Australian Water Recycling
Centre of Excellence

Project Report

Enhancing risk communication from science to policy, regulation and implementation of recycled water projects in Australia

A report of a study funded by the
Australian Water Recycling Centre of Excellence

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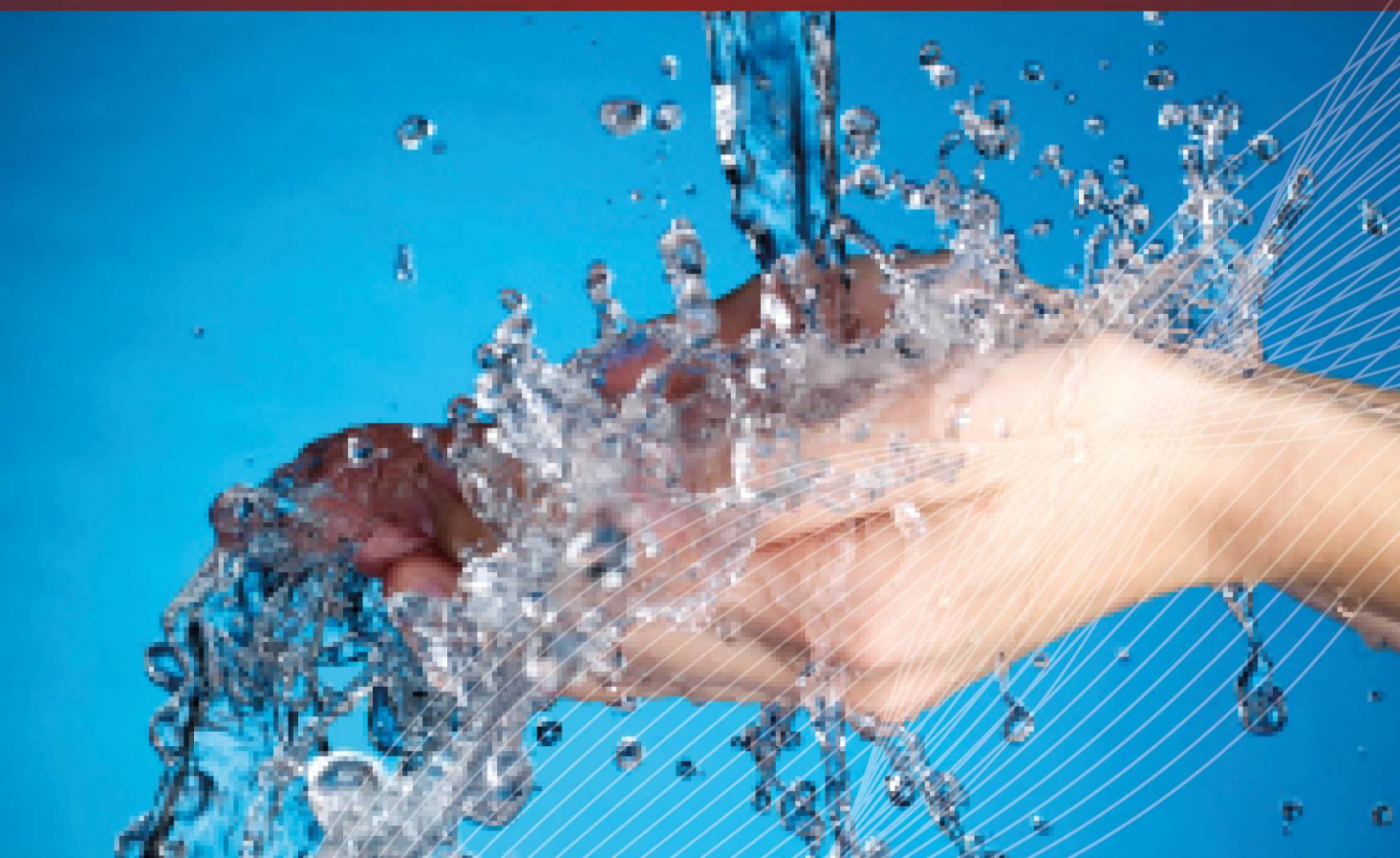

Risk Communication (Sub-Stream 2.3)

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About the Australian Water Recycling Centre of Excellence

The mission of the Australian Water Recycling Centre of Excellence is to enhance management and use of water recycling through industry partnerships, build capacity and capability within the recycled water industry, and promote water recycling as a socially, environmentally and economically sustainable option for future water security.

The Australian Government has provided $20 million to the Centre through its National Urban Water and Desalination Plan to support applied research and development projects which meet water recycling challenges for Australia's irrigation, urban development, food processing, heavy industry and water utility sectors. This funding has levered an additional $40 million investment from more than 80 private and public organisations, in Australia and overseas.

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1 INTRODUCTION

One of the major impediments to water recycling in Australia has been the lack of public acceptance of some forms of recycled water and lack of clarity concerning regulatory guidance concerning the chemical content allowed in recycled water for drinking purposes. Given that public perceptions of risk are a key factor in the rejection of recycled water schemes (Hurlimann & Dolnicar, 2010; Po, Kaercher, & Nancarrow, 2003; Ross, 2009; Uhlmann & Head, 2011), a major challenge in gaining public acceptance of these schemes will be improving the way estimated health risks are communicated.

As public perceptions of risk have been shown to be influenced by perceptions of the credibility (Tyler & Degoey, 1996) of the responsible authorities (e.g., policy makers/ regulators or water managers), it is vital that policy makers, regulators, and water managers provide clear and credible assurances to the community that they are making decisions informed by the best available science. To achieve this it will be necessary to establish and maintain stronger links and more comprehensive communication between scientists, policy makers and managers of recycled water schemes.

This review of the relevant literature begins by presenting a brief account of unsuccessful recycled water projects in Australia. The following sections then explore the concept of risk communication and provide theoretical perspectives for understanding the social and cultural influences on risk perceptions. An outline of the national and international research on communication and science/policy/practice issues will then be presented, and current communication issues relating to recycled water in these arenas are identified. Finally, key research areas to be further explored are identified and formulated into research questions.

1.1 Risk perceptions and the rejection of water recycling schemes

Research to date has shown that high levels of public support for water recycling are usually only seen for non-drinking uses and contexts (Hurlimann & McKay, 2004; Marks, 2004). There have been noteworthy examples in Australia and the US, where proposed recycled water projects have been rejected by the public because of

perceived health risks. In Australia, proposals for recycled water projects by the Maroochy, Caloundra and Toowoomba councils in the decade 1996-2006 were strongly opposed by their respective communities and were ultimately rejected. Public opposition to the projects was fuelled by campaigns from opposition groups such as CADS ("citizens against drinking sewage") who warned of alleged health risks associated with drinking recycled water, for example, claims of the presence of "gender-bending" hormones, infectious hospital, abattoir and industrial waste in the water (Hurlimann & Dolnicar, 2010; Po, et al., 2003; Uhlmann & Head, 2011).

More recently, in South East Queensland (SEQ), the full implementation of the Western Corridor Recycled Water Project (intended to provide recycled water to augment the drinking water supply in Wivenhoe Dam) was put on hold by the state government in early 2009, despite the completion of the extensive infrastructure necessary for the project. Extensive media speculation (Roberts, 2008) regarding possible health risks had impacted significantly on community confidence.[1] As a result of erosion of community confidence in the project (as well as seasonal rainfall which began to restore dam levels) the Queensland government changed its policy commitment, regarding the introduction of recycled water to drinking water supplies as an emergency measure – which would be triggered by any future drop in combined SEQ dam levels to below 40% (Queensland Water Commission, 2009).

As demonstrated by the cases of unsuccessful recycled water projects noted above, a central factor influencing public acceptance is the perceived risk to public health from the recycled water. Given that treatment technologies are now highly advanced and reliable, the continuing rejection of such projects clearly demonstrates that the health risks associated with recycled water are not well understood by the public and are still perceived as unacceptable. To increase public understanding of recycled water projects and thus enhance public confidence in the underlying systems of quality control and risk management, it is therefore vital to improve the way estimated risks associated with reuse projects are communicated, both within the industry and from government/industry experts to consumers.

[1] Market research conducted by the government showed support for the project dropped from 75% in early 2007 to only 55% in late 2008 (Queensland Water Commission, 2009).

It has been demonstrated that the ways in which the public perceive risk is different and more complex than the way risk is viewed and assessed by technical experts. For example, public perceptions of risk are linked to levels of perceived credibility and trust attributed to the responsible authority (Baggett, Jeffrey, & Jefferson, 2006; Frewer, Howard, Hedderley, & Shepherd, 1996; Ross, 2009; Tyler & Degoey, 1996). Public confidence can be seriously weakened if the authority is perceived to be incompetent, biased or compromised, or appear to arrive at decisions without consideration for the public (Baggett, et al., 2006). A demonstrated focus on the public good and the use of open communication may be essential dimensions of building credibility. The credibility of the organisation responsible for the recycled water project and its senior managers is as important to the success of the project as the quality of the project itself (Khan & Gerrard, 2006).

When criticism and misunderstanding exist between scientists, policy makers and the public, the result is a loss of the public's faith in the ability of science to solve its problems and in the capacity of political leaders to act in the public's interest (Garvin, 2001). It is thus crucial to ensure that scientists, policy makers and managers of recycled water understand each other before attempting to communicate risks to the public. Stronger links and improved communication between these groups will also reassure the public that policy decisions are informed by the best available science. The risk communication process should enable all stakeholders to make informed decisions about risks and their management (EnHealth, 2004).

2 RISK COMMUNICATION

Risk communication has been defined as: "*An interactive process involving the exchange among individuals, groups and institutions of information and expert opinion about the nature, severity and acceptability of risks and the decisions taken to combat them"* (EnHealth, 2004). According to the literature, risk communication is important from a societal perspective as it aims to communicate information about potential threats to people's health, safety or well-being (Gurabardhi, Gutteling, & Kuttschreuter, 2004). However, it has been noted that the transfer of risk information can often become a political issue, particularly when the safety or reliability of the technology causing the risks is disputed (Gurabardhi, et al., 2004; Kasperson, Golding, & Tuler, 1992). As discussed in the introduction, this has certainly been the case with communication around proposed reuse water schemes in Australia and internationally (Hurlimann & Dolnicar, 2010; Po, et al., 2003; Uhlmann & Head, 2011).

The Water Services Association of Australia (Water Services Association of Australia, 2005) suggests that the safe and reliable supply of water is taken for granted by Australians, but in actuality all alternative management strategies have some degree of uncertainty or risk. Therefore, when risk communication is applied to the water domain, where the highest standards are assumed to prevail, it is important to consider whether all water management options are perceived or framed as risky, as well as whether they actually are "risky" (Green, Fielding, Leviston, & Price, 2010). This is particularly important when communicating about recycled water in the science, policy, and practice arenas. Green et al. (2010) emphasise the importance of understanding the alternative views, knowledge and arguments of stakeholders involved in water management options through a participatory process that takes into account the views and knowledge of water managers and practitioners.

Research has demonstrated that inaccurate risk perceptions will not necessarily be corrected by the provision of more accurate information because perceptions of risk are more complex than judgements based purely on technical information (Green, et al., 2010; Kahan, Jenkins- Smith, & Braman, 2011; Lorenzoni, Pidgeon, & O'Connor,

2005). It has been argued that risk is a subjective, multidimensional, value-laden construct that is sensitive to the context in which risk decisions are made. In the following section, the influence of social and cultural influences on risk perceptions will be discussed in more detail (Slovic, 1999).

2.1 Social and Cultural influences on risk perceptions

Vaughan argues that risk perceptions are based on social norms, values, beliefs, trust, and past actions of the agencies and therefore they cannot be isolated from the broader social and cultural context in which they occur (E. Vaughan, 1999). In other words, audiences filter information through the lens of their value and belief systems and cultural experiences and norms (G. M. Vaughan & Hogg, 1995). Research has shown that people are not always 'rational' in their perceptions and decision-making due to the influence of perceptual biases. There is a growing body of social psychological theory on the influence of cognitive biases such as confirmation bias (searching for evidence that supports one's position) and the use of availability heuristics, or mental shortcuts that may lead to inaccurate judgments (Oskamp & Schultz, 1998; G. M. Vaughan & Hogg, 1995). For example, social identity theory posits that the sense of identity we derive from our group memberships forms an important part of our self-concept (Tajfel & Turner, 1986; J.C. Turner, 1982; J C Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). Thus, a sense of 'them' and 'us' accompanies the process of social categorisation: for example, 'we' lay people versus 'those' experts. Within the context of water management, social identity could powerfully influence responses to alternative water supply options. An example of this is members of the "CADS" group aligning their attitudes and responses with those of other group members; and treating with distrust information from outgroups such as government and scientists.

2.2 Cultural cognition theory

Another theory that recognises the influence of social and cultural factors on risk perceptions is the cultural cognition theory of risk. This theory refers to the hypothesised tendency of persons to form perceptions of risk and related facts that cohere with their self-defining values (Kahan, et al., 2011). Kahan and Braman (2006) advanced their conceptual framework to help explain public disagreement

about the significance of empirical evidence relating to risk. Cultural cognition theory proposes that psychological mechanisms predispose individuals to credit or dismiss evidence of risk in patterns that fit values they share with others. In other words, the theory suggests that individuals accept or reject empirical claims about the consequences of controversial polices based on their vision of desirable social relations and values (Kahan & Braman, 2006).

According to cultural cognition theory, when people have to make decisions in an area where they do not have expertise, their only option is to rely on experts whom they trust concerning whether empirical claims, and the supporting data for such claims, are credible (Kahan & Braman, 2006). The authors assert that these trusted people are inevitably the ones whose cultural values they share, and who are inclined to credit or dismiss scientific evidence based on its conformity to their cultural values. In other words, cultural cognition influences perceptions of credibility (Kahan, et al., 2011).

It has been widely claimed that people more readily impute expert knowledge and trustworthiness to information sources they perceive as sharing their worldviews, and deny the same standing to those whose worldviews they perceive as different from theirs (Earle & Cvetkovich, 1995; Kahan, et al., 2011; Siegrist, Cvetkovich, & Roth, 2000). According to cultural cognition theory, individuals reflexively reject information inconsistent with their predispositions when they perceive that it is being advocated by experts whose values they reject and opposed by alternative people whose values they share. In contrast, they attend more open-mindedly to information, and are more accepting of it, if they perceive that there are experts of diverse values on both sides of the debate (Earle & Cvetkovich, 1995; Kahan, et al., 2011). Kahan et al. therefore assert that to overcome the cultural cognition effect, communicators must attend to the cultural meaning as well as the scientific content of information.

Given the lack of consensus or alignment that currently exists between scientists, policy/regulation and water professionals with regard to the risks related to recycled water (as outlined in a later section), the concept of cultural cognition theory is particularly relevant to the current research. The cultural cognition theory of risk will

therefore provide a guiding theoretical framework for understanding and overcoming conflicting risk perceptions for this research project.

3 SCIENCE, POLICY, PRACTICE ISSUES

Within the “science to policy” literature, attention has been drawn to the gap that seems to exist between the science community and the policy making community (Haas, 2004; Lomas, 2000; Owens, Petts, & Bulkeley, 2006; Pohl, 2008; Tsui, 2006; WHO, 2009). The importance of bridging this gap has been highlighted across a range of contexts, including the area of water supply and reuse (CCME, 2002; Quevauviller, 2010). Much of the literature emphasises the importance of establishing and maintaining links and more comprehensive communication between researchers, water policy and program managers through a variety of forums, channels and boundary organizations (CCME, 2002; Lomas, 2000; Quevauviller, 2010).

To achieve the goal of strengthening links between science, policy and practice it is important to first understand why members of these groups often talk “past and through one another” (Garvin, 2001). Consistent with cultural cognition theory, researchers have suggested that gaps between science, policy and practice are due to different values, goals and priorities (Francis, Whittaker, Shandas, Mills, & Graybill, 2005; Garvin, 2001; Head, 2008; Tsui, 2006). It has been asserted that researchers and policy makers often work in independent cycles – researchers acquire knowledge, while policy makers and managers try to apply knowledge without any feedback loop having been set up between the two groups (Bosch, Ross, & Beeton, 2003). In addition, Baggett et al. (2006) suggest that one of the most difficult aspects of translating science into policy is scientific uncertainty. While scientists are familiar with uncertainty and complexity, policy makers, on the other hand, often require a reasonable degree of certainty to guide their decisions. Garvin (2001) argues that scientists often have difficulty understanding the political nature of the policy process, while policy makers often see scientists as methodologically rigid, limited in scope, and non-committal in conclusions. To ensure a better understanding of each other’s worlds, more consideration of each other’s values and objectives will be required (Lomas, 2000; Tsui, 2006).

4 INTERNATIONAL RESEARCH

4.1 Options for improving communication

As part of a series of workshops on linking water science to policy, the Canadian Council of Ministers of the Environment (CCME, 2002) conducted a Water Reuse and Recycling workshop. The aim was to communicate the results of new research and management practices to senior decision makers and policy makers as a means for scientists and policy makers to contribute expert input into water programs. A range of options for maintaining and expanding on the dialogue were recommended in the workshop report. These were, to create a committee/ task force of academic, industry and government experts to develop a relevant context for recycling; identify short- term and long- term implementation opportunities; refine research needs; convene periodic follow-up workshops for both the science and policy communities; and the use of electronic networking as a means of ensuring information flow. Given the need to improve understanding between scientists, policy makers and managers of recycled water, these recommendations would appear a practical starting place for addressing communication issues between these groups. The workshop report stated that ultimately, the logic for bringing researchers and public policy managers together is to make better public policy decisions. Alignment among these expert groups is necessary for better managing the public communications challenges.

4.2 What is working, what is not, and why?

Holmes & Clark reported on research conducted in the UK by the Environment Research Funder's Forum (ERFF) (Holmes & Clark, 2008). The research investigated what is working, what is not, and why, in relation to the link between science and environmental policy making and regulation. The studies were conducted in response to the UK government's strong promotion of the more effective use of science to inform policy and regulation. The research was conducted through semi-structured interviews with participants selected to represent different roles relating to the science-policy interface. A scoping study was initially conducted to identify key issues needing to be addressed to enhance the use of science in policy and regulation. This was followed by a more in-depth study which built on the findings from the scoping study. The second study addressed four key issues,

namely, establishing research questions and agendas; accessing information and expertise; the role of interpreters; and transparency and evaluation.

In terms of the first key issue – establishing research questions and agendas – participants identified a number of difficulties. These were associated with scientific evidence not being sufficiently used in establishing policy, the framing of policy questions, the lack of time devoted to the anticipation of issues requiring research, the need for a better understanding of public concerns from researchers and policy makers, and research often not providing sufficiently coherent outputs to inform policy making.

With regard to the second key issue – accessing information and expertise – participants expressed concerns that policy makers made relatively little use of papers published in peer reviewed journals. However it was also acknowledged that most scientific papers tend to be too technical and detailed for policy makers and that policy makers do not have time to read enough papers to develop an overall understanding of an issue. Assessing the reliability and quality of information was also a concern for policy makers, as was knowing how to contact experts about particular issues.

Participants highlighted the need for a searchable database or register of experts as well as the need for more opportunities for researchers and policy makers to meet and interact. Respondents also acknowledged that barriers to communication between researchers and policy makers often lead to a science/policy gap, giving rise to a need for the increased role of interpreters to facilitate interactions between researchers and policy makers. Participants suggested that this role should involve describing the policy implications of research findings to policy makers, facilitating the development of research questions to meet policy needs, and communicating these to researchers, as well as providing a balanced overview and synthesis on scientific knowledge relating to policy issues. In terms of transparency, the importance of the science to policy process in engendering trust was emphasised. The need was stressed for the establishment of clearer “audit trails” to evaluate how science is used in policy making.

In presenting the results of these studies, Holmes & Clark (2008) provided an informative and up to date evidence base of what is working and what is not regarding science and environmental policy-making and regulation in the UK. As they argue, this provides a basis for new initiatives, as well as ways to address some of the problems identified. Holmes and Clark assert that the results demonstrate a desire to strengthen the use of science and evidence in policy making and regulatory decision making, but they caution that the actions of researchers and policy makers are not aligned appropriately as yet.

4.3 Overcoming global barriers to reuse

Black and Veatch conducted a series of high-level global discussions with 75 water industry leaders to identify barriers to water reuse and to explore the solutions and processes needed for overcoming them (Black & Veatch, 2010). The discussions aimed to assist international water and wastewater industry leaders to better understand and respond to the challenges of using recycled water.

Discussions often focused on the importance of using good data and good science, and considering the bigger picture, when making decisions about water reuse. Participants felt that the body of knowledge available about recycled water is not very mature and not fully peer reviewed, so utilities and other water-related organizations need to make more information readily available. It was noted that even regulators do not always understand the performance capabilities of new technologies. Participants concluded that in order to gain the trust and respect of the public, the politicians, and the regulators, members of the water industry need to work together to build a bank of credible, robust data that they can use to demonstrate continuously that recycled water is safe and acceptable for public use.

It was also concluded that utility leaders additionally need to work in partnership with local, regional, state and federal agencies to develop appropriate guidelines for recycled water that will work in their local areas. Participants generally thought that advancing the option of water purification will require new approaches and new paradigms to enhance greater cooperation and interaction among agencies working with water and wastewater (Black & Veatch, 2010).

5 AUSTRALIAN RESEARCH

5.1 Impediments to recycled water investment

In a research project conducted for the Australian government on access to recycled water and impediments to recycled water investment, ACIL Tasman (ACIL Tasman, 2005) noted that there is a growing policy focus on encouraging greater utilisation of and investment in recycled water. For example, the National Water Initiative commits States to encourage the reuse of wastewater, where cost-effective. Each of the States and Territories has developed policies and strategies to promote recycled water, often encompassing specific targets and/or financial assistance. However, the report suggested that while this high-level policy environment might be seen as favourable to recycled water, existing regulatory and approvals processes can, in practice, impede water reuse projects (ACIL Tasman, 2005).

It was noted that regulatory responsibility for recycled water traverses a number of different government agencies with responsibilities for health, environment and water, resulting in a complex coordination of both policies and regulations. According to the report, while appropriate safeguards are necessary to protect public and environmental health, guidelines may themselves become impediments if they are unnecessarily cautious, prescriptive, inconsistent, or fail to keep abreast of changes in technology and social attitudes (ACIL Tasman, 2005). The research showed that different perceptions of the issues existed between different stakeholder groups with different roles in the industry. The stakeholder groups with the most divergent views tended to be users compared with the views of researchers and regulators. These findings are consistent with cultural cognition theory and the assertion that conflicting views are often due to people's different values, goals and priorities (Francis, et al., 2005; Tsui, 2006).

5.2 Regulatory impediments

Power conducted a review and comparison of the regulatory processes and guidelines in place for Australian jurisdictions, and discussions with regulators (Power, 2010). The results indicated that the Australian Guidelines for Water Recycling (AGWR, 2008) were not being applied consistently to the management of

recycled water. Recommendations were made to address these differences and develop a nationally consistent approach to recycled water regulation and the application of the AGWR *(Power, 2010).* This barrier to the implementation of recycled water projects is clearly an area that requires further research into how improved communication between, scientists, regulation/policy and water industry professionals could facilitate more consistent application of the AGWR.

5.3 Risk communication in Australia

To obtain a baseline measure of current risk communication practices in the science, policy and regulation, and industry sectors with regard to water purification in Australia, (Chapman et al., 2011) conducted face-to-face interviews with water industry representatives from Queensland, New South Wales, ACT, Victoria, South Australia and Western Australia. A semi-structured questionnaire was used to gain a range of perspectives on the way water science is transferred through to policy and regulation, and to the implementation of recycled water policies in Australia. The project also aimed to identify any key communication issues and to investigate whether issues reported in overseas experience (e.g., difficulties accessing and keeping up with scientific information, communication issues) were also a concern in Australia. A number of obstacles to improving links between science policy and practice were identified and will be discussed below.

5.3.1 The need for a more strategic approach

A significant theme that emerged from participants from every sector is the strong need for a more strategic and national approach to water research in Australia. It was generally thought that the present approach to research was not coordinated and that there should be more cohesion within the research community. A senior water industry professional pointed out that Australia does not currently have a system for translating science into water policy and that current practice was disconnected and fragmented. The results clearly identify a need for formal structures and processes to be put in place to facilitate research priority setting, a more strategic approach to water research in Australia, and to provide a dialogue for water researchers. It was suggested that good scientists need to be good communicators and would better deliver their message if they could discuss their

research and the relevance of research outcomes in layman's terms. "*Good scientists and good policy people are the ones who can condense a complex issue into something that is digestible and makes sense to people…*"

5.3.2 Science into policy issues

In terms of science to policy translation, it was clear that there was a need for more effective interaction between industry members, scientists, and policy formulators and regulators so that they can better understand each other's roles. Consistent with Holmes and Clark's (2008) research, Australian water policy makers and regulators were described as under-resourced and reported difficulties accessing and keeping up with scientific information. A number of participants felt that policy makers and regulators should be more proactive in approaching scientists, while some regulators felt that scientists should approach them to ask about the gaps in science that need to be addressed. Several scientists mentioned that they were having some success in getting around this problem by going out and giving presentations to regulators and by writing up lay persons' summaries of their research.

Consistent with Holmes and Clark (2008), the issue of the different timeframes between science and policy was identified as a barrier to effective communication. It was noted that the policy arena can be very reactionary and tends to involve very short term thinking and time frames, whereas research is a very long term, forward thinking environment. Policy and regulation professionals described difficulties with having to make decisions within short time frames.

Many interviewees stressed the importance of developing and maintaining good relationships between scientists and regulators and that these relationships promote accessibility of research information. However, a number of people thought that policy makers do not necessarily have a network with the research sector and as a result experienced difficulties in locating scientific knowledge. To overcome this, participants felt there should be more formal networking opportunities and more formal consultation with the research and industry sectors. The employment of more scientists in government departments to act as interpreters was seen as an effective way of overcoming the science/ policy gap. A national database was also suggested

as a systematic way of collecting and sharing information. It was also noted that this type of coordination would not happen automatically and would require resources and incentives.

5.3.3 Implementation issues

Implementation of recycled water projects was clearly perceived as the most difficult part of the science, policy, and practice processes. Difficulties in complying with strict regulations, as well as time and costs involved with putting the required resources in place, were seen as major obstacles to implementation. In addition, political nervousness, differing risk perceptions and a lack of national consistency in implementation of guidelines were also seen as issues. The results suggest that more consultation is needed between stakeholders to assist with more accurate estimation of the time, costs and resources required to implement projects. Although some industry professionals reported good relationships and networks with their peers, it is apparent that more effort is required to facilitate and maintain strong professional networks between the research, government and industry sectors. A need was identified for more industry consultation and discussion with operational people about what would be needed "*people wise and resource wise*". One interviewee made the point that a lot could be learnt from private contractors (e.g., Veolia, GHD, Black and Veitch) due to the experience and expertise they bring from implementing recycled water projects overseas.

5.3.4 Regulation and compliance

Regulation and compliance were seen as the main barriers to implementation of recycled water schemes. As one interviewee stated "*regulation and compliance cost money… anything you try and advance - the more regulations and economic impact it potentially has, the less likely it is to be implemented, even though the benefits might be very, very high. It will require more approval processes and cost more money*". It was also claimed that policy and regulation people "*don't understand the practicalities of trying to replicate what was done in a laboratory in a university to conditions in the field*". As a result, participants said that some projects become impossible to implement due to time and cost, and they "*fall over*". One industry professional explained that to overcome barriers to implementation, their

organisation made an effort to "*bring our regulators along with what we want to implement, to ensure there is policy there that they can develop as we go, so there's quite a close link then between the policy and being able to implement it*".

5.3.5 Differing risk perceptions

Consistent with Baggett et al.'s (2006) research, interviewees identified differing perceptions of risk between industry, government, scientists and the public as barriers to risk communication. Policy makers were described as "*risk averse*" and some regulators were seen as too rigid in their approach. Others pointed out that policy makers and regulators have a responsibility to protect public health and therefore have to be conservative in their decision making. Some interviewees also felt that there were differences among regulators in terms of levels of understanding of risk and how to interpret it. Consistent with cultural cognition theory, interviewees felt that people's attitudes towards risk are generally influenced by their backgrounds. They described a continuum, with scientists and engineers seen as most comfortable with risk, and policy and regulation professionals and the general public seen as the least comfortable. As stated by one participant "*I think that a lot of people in policy don't necessarily have a technical background; they've got a law background. They don't have any more understanding of how safe it is or not. I think some of the policies have been written from that perspective".*

Other interviewees believed that differences in opinion on the safety of recycled water create public uncertainty and undermine public trust. Some participants stressed that when communicating with the public and the media it was important to have a consistent message and a united front. "*You don't want an ugly conflict in public, with industry saying this is safe and the health regulator saying it's not*". A number of interviewees mentioned the damage done to public confidence in recycled water projects when "*the occasional renegade scientist*" has made controversial comments about possible health risks, which were seen as motivated by a desire to attract publicity. The negative publicity about the Western Corridor Recycled Water Scheme (as described in the introduction) was cited as an example. The role of the media in negatively influencing the public's and possibly politicians' perceptions of recycled water was also raised.

5.3.6 Political nervousness

The lack of a strong federal government policy on recycled water was also identified as an obstacle to the implementation of projects. Some interviewees felt that decisions about recycled water made by politicians and their advisors are influenced by vested interests and the media. Another suggested that political decisions are also emotive and "*even though we could probably sit with them and work out how to do it without any public health risk it's not on the agenda…. It's a very difficult thing to do in an election cycle*".

One industry professional made the point that "*politics can get in the way of good policy*" and used the halting of the Western Corridor Recycled Water project as a good example of this. "*In the circumstances of the main dams being down to 18 per cent… it was good policy to secure a safe alternative water supply in recycled water, but it didn't turn out to be good politics (in terms of public unpopularity)*".

5.3.7 Terminology

Participants identified the confusing and inconsistent use of language and terminology as a barrier to communication about recycled water, both within the industry and when communicating with the public. A number of interviewees mentioned that there was significant confusion about terminology within the water industry and that there was a need for a consistent and common language. This was felt to be particularly important when industry professionals are working together to discuss policy and regulation. As one participant said "*I think this is a real problem because people use the same terms and mean different things. It can be quite difficult, I think, to get conformity across the industry. So you think you're talking about the same thing, when in actual fact you're not. So I think there's a lot of difficulty in getting a coherent policy platform out there*".

It was noted that there is still much confusion among non-technical people about basic recycled water terminology. An example was given of a City Councillor who spoke to the media about the council's achievement in introducing "*grey water*" to irrigate parklands, when in fact the water was treated sewage. A number of interviewees felt that confusing terms and inconsistent use of language created

uncertainty and fear in the public. It is clear that the development and use of a clear and consistent terminology around recycled water would provide clarity and greatly enhance communication processes. Research on recycled water terminology will be discussed in more detail below.

5.3.8 Consistency of guidelines and regulations

The Australian Guidelines for Water Recycling document were identified as a significant step forward and the best source of technical information for decision making regarding recycled water. However, consistent with Power (2010), the research interviews identified concerns with the fact that the implementation of the Guidelines was not occurring consistently across different jurisdictions in Australia. This lack of consistency between states was identified as an issue of concern. Views were divided as to the importance of consistency of regulations across states. While some respondents felt that it was important to be consistent across states, others felt that implementation should be regionally dependent due to the different resources available to different regions. It was noted that building a national validation framework for recycled water would be addressed through one of the goals of the Australian Water Recycling Centre of Excellence.

Overall, the findings from this research project (Chapman, et al., 2011) identified some significant issues that should be explored further in order to improve the way science is currently transferred into policy and implementation of recycled water projects in Australia.

5.4 Recycled water terminology research

Simpson and Stratton compiled a literature review and conducted research into recycled water terminology which demonstrated a debilitating gap between scientific understanding, policy and public perception of recycled water issues (Simpson & Stratton, 2011). The authors also found that there was confusion about recycled water terminology even within the water sector. A review of the terminology used in water industry publications revealed inconsistent use of language, particularly in terms of the names used for the recycled water produced for augmentation of the drinking supply. Even within single papers there were several instances of the use of

different terms for the same product (e.g., ‘recycled sewage’, ‘recycled effluent’, ‘treated effluent’, and ‘recycled water’). Simpson and Stratton concluded that this clearly demonstrates that the water sector has not agreed on terms to describe water treatment processes and quality.

The research also showed that terms used to communicate water-reuse processes and products are inconsistent and difficult for the lay audience to understand. According to the authors, the current recycled water language is mainly jargon, technical terms and acronyms that have evolved over decades that are not suitable for explaining water quality and treatment, and the concepts of reuse and recycling, to a lay audience. Simpson and Stratton assert that because water professionals tend to work independently, there is a need to develop strategies to translate technical engineering language, and build and maintain communication pathways for the sharing of information and developing a common language. Confusing and stigmatizing terminology only reinforces negative risk perceptions and hinders community consultation and education efforts (Simpson & Stratton, 2011).

Simpson and Stratton conclude that professional water organisations should therefore encourage their members to carefully consider their choice of words and the impact they have on understanding and risk perceptions of recycled water. An industry cultural change is required to encourage accurate, simple, and consistent terminology at least nationally, and hopefully, internationally (Simpson & Stratton, 2011). The authors also make the point that regulators are in a position to ensure that monitoring procedures are widely disseminated and explained in terms that laypeople can easily grasp. Before full advantage can be taken of water purification it will be vital to ensure that politicians are able to consider recycled water without the worry that it will be politically unpopular (Simpson & Stratton, 2011).

5.5 The problem of policy change

Overall, there is limited knowledge about how scientific findings can be most effectively communicated, accessed, and taken up in the “policy” and regulatory sectors of government and in water operations management. It has been shown above that while there is a massive amount of research and information available,

little is effectively communicated and accessed across the sectors. Even among scientists themselves, there is a range of views about the proper role of science in seeking to inform policy either directly or indirectly (Steel, List, Lach, & Schindler, 2004). The majority of applied scientists do seek to influence these policy and practice domains, but find it difficult to disseminate their work in ways most conducive to achieving this desired influence (Holmes & Clark, 2008; Pannell & Roberts, 2009). Among the potential users of scientific research among policy and regulation managers, there are political, organisational and cultural obstacles to accessing and making use of the findings. The policy and regulatory advisors to government find there are many factors beyond science and technology that need to be accounted for in decision-making, including stakeholders and public opinion as mediated through the media (Head, 2008).

In general, policy and regulatory change occurs in response to a perceived problem (Kingdon, 2003). When the predominant concern in Australian cities was with providing water security in a period of drought, it was easier for politicians and the public to accept that exploring alternative water sources was a reasonable and even necessary option to support. When this perception of the water challenge switched, under subsequent conditions of water abundance, the necessary alignment of problem / solution / support collapsed. Working to better frame the problem, as well as the solution, will be an inherent part of risk communication for the future. It has been argued that risk issues tend to have three main dimensions: levels of complexity, levels of scientific uncertainty, and levels of socio-political ambiguity (Renn & Klinke, 2012). Water re-use has made great advances in the first two dimensions, but the third remains problematic and cannot be resolved by top-down technical knowledge alone.

6 CONCLUSIONS AND FUTURE RESEARCH QUESTIONS

Risk issues relevant to the provision of safe, reliable and affordable water, including various uses of recycled water, are best managed with the appropriate involvement of four key groups of stakeholders: the water professionals who plan and operate water systems, the policy and regulatory decision-makers, scientific researchers in related disciplines, and very importantly the diverse consumers and users of water for different purposes, including domestic, industrial and agricultural. The above analysis has shown they often have different perspectives (Garvin, 2001; Steel, et al., 2004). Their different viewpoints and needs for information/support should be recognised in developing a comprehensive risk management approach that warrants the trust and confidence of all stakeholders.

Given the known history of distrust and misinformation concerning recycled water, it is necessary to build improved relationships across these stakeholders as a basis for improved understanding and alignment. Water reuse is an area of policy and practice where it is crucially important to promote and maintain widespread confidence and stakeholder trust in organizational expertise. Trust can break down where decision-makers and advisors are seen to be less than fully competent and rigorously objective in protecting public safety. Confidence is necessary both in relation to the professionalism of water management and their scientific advisors (technical expertise), and also in relation to the quality and transparency of regulatory arrangements (good governance).

This review of the relevant literature on risk communication from science, policy/regulation and implementation of recycled water in Australia provides a starting point for a better understanding of the issues. The results also provide a foundation for enhancing risk communication around recycled water. A number of research areas to be explored further have been identified and formulated into the following research questions:

1. Using cultural cognition theory as a basis, how can we distinguish the values and bases for risk perception used by different stakeholders with regard to acceptance of recycled water?

2. What strategies can be developed to overcome cultural influences and barriers to risk communication?

3. What are the critical elements for the successful implementation of recycled water?

4. What lessons can we learn from the failures and successes of the implementation of recycled water projects, both nationally and internationally?

These research questions will be used to guide the next phase of this research project, which will apply case study and interview methodologies. Using these methods, the issues identified in the literature review will be addressed to facilitate improved communication and thus greater public confidence and acceptance of recycled water projects.

7 CASE STUDIES

As identified in the introduction, a major challenge in gaining public acceptance of recycled water schemes will be improving the way estimated health risks are communicated. A chief aim of the project is to identify the key barriers and enablers to improve communication among scientists, policy and regulation professionals, and the water industry. This research will provide information that will be crucial to enhancing the way risk is communicated between scientists, health regulators and policy makers and water managers. Stronger links and improved communication between these groups will ensure that they better understand each other, and thus increase the likelihood that policy decisions about recycled water are informed by best available science. As described in the introduction, improved communication and decision making processes should also aid in providing assurance of the safety of potable reuse projects to the public.

The research project aims to conduct case studies of recycled water projects from around the world to identify fundamental communication issues and thus inform the research questions developed in the previous section. Studying reuse schemes that have been successfully implemented can provide valuable insights into the experience of others that can inform stakeholders in the future. Given the history of failed and successful recycled water projects worldwide, there will be some vital lessons to be learned that can guide the implementation of future projects.

The process of purifying water to supplement drinking water supplies has been carried out in many places in the world for over 40 years. In Section 1.1, a brief

account was provided of unsuccessful recycled water projects in Australia. However, there are numerous examples of successful water reuse projects that can be found in the United Kingdom, Europe, Africa, Singapore and the United States. In addition, in Perth, Western Australia, a groundwater replenishment trial is underway, where recycled water is being added to underground aquifers to supplement drinking water supplies.

7.1 Rationale for case study selection

A criterion for case study selection was developed to ensure that the most relevant case study sites were chosen so that data obtained would be applicable to the Australian context. The framework for the basis of the case study selection was based around four key criteria; a) sites must be examples where recycled water is used augment drinking water supplies, b), sites should be examples of planned recycled water projects (as opposed to “unplanned reuse” where a town downstream is indirectly reusing another other town’s recycled wastewater without planning to do so, c), selected sites should provide examples of both surface water augmentation and aquifer recharge and, d), sites must be relevant to the Australian culture and political system.

Given the number of recycled water projects in the United States and the similarities of culture and political systems (e.g., compared to Singapore) it was decided that there would be high value in comparing and contrasting several Australian sites with several sites based in the U.S. There are a number of recycled water schemes currently operating in Australia, where recycled water is used for both drinking and non-drinking purposes (e.g., irrigation and industry). The site of Perth was chosen because it fitted the selection criterion of being a planned example of recycled water

being added to the drinking water supply (through underground aquifers). The site of SEQ was also selected. Although the recycled water produced from the Western Corridor Recycled Water Project is currently being used to supply power stations, the scheme also fits the selection criteria because it is intended to augment the drinking water supply of Wivenhoe Dam (once the region's water supply falls below 40 per cent). In addition, the SEQ site is an example of surface water augmentation while the Perth site provides an example of aquifer recharge.

The two U.S. sites of the City of San Diego and Orange County Water District were chosen to compare and contrast with the Australian sites. Both of these sites are examples of "planned" projects to augment drinking water supplies with recycled water. Although the San Diego site is still in the testing phase, it provides a good example of surface water augmentation. The Orange County site, on the other hand is an example of aquifer recharge. The case studies aim to compare and contrast the processes undertaken, and to identify the enabling and constraining factors involved during the course of project development and implementation. The research will have a focus on risk perception and communication issues.

8 METHOD

8.1 Participants and procedure

The method for data collection was a combination of semi- structured individual interviews (both face-to-face and via Skype) and historical data. Interview participants included representatives from research, communications, policy/regulation, planning, implementation and industry (including private contractors). The project team initially liaised with industry reference group members to guide the initial selection of relevant interviewees. A snowballing sampling technique (where interviewees recommend other relevant participants) was then applied to ensure an appropriate range of participants. The project team also engaged with other sub-stream team members to facilitate a collaborative approach to the research as well as to identify and avoid any potential areas of overlap.

A total of 17 participants were interviewed across the four case study sites. Information regarding the purpose and scope of the research, including assurance of confidentiality, was be provided to participants in advance. Ethical clearance has been provided by the relevant human research ethics committees from the participating universities. The interviews were digitally recorded and on average took about 60 minutes to complete. The recorded interviews were then transcribed into verbatim written transcripts and imported into the qualitative data program, NVivo. The data was then analysed using content analysis, a qualitative research technique for making replicable and valid inferences from texts (Krippendorff, 2004).

8.2 Measures

Five separate semi-structured questionnaires were specifically designed for each of the five categories of interviewees (i.e., communications, research, policy/regulation,

planning/implementation, and industry/private contractors). Questionnaire development was guided by the research questions presented in Section 6. In addition, the questionnaires were designed to capture participants' experiences with the planning and implementation of recycled water projects for each case study site. This approach was applied to provide a range of perspectives on the challenges of communication around these projects. It also aimed to identify any key issues and potential strategies for dealing with these problems. The semi-structured format was chosen because it provided enough consistency across interviews for points of comparison, while still being open ended to elicit in-depth responses and flexible enough to be tailored to different perspectives of the participants.

9 RESULTS

9.1 Cultural values and stakeholders' differing risk perceptions

Scientists, policy/ regulation professionals, politicians and the public were shown to hold quite different perceptions of water reuse risks depending on their professional training, work role/setting, personal values and/or experiences. Key results discussed below are consistent with previous research (Chapman, et al., 2011) and with cultural cognition theory which asserts that people tend to form perceptions of risk and related facts that cohere with their self-defining values (Kahan, et al., 2011). Cultural cognition theory proposes that psychological mechanisms predispose individuals to credit or dismiss evidence of risk in patterns that fit values they share with others. The following section presents brief summaries of how the interview participants reflected on the risks, and how public opinion was perceived by them. These perceptions are organised according to four sectors - scientists, policy/ regulation professionals, politicians, and the general public.

9.1.1 Scientific and technical experts

Scientists and engineers generally expressed a greater level of comfort with risk than other stakeholders. A clear example of this was conveyed by a water quality manager. "*I think from a scientific point of view… I'm very comfortable with the risk, because to me - maybe because of my background I've never really seen a big difference between water, wastewater, and natural water. It's all water. I think that we over-engineer things here, because we have got this perception of risk in the public... I think that regulators have suffered almost the same as the general public in terms of the yuck-factor*".

9.1.2 Health regulators

In contrast, regulators, whose professional responsibilities are centred on public health protection, consistently stressed the importance of strict regulations and

rigorous drinking water protection programs. As illustrated by one participant – "*We get a lot of criticism … from the other potable reuse agencies in California for being excessively strict. We're not uncomfortable with that reputation. It's a useful position to have when you're trying to convince the elected officials and the public that a project is safe, if they know that your sole concern is to assure safe drinking water rather than promote reclaimed water or promote water reuse or water resources. It greatly facilitates gaining the confidence of the public*".

9.1.3 Policy/politicians

Public opinion, rather than science, was the predominant influence on many policy decisions by politicians. This was the consistently the view held by industry professionals when asked about the risk perceptions of politicians. As one industry professional stated "*public opinions are more likely to influence political decision making than science. When the public opinion (on the Western Corridor Project) flipped from 60 per cent support to 40 per cent support, the policy changed. I don't think you need much more evidence than that.'*

In addition, a number of technical experts criticised politicians for not making an effort to understand the science and having a lack of understanding of the health risks involved with reuse projects. These responses are consistent with Holmes and Clark's (2008) conclusions that there is a need to strengthen the use of science and evidence in policy making and regulatory decision making. As one person stated: *"I really think that the politicians did not make the effort to really understand the science. I don't think there was anybody in the government, or indeed in the opposition, who actually really understood what it was all about. For them, it was recycled water; we've got a couple of experts here telling me it's going to be okay. I've got my professor over here and my expert panel, so we've got it all sorted. I think*

that that sort of education - it didn't have to be a long process to educate them as to what was going on. I think that we really could have got a lot of value out of that if some of them - someone in the government actually had sufficient technical knowledge to be able to talk about it".

9.1.4 Public perceptions

9.1.4.1 Misconceptions about source water quality

It was noted that in general, the public (and often politicians), have a poor understanding of the quality of the intake water for their current drinking water supply due to "unplanned potable reuse". A water industry interviewee gave a clear description of current source water quality and how it might compare unfavourably with highly treated recycled water as a potential source of raw water.

"There's a bit of a tension there because if you see the intake water at a typical Queensland water treatment plant, it's not real flash to be honest. It's pretty turbid, there'll certainly be plenty of bacteria in it, maybe viruses … depends on if there's recently been a surcharge from a sewerage scheme upstream or what the state of the discharge from the upstream sewage treatment plants may be. But it's by no means pristine, I guess is what I'm saying, and could be compared unfavourably with highly treated tertiary effluent. But, by the same token, you don't want to bring into question the safety of all the other drinking water supplies in Queensland or elsewhere...

So it is a bit of a challenge to position potable reuse in terms of risk because you could easily alarm the population to some of the hazards that exist in existing drinking water supplies. The positioning of the argument's got to be a bit subtle so as not to raise community concerns. It does rely on a certain level of understanding of

the science behind the processes. That's very challenging for a large chunk of our population, unfortunately".

Public misconceptions of high quality source water are consistent with non-scientists' cultural values of traditional drinking water supplies as pure and pristine (Doria, 2006). It is reasonable to expect that greater awareness of the widespread practice of unplanned potable reuse would lead to greater understanding and acceptance of planned recycled water projects. However, as this interviewee explained, the difficulty lies in educating people without overly alarming them about the safety of their traditional drinking water supplies. This is clearly an area that requires future attention and discussion.

9.1.4.2 The impact of knowledge and familiarity

In terms of public risk perceptions, an interesting observation from a water industry professional was that Western Australians are more aware of water issues as a result of long-term water shortages and therefore might be more open to groundwater replenishment than communities that are not so knowledgeable about the water cycle. As the following West Australian interviewee put it:

"So I think West Australians do know a little bit more about the water cycle, just only because they have a close relationship to groundwater through their own backyard bores or just drinking water that they drink out of a tap and how it tastes etc - the last ten years the constant drying of the climate has meant that bore is forefront of people minds. People do know a little more about the water cycle than I think a person from another typical capital city would".

This observation of Western Australian's familiarity with their groundwater supply and apparent understanding and acceptance of groundwater replenishment is an example of how a community's social norms and cultural values are influenced by the status of these water systems that they rely on and that, in turn, can influence their responses to alternative water supply options.

The examples of social and cultural influences on different stakeholder groups' perceptions of risk provided in this section are in line with the social psychological literature reviewed in the introduction. Strategies for overcoming these cultural perceptual biases and barriers to communication will be outlined in a later section.

9.1.5 Regulatory concerns

Despite the obvious differences in stakeholder groups' perceptions of the risks involved with water reuse, many interviewees acknowledged the long and difficult task of developing the science and safe health guidelines and regulations for recycled water projects. The difficulties involved with communicating risk assessment procedures and the safety of recycled water projects to non-scientists were also raised.

9.1.5.1 Laborious process/ testing regimes

Health regulators emphasised the laborious and often expensive process involved with building up the science needed to authorise recycled water projects.

"It's been a very extensive, ongoing scientific research activity. We keep finding more and more things in wastewater that maybe we should be worried about and it's because the laboratory techniques are getting better and better all the time. Well every time a new chemical pops up in the test, it's not because it hasn't been there before but it's because now all of a sudden we can find it. Doing the studies to find

out if the chemical is a health hazard is very expensive and there really aren't enough mice in the world to do all the experiments".

"We've got to have toxicologists look at it, study it and think about whether or not it's a problem and at what level it might be a problem. We have to look at the treatment and see if the treatment can remove it and how well it removes it. So it's a two-pronged approach, very expensive, very laborious".

9.1.5.2 Protecting public health

A regulator from California described how some contamination incidents in the early history of the Orange County Water District highlighted the need for conservative safety regulations.

"They had two negative experiences with water quality... contaminating the groundwater basin with levels … that we at the State Health Department felt were unsafe. They had to stop the project for a while until they resolved that. So each of those situations required them to shut down for a while and caused the Health Department to completely revisit our criteria... It was a very humbling experience... We've become much more conservative as a result".

These comments demonstrate the importance of the balance between developing safe regulations to protect public health and the environment, while ensuring they are not so rigid as to make compliance impossible.

9.1.5.3 How to communicate risk?

The difficulties around communicating risk assessment in relation to recycled water to non-scientists were described as a major communication issue. This is in line with Baggett et al's (2006) assertion that one of the most difficult aspects of translating science into policy is scientific uncertainty. While scientists are generally comfortable with uncertainty and complexity, policy makers (and the public) expect and often

require a reasonable degree of certainty to guide their perceptions and subsequent decisions and behaviours. A regulator outlined these communication difficulties below.

"I mean I'm a Public Health official and to ask me if something is safe, you know we don't think in terms of safe, necessarily. We have to phrase it that way but that's sort of alien to the way we approach the problem. We approach the problem as what is the risk and if the risk is low enough, then it's safe. But that's not to say that the risk is absent, which is what they want to hear. So communication on the issue of safety and risk is just a very, very difficult problem for us".

9.2 Strategies for overcoming cultural barriers to risk communication

Different stakeholder groups involved with implementation of recycled water projects have quite different values and priorities according to their roles. This leads to problems with communication and consensus about types and levels of risks. To overcome this significant communication barrier, participants from all case study sites stressed the importance of creating opportunities to get researchers, policy/regulation and industry professionals in "the same room". Interviewees from water utilities emphasised the importance of developing good relationships with regulators by working with them from the start. As one person stated, "*Get your regulators on board early, address their concerns from day one. It's not us and them, it's together. Once you take an approach like that you will find that most regulators will come on board and support the project much earlier on".*

A number of strategies identified through the case studies as being effective in overcoming cultural barriers to communication will be outlined below. These are inter-agency working groups; communicating public support; transparency; expert

advisory panels; early engagement with politicians; building public support; and understanding community values.

9.2.1 Inter-agency working groups

These examples provided by interviewees from the sites of Perth and Orange County demonstrate how interagency working groups were successful in facilitating effective communication.

Western Australian interviewees described the positive experience of developing an interagency working group between the Water Corporation and three key government agencies. The parties entered in a four way memorandum of understanding to work together to develop the necessary regulatory framework for the groundwater replenishment project. The group aimed to work collaboratively and with transparency, and met on a regular basis. As one interviewee described: "*We asked them (the government agencies)to work with us to develop policy and regulation... inviting them into the process, to be clear about what their objectives were, in order for them to develop policy regulation. Be clear about the information they required and then ride alongside of us to gather information they needed. So at the end they could do two things. They could develop the policy and regulation and they could make an assessment of groundwater replenishment overall*".

"Since day one, we have our water resource regulator, our environment regulator and our health regulator on board to go, we're looking to do this, we want all the approvals, tell us what you need, and if we don't know let's work it out together". Another interviewee added:

“So on that front it might have taken a while but it wasn't an adversarial relationship where we're fighting to get an approval. This is a more of a fact finding process together, to find out what worked and what didn't. We did bring in a lot of experts, international experts around to work on the project. It is a long process but it's not necessarily an adversarial one”.

A regulator involved with the process also spoke positively of the success of the working group:

“For us as regulators having the general meetings and discussing the issues was very good... it was quite successful from the regulatory point of view, being able to have a consistent and a standard approach for regulation”.

Participants from the Orange County site described the partnership between Orange County Water District and the Orange County Sanitation District as a key element to the success of the project. Given the mutual benefits of avoiding the significant cost of building a new ocean outfall, and instead investing the funds into groundwater replenishment, the two agencies formed a joint committee for the Groundwater Replenishment System.

“So that was a key, and as a result of that partnership, when we decided to move forward with the ground water replenishment system, they formed a joint committee. So we had three members of the sanitation district’s board and three of our members that sat on this committee and all of the decision-making was taken through that committee initially, and then it would move forward to the respective boards for final approval. Most of the heavy-lifting and all the decision-making was made in that committee”.

9.2.2 Communicating public support

It was noted that as protectors of public health, it is important to regulators that the community is confident in the safety of recycled water projects. Interviewees therefore stressed the importance of building confidence in regulators by undertaking stakeholder engagement and sharing data demonstrating community acceptance of projects. As one participant said:

"Regulatory processes for both Department of Health and Department of Environment and Conservation, have a public consultation, a public comment period in the approvals process. So the better job that we do now, you are less likely … when we are seeking approval for a full scale project - to have lots and lots of public submissions".

9.2.3 Transparency

Policy and regulatory professionals highlighted how transparency is essential to successful stakeholder communication, particularly in terms contamination incidents. "*It was a very educational experience for the whole potable reuse industry because Orange County Water District handled the situation just beautifully. They were very responsive, they shut down everything immediately, they didn't start up until they had agreement from everybody that what they were going to do was completely safe again. They immediately held press conferences down there in Orange County and were very frank about everything. They explained everything, didn't hold anything back. They weren't trying to cover anything up, hide anything. As a result of that, we've written a lot of their procedures that they carried out at that time into our regulations now".*

9.2.4 Expert advisory panels

Having an independent expert panel was described by participants as essential to building confidence in regulators and in guiding the development of regulations and testing regimes. This Californian regulator reported:

"The regulators really didn't know where to go, as far as, what do we have to test for, what are the levels of testing that are required for certain compounds? They were supposed to develop the permit, or the criteria for the permit. So one of the things we did is we got together an expert panel and we did this through the National Water Research Institute here in southern California. What they did is they helped create the criteria for our permit with the regulators. So the California Department of Public Health was the agency that developed the criteria for the permit. They were physically in those meetings with our expert panel and ourselves when we developed what ended up being our permit".

Interestingly, not all people believed expert panels were useful in building confidence and developing guidelines. Although several SEQ interviewees described the SEQ advisory panel as very useful, another SEQ respondent mentioned: "the regulators didn't follow the *direction (of the SEQ expert panel) anyway".* The issue of context and how strategic approaches need to be tailored to specific contexts will be outlined in the section on "critical elements for successful implementation".

9.2.5 Early engagement with politicians

To avoid recycled water projects becoming politicised as an election issue, interviewees stressed that it was critical to engage key decision makers and opinion leaders to obtain their support early. The following quotes summarise respondents' key points regarding obtaining political support:

“If you were running for a certain office, you want to make sure that you do outreach to different interest groups within your voting district to get their support. So that's similarly what we did with the policy makers. We made sure that we understood what their issues and drive were and to see that we made sure that we hit those points with our project”.

“So we found the key health, environment, social, stakeholders, opinion leaders, decision makers, commentators in the community and we kept them informed”.

“Really frequent briefings, especially with elected officials, because they have no memory and so if you didn't talk to them six seconds ago they've probably forgotten you. So you need to stay on the case because somebody will come in and tell them a bad thing and they'll think oh my god, if I vote for this I'll lose my next election.”

“The other thing that we found and that we learned from some of the other projects failing, like in San Diego and in Los Angeles, was to make sure that we get the elected officials support in writing. Because it's a lot more difficult for them to change their mind”.

9.2.6 Community support – the case of San Diego

In San Diego, the Water Purification Demonstration Project receives strong support from a coalition of environmental, business and community organisations known as the “Water Reliability Coalition”. The group was spearheaded by environmental groups who wanted to reuse wastewater locally rather than import their water from Northern California and then discharge wastewater into the ocean.

"They basically came down on the side of saying … treating this water very highly and augmenting a reservoir makes the most sense, it's the most sensible thing to do with this water. We brought it all this way (imported water from northern California) let's get some more use out of it. So that started the ball rolling again. There was and is a very interesting coalition of groups that formed to support this project … there's about 22 of them … They said to the city council and to the mayor, 'you need to do this project. This makes sense for San Diego'".

The Water Reliability Coalition is a good example of how community (in this case, driven by environmental concerns/benefits) can be a powerful driver of politicians' support for recycled water projects. As one interviewee concluded:

"At the end of the day they (politicians) are the voice of the community and if the community are behind it and if the regulators are behind it, then the politicians don't really have a lot of grounds to object the project".

9.2.7 Understanding communities' values

Both industry and communications professionals stressed the importance of engaging with communities through learning about and addressing their concerns rather than just running mass media campaigns. For example:

"You've got to understand the concerns of the people that you're working with. You've got to understand their perspective and try to help them understand how this is going to benefit them".

"You run the risk that - the perception of risk of groundwater replenishment is much greater than the technical risks. Once you are able to explain to people this is what it's about, this is how the plant is performing, everybody kind of thought that - agreed that it was a feasible idea".

It was also noted by several technical and communications that community engagement does not necessarily mean that all people will be supportive of recycled water.

"I think we're pretty confident that if you talked to people, to them naturally and don't try and defend your position to the hilt… You can lay the facts out and if they're not on side, then they're not on side, and jumping up and down and repeating it and saying it louder isn't going to do it. Getting them worked up about it is not going to help. So that's what - yeah, I think you agree to disagree and walk away... and always make ourselves available".

"Mind a little's change – mind a lot's never will – so don't focus too much on them – get support from other parts of the community and key leaders".

"So the sense that I get from talking to people when we do tours and just talking to people on the street about this. I don't see a difference, just that people who are opposed to recycling water don't want it recycled in any form whatsoever. The people, who are okay with it, just want to make sure it's safe. It's just understanding the value they have and what they're looking for".

Interestingly, several water industry and communications professionals noted that often when people gain an understanding of the science behind recycled water, they tend to see the logic and additional benefits of direct potable reuse (i.e., not needing multiple barriers or having to pipe the water over long distances).

9.3 Critical elements for successful implementation of recycled water projects

There is much to be learnt from examining the factors behind the successes and failures of recycled water projects. The key elements for the successful implementation of potable reuse projects identified from this case study research are outlined below.

9.3.1 The importance of context

This case study research has indicated that the successful implementation of reuse projects depends to some extent, on the contextual drivers of each particular site. For example, the implementation of the Californian sites was driven by the need for an independent water supply, prevention of saltwater intrusion, and reduction of wastewater discharges into the ocean. In Western Australia, it appears that long-term water shortages and a subsequent public awareness of water issues has enhanced acceptance of the groundwater replenishment project. In contrast, in SEQ rainfall and restored dam levels (and thus decreased urgency for the project) combined with negative media reports caused a significant drop in community support for the Western Corridor Recycled Water Scheme.

The contextual differences between each of the case study sites were highlighted through the wide-ranging variance in preferred recycled water terminology across sites. As every recycled water project is different, interviewees emphasised that "*there is no cookie cutter approach*". It is important to examine the particular

community and develop a strategic outreach plan that fits that community and its experience (Tennyson, 2013).

9.3.2 Long-term approach to stakeholder engagement and communications

Communications experts consistently emphasised the critical importance of a long-term approach to the implementation of potable reuse projects. Having a communications strategy that engaged with all stakeholders (community, politicians, policy/regulation professionals, media) from the very beginning, and continuing to engage was described as key. As one interviewee put it:

"*You can't just develop the public trust once you're trying to sell the project. That's something that takes a longer-term investment".*

In SEQ, engagement for the Western Corridor project had to be rushed due to the urgency of needing an additional water supply. As this SEQ respondent stated:

"I think the element about … messaging around recycled water, that is really, really important and what we didn't have is time. That proved to be really important in the Orange County experience - the way that they engaged the public was over a long period of time".

In contrast, the groundwater replenishment project in Perth has been a long-term process which has been successful in gradually building up community trust.

"I think part of the success here so far is that the system has been very slow to give the community time to digest and to understand and the Corporation is trying to, their best to inform the community… So if you look at all; it has been so many years of work and the community has been slowly, slowly moving on that. We have obviously water issues but it doesn't happen in the east at the moment, so it's a recent

situation, but for us this is still a very dry state. People are conscious on that, so it seems that there's a slow increase in the acceptance of the project".

9.3.3 Comprehensive engagement strategies

All case study participants emphasised the importance of having a comprehensive, sustained engagement strategy and constantly engaging with all stakeholders (community, policy/ regulation professionals, elected officials, and the media). As these interviewees articulated:

"So we (communication professionals) knew we weren't going to change people's views in two minutes. I think constancy and consistency are the key aspects to it. So we've just kept doing it. I think that's one of the key messages: you don't just go out there, stick it in everybody's face and then move away - it doesn't work like that. You have to be consistent. You have to use as many channels as possible and you have to track it".

"That was focused on ensuring that they understood the science, ensuring they understood the process, understood the regulatory regime, all of that sort of stuff. That was about building, in the longer term, advocates who would openly support the process in the community".

"I think regardless of where your project is trying to be implemented and regardless of cultural differences, political differences and views, bottom line is you have to get out and inform people and communicate and talk to as many people as you possibly can, and you have to be flexible".

9.3.4 Begin with a trial/demonstration project

One of the key differences between SEQ and the other case study sites is that given the urgency of the project, there was not time to firstly develop an official demonstration project (or in Orange County's case, non-potable groundwater replenishment) before attempting to implement a permanent potable reuse project. Interviewees from a range of stakeholder groups from the Orange County, San Diego and WA sites consistently cited a demonstration/trial project as critical to gaining stakeholder confidence. These participants reported that conducting an initial trial allows time to build up data demonstrating the safety of the water, establish appropriate health regulations and stakeholder confidence in the safety of the project. As this respondent from Orange County stated:

"So we build upon 40 years of trust and data, from that previous water recycling project, and that helped us tremendously to be able to go out into the community and talk about an existing project… had the data to support it, and that trust. So that definitely led to the public accepting our project. Trust is key".

9.3.5 Visitor centre

The importance of having a visitor centre as an integral part of the communications strategy was also identified by both technical and communication professionals as key to the success of recycled water projects.

"It's a component of a communication strategy. The more people you can walk through the whole process the more people will support it. So you can't deny the education aspect of it. You can't deny the information aspect of it. So the more information you've got - but targeted at the right level - the better your results will be".

9.3.6 Ongoing communication

Communication experts and industry professionals all agreed that it is important to understand that successful implementation of recycled water projects means that the *communication and engagement process is never over.*

"I don't think it's over. I don't think it's successful - us deciding it's a successful trial and to break into a dance … one of our GM's eloquently puts it as this is not cutting it, this is kind of leading edge technology and you'll always be talking to the community about what you're learning every day and why this is a good thing".

"I don't think this is a set and forget process. So you have to keep - you have to maintain transparency. You have to be working with your regulators openly. You have to keep the community engaged. We found that really hard. It's really, really hard to get recycled water at the top of people's minds, if they're not worried about it. So continuing to make available information to the people that want it, that's current, I think is how we will keep maintaining a social licence to continue".

Communication professionals also stressed the importance of conducting ongoing market research on public acceptance, and continuing to share the results with politicians, policy makers and regulators to build confidence.

9.4 Lessons learnt

This research has provided considerable insight into the successes and failures of recycled water projects across study sites of SEQ, Perth, Orange County and San Diego. The following section outlines the key lessons learnt from these case studies. We firstly describe the important lessons learnt from the failure of the implementation of SEQ's Western corridor project and then provide a more general summary of participants' feedback on lessons learnt across all sites.

9.4.1 SEQ

SEQ interviewees across all stakeholder groups expressed disappointment that despite substantial effort and investment, the Western Corridor Recycled Water project did not go ahead as a potable reuse project as planned. As one industry professional put it:

"It effectively absorbed a couple of years of my professional life… that whole process was very disappointing to see it all fail at the finish line".

9.4.1.1 Lack of political commitment

A key technical expert involved with the implementation of the project described a lack of political commitment and leadership as the key reason behind the failure of the project to go ahead.

"The political commitment wasn't there. I think if the political commitment had been there, and the political will had been there, it could have been made to happen. In my opinion, the community was looking for some leadership in the space. The government didn't want to risk it. So, they ran away".

"It's pretty clear they were looking at a very tight election…They were concerned to get any potential issues off the table and they looked around and they said 'what issues could derail the government over the next four months' and one of them was recycled water. So, they took a decision, which if I dare say it, was utterly politically expedient and said, well, we'll get it off the agenda. So, they did".

A policy professional also noted that another reason for the failure was because the government was not totally committed to Western Corridor project. As will be discussed in the following section, the project was just one mechanism of a larger drought proofing plan. As this policy professional noted:

"I don't think the Government was ever committed to potable reuse. They were committed to overcoming the drought in south-east Queensland, PRW (purified recycled water) was just one mechanism for achieving that".

9.4.1.2 Over-investment in infrastructure

The same interviewee said that the attempt to "drought proof" SEQ had resulted in over-investment in infrastructure (e.g., the Water Grid, the Western corridor project, three Advanced Wastewater Treatment Plants, the Tugun Desalination Plant, and the proposed Traveston Dam). A communication expert added that the restructuring of the water industry at the same time presented too many changes for public to accept.

A project engineer also noted that politicians didn't seem to have a strong understanding of how the infrastructure works:

"I think the politicians still haven't got their heads around, that if you run out of water – 'so you turn on the desal plant, you turn on the recycling plant and you'll be alright'. But, it's not designed that way. It's designed as a supplement to the water supply, not a replacement, But I think that's beyond the grasp of most of the politicians to understand that".

9.4.1.3 Insufficient investment in stakeholder engagement

Despite over-investing in infrastructure, SEQ industry and communication professionals reported under- investment in stakeholder engagement and an appropriate visitor centre. One interviewee identified not prioritising stakeholder engagement and a visitor centre as the key lessons learnt in SEQ. Another

described the inadequacy of engagement and the small demonstration plant at Luggage Point below:

"I guess it illustrated that you can't do these things in a half-hearted fashion. If you're going to build a demonstration plant, build a proper one, resource it properly and make it attractive for people to want to visit. Luggage Point had a couple of open days out there… But the vast majority of people who went to the open day... It was mostly friends and relatives of the people involved in the project, it wasn't the general public".

9.4.1.4 Burdensome regulations

As with other case study sites, developing the regulations for recycled water in SEQ was described as a difficult process; complicated by the fact that there was no actual regulation of drinking water in SEQ before 2008. The development of recycled water regulations was described as "an inefficient process" with a bureaucratic approach rather than a risk- based approach. The regulations themselves were also described as "burdensome".

Another interviewee added:

"But another problem I think we had was that from a regulatory point of view it was always quite uncertain what we could and couldn't do, and these sorts of regulatory controls are there for good reason. You don't want to poison the population. But I think that there's probably a better way of doing this so that you can actually do things to build public confidence, and the way I understood the regulations it was at least uncertain, if not impossible for us to have a pilot plant that produced water for people to consume or to thrust a bottle and then consume it later".

The SEQ context is a clear example of how, by attempting to fast-track the project, the critical elements for the successful implementation were not able to be applied, resulting in its failure to be implemented as intended.

A communications professional summed up the lessons learnt from the SEQ context *this way:*

"It was the lesson learnt… was that you can spend $2.5 billion, you can build something at break neck pace and you can win a variety of awards, state, national and international all the way up to winning the International Water Association's highest award - and all of that can come to nothing if you haven't got the confidence of the key decision makers at the time".

9.4.2 General

Interestingly, a number of technical experts highlighted the role of communication and engagement in the success of recycled water projects. As this interviewee put it:

"Projects like the Groundwater Replenishment System are really more communication projects than they are engineering projects. The engineers aren't thrilled to hear that because they see building projects as the important part. 'We build it, we get it right, we produce high quality, we're done'; but convincing the public - that it's the right thing to do… they may understand that you can do it but convincing them that that's what you should do, I think that's a tougher job - selling the public on the idea that this is the best way to bolster the reliability of their water supply. Just engineering, designing, building the project, even operating it well isn't enough if the public doesn't have confidence".

In general, participants from all stakeholder groups emphasised the importance of a balanced approach towards the technology, regulation and stakeholder engagement. As this water industry professional summarised:

"*Actually I think the key lesson learned is that there are a number of different pieces that need to be integrated together. The pieces are the education and outreach components. Demonstrating the technical aspects to the regulators, having an Independent Advisory Panel that looked over all the results - Integrating all those together. They're all thought of as parts of a project. I think if I were to describe the key successes – they are that we gave equal consideration to education outreach that we did to technical and that we did to the Independent Advisory Panel that supported the work of the regulators".*

9.5 Conclusions

In line with previous research and with cultural cognition theory, scientists, policy and regulation professionals, politicians and the public were shown to hold quite different perceptions of water reuse risks depending on their professional training, work role, personal values and/or experiences. This research has highlighted a number of strategies that have been used successfully to overcome these cultural barriers and facilitate effective stakeholder communication and engagement. Critical elements for successful implementation of recycled water projects have also been identified. Valuable lessons learnt from the successes and failures of these case studies have also been outlined.

9.5.1 NDEEP products

Sub-stream 2.3 will take the key findings from this research and work collaboratively with other Streams and sub-streams to develop appropriate evidence-based products for the NDEEP. Potential products under discussion at this stage are in the

form of toolkit or decision support tool for assisting utilities or government agencies when considering the implementation of recycled water projects.

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