenario was the most 'clear cut' scenario with a high level of acceptance across most of the factors, and only one participant not loading on any factor. This indicated the Q-Sample (set of

statements) effectively captured the range of views characteristic of the POS scenario. The horticultural scenario was more ambiguous with participants less distinctly expressing opinions about acceptance/lack of acceptance of MAR for this fit-for-purpose usage. Despite the comparative ambivalence (to POS) regarding the influence of risk on decision making, three participants did not load on any factor. This indicated, Q-Sample may not precisely capture their views, or that opinions about MAR for horticultural use were less well formed (relative to POS). Lack of response to our request for feedback indicating any other possible statements/issues that more effectively captured people's perspectives; it would be likely that opinions for horticulture were not as well formed as for POS. Finally, the community indirect potable scenario reflected the most complex, unclear and ambivalent set of factors out of the three Q-Sorts.

The POS Q-Sort with community resulted in a very clear set of factors. Although each factor had different issues underlying decision making, there was a general acceptance of MAR. Other issues possibly driving peoples' acceptance of MAR for POS irrigation may also be due to the Western Australian drought. People may identify benefits from POS irrigation and MAR as a tangible, observable outcome relative to perceived risk of the drought. As well as the greater distance from personal contact and the familiarity of the scheme, this strongly recognised drought context may contribute to the acceptance of POS irrigation.

Complex environmental concerns might be specific to irrigating POS with wastewater (or when people think about using recycled wastewater for wetland regeneration). There were strong environmental concerns connected with a number of the factors emerging from the POS scenario that did not come out as strongly in the factors for the other two scenarios. It is interesting to pose the hypothesis that environmental concern may be in some way mediating people's lack of acceptance specifically for the POS scenario. However, it did appear that environmental concern for the POS scenario was not coupled with a strong negativity towards the scheme. The only area where environmental concern emerged as a feature shaping the factors was for the technical indirect potable water scenario (Factors 3 and 4). Although not examined in this study, it would be interesting to explore whether this environmental concern that emerge for the indirect potable scenario would be present in technical assessments of risk for horticultural and POS irrigation. Böhm and Pfister (2000) explored people's action tendencies in relation to the characteristics of environmental risks which were thought to shape emotion and to shape 'human actions'. They found that perceived riskiness was dependent on consequences, with negative consequences regarded as more risky for humans than for the environment. Reduced perception of riskiness for humans with the POS scenario, and the general acceptance of this type of use of MAR facilitated the emergence of less intense concerns toward the environment than in other usage scenarios where there were larger perceived risks for humans.

Compared with the POS scenario, factors emerging for the horticulture scenario were less distinct in terms of the acceptance/lack of acceptance of MAR water for horticulture. Ambiguity and ambivalence in decision making appeared to be more characteristic for this scenario. Future research could concentrate on extrapolating the relationship between more complex set of conditions than just the 'yuck factor', and the 'closeness' of contact and ingestion relative to POS irrigation. Although the use of wastewater and recycled wastewater for POS irrigation has been, and is emerging as a relatively common practice, is ambivalence connected to the familiarity with the scheme? Does the formalisation of this practice through planning and policy recommendations connect with a greater ambivalence about the process compared to when it was an informal or suggested process?

Results from the community indirect potable water scenario highlight the complexity of community perspectives involved in decision making about drinking MAR water. Despite the clarity of factors that emerged for POS/Horticultural scenarios, most people loaded on a factor, there were many people

who did not load on any factor for the indirect potable water scenario. This would indicate that there was something occurring beyond the factors currently not captured by the research process. Alternatively, other authors have suggested that participants who do not load on factors may be people who do not have well-formed opinions about a particular issue (Webler et al. 2001). The complexity of decision making about indirect potable use of MAR water is evident from the Q-Sort process. Future research needs to be directed at more clearly articulating that complexity, particularly in the face of ambiguous and unclear perspectives about MAR for indirect potable use. For example, people who maximised health risks were not necessarily those who were most opposed to the scheme. In fact they may be those people who hold ambivalent perspectives, particularly for indirect potable uses of the water. Understanding the role of different risk categorisations and foci of concern, particularly in relation to how strongly grounded or ambivalent people are in their decision making patterns, will be important to explore in future research.

As well as the complexity, and possible participant ambiguity about decisions for this fit-for-purpose use, the heterogeneity and complexity of community opinions was captured in the 12 significantly different factors that initially emerged (Eigenvalues >1). Factors were eliminated as discussed in the results section. However, these initial 12 significant factors emerged from 37 community participants. Although this is an appropriate number of participants for the validity of this Q-Study, it is interesting to then imagine the complexity that may arise if this was to be done with a larger sample, or in fact across the entire Perth metropolitan area.

Despite a 'general consensus' in the literature about the salience of emotion-based assessments for community in making decisions about risk, particularly for recycled water, the emotion statement "the thought of drinking sewerage disgusts me" did *not* play a significant role in any of the factors, suggesting (given previous ARCWIS research findings) that the link between emotion and risk is complex, and that emotion-based assessments go beyond the 'yuck factor' to include other more specific risk considerations and assessments. 'Perceived risk' is often characterised as differing from 'real' or 'expert' assessments of risk by entailing elements of irrationality or emotionality (Russell & Lux 2006). However, perceptions of risk were not just based in emotion, or eliciting of the 'yuck factor', and risk may be strongly linked in the case of MAR with other categorisations of affect such as dread risk, feelings of dread, and uncertainty amongst other (risk) considerations.

7.2 Breaking Down the Barriers: Technical and Community Perspectives of Risk

An interesting reflection from the technical focus groups, supported by the fact that only two factors emerged in the technical perceptions of community indirect potable scenario, was the construction of community perspectives on indirect potable water under MAR as relatively homogeneous. It has been suggested that there is a tendency for planners and researchers to get swept up in thinking about the impact of community perspectives. This appears to be characterised by a perception that the community will be relatively non-accepting, emotion focussed and driven, focussed on health concerns, with a lack of faith and confidence in scientific, policy and management processes.

However, as was evidenced with emergent factors for the community indirect potable water scenario, the strongest typology consisted of people who were not in fact opposed to the scheme. Factor 1 was characterised by people who were accepting, governance focussed with appeased health concerns connected to the scheme. The features of the strongest typology for perceptions of community drinking water opposed the salient typology for community drinking water that actually emerged. The

type of thinking that characterised the second Factor for technical perceptions of community on which the fewest people loaded was similar to the characteristics of the strongest community drinking water factor, Factor 1.

Both factors that emerged for perceptions of community strongly highlighted the health focus of the community. This is in fact not a significant consideration for many of the community indirect potable water factors. However, the strongest health concern actually emerged from the group that had not really made up their minds, and were ambivalent about the indirect potable water scenario.

Consensus statements on technical perceptions of community risk assessments revealed themes that unified both factors in their perceptions of community. These statements included perception of community as health concerned, a belief that financial investment would not necessarily overcome risk, that communities would not tolerate or be resigned to risk, they were emotion focused, and would perceive problems with information from the media, filtration, and that they would disagree about the risks of MAR being low compared with other risks. As a whole, technical experts thought communities would be relatively unconcerned (compared to other issues) about systems failure, management, political compromise, fairness, financial risk, chemical/toxicological risk, voluntary versus imposed risk, alternative water augmentation options and perceptions of abundant supply. However, the only statements that achieved consensus amongst community participants in this study concerned political compromise, risk of paying too much to get the water to a level the community will accept, and energy intensiveness of MAR. All statements were ranked relatively neutrally. Therefore, although there appeared to be many statements that unified technical perceptions of community assessments of risk, this perception does not accurately reflect the lack of unity or complexity of community when it comes to thinking about risk of MAR for an indirect potable scenario.

7.3 Planning Implications

Many findings support the concept that people's conceptualisation of risk in relation to schemes involving wastewater is dependent on end-use. Consequently, risk perceptions and methods of addressing them are probably best if tailored specifically to the intended end-use. That is, the communication approach would differ for horticultural schemes and public-open-space irrigation. Indirect potable use schemes would address different concerns again. Interestingly, the most challenging and complex communication strategy may well involve latter end-use, indirect potable schemes.

7.3.1 Unknown Risks and the Precautionary Principle

The impact of unknown risks on decision-making is a key element for policy makers to address. To this end there may be a temptation to refrain from interacting honestly and openly with the community about what the science 'does and doesn't know', rather than run the risk of inducing fears of uncertainty in people. Inclusiveness of the community is equally prominent and important. Ramifications of admitting prior uncertainty further down the track (typically as a consequence of an 'incident') could hold greater gravity, as it compromises not only the distributive justice process of the scheme's implementation, but also the trust and credibility of agencies – a much harder thing from which to recover.

For the sake of prudent decision-making, it may be advisable to address unknowns and the communication of them through a 'precautionary' approach (see Raffensperger & Tickner 1999; Schäfer & Beder 2006 for a background to the Precautionary Principle and its application to policy making in the area of water recycling).

7.3.2 Presenting in Context – the Importance of Alternatives and Complexity

A key issue highlighted by the Q-Sorts is that alternative options for water augmentation are foremost in the minds of people who don't accept the proposed indirect potable MAR scheme. That is, the scheme may be unattractive when thought of in relation to schemes with higher perceived viability and/or palatability. There are several clear communication implications. The findings reinforce the importance of presenting new water augmentation options *in combination* with the range of other steps that will be taken. That is, rather than presenting an augmentation option in isolation, it should be expressed and presented in the context of 'holistic' action. However, it is important to note that it is not necessarily good strategy to present to the community a suite of scientifically tested yet *pre-determined* 'solutions', rather this suite should be decided *in conjunction* with what the community consider *suitable* solutions based on environmental, health and economic concerns (Schafer & Beder 2006). Western Australia is well placed *to not* adopt a Decide-Announce-Defend model for the implementation of MAR. There are significant opportunities to adopt and experiment with a range of participatory and democratic approaches that focus on involving community in the process of decision making, not just the communication of outcome.

Presenting a water augmentation option such as MAR in the context of other options may have an additional influence for mitigating risk perception. There is evidence to suggest that, when something is presented in isolation, the perceptions and values and risk people ascribe to it are often exaggerated. If presented in an overall or holistic context, however, these 'embedding effects' are ameliorated (Po, Syme & Nancarrow 2002). Highlighting the planning complexity of water sustainability to the community may 'water down' the risks of MAR by bringing into play the risks associated with other water management options, including the option of not doing enough to secure a long-term, sustainable water supply for Western Australia.

The perspective that complexity of a water augmentation strategy needs to be highlighted to the community to ameliorate risk perception is supported both by the Q-Sorts and by the focus groups which guided the development of the Q-Statements There was not a blatant refusal of acceptance of an indirect potable reuse scheme that emerged, rather a dislike of reuse in the face of competing options. Furthermore, allowing people to make decisions about MAR in context with their decisions about other water augmentation options would ultimately provide a set of community responses and attitudes that were more realistic in keeping with a Western Australian water policy context.

7.3.3 Community Inclusion – Beyond the 'Yuck Factor'

Findings support the notion of community involvement in the decision-making process as a key ingredient for support and success of a range of MAR end-uses. Such involvement necessitates long-term timeframes and in this respect Western Australia already has an advantage: it has factored in timelines for research and planning process more adequately than many other states in Australia. There are potential traps, even within long-term public engagement strategies, of anticipating the types of questions and concerns of the community, and tailoring research and policy processes according to

these *perceptions* of community concern. A deliberative process, in which an authentic and ongoing dialogue with the community is established *and* that community are engaged in decision making processes will establish actual community concerns and questions. Such a process would also mean that planning and research would be more responsive, and ready to address community concerns as the process evolves. This dialogue should neither exclude nor focus solely on the 'vocal minority' or the 'silent majority'. The dialogue should not neglect the 'ambivalent'– that sizeable and significant number of people who hold mixed, yet strong, views – as many meaningful gains are to be made with these groups. A deliberative approach may mean also that a range of communication strategies will need to be adopted for people on the continuum from acceptance, through ambivalence on to non-acceptance. Future research could explore different methods of communication that may be appropriate in this setting for different factors, particularly for a scenario that involved indirect potable water.

The notable omission of the 'yuck factor' as the prominent concern for community is perhaps an example of the limitations of ascribing questions rather than having them generated in the process of deliberative debate. It is proposed here that focusing solely on emotive aspects of community decision making is to underestimate the complexity of community opinion, and effectively reduce planners and researchers' ability to respond to *actual* community concerns and debates. Considered the staple cause of rejection of schemes involving recycled wastewater, the community appears as a whole to have moved beyond a 'toilet to tap' mentality to a more complex conceptualisation of the issue. Scientific and decision making communities need to be open and responsive to new and increasingly multifaceted concerns that comprise the new arena of concerns i.e., what the community wants to know is not necessarily what we think they want to know!

7.3.4 Regulate, Regulate, Regulate

Clearly, Q-Sort highlighted the importance of the need for transparent political, legal and scientific processes. This was important for nearly every factor that emerged, not just for those who agreed with the particular MAR scheme, or for those who disagreed with it. Regulations and responsibility for the day to day management of the scheme were highlighted, with the vast majority supporting a government run-and-owned system – consistent with previous research undertaken by ARCWIS (Leviston et al. 2006). These concerns were inextricably linked with trust in the organisations charged with running and regulating augmentation schemes, especially one involving perceived risks to human health. Communicating the 'fail-safes' of a system – immunity from human error and the innocuous consequences of system breakdown (so long as that information is true) is the assurance that much of the community will seek before committing to the scheme without major reservation.

8.0 FUTURE RESEARCH

Stage 1 of the MAR Premier's Water Foundation research program explored the broad attitudes and intended behaviours associated with an indirect potable MAR scheme, allowing extrapolation to the entire Perth community. It provided an overview of what psycho-sociological factors were driving those behaviours.

Stage 2 processes have illuminated *patterns of similarities and differences* between people's perception of risk – a major driver of intended behaviour. Stage 2 processes have uncovered complexities and nuances describing patterns of decision-making, particularly in relation to the indirect potable MAR scenario. Development of suitable schemes for recycled wastewater, is characterised by uncertainty, difficult time frames, and underpinned (as has been shown in previous research) by a complex interaction of issues of trust, risk, emotion and fairness of different groups. Q-Method facilitated an exploration of the nuances of the viewpoints of the expert and lay stakeholders involved in the research, policy and decision making process.

The next stage of the research program will be development of a communication strategy for resolving the differences in risk perceptions between professionals and communities and for addressing community risk concerns associated with a range of uses for fit-for-purpose quality water. This will be developed in collaboration with the key stakeholders for MAR implementation in Western Australia.

Q-Method presents as a valuable longitudinal tool for understanding and tracking changing community opinion through time periods. As more information becomes available to the community, and as different issues come to the fore, a barometer of changing risk perceptions may be regarded as valuable information for scheme implementation and community involvement strategies.

9.0 REFERENCES

Addams, H. (2000). Q Methodology in H. Addams & J. Proops (Eds.), Social discourse and environmental policy: An application of Q-Methodology (pp. 14-40). Cheltenham, U.K.: Edward Elgar

Adger, W.N. (2000). Vulnerability. *Global Environmental Change, 16*, 268-281

Baggett, S., Jeffrey, P. & Jefferson, B. (2006). Risk perception in participatory planning for water use. *Desalination*. *187*, 149-158.

Barry, J., & Proops, J. (1999). Seeking sustainability discourses with Q-Methodology. *Ecological Economics, 28*, 337-345

Bayerische, R. (1993). *Risk is a construct. Perceptions of risk perception*. Munich: Knesebeck.

Beckwith, J.A.E. (1996). *Judgement strategies in determining risk acceptability.* Unpublished doctoral dissertation, Curtin University of Technology, Perth, Western Australia

Biek, M., Wood, W., and Chaiken, S. (1996). Working knowledge, cognitive processing, and attitudes: On the determinants of bias. *Personality and Social Psychology Bulletin, 22*, 547-57

Blowers, A. (1997). Environmental policy: Ecological modernisation or the Risk Society? *Urban Studies, 34*, 845-871

Böhm, G., & Pfister, H-R. (2000). Action tendencies and characteristics of environmental risks. *Acta Psychologica, 104*, 317-337

Bord, R.J. & O'Connor, R.E. (1997). The gender gap in environmental attitudes: The case of perceived vulnerability to risk. *Social Science Quarterly, 78*, 830-840.

Brown, SR (1996), 'Frequently asked questions about Q methodology', Q-Method Listserv, viewed 13 July 2007.

Brown S.R. (1993). A primer on Q methodology. *Operant Subjectivity* 16(3/4): 91-138

Brown, S.R. (1980). Political subjectivity: Applications of Q-Methodology in political science. Yale University Press: New Haven, CT

Cameron, T.A. (2005). Updating subjective risks in the presence of conflicting information: An application to climate change. *The Journal of Risk and Uncertainty, 30*, 63-97

Campbell, S. (2006). Risk and the subjectivity of preference. *Journal of Risk Research, 9*, 225-242

Charash, M., & McKay, D. (2002). Attention bias for disgust. *Anxiety Disorders, 16*, 529-541

Dingfelder, SF. (2004). From toilet to tap. *Monitor on Psychology*, vol. 35, no. 8. Retrieved October 7, 2008, from http://www.apa.org/monitor/sep04/toilet.html

Dryzek, J. (1990). *Discursive democracy: Politics, policy, and political science.* Cambridge, U.K.: Cambridge University Press

Eden, S., Donaldson, A., & Walker, G. (2005). Structuring subjectivities? Using Q methodology in human geography. *Area*, 37, 413-422

Frewer, L. (1999). Risk perception, social trust, and public participation in strategic decision making: Implications for emerging technologies. *Ambio, 28*, 569-574

Funtowitz, S.O., & Ravetz, J.R. (1990). *Uncertainty and quality in science*. Dordrecht, NL: Kluwer Academic Publishers

Hamilton, D.L., & Sherman, S.J.(1996). Perceiving persons and groups. *Psychological Review, 103(2)*, 336-55.

Kaercher, J. D., Po., M. & Nancarrow, B. E. (2003). *Water recycling community discussion meeting* (Unpublished Manuscript). Perth: Australian Research Centre for Water in Society.

Kahlor, L., Dunwoody, S., Griffin, R.J., & Neuwirth, K. (2006). Seeking and processing information about impersonal risk. *Science Communication, 28*, 163-194

Keeney, R.L., & von Winterfeldt, d. (1986). Improving risk communication. *Risk Analysis, 6*, 417-24

Kjoernes, U., Warde, A., & Harvey, M. (2006). Politicising consumer trust in food: A socio-institutional explanation to variations in trust. In M. Kaiser & M.E. Lien (Eds.). *Politicising consumer trust in food: A socio-institutional explanation to variations in trust* (pp. 162-166). Wageningen Academic Publishers: The Netherlands

Leviston, Z., Nancarrow, B.E., Tucker, D.I. & Porter, N.B. (2006). *Predicting community behaviour: indirect potable reuse of wastewater through Managed Aquifer Recharge*. CSIRO: Perth.

Liberman, A., & Chaiken, S. (1992). Defensive processing of personally relevant health messages. *Personality and Social Psychology Bulletin, 18,* 669-79

Luhmann, N. (1988). "Familiarity, confidence, trust: Problems and alternatives," in Trust: Making and Breaking Cooperative Relations, D. Gambetta, Ed. New York: Basil Blackwell, , pp. 94-107.

Markova, I., & Power, K. (1992). Audience response to health messages about AIDS. In T. Edgar, M.A. Fitzpatrick & V. Freimuth (Eds.), *AIDS: A communication perspective* (pp. 111-30). NJ: Lawrence Erlbaum

Marzillier, S.L., & Davey, G.C.L. (2004). The emotional profiling of disgust-eliciting stimuli: Evidence for primary and complex disgusts. *Cognition and Emotion, 18*, 313-336

Marks, J.S., Martin, B., and Zadoroznyj, M. (2006). Acceptance of water recycling in Australia: National baseline data. *Water, 33*, 151-157

Marks, J.S., & Zadoroznyj, M. (2005). Managing sustainable urban water reuse: Structural context and cultures of trust. *Society and Natural Resources, 18*, 557-572

McDonell, G. (1997). Scientific and everyday knowledge: Trust and the politics of environmental initiatives. *Social Studies of Science*, *27*, 819-863

McKeown, B., & Thomas, D. (1988). *Q-Methodology*. CA: Sage

Melbourne Water. (1998). *Exploring community attitudes to water conservation and effluent reuse.* Melbourne: A consultancy report prepared by Open Mind Group.

Niemeyer, S., Petts, J., & Hobson, K (2005). Rapid climate change and society: Assessing responses and thresholds. *Risk Analysis*, *25*, 1443-1456

Peters, E.M., Burraston, B., & Mertz, C.K. (2004). An emotion-based model of risk perception and stigma susceptibility: Cognitive appraisals of emotion, affective reactivity, worldviews, and risk perceptions in the generation of technological stigma. *Risk Analysis, 24,* 1349-1367

Po, M., Kaercher, J. D. & Nancarrow, B. E. (2004). *Literature review of factors influencing public perceptions of water reuse*. Australian Water Conservation and Reuse Research Program. Perth: CSIRO Land & Water.

Po, M., Nancarrow, B.E., Leviston, Z., Porter, N.B., Syme, G.J., & Kaercher, J.D. (2005). *Predicting community behaviour in relation to wastewater reuse: What drives decisions to accept or reject?* Water for a Healthy Country National Research Flagship. CSIRO Land and Water: Perth.

Po, M., Syme, G. J., & Nancarrow, B.E. (2002). *The development of a methodology for assessing customer preferences for levels of service: Continuity of supply.* CSIRO Land & Water: Perth.

Previte, J., Pini, B., & Haslam-McKenzie, F. (2007). Q Methodology and Rural Research. *Sociologia Ruralis*, *47*, 135-147.

Raffensperger, C., & Tickner, J. (Eds.) (1999), *Protecting public health and the environment: Implementing the precautionary principle*. Washington, DC: Island Press.

Robbins, P., & Krueger, R. (2000). Beyond bias? The promise and limits of Q method in human geography. *Professional Geographer*, *52*, 636-648

Rose, N. (1999). The politics of life itself. *Theory Culture Society, 18,* 1-30

Russell, S., & Lux, C. (2006). *Getting over yuck: Moving from psychological to cultural analyses of responses to water recycling*. [Working Paper 2]. University of Wollongong, Oz-AQUAREC: Wollongong.

Schäfer, A.I., & Beder, S. (2006). Relevance of the precautionary principle in water recycling. *Desalination*, *187*, 241-252

Schmolck, P., 2002. PQMethod 2.11. Downloaded from http://www.rz.unibwmuenchen.de/~p41bsmk/qmethod/

Schofield, B. (2002). Partners in power: Governing the self-sustaining community. *Sociology, 36*, 663-683

Simmons, P., & Walker, G. (1999). Tolerating risk: Policy principles and public perceptions. *Risk Decision and Policy*, 179-190

Sjoberg, L. (2001). Limits of knowledge and the limited importance of trust. *Risk Analysis, 21*, 189-198

Slovic, P. (1987). Perception of risk. *Science, 236*, 280-285

Stainton-Rogers, R. (1998). Q methodology. In J.A. Smith, R. Harre, & L. Van Langenhove (Eds.), *Rethinking methods in psychology* (pp. 178-192). London: Sage

Steelman, T.A., & Maguire, L.A. (1999). Understanding participant perspectives: Q-Methodology in national forest management. *Journal of Policy Analysis and Management*, *18*, 361-379

Stenekes, N., Colebatch, H.K., Waite, T.D., & Ashbolt, N.J. (2006). Risk and governance in water recycling: Public acceptance revisited. *Science Technology Human Values, 31*, 107-134

Stockdale, J., Dockrell, J., & Wells, A. (1989). The self in relation to mass media representations of HIV and AIDS: Match or mismatch? *Health Education Journal, 48*, 121-130

Swedeen, P. (2006). Post-normal science in practice: A Q study of the potential for sustainable forestry in Washington State, USA

Stephenson, W. (1953). *The study of behaviour: Q-technique and its methodology*. University of Chicago Press: Chicago

Sydney Water. (1999). *Community views on re-cycled water*. Sydney: Author.

Syme, G.J., & Bishop, B.J. (1992). *Community perceptions of dam safety issues: A preliminary study*. CSIRO Division of Water Resources: DWR Consultancy Report No. 92/32

Thalmann, A.T., & Wiedemann, P.M. (2006). Beliefs and emotionality in risk appraisals. *Journal of Risk Research*, *9*, 453-466

Tuler, S., Webler, T., & Finson, R. (2005). Competing perspectives on public involvement: Planning for risk categorisation and risk communication about radiological contamination from a national laboratory. *Health, Risk & Society, 7*, 2247-266

Turner, B. (2006). Transitional fears: Water, surveillance and the abject in Australia. Refereed paper proceedings presented at UNAUSTRALIA, Cultural Studies of Australasia Annual Conference, December 6th – 8th University of Canberra.

Water Corporation (2003). *Community attitudes and public perceptions.* Perth: Paper presented at the Water Recycling Workshop 225th-26th June 2003.

Watts, S., & Stenner, P. (2005). Doing Q methodology: Theory, method and interpretation. *Qualitative Research in Psychology*, 2, 67-91

Webler, T., & Tuler, S. (2006). Four perspectives on public participation process in environmental assessment and decision making: Combined results from 10 case studies. *The Policy Studies Journal*, *34*, 699-722

Webler, T., Tuler, S., & Krueger, R. (2001). What is a good public participation process? Five perspectives from the public. *Environmental Management, 27*, 435-450

APPENDIX 1

SCENARIOS FOR COMMUNITY AND TECHNICAL Q-SORT PARTICIPANTS

The Water Corporation is currently considering a process known as Managed Aquifer Recharge (MAR) as a possible new *drinking water* source for people in Perth.

Introducing MAR, or groundwater replenishment as it is sometimes known, would mean that Perth's wastewater, which comes from a number of sources (e.g. household, commercial, industrial and hospital/medical wastewater) would be treated, and then placed into natural groundwater supplies (aquifers).

The proposed MAR scheme would use a type of treatment called Reverse Osmosis (RO) to treat wastewater before it entered the aquifer. RO works by filtering water through barriers, or membranes, that are designed to filter out things like salt, bacteria and viruses, and let clean water through.

Once the treated wastewater is placed into the aquifer, it would mix with the natural groundwater and be drawn out at a later time to form a part of Perth's drinking water supplies. The water would be delivered to households through the existing scheme water system – that is, the water would come through your normal household/scheme water taps.

Figure 2. Scenario given to participants for MAR Indirect Potable Scheme Q-Sort

The Water Corporation is currently considering a process known as Managed Aquifer Recharge (MAR) as a possible water source for watering commercial fruit and vegetable crops.

Introducing MAR, or groundwater replenishment as it is sometimes known, would mean that Perth's wastewater, which comes from a number of sources (e.g. household, commercial, industrial and hospital/medical wastewater) would be treated, and then placed into natural groundwater supplies (aquifers) that are used to irrigate horticultural crops.

The proposed MAR scheme would use secondary treated water from a wastewater treatment plant. This type of treatment is the same as that used currently before wastewater is disposed of into the ocean, but not as high quality as if it was to be used for drinking.

Once the treated wastewater was placed into the aquifers, it would mix with the natural groundwater and be drawn out at a later time to form a part of horticulture irrigation supplies.

Figure 3. Scenario given to participants for MAR Horticultural Irrigation Q-Sort

The Water Corporation is currently considering a process known as Managed Aquifer Recharge (MAR) as a possible water source for use for watering *public open spaces* in Perth. Public open spaces can include local parks, race courses, golf courses and other sporting grounds.

Introducing MAR, or groundwater replenishment as it is sometimes known, would mean that Perth's wastewater, which comes from a number of sources (e.g. household, commercial, industrial and hospital/medical wastewater) would be treated, and then placed into specific underground water supplies (aquifers).

The proposed MAR scheme would use secondary treated water from a wastewater treatment plant. This type of treatment is the same as that used currently before wastewater is disposed of into the ocean, but not as high quality as if it was to be used for drinking.

This treated wastewater would be put into the aquifers, where it would mix with the natural groundwater and drawn out at a later time for watering public open space.

Figure 4. Scenario given to participants for MAR Public Open Space Q-Sort

APPENDIX 2

CONDITIONS OF INSTRUCTION AND SORTING PROCEDURE FOR Q-SORT

Sorting Instructions

Imagine that MAR was going to happen in Perth as in the introduction provided.

You have in front of you a series of cards and a board on which we will ask you to place the cards. Each card holds one statement. The purpose of this exercise is to sort the cards according to which statements most closely represent your point of view on the issue.

The following two pages provide a step-by-step guide to sorting the cards.

Figure 5. Sorting instructions for community participants

Sorting Instructions – 1st Exercise

Imagine that MAR with recycled wastewater (for drinking) was going to happen in Perth as in the introduction/scenario.

You have in front of you a series of cards and a board on which we will ask you to place the cards. Each card holds one statement.

The purpose of this first exercise is to sort the cards according to which statements most closely represent your point of view on the issue. That is, you are sorting the cards based on your own personal opinion(s) about MAR and groundwater replenishment.

The following two pages provide a step-by-step guide to sorting the cards.

Sorting Instructions – 2nd Exercise

Imagine that MAR with recycled wastewater (for drinking) was going to happen in Perth as in the introduction/scenario.

You have in front of you a series of cards and a board on which we will ask you to place the cards. Each card holds one statement.

The purpose of this second exercise is to sort the cards according to what you think most closely resembles a stereotypical 'community' point of view. When doing this exercise, imagine you are answering as a community member outside of political and scientific domains that actually deal with water issues. That is, you are sorting the cards, based on your thoughts about community opinion(s) and groundwater replenishment.

The following two pages provides a step-by-step guide to sorting the cards.

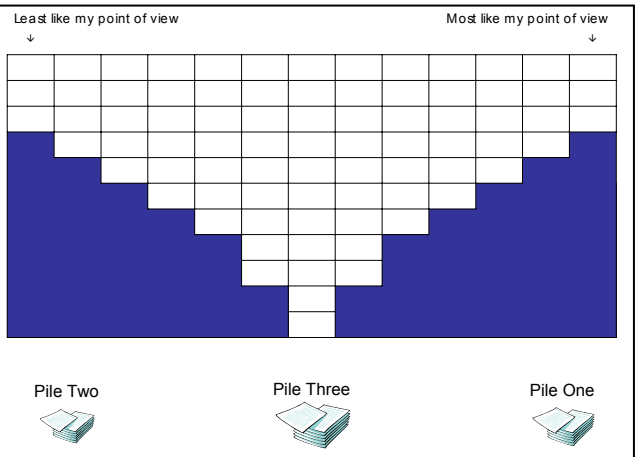
Figure 6. Sorting instructions for technical participants

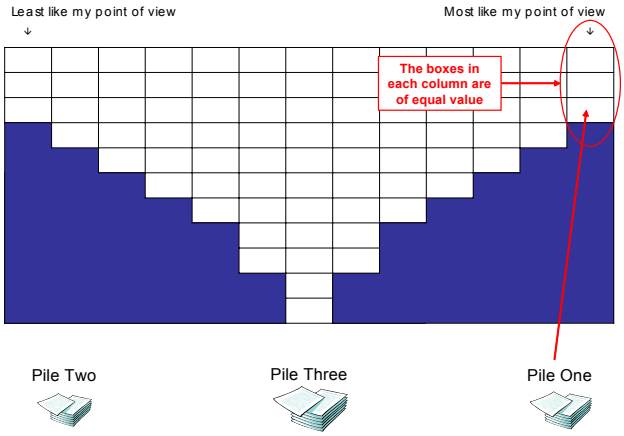
Step 1:

Read through the cards to become familiar with the statements. As you are doing so, sort the cards into three piles:

- Pile One - statements that are *like* your point of view
- Pile Two - statements that are *unlike* your point of view
- Pile Three - statements that you are *uncertain* about or feel *neutral* towards.

Don't worry if the number of cards in each pile is not the same!



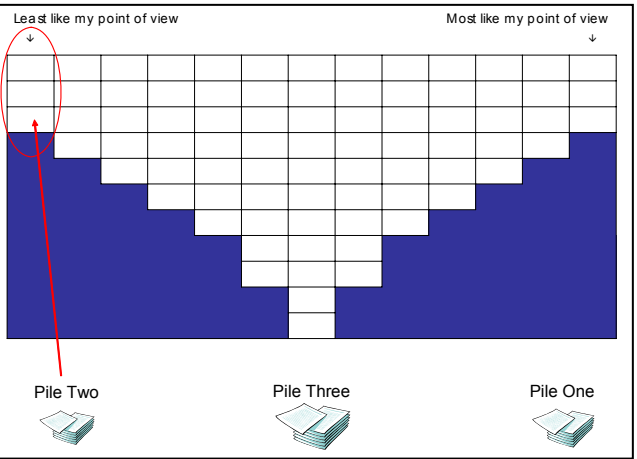


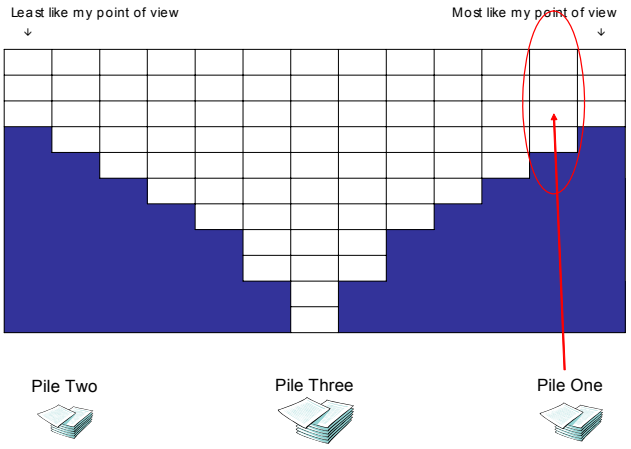
Step 2:

Once you have placed the cards into the three piles, start sorting them onto the board in front of you. Place the three cards from Pile One that are most strongly *like* your point of view into the extreme right hand column.

Step 3:

Once you have done this, place three cards from Pile Two that are most strongly *unlike* your point of view into the extreme left hand column.



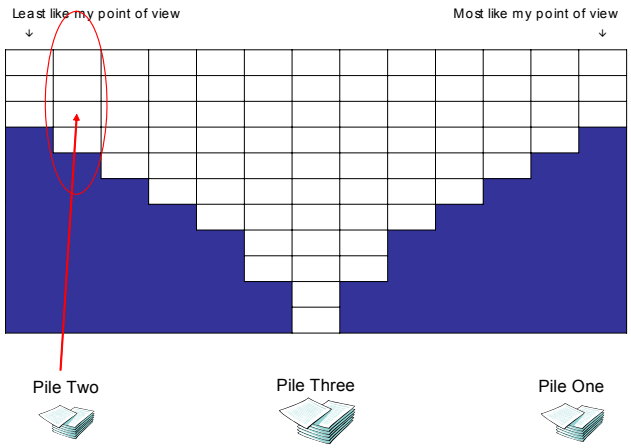


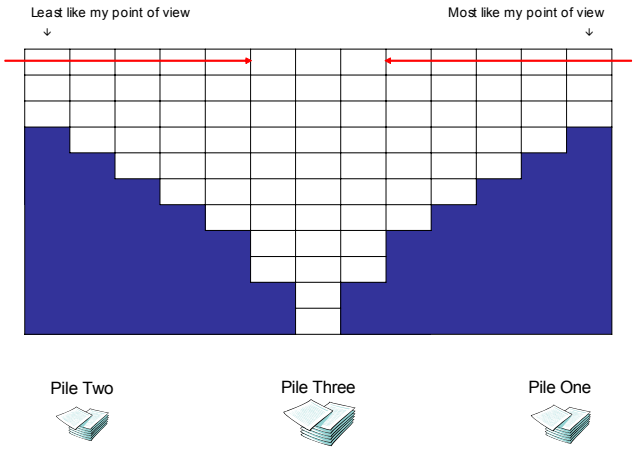
Step 4:

Returning to the right side of the board, now pick the four cards out of the remaining cards in Pile One that are most strongly like your point of view. Place these into the next free column on the right.

Step 5:

Continue by moving to the left of the board and the next free column and similarly place the four cards from Pile Two that are most unlike your point of view.



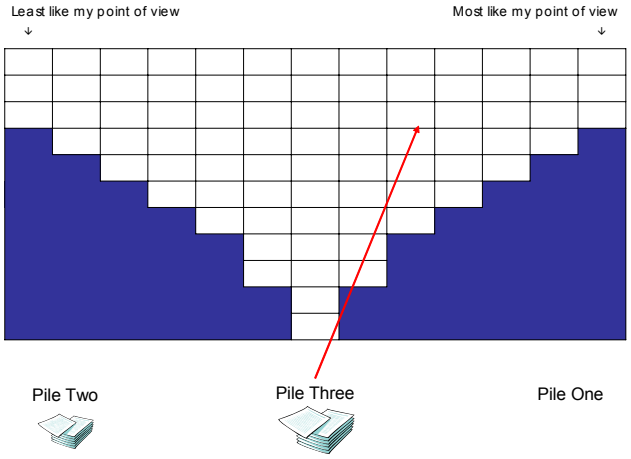


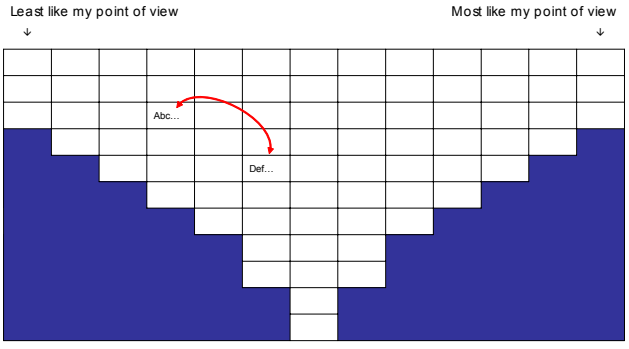
Step 6:

Continue placing the cards from Pile One and Pile Two onto the board, moving back and forward from the right to left hand side of the board, working towards the middle.

Step 7:

If you run out of cards from Pile One/Two then move onto the cards you have placed in Pile Three and continue sorting the statements in the same manner according to which statements are most like/most unlike your point of view.





Step 8:

At any stage you may switch cards that you have placed in one column with cards in another column. Once you have finished sorting all of the cards onto the board – do a final check and move any cards that you wish.

APPENDIX 3

Q-SORT THEMES, STATEMENTS AND FACTOR ARRAYS

Table 12. Public open space q-sort statements and their factor rankings (factor arrays)

Statement	Factor Rank 1	2	3	4
Unknown Risks/ Uncertainties (inc what is actually not known and public perceptions of unknowns)				
1. I am worried about water-borne diseases that we don't know about yet.	-1	1	2	0
2. It is the uncertainty of what could go wrong that troubles me.	-3	3	0	1
3. Scientists and governments have been wrong in the past about what is safe for us, what is to say they won't be wrong about this?	0	0	1	-3
Trust				
4. I would be reassured that the water was safe if there was a panel of independent experts who could guarantee its safety.	2	3	1	4
5. I feel I can trust the media for information and messages about MAR.	-1	-4	-4	-2
6. I trust scientists to tell me whether the water is safe or not. Due to their training they are in the best position to know.	2	-2	3	4
7. Government bodies would be more accountable than privatised companies for such a scheme.	5	-1	3	-3
8. It wouldn't go ahead unless the authorities were satisfied it was safe.	3	-3	0	22
Time in Aquifer				
9. Once the wastewater has been in the aquifer for a number of years, it basically becomes purified and like groundwater anyway.	3	-3	-1	3
System Failure Risk (inc mismanagement/monitoring)				
10. Human and mechanical errors are always possible which makes a scheme like MAR too risky.	-1	0	-1	-1
11. A big risk with MAR is that the aquifer could become contaminated and nothing could be done about it.	-2	2	4	4
12. I am concerned about something going wrong such as breakdowns or something not working properly.	-1	4	-1	3
Management (inc scientific, policy and infrastructure management and knowledge)				
13. I believe there is enough knowledge around about water testing, disease minimisation and harm reduction that MAR will not be a problem.	3	-4	1	4
14. A main management priority should be to reduce industrial emissions and waste entering the water system before it becomes recycled water.	3	4	0	4
15. There needs to be strict legal and legislative requirements to make sure that the system is managed well.	5	5	4	2
Relative/Competitive Risk (risk compared to other risks/other water sources)				
16. I don't have a problem with MAR.	4	-5	0	2
17. People are exposed to so many risks everyday that the risk of MAR is too small to worry about.	1	-4	2	1

Contd.

Statement	Factor Rank			
	1	2	3	4
Political Risk (inc risk to political domain, community backlash)				
18. Political interests and processes could compromise the MAR scheme.	4	2	1	-1
Personal Health Risk (inc family health risk, and personal cumulative health risk)				
19. I am concerned about the health effects of public open space being watered with recycled wastewater.	-1	3	2	-1
20. There could be an outbreak of diseases and other illnesses.	-4	1	0	-1
21. I am concerned about a build-up of chemicals and toxins in my body over time.	-3	1	-3	-1
Intergenerational Issues (inc cumulative intergenerational issues)				
22. I am worried about how this might effect generations to come.	-1	1	-2	0
23. I am worried about the effects of the water on unborn babies and young children.	-5	2	0	0
Aesthetics				
24. I am concerned that MAR will make the water smell bad.	-5	-2	-2	-3
25. I am concerned that MAR water will stain buildings and equipment at sporting fields and public open space.	-2	-3	-4	-4
Geographical Location and Fairness				
26. I would want to see other areas and gardens using recycled water before it was used in my area.	-4	-3	-2	-2
Fairness (General)				
27. Those who pollute or use the water the most should have to use it before anyone else.	0	-1	-3	1
Financial Risk				
28. If you put enough money into MAR, you could overcome just about any issue or risk.	1	-2	-1	-2
29. We run the risk of paying way too much to get the water treated to a level that the community will tolerate.	0	-2	-5	3
30. Government should be looking for water options that are the safest, not the cheapest.	2	1	3	0
Environmental (inc Risk)				
31. I am concerned about the environmental impact on the aquifer.	0	5	5	-1
32. Given that we are already using water from the underground aquifers we should be replenishing it with something like recycled water.	5	-1	3	2
33. I am concerned that the MAR process will be too energy intensive.	-1	-1	-5	0
Perceptions of Community Response				
34. Scientists base their decision-making on fact, community base their decisions on feeling.	1	-1	4	3

Contd.

Statement	Factor Rank			
	1	**2**	**3**	**4**
35. If scientists can't agree on many things, how can the community be expected to agree?	0	0	1	-3
36. We don't have the time to wait till the entire community is happy with the level of risk in using treated wastewater for watering public open space before it proceeds.	1	-2	2	5
37. The community do not have the required expertise or information to make a decision about MAR.	1	1	2	1
38. I support it, but you will have a hard time convincing others to support it.	1	-4	4	2
Chemical/Toxicological Risk				
39. I have every faith in filtration. If you use enough filtration then even miniscule things can be removed.	4	-2	0	1
40. You can't possibly account for all the different things that people flush down their toilets.	-2	0	1	-1
41. It is extremely unlikely that scientists can know how the different chemicals in recycled wastewater will react together.	-3	-1	-1	-4
Voluntary versus Imposed Risk				
42. There is a difference between choosing to take risks and having risks imposed on us like this would be.	-2	1	-1	0
Tolerability and Resignation to Risk				
43. If I was told it was safe I would probably just get used to it.	1	-3	1	1
44. My life is too busy and there are too many other things to think about that I would probably just tolerate it even though I didn't like it.	-4	-5	0	-1
45. I would rather have green public space available that had been watered with recycled wastewater than have dead and brown parks and gardens.	3	0	5	2
46. There is controversy surrounding the use of recycled wastewater because it is a new concept.	2	0	0	-2
47. I believe it is going to happen anyway, regardless of how I feel about it.	0	-1	3	3
Alternative Futures				
48. We need to focus on behaviour change and reducing water use before we look at other solutions.	0	5	1	0
49. I think that other solutions are a better source of water for WA than MAR (eg rainwater tanks and/or home water recycling, Ord River pipeline, desalination, SW Yaragadee etc).	0	2	0	-5
50. Water is too cheap and should cost more so that people don't waste it.	2	0	-3	-3
51. The real issue is controlling population growth, otherwise we will always be searching for more and more water.	1	-1	-3	0
Perceptions of Abundant Supply through MAR				
52. Recycling wastewater will just encourage people to use more water anyway.	-1	0	-1	0
53. WA is managing its water well enough to not need wastewater recycling.	-4	-5	-4	-5

Contd.

Statement	Factor Rank			
	1	2	3	4
Societal Issues				
54. As a developed country, we have the technology and the finances to not have a water system that means we're using recycled sewage.	0	4	-5	-5
55. This is a fundamental public issue that needs more community debate before a decision is made.	0	3	-1	1
POS Specific Statements				
56. I am worried about the diseases and infections that could be transferred to humans from animals/birds that have had contact with the water.	-2	2	-2	0
57. I am worried about the risk of infection when playing sport on fields irrigated with recycled wastewater.	-3	0	-2	-3
58. I think it is ok to use the water to preserve local amenities such as wetlands	4	1	5	-2
59. The recycled wastewater should be used for wetland regeneration or public open space watering first so people become familiar with it and see there are no problems, and will in time accept it for other uses.	2	4	2	5
60. I am concerned about the effects on birds and other wildlife by using recycled water to water public open space and wetlands.	-3	3	-2	1
61. I would be worried about (my) children playing in areas that had been watered with recycled wastewater.	-2	2	-3	-4
62. I would not want to play sport on ovals or sporting grounds that had been watered with recycled wastewater.	-5	0	-4	-4

Table 13. Horticulture Q-sort statements and their factors rankings (factor arrays)

Statement	Factor Rank			
	1	2	3	4
Unknown Risks/Uncertainties (inc what is actually not known and public perceptions of unknowns)				
1. I am worried about water-borne diseases that we don't know about yet.	-5	4	-2	1
2. It is the uncertainty of what could go wrong that troubles me.	0	3	-2	0
3. Scientists and governments have been wrong in the past about what is safe for us, what is to say they won't be wrong about this?	1	1	-4	-1
Trust				
4. I would be reassured that the water was safe if there was a panel of independent experts who could guarantee its safety.	-1	0	-1	-1
5. I feel I can trust the media for information and messages about MAR.	-1	-5	1	-3
6. I trust scientists to tell me whether the water is safe or not.	2	-1	0	-5
7. Government bodies would be more accountable than privatised companies for such a scheme.	5	-4	-2	0
8. It wouldn't go ahead unless the authorities were satisfied it was safe.	2	1	3	-4
Time in Aquifer				
9. Once the wastewater has been in the aquifer for a number of years, it basically becomes purified and like groundwater anyway.	2	-1	2	0
System Failure Risk (inc mismanagement/monitoring)				
10. Human and mechanical errors are always possible which makes a scheme like MAR too risky.	0	0	1	3
11. A big risk with MAR is that the aquifer could become contaminated and nothing could be done about it.	-1	1	-4	2
12. I am concerned about something going wrong such as breakdowns or something not working properly.	0	2	-5	2
Management (inc scientific, policy and infrastructure management and knowledge)				
13. I believe there is enough knowledge around about water testing, disease minimisation and harm reduction that MAR will not be a problem.	5	-3	5	-3
14. A main management priority should be to reduce industrial emissions and waste entering the water system before it becomes recycled water.	4	4	5	1
15. There needs to be strict legal and legislative requirements to make sure that the system is managed well.	5	2	1	2
Relative/Competitive Risk (risk compared to other risks/other water sources)				
16. I don't have a problem with MAR.	4	-3	5	-4
17. People are exposed to so many risks everyday that the risk of MAR is too small to worry about.	0	-3	3	-2
Political Risk (inc risk to political domain, community backlash)				
18. Political interests and processes could compromise the MAR scheme.	5	2	-2	4

Contd.

Statement	Factor Rank			
	1	2	3	4
Personal Health Risk (inc family health risk, and personal cumulative health risk)				
19. I am concerned about the health effects of eating food that has been grown in the water.	-2	2	-1	-2
20. There could be an outbreak of diseases and other illnesses.	-3	5	-2	1
21. I am concerned about a build-up of chemicals and toxins in my body over time.	-4	5	-1	1
Population Health Risks (include comments from Family Case study re risk to pop.)				
22. I am concerned about the impact of the water on reproductive health and fertility.	-3	4	-4	-1
23. I am worried about the effects from so called 'gender bending' chemicals.	-4	-2	-2	-3
Intergenerational Issues (inc cumulative intergenerational issues)				
24. I am worried about how this might effect generations to come.	-4	5	-1	0
25. I am worried about the effects of the water on unborn babies and young children.	-4	4	-3	0
Aesthetics				
26. I am concerned that MAR will make the water smell bad.	-3	-2	-5	-4
27. I am concerned that MAR water will make fruit and vegetables taste strange.	-3	-1	-2	-4
Geographical Location and Fairness				
28. I would want other people to eat food irrigated by recycled water before I did.	-2	-1	-3	-2
Fairness (General)				
29. Those who pollute or use the water the most should have to use recycled wastewater before anyone else.	-1	0	3	-5
Financial Risk				
30. If you put enough money into MAR, you could overcome just about any issue or risk.	1	-4	4	-2
31. We run the risk of paying way too much to get the water treated to a level that the community will tolerate.	0	-3	0	4
32. Government should be looking for water options that are the safest, not the cheapest.	1	3	0	5
Environmental (inc Risk)				
33. I am concerned about the environmental impact on the aquifer.	0	3	2	1
34. Given that we are already using water from the underground aquifers we should be replenishing it with something like recycled water.	4	0	0	-3
35. I am concerned that the MAR process will be too energy intensive.	-1	0	-3	4
Perceptions of Community Response				
36. Scientists base their decision-making on fact, community base their decisions on feeling.	1	1	1	-1
37. If scientists can't agree on many things, how can the community be expected to agree?	0	-2	0	3

Contd.

Statement	Factor Rank			
	1	2	3	4
38. We don't have the time to wait till the entire community is happy with the level of risk in using treated wastewater for horticulture before it proceeds.	2	1	2	-1
39. The community do not have the required expertise or information to make a decision about MAR.	1	0	0	3
40. I support it, but you will have a hard time convincing others to support it.	3	-1	2	0
Chemical/Toxicological Risk				
41. I have every faith in filtration. If you use enough filtration then even miniscule things can be removed.	3	-4	4	-2
42. You can't possibly account for all the different things that people flush down their toilets.	-1	1	0	1
43. It is extremely unlikely that scientists can know how the different chemicals in recycled wastewater will react together.	-2	-4	0	0
Voluntary versus Imposed Risk				
44. If people are not happy eating food grown in recycled water they should go out and buy other food.	0	-2	-1	-3
45. There is a difference between choosing to take risks and having risks imposed on us like this would be.	0	0	-1	-1
Tolerability and Resignation to Risk				
46. If I was told it was safe to eat food grown with recycled water I would probably just get used to it.	1	-1	3	1
47. My life is too busy and there are too many other things to think about that I would probably just tolerate it even though I didn't like it.	-1	-2	-5	-1
48. Any potential risks aside, I would rather eat food grown with recycled water than live with the anxiety that we could run out of water.	3	0	0	-1
49. There is controversy surrounding the use of recycled wastewater because it is a new concept.	2	0	0	-3
50. I believe it is going to happen anyway, regardless of how I feel about it.	1	-1	1	0
Alternative Futures				
51. We need to focus on behaviour change and reducing water use before we look at other solutions.	4	1	4	5
52. I think that other solutions are a better source of water for WA than MAR (e.g., rainwater tanks and/or home water recycling, Ord River pipeline, desalination, SW Yaragadee etc).	-2	3	1	5
53. Water is too cheap and should cost more so that people don't waste it.	1	0	2	3
54. The real issue is controlling population growth, otherwise we will always be searching for more and more water.	-1	-5	-3	0
55. I would prefer a scheme where recycled water was stored separately from our other water supplies.	-2	3	1	4

Contd.

Statement	Factor Rank			
	1	2	3	4
Perceptions of Abundant Supply through MAR				
56. Recycling wastewater will just encourage people to use more water anyway.	-2	-1	3	2
57. WA is managing its water well enough to not need wastewater recycling.	-5	-3	-3	-5
Societal Issues				
58. As a developed country, we have the technology and the finances to not have a water system that means we're using recycled sewage.	-5	-5	1	3
59. This is a fundamental public issue that needs more community debate before a decision is made.	0	2	1	2
60. It is a contradiction that there is a worry about using recycled wastewater when many people buy imported fruit, vegetables and produce that could be treated with wastewater and chemicals Australia prohibits the use of.	3	1	-2	-1
Horticulture Specific Statements				
61. I would prefer to eat things that don't come into direct contact with the water such as oranges and other tree fruits.	-3	-2	-4	0
62. I would be happy to eat fruit and vegetables grown with recycled water if I washed them before I ate them.	2	2	4	2

Table 14. Community drinking water statements and their factor rankings (factor arrays)

Statements	Factor Rank				
	1	2	3	4	5
Unknown Risks/Uncertainties (inc what is actually not known and public perceptions of unknowns)					
1. I am worried about water-borne diseases that we don't know about yet.	-4	1	4	-5	1
2. It is the uncertainty of what could go wrong that troubles me.	-1	4	1	1	-1
3. Scientists and governments have been wrong in the past about what is safe for us, what is to say they won't be wrong about this?	0	3	-3	1	2
Trust					
4. I would be reassured that the water was safe if there was a panel of independent experts who could guarantee its safety.	1	-1	0	-1	1
5. I feel I can trust the media for information and messages about MAR.	-4	-4	-5	2	0
6. I trust scientists to tell me whether the water is safe or not.	3	-2	-1	2	4
7. Government bodies would be more accountable than privatised companies for such a scheme.	4	-2	-3	4	-2
8. It wouldn't go ahead unless the authorities were satisfied it was safe.	1	-2	0	2	3
Time in Aquifer					
9. Once the wastewater has been in the aquifer for a number of years, it basically becomes purified and like groundwater anyway.	3	-1	-4	0	2
System Failure Risk (inc mismanagement/monitoring)					
10. Human and mechanical errors are always possible which makes a scheme like MAR too risky.	-2	3	-1	1	-5
11. A big risk with MAR is that the aquifer could become contaminated and nothing could be done about it.	-1	2	5	4	-4
12. I am concerned about something going wrong such as breakdowns or something not working properly.	-1	2	0	5	0
Management (inc scientific, policy and infrastructure management and knowledge)					
13. I believe there is enough knowledge around about water testing, disease minimisation and harm reduction that MAR will not be a problem.	4	-5	-1	-1	5
14. A main management priority should be to reduce industrial emissions and waste entering the water system before it becomes recycled water.	5	4	5	0	2
15. There needs to be strict legal and legislative requirements to make sure that the system is managed well.	5	1	3	5	0
Relative/Competitive Risk (risk compared to other risks/other water sources)					
16. I don't have a problem with MAR.	3	-5	0	-5	5
17. People are exposed to so many risks everyday that the risk of MAR is too small to worry about.	1	-3	-1	-3	-2
18. People don't really know what comes out of their tap now, so what's the difference if they put treated wastewater in it or not?	2	-1	-2	0	-4

Contd.

Statements	Factor Rank				
	1	2	3	4	5
Political Risk (inc risk to political domain, community backlash)					
19. Political interests and processes could compromise the MAR scheme.	2	2	3	3	0
Personal Health Risk (inc family health risk, and personal cumulative health risk)					
20. My biggest concern is the health effects of drinking the recycled water.	-4	3	5	0	3
21. I am worried about an outbreak of diseases and other illnesses.	-3	2	1	-2	0
22. I am concerned about a build-up of chemicals and toxins in my body over time.	-3	1	2	-1	1
Population Health Risks (include comments from Family Case study re risk to pop.)					
23. I am concerned about the impact of the water on reproductive health and fertility.	-3	1	2	-1	1
24. I am worried about the effects from so called 'gender bending' chemicals.	-5	-3	-1	4	1
Intergenerational Issues (inc cumulative intergenerational issues)					
25. I am worried about how this might effect generations to come.	-2	2	3	-4	-2
26. I am worried about the effects of the water on unborn babies and young children.	-4	0	2	-1	0
Aesthetics					
27. I am concerned that MAR will make the water taste and/or smell bad.	-3	-2	2	-2	1
Geographical Location and Fairness					
28. I would be unhappy if I had to drink it and others didn't.	-2	-1	0	-1	-5
Fairness (General)					
29. Those who pollute or use the water the most should have to use recycled wastewater before anyone else.	-1	0	2	-2	1
Financial Risk					
30. If you put enough money into MAR, you could overcome just about any issue or risk.	0	-3	-1	0	4
31. We run the risk of paying way too much to get the water treated to a level that the community will accept.	-1	0	-3	-1	-1
32. Government should be looking for water options that are the safest, not the cheapest.	2	4	1	-2	0
Environmental (inc Risk)					
33. I am concerned about the environmental impact on the aquifer.	0	1	2	2	-2
34. Given that we are already using water from the underground aquifers we should be replenishing it with something like recycled water.	4	-1	1	-3	2
35. If the water is clean enough for us to drink then it will be clean enough for the environment.	3	0	1	3	4
36. I am concerned that the MAR process will be too energy intensive.	0	0	0	0	-1
Perceptions of Community Response					
37. Scientists base their decision-making on fact, community base their decisions on feeling.	1	-1	0	4	-4

Contd.

Statements	Factor Rank				
	1	**2**	**3**	**4**	**5**
38. If scientists can't agree on many things, how can the community be expected to agree?	-1	3	0	0	0
39. We don't have the time to wait till the entire community is happy with the level of risk in drinking treated wastewater before it proceeds.	2	-4	2	3	1
40. The community do not have the required expertise or information to make a decision about MAR.	0	1	4	1	1
41. I support it, but you will have a hard time convincing others to use it.	3	-2	3	5	-1
Chemical/Toxicological Risk					
42. I have every faith in filtration. If you use enough filtration then even miniscule things can be removed.	2	-4	-2	-1	-5
43. You can't possibly account for all the different things that people flush down their toilets.	-1	1	-1	-1	-1
44. It is extremely unlikely that scientists can know how the different chemicals in recycled wastewater will react together.	-3	0	0	-1	2
Emotion					
45. The thought of drinking sewage disgusts me.	-5	0	-2	0	4
Voluntary versus Imposed Risk					
46. If people are not happy with drinking recycled water they should go out and buy bottled water.	0	-2	-4	-4	-4
47. There is a difference between choosing to take risks and having risks imposed on us like this would be.	-1	2	-2	2	-2
Tolerability and Resignation to Risk					
48. If I was told it was safe to drink I would probably just get used to drinking it.	2	-4	-2	0	3
49. My life is too busy and there are too many other things to think about that I would probably just tolerate it even though I didn't like it.	-2	-5	-3	2	-4
50. I would rather drink recycled water than live with the anxiety that we could run out of water to drink.	4	-3	4	-4	0
51. There is controversy surrounding the use of recycled wastewater because it is a new concept.	1	1	-2	1	2
52. I believe it is going to happen anyway, regardless of how I feel about it.	1	-1	0	-2	0
Alternative Futures					
53. We need to focus on behaviour change and reducing water use before we look at other solutions.	1	5	1	-1	1
54. I think that other solutions are a better source of drinking water for WA than MAR (e.g., rainwater tanks, and/or home water recycling, Ord River pipeline, desalination, SW Yarragadee).	0	5	-4	3	-2
55. Water is too cheap and should cost more so that people don't waste it.	1	0	1	-3	-1
56. The real issue is controlling population growth, otherwise we will always be searching for more and more water.	0	0	-4	-5	-5

Contd.

Statements	Factor Rank				
	1	**2**	**3**	**4**	**5**
57. I would prefer a scheme where recycled water was stored separately from our other drinking water supplies.	0	3	3	-3	-3
Perceptions of Abundant Supply					
58. Recycling wastewater will just encourage people to use more water anyway.	-2	0	1	-3	-3
59. WA is managing its water well enough to not need wastewater recycling.	-5	-3	-5	1	-3
Societal Issues					
60. I think it is safe as other countries have been drinking recycled water for a long time with no problems.	5	-1	-1	1	-1
61. As a developed country, we have the technology and the finances to not have a water system that means we're drinking recycled sewage.	-2	5	-5	-4	0
62. This is a fundamental public issue that needs more community debate before a decision is made.	0	4	-3	3	-1

Table 15. Technical experts drinking water statements and their factor rankings (factor arrays)

Statement	Factor Rank			
	1	2	3	4
Unknown Risks/Uncertainties (inc what is actually not known and public perceptions of unknowns)				
1. I am worried about water-borne diseases that we don't know about yet.	-4	2	2	-2
2. It is the uncertainty of what could go wrong that troubles me.	-3	4	2	0
3. Scientists and governments have been wrong in the past about what is safe for us, what is to say they won't be wrong about this?	-1	4	0	0
Trust				
4. I would be reassured that the water was safe if there was a panel of independent experts who could guarantee its safety.	3	-3	-2	5
5. I feel I can trust the media for information and messages about MAR.	-4	-5	-2	-5
6. I trust scientists to tell me whether the water is safe or not.	3	-3	-3	-3
7. Government bodies would be more accountable than privatised companies for such a scheme.	2	1	0	3
8. It wouldn't go ahead unless the authorities were satisfied it was safe.	4	-3	-3	1
Time in Aquifer				
9. Once the wastewater has been in the aquifer for a number of years, it basically becomes purified and like groundwater anyway.	5	-1	-2	1
System Failure Risk (inc mismanagement/monitoring)				
10. Human and mechanical errors are always possible which makes a scheme like MAR too risky.	-1	3	0	1
11. A big risk with MAR is that the aquifer could become contaminated and nothing could be done about it.	-2	3	3	4
12. I am concerned about something going wrong such as breakdowns or something not working properly.	-2	4	1	3
Management (inc scientific, policy and infrastructure management and knowledge)				
13. I believe there is enough knowledge around about water testing, disease minimisation and harm reduction that MAR will not be a problem.	3	-2	-1	-4
14. A main management priority should be to reduce industrial emissions and waste entering the water system before it becomes recycled water.	0	1	3	3
15. There needs to be strict legal and legislative requirements to make sure that the system is managed well.	5	3	0	5
Relative/Competitive Risk (risk compared to other risks/other water sources)				
16. I don't have a problem with MAR.	4	-2	-1	0
17. People are exposed to so many risks everyday that the risk of MAR is too small to worry about.	2	-3	2	2
18. People don't really know what comes out of their tap now, so what's the difference if they put treated wastewater in it or not?	0	-2	-3	-1

Contd.

Statement	Factor Rank			
	1	2	3	4
Political Risk (inc risk to political domain, community backlash)				
19. Political interests and processes could compromise the MAR scheme.	2	5	-5	1
Personal Health Risk (inc family health risk, and personal cumulative health risk)				
20. My biggest concern is the health effects of drinking the recycled water.	-1	5	2	-1
21. I am worried about an outbreak of diseases and other illnesses.	-3	3	0	-1
22. I am concerned about a build-up of chemicals and toxins in my body over time.	-3	2	-1	-2
Population Health Risks (include comments from Family Case study re risk to pop.)				
23. I am concerned about the impact of the water on reproductive health and fertility.	-2	1	-4	3
24. I am worried about the effects from so called 'gender bending' chemicals.	-1	1	-4	2
Intergenerational Issues (inc cumulative intergenerational issues)				
25. I am worried about how this might effect generations to come.	-1	3	-4	-3
26. I am worried about the effects of the water on unborn babies and young children.	-3	0	-4	-1
Aesthetics				
27. I am concerned that MAR will make the water taste and/or smell bad.	-5	-2	-2	-1
Geographical Location and Fairness				
28. I would be unhappy if I had to drink it and others didn't.	0	-1	0	0
Fairness (General)				
29. Those who pollute or use the water the most should have to use recycled wastewater before anyone else.	-3	-4	4	2
Financial Risk				
30. If you put enough money into MAR, you could overcome just about any issue or risk.	3	-5	1	-4
31. We run the risk of paying way too much to get the water treated to a level that the community will accept.	0	-2	3	-1
32. Government should be looking for water options that are the safest, not the cheapest.	0	0	-2	1
Environmental (inc Risk)				
33. I am concerned about the environmental impact on the aquifer.	-2	1	3	5
34. Given that we are already using water from the underground aquifers we should be replenishing it with something like recycled water.	4	0	2	4
35. If the water is clean enough for us to drink then it will be clean enough for the environment.	1	0	1	-4
36. I am concerned that the MAR process will be too energy intensive.	0	0	4	-3
Perceptions of Community Response				
37. Scientists base their decision-making on fact, community base their decisions on feeling.	4	-4	-3	1

Contd.

Statement	Factor Rank			
	1	2	3	4
38. If scientists can't agree on many things, how can the community be expected to agree?	0	0	-1	-1
39. The community do not have the required expertise or information to make a decision about MAR.	1	-4	0	4
40. I support it, but you will have a hard time convincing others to use it.	3	-1	0	2
Chemical/Toxicological Risk				
41. I have every faith in filtration. If you use enough filtration then even miniscule things can be removed.	1	-4	-2	-5
42. You can't possibly account for all the different things that people flush down their toilets.	0	2	0	0
43. It is extremely unlikely that scientists can know how the different chemicals in recycled wastewater will react together.	-1	4	1	4
Emotion				
44. The thought of drinking sewage disgusts me.	-5	-1	3	-3
Voluntary versus Imposed Risk				
45. If people are not happy with drinking recycled water they should go out and buy bottled water.	-2	-5	1	0
46. There is a difference between choosing to take risks and having risks imposed on us like this would be.	1	2	-1	0
Tolerability and Resignation to Risk				
47. If I was told it was safe to drink I would probably just get used to drinking it.	1	0	-5	-2
48. My life is too busy and there are too many other things to think about that I would probably just tolerate it even though I didn't like it.	-1	-1	-5	-2
49. I would rather drink recycled water than live with the anxiety that we could run out of water to drink.	1	0	-1	-1
50. There is controversy surrounding the use of recycled wastewater because it is a new concept.	2	1	1	2
51. I believe it is going to happen anyway, regardless of how I feel about it.	-1	1	-1	0
Alternative Futures				
52. We need to focus on behaviour change and reducing water use before we look at other solutions.	0	2	4	0
53. I think that other solutions are a better source of drinking water for WA than MAR (e.g., rainwater tanks, and/or home water recycling, Ord River pipeline, desalination, SW Yarragadee).	0	-1	-2	0
54. Water is too cheap and should cost more so that people don't waste it.	5	0	4	1
55. The real issue is controlling population growth, otherwise we will always be searching for more and more water.	1	-1	5	-4
56. I would prefer a scheme where recycled water was stored separately from our other drinking water supplies.	-5	2	5	0
Perceptions of Abundant Supply through MAR				
57. Recycling wastewater will just encourage people to use more water anyway.	-4	1	5	-4

Contd.

Statement	Factor Rank			
	1	**2**	**3**	**4**
58. WA is managing its water well enough to not need wastewater recycling.	-4	-1	0	-5
Societal Issues				
59. I think it is safe as other countries have been drinking recycled water for a long time with no problems.	2	-3	1	0
60. As a developed country, we have the technology and the finances to not have a water system that means we're drinking recycled sewage.	-2	0	-1	-2
61. This is a fundamental public issue that needs more community debate before a decision is made.	2	5	1	-2

Table 16. Technical perceptions of community (indirect potable water) statements and their factor rankings (factor arrays)

Statement	Factor Rank	
	1	2
Unknown Risks/Uncertainties (inc what is actually not known and public perceptions of unknowns)		
1. I am worried about water-borne diseases that we don't know about yet.	5	1
2. It is the uncertainty of what could go wrong that troubles me.	4	1
3. Scientists and governments have been wrong in the past about what is safe for us, what is to say they won't be wrong about this?	1	-1
Trust		
4. I would be reassured that the water was safe if there was a panel of independent experts who could guarantee its safety.	-1	4
5. I feel I can trust the media for information and messages about MAR.	-3	-2
6. I trust scientists to tell me whether the water is safe or not.	-4	3
7. Government bodies would be more accountable than privatised companies for such a scheme.	-1	3
8. It wouldn't go ahead unless the authorities were satisfied it was safe.	-2	2
Time in Aquifer		
9. Once the wastewater has been in the aquifer for a number of years, it basically becomes purified and like groundwater anyway.	-3	2
System Failure Risk (inc mismanagement/monitoring)		
10. Human and mechanical errors are always possible which makes a scheme like MAR too risky.	3	0
11. A big risk with MAR is that the aquifer could become contaminated and nothing could be done about it.	2	1
12. I am concerned about something going wrong such as breakdowns or something not working properly.	2	1
Management (inc scientific, policy and infrastructure management and knowledge)		
13. I believe there is enough knowledge around about water testing, disease minimisation and harm reduction that MAR will not be a problem.	-2	-1
14. A main management priority should be to reduce industrial emissions and waste entering the water system before it becomes recycled water.	0	-1
15. There needs to be strict legal and legislative requirements to make sure that the system is managed well.	3	5
Relative/Competitive Risk (risk compared to other risks/other water sources)		
16. I don't have a problem with MAR.	-5	0
17. People are exposed to so many risks everyday that the risk of MAR is too small to worry about.	-5	-2
18. People don't really know what comes out of their tap now, so what's the difference if they put treated wastewater in it or not?	-3	-1

Contd.

Statement	Factor Rank 1	Factor Rank 2
Political Risk (inc risk to political domain, community backlash)		
19. Political interests and processes could compromise the MAR scheme.	0	0
Personal Health Risk (inc family health risk, and personal cumulative health risk)		
20. My biggest concern is the health effects of drinking the recycled water.	5	4
21. I am worried about an outbreak of diseases and other illnesses.	4	1
22. I am concerned about a build-up of chemicals and toxins in my body over time.	5	2
Population Health Risks (include comments from Family Case study re risk to pop.)		
23. I am concerned about the impact of the water on reproductive health and fertility.	4	5
24. I am worried about the effects from so called 'gender bending' chemicals.	3	4
Intergenerational Issues (inc cumulative intergenerational issues)		
25. I am worried about how this might effect generations to come.	4	3
26. I am worried about the effects of the water on unborn babies and young children.	3	4
Aesthetics		
27. I am concerned that MAR will make the water taste and/or smell bad.	1	-3
Geographical Location and Fairness		
28. I would be unhappy if I had to drink it and others didn't.	1	3
Fairness (General)		
29. Those who pollute or use the water the most should have to use recycled wastewater before anyone else.	0	0
Financial Risk		
30. If you put enough money into MAR, you could overcome just about any issue or risk.	-4	-4
31. We run the risk of paying way too much to get the water treated to a level that the community will accept.	-1	-5
32. Government should be looking for water options that are the safest, not the cheapest.	2	1
Environmental (inc Risk)		
33. I am concerned about the environmental impact on the aquifer.	1	-2
34. Given that we are already using water from the underground aquifers we should be replenishing it with something like recycled water.	-2	2
35. If the water is clean enough for us to drink then it will be clean enough for the environment.	0	-2
36. I am concerned that the MAR process will be too energy intensive.	0	-4
Perceptions of Community Response		
37. Scientists base their decision-making on fact, community base their decisions on feeling.	-1	-1
38. If scientists can't agree on many things, how can the community be expected to agree?	1	-3
39. We don't have the time to wait till the entire community is happy with the level of risk in drinking treated wastewater before it proceeds.	-4	0

Contd.

Statement	Factor Rank 1	Factor Rank 2
40. The community do not have the required expertise or information to make a decision about MAR.	-1	-2
41. I support it, but you will have a hard time convincing others to use it.	0	0
Chemical/Toxicological Risk		
42. I have every faith in filtration. If you use enough filtration then even miniscule things can be removed.	-4	-2
43. You can't possibly account for all the different things that people flush down their toilets.	0	2
44. It is extremely unlikely that scientists can know how the different chemicals in recycled wastewater will react together.	1	2
Emotion		
45. The thought of drinking sewage disgusts me.	3	4
Voluntary versus Imposed Risk		
46. If people are not happy with drinking recycled water they should go out and buy bottled water.	-5	0
47. There is a difference between choosing to take risks and having risks imposed on us like this would be.	2	0
Tolerability and Resignation to Risk		
48. If I was told it was safe to drink I would probably just get used to drinking it.	-3	-3
49. My life is too busy and there are too many other things to think about that I would probably just tolerate it even though I didn't like it.	-1	1
50. I would rather drink recycled water than live with the anxiety that we could run out of water to drink.	-2	-4
51. There is controversy surrounding the use of recycled wastewater because it is a new concept.	-2	-5
52. I believe it is going to happen anyway, regardless of how I feel about it.	2	0
Alternative Futures		
53. We need to focus on behaviour change and reducing water use before we look at other solutions.	0	-1
54. I think that other solutions are a better source of drinking water for WA than MAR (e.g., rainwater tanks, and/or home water recycling, Ord River pipeline, desalination, SW Yarragadee).	1	0
55. Water is too cheap and should cost more so that people don't waste it.	-3	3
56. The real issue is controlling population growth, otherwise we will always be searching for more and more water.	0	-3
57. I would prefer a scheme where recycled water was stored separately from our other drinking water supplies.	1	-1
Perceptions of Abundant Supply through MAR		
58. Recycling wastewater will just encourage people to use more water anyway.	-1	-4
59. WA is managing its water well enough to not need wastewater recycling.	-1	-5
Societal Issues		
60. I think it is safe as other countries have been drinking recycled water for a long time with no problems.	-2	1
61. As a developed country, we have the technology and the finances to not have a water system that means we're drinking recycled sewage.	0	-3
62. This is a fundamental public issue that needs more community debate before a decision is made.	2	-1

Table 17. Combined community and technical drinking water statements and their factor rankings (factor arrays)

Statements	Factor Rank					
	1	2	3	4	5	6
Unknown Risks/Uncertainties (inc what is actually not known and public perceptions of unknowns)						
1. I am worried about water-borne diseases that we don't know about yet.	-5	2	-3	2	-4	2
2. It is the uncertainty of what could go wrong that troubles me.	-1	5	-1	-1	1	0
3. Scientists and governments have been wrong in the past about what is safe for us, what is to say they won't be wrong about this?	0	3	1	-2	1	1
Trust						
4. I would be reassured that the water was safe if there was a panel of independent experts who could guarantee its safety.	3	-2	0	3	-2	0
5. I feel I can trust the media for information and messages about MAR.	-4	-5	-4	-5	2	2
6. I trust scientists to tell me whether the water is safe or not.	4	-4	-5	-1	1	4
7. Government bodies would be more accountable than privatised companies for such a scheme.	4	0	-1	2	3	-4
Time in Aquifer						
8. It wouldn't go ahead unless the authorities were satisfied it was safe.	3	-2	0	3	2	2
Systems Failure Risk (inc mismanagement/monitoring)						
9. Once the wastewater has been in the aquifer for a number of years, it basically becomes purified and like groundwater anyway.	3	-2	0	-2	0	3
10. Human and mechanical errors are always possible which makes a scheme like MAR too risky.	-2	3	1	-2	1	-4
11. A big risk with MAR is that the aquifer could become contaminated and nothing could be done about it.	-1	4	3	5	5	-3
12. I am concerned about something going wrong such as breakdowns or something not working properly.	-1	4	-1	0	5	1
Management (inc scientific, policy and infrastructure management and knowledge)						
13. I believe there is enough knowledge around about water testing, disease minimisation and harm reduction that MAR will not be a problem.	4	-5	0	-1	2	5
14. A main management priority should be to reduce industrial emissions and waste entering the water system before it becomes recycled water.	2	3	3	5	0	3
15. There needs to be strict legal and legislative requirements to make sure that the system is managed well.	5	1	2	3	4	3
Relative/Competitive Risk (risk compared to other risks/other water sources)						
16. I don't have a problem with MAR.	4	-4	1	4	-4	4
17. People are exposed to so many risks everyday that the risk of MAR is too small to worry about.	1	-3	5	1	-2	-3

Contd.

Statements	Factor Rank					
	1	2	3	4	5	6
18. People don't really know what comes out of their tap now, so what's the difference if they put treated wastewater in it or not?	0	-2	2	-3	0	-5
Political Risk (inc risk to political domain, community backlash)						
19. Political interests and processes could compromise the MAR scheme.	1	2	0	2	3	0
Personal Health Risk (inc family health risk, and personal cumulative health risk)						
20. My biggest concern is the health effects of drinking the recycled water.	-2	5	-1	3	0	4
21. I am worried about an outbreak of diseases and other illnesses.	-3	2	-4	1	-1	1
22. I am concerned about a build-up of chemicals and toxins in my body over time.	-3	2	-2	-1	-1	4
Population Health Risks (include comments from Family Case study re risk to pop.)						
23. I am concerned about the impact of the water on reproductive health and fertility.	-2	1	-5	2	-1	-1
24. I am worried about the effects from so called 'gender bending' chemicals.	-4	-1	-3	0	4	-1
Intergenerational Issues (inc cumulative intergenerational issues)						
25. I am worried about how this might effect generations to come.	-2	2	-5	-1	-5	-1
26. I am worried about the effects of the water on unborn babies and young children.	-3	1	-4	0	0	1
Aesthetics						
27. I am concerned that MAR will make the water taste and/or smell bad.	-4	-2	-3	0	-2	-2
Geographical Location and Fairness						
28. I would be unhappy if I had to drink it and others didn't.	-2	-1	1	-2	0	-5
29. Those who pollute or use the water the most should have to use recycled wastewater before anyone else.	-3	-1	4	1	-2	3
30. If you put enough money into MAR, you could overcome just about any issue or risk.	2	-3	-1	-1	-1	5
31. We run the risk of paying way too much to get the water treated to a level that the community will accept.	0	-1	-2	-1	-1	0
32. Government should be looking for water options that are the safest, not the cheapest.	2	4	-2	2	-2	-1
Environmental (inc Risk)						
33. I am concerned about the environmental impact on the aquifer.	-1	1	5	4	3	-3
34. Given that we are already using water from the underground aquifers we should be replenishing it with something like recycled water.	5	-1	5	5	-4	-1
35. If the water is clean enough for us to drink then it will be clean enough for the environment.	2	0	-1	0	3	2
36. I am concerned that the MAR process will be too energy intensive.	0	0	0	-4	0	0

Contd.

Statements	Factor Rank					
	1	**2**	**3**	**4**	**5**	**6**
Perceptions of Community Response						
37. Scientists base their decision-making on fact, community base their decisions on feeling.	3	-1	-2	0	4	-3
38. If scientists can't agree on many things, how can the community be expected to agree?	0	1	-2	-2	0	0
39. We don't have the time to wait till the entire community is happy with the level of risk in drinking treated wastewater before it proceeds.	1	-3	4	1	3	0
40. The community do not have the required expertise or information to make a decision about MAR.	0	0	2	4	1	-1
41. I support it, but you will have a hard time convincing others to use it.	3	-1	3	2	5	0
Chemical/Toxicological Risk						
42. I have every faith in filtration. If you use enough filtration then even miniscule things can be removed.	1	-5	-3	0	-1	5
43. You can't possibly account for all the different things that people flush down their toilets.	-1	1	2	0	-1	-1
44. It is extremely unlikely that scientists can know how the different chemicals in recycled wastewater will react together.	-2	2	1	1	0	0
Emotion						
45. The thought of drinking sewage disgusts me.	-5	0	0	-3	0	2
Voluntary versus Imposed Risk						
46. If people are not happy with drinking recycled water they should go out and buy bottled water.	-1	-4	0	-3	-3	-4
47. There is a difference between choosing to take risks and having risks imposed on us like this would be.	0	1	0	-3	2	-2
Tolerability and Resignation to Risk						
48. If I was told it was safe to drink I would probably just get used to drinking it.	1	-3	-2	0	1	3
49. My life is too busy and there are too many other things to think about that I would probably just tolerate it even though I didn't like it.	-1	-4	-3	-2	2	-4
50. I would rather drink recycled water than live with the anxiety that we could run out of water to drink.	1	-1	4	3	-5	-2
51. There is controversy surrounding the use of recycled wastewater because it is a new concept.	2	0	-1	1	2	1
52. I believe it is going to happen anyway, regardless of how I feel about it.	0	0	2	1	-2	1
Alternative Futures						
53. We need to focus on behaviour change and reducing water use before we look at other solutions.	1	4	4	-1	-1	2
54. I think that other solutions are a better source of drinking water for WA than MAR (e.g., rainwater tanks, and/or home water recycling, Ord River pipeline, desalination, SW Yarragadee).	0	3	1	-4	4	-3

Contd.

Statements	Factor Rank					
	1	**2**	**3**	**4**	**5**	**6**
55. Water is too cheap and should cost more so that people don't waste it.	2	0	1	1	-3	1
56. The real issue is controlling population growth, otherwise we will always be searching for more and more water.	0	0	0	-4	-5	-5
57. I would prefer a scheme where recycled water was stored separately from our other drinking water supplies.	-2	3	3	1	-3	2
Perceptions of Abundant Supply						
58. Recycling wastewater will just encourage people to use more water anyway.	-4	0	2	-2	-3	-2
59. WA is managing its water well enough to not need wastewater recycling.	-5	-3	-1	-5	1	-1
Societal Issues						
60. I think it is safe as other countries have been drinking recycled water for a long time with no problems.	5	-2	3	4	1	-2
61. As a developed country, we have the technology and the finances to not have a water system that means we're drinking recycled sewage.	-1	1	-4	-5	-4	1
62. This is a fundamental public issue that needs more community debate before a decision is made.	1	5	1	-4	2	0

Contact Us
Phone: 1300 363 400
+61 3 9545 2176
Email: enquiries@csiro.au
Web: www.csiro.au

Your CSIRO

Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills for building prosperity, growth, health and sustainability. It serves governments, industries, business and communities across the nation.