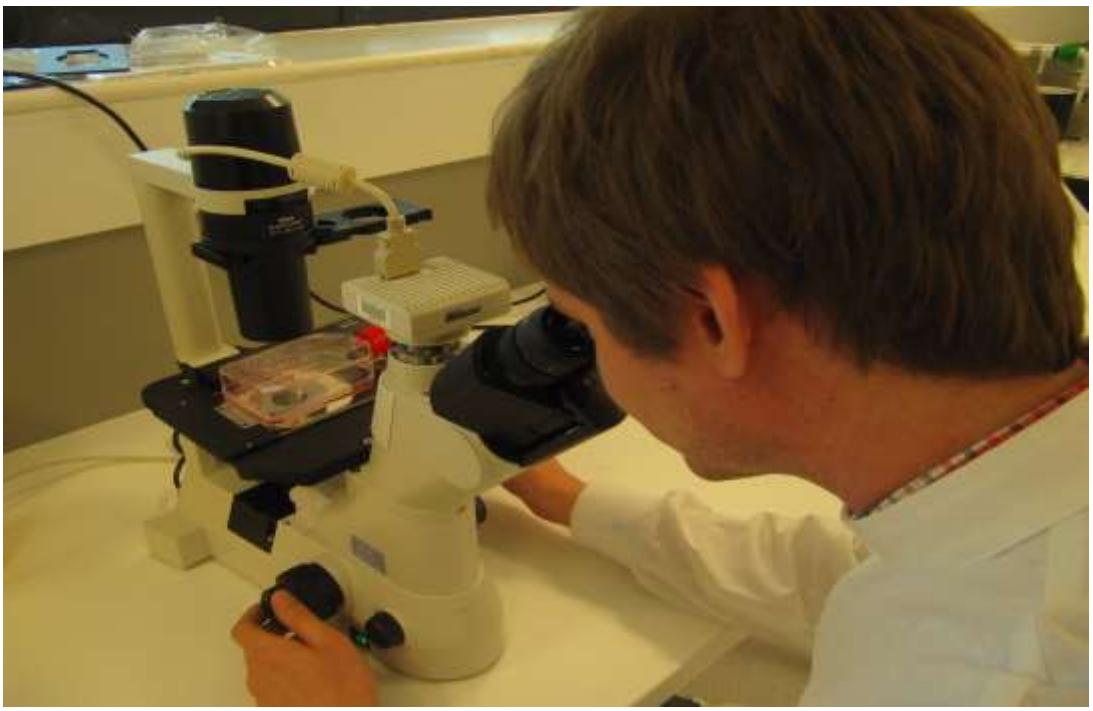
Evaluating a Science Communication Workshop as an Educational Tool

Victoria Ross and Heather Chapman

July 2012



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The Urban Water Security Research Alliance (UWSRA) is a $50 million partnership over five years between the Queensland Government, CSIRO's Water for a Healthy Country Flagship, Griffith University and The University of Queensland. The Alliance has been formed to address South East Queensland's emerging urban water issues with a focus on water security and recycling. The program will bring new research capacity to South East Queensland tailored to tackling existing and anticipated future issues to inform the implementation of the Water Strategy.

For more information about the:

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FOREWORD

Water is fundamental to our quality of life, to economic growth and to the environment. With its booming economy and growing population, Australia's South East Queensland (SEQ) region faces increasing pressure on its water resources. These pressures are compounded by the impact of climate variability and accelerating climate change.

The Urban Water Security Research Alliance, through targeted, multidisciplinary research initiatives, has been formed to address the region's emerging urban water issues.

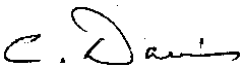
As the largest regionally focused urban water research program in Australia, the Alliance is focused on water security and recycling, but will align research where appropriate with other water research programs such as those of other SEQ water agencies, CSIRO's Water for a Healthy Country National Research Flagship, Water Quality Research Australia, eWater CRC and the Water Services Association of Australia (WSAA).

The Alliance is a partnership between the Queensland Government, CSIRO's Water for a Healthy Country National Research Flagship, The University of Queensland and Griffith University. It brings new research capacity to SEQ, tailored to tackling existing and anticipated future risks, assumptions and uncertainties facing water supply strategy. It is a $50 million partnership over five years.

Alliance research is examining fundamental issues necessary to deliver the region's water needs, including:

- ensuring the reliability and safety of recycled water systems.
- advising on infrastructure and technology for the recycling of wastewater and stormwater.
- building scientific knowledge into the management of health and safety risks in the water supply system.
- increasing community confidence in the future of water supply.

This report is part of a series summarising the output from the Urban Water Security Research Alliance. All reports and additional information about the Alliance can be found at http://www.urbanwateralliance.org.au/about.html.



Chris Davis
Chair, Urban Water Security Research Alliance

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EXECUTIVE SUMMARY

This social research project, a component of the "Bioanalytical Tools and Risk Communication" project, aimed to assess the effectiveness of a science communication workshop as an educational tool for the application of bioassays in water quality monitoring. Eleven people representing science, policy, regulation and industry were interviewed both before and after attending the workshop. All interviewees reported that attending the workshop was beneficial in improving their knowledge of bioanalytical tools. Many participants felt more positive about the value of bioassays after the workshop and others felt it had helped to improve their understanding and clarify their views about the usefulness of bioassays. A number of constructive recommendations were made, including clarifying some of the more confusing aspects of the presentations, and further developing the workshop to target more specific topics and audiences.

An additional aim of the research was to identify any barriers to effective communication within the water sector. Results showed that the main barriers to communication were: inconsistent use of recycled water terminology; content-free approaches to policy; staffing changes; and policy-makers, regulators and industry not being "on the same page" when implementing recycled water projects.

The same 11 participants agreed to be interviewed again approximately one year after the workshop was held. All of the participants were able to recall particular aspects of the workshop that they found useful, and all were able to identify at least some of what they felt were key messages. While several participants said that they believed more research was needed before bioassays could be adopted as a viable monitoring tool, others reported that health regulators were already investigating the possibility of using bioassays in their work. This research is relevant because it demonstrated that the science communication workshop was an effective means of informing industry professionals about the application of bioassays and encouraging their uptake within the water industry.

1. INTRODUCTION

One of the major challenges to the implementation of recycled water projects in Australia has been the lack of both public acceptance and consistent policies and regulations for the management of the treated water. As public perceptions of risk are influenced by perceptions of the credibility of the responsible authority (Baggett, Jeffrey, and Jefferson, 2006; Frewer, Scholderer, and Bredah, 2003; Ross, 2009; Tyler and Degoey, 1996), it is vital that policy makers, regulators and water managers provide assurance to the community that they are making decisions informed by the best available science.

Research shows that public confidence can be seriously diminished if authorities are perceived as incompetent or biased (e.g., Baggett *et al.*, 2006). It is therefore important that scientists, policy makers, regulators and water managers are shown to have a good communication process and that policy decisions are made based on reliable information. Given the history of public rejection of indirect potable reuse schemes in Australia, having the water industry well informed will be crucial towards public acceptance of future schemes.

Within the "science to policy" literature, attention has been drawn to the gap that seems to exist between science and policy making communities (Haas, 2004; Lomas, 2000; Owens, Petts, and Bulkeley, 2006; Pohl, 2008; Tsui, 2006; WHO, 2009). The need to bridge 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 (CCME, 2002; Lomas, 2000; Quevauviller, 2010).

The Communication Strategy (Goal 2) of the "Bioassays and Risk Communication" project aimed to improve communication about the application and interpretation of bioanalytical tools for industry, policy and regulation in Queensland's water quality monitoring programs. As part of this strategy, a science communication workshop about the application and interpretation of bioanalytical tools in water quality monitoring was designed and presented to a group of water industry, policy and regulation professionals.

The current research, an additional component of the Communication Strategy, aimed to evaluate the effectiveness of the science communication workshop as an educational tool. The results of this research provide crucial information for enhancing the development of this and future workshops, and will assist in building confidence in the use of bioassays for water professionals. An additional aim of the research was to identify key issues that need to be addressed to improve risk communication between science, policy and industry, with a particular focus on recycled water.

This evaluation research, along with the bioassays workshop, publication of the book "Bioanalytical Tools in Water Quality Assessment" (Escher and Leusch, 2011) and the development of an overall communication strategy, form the key components of Goal 2 of the "Bioassays and Risk Communication" project. Both Goal 1 (to strengthen and validate bioanalytical tools for application in water quality assessment) and Goal 2 support the overall project goal aim to develop the scientific, technical and communication basis for implementation of bioanalytical tools in Queensland's water quality monitoring programs.

2. METHOD

Invitations to attend the bioassays workshop were emailed to relevant State and National representatives from water research, policy and regulation, and industry. Thirty-four people (including the research participants) attended the bioassays workshop held on 12 April 2012. As noted above, the goal of the workshop was to facilitate communication about the application and interpretation of bioassays in water quality assessment, and was designed to provide practical information for water providers, regulators and researchers. Topics covered over the two hour presentation were: the risk assessment framework and water recycling guidelines; chemical analysis and direct toxicity testing; dose response and TEQ concept; mixtures, practical application, including both the endpoint and mode of action approach; strengths and weaknesses; and putting knowledge into practice.

Of the workshop invitees, 23 local representatives from research, policy/regulation, and industry were also invited to participate in the workshop evaluation research. Information regarding the purpose and scope of the research, including assurance of confidentiality and anonymity, were provided to participants in advance. A total of 11 respondents were both willing and available to participate in all three of the interviews comprising the research, a 48 per cent response rate. The sample consisted of three females and eight males with experience in the water industry ranging from two and a half years to 19 years. The average water industry experience across the sample was just under ten years. Four participants worked in policy roles, five in regulation, and one each from research and industry respectively. The research participants were interviewed during the two months before the workshop and then again during two months following the workshop. A third set of interviews was conducted with the same 11 participants approximately 12 months after the workshop. All interviews were semi-structured, individual, and face-to-face.

To reduce "social desirability response bias", the tendency of respondents to respond in a manner that will be viewed favourably by others (Thompson and Phua, 2005), it was explained to participants that "honest answers", good or bad, were required for the research. Participants were also assured that their responses would be confidential and unidentifiable. To provide consistency and reliability, the same interviewer conducted all interviews and the same format was used throughout.

The interviews conducted prior to the bioassays workshop aimed to gain an understanding of participants' current knowledge of and views about the applicability and limitations of bioassays. An additional aim of the pre-workshop interviews was to also identify communication barriers between scientists, regulators and policy makers, and industry representatives.

The second set of interviews was conducted with the same participants after the bioassays workshop to provide qualitative feedback and thus assess its effectiveness. Using evaluation criteria, the workshop was assessed based on participants' responses across a number of key points, which included:

- communication of key messages;
- if and how the workshop had improved knowledge levels about the use of bioassays;
- whether participants felt better equipped to locate scientific information and bioassay experts; and
- whether their views had altered regarding the applicability and limitations of bioassays.

In the long-term interviews (12 months later), the same 11 participants were asked if they could recall any specific information that they learnt from the workshop which was useful to them. As with the second set of interviews, participants were also asked about key messages, if the workshop had improved knowledge levels about the use of bioassays, and whether they felt better equipped to locate scientific information and experts on bioassays. Participants were also asked about how likely they felt it was that bioassays could be incorporated into water quality assessment programs, as well as what they felt were the main barriers to the uptake of bioanalytical techniques by regulators and by industry.

The digitally recorded interviews were converted into verbatim written transcripts using a professional transcription service. All transcripts were checked for accuracy and spelling against the original recordings before being imported into the qualitative data program, NVivo. The data was analysed using content analysis, a qualitative research technique for making replicable and valid inferences from texts (Krippendorff, 2004). Information regarding the purpose and scope of the research, including assurance of confidentiality and anonymity, were provided to participants in advance. Ethical clearance was provided by the Griffith University Human Research Ethics Committee.

3. RESULTS

3.1. Pre-Workshop Interviews

3.1.1. Current Level of Knowledge

Participants' self-reported (i.e., perceived) level of knowledge of water quality monitoring and assessment techniques indicated that four of the participants believed they had a high level of knowledge, five people felt their knowledge level was medium, and two felt their knowledge was poor. Similarly, when asked to describe their knowledge of bioassays, the same participants reported their knowledge levels in exactly the same way, that is, four with a high level of knowledge, five with medium knowledge, and two with poor knowledge.

3.1.2. Workshop Expectations

Participants generally expressed a desire to know more about the value of bioassays, how they are used and what they can achieve. A number of interviewees were also keen to discover if bioassays could have coal seam gas water and environmental applications. Several respondents were also interested to know if bioassays could be used to provide an extra level of assurance for the public of the safety of recycled water, and thus aid in increasing public confidence in water recycling. Examples of key questions that interviewees hoped to have answered through the workshop were:

> "W*ill these tests mean that you can actually assess those standards quicker or faster or easier or cheaper?"*
> *"How easy is it to apply to a normal laboratory?"*
> *"Do you need experts or…can you have people with laboratory certificates being able to run these assays?"*
> *"Can a genuine link from bioassays to public health be demonstrated?"*
> *"If we were to establish the fact that the processes work… where do we go from here?"*

3.1.3. Perceived Communication Barriers

Recycled water terminology was most commonly cited as a barrier to effective communication. Respondents reported that terminology differed between guidelines, legislation, Acts, and community education documents. In terms of communicating to the public, it was noted that inconsistent use of recycled water terminology results in sending mixed messages, which in turn creates confusion and nervousness. Some participants felt that, even within the technical arena, there can be substantial differences in the understanding of terminology. As one interviewee suggested:

> *"….so I think if you were to get three engineers in the room you could potentially get two very different ideas".*

It was also noted that differences in both terminology and levels of knowledge created communication difficulties between people working on policy and regulations. A trend towards "content free management" (where policy writers are not required to have background knowledge on the relevant policy area) was identified as a significant barrier to communication between regulators and policy writers. A respondent described a situation where water regulators experienced communication difficulties when working with a group of policy makers and drafters who did not have any technical knowledge on the topic. The lack of technical understanding on the part of the policy team created tension between the regulation and policy groups in a situation where a good working relationship between these groups would have been beneficial.

The importance of policy, regulation and industry being "on the same page" in terms of risk communication was also acknowledged. One interviewee explained that a great deal of time and effort goes into writing and requesting information, retesting and sometimes even redesigning recycled water projects. He stressed the importance of a shared understanding during this process, to avoid recycled water projects "falling over", resulting in wasted time and investment.

The majority of participants reported that they had few difficulties with locating scientific information and expertise that they required. The importance of professional networks was identified as integral to this process. However, as one interviewee pointed out, staffing changes (which are not uncommon in government departments) can sever these connections very quickly. A number of people mentioned that they sometimes have difficulties obtaining very specific scientific information. Given that it is a relatively new technology, this was particularly true in the area of purified recycled water (PRW). Several respondents mentioned that they found research conducted by the Urban Water Security Research Alliance to be useful in this area. The issue of commercially confidential data was also cited as barrier to communication. Respondents described the frustration of being unable to obtain water quality information. One interviewee stated:

> "*How do you communicate that something is safe if you can't access the data that demonstrates that it is safe?"*

3.1.4. Views on Bioassays Prior to the Workshop

Several participants believed that the link between a bioassay and public health was tenuous, in other words, it would be difficult to infer human health risk, particularly from the cell-based assays. A number of interviewees believed that bioanalytical techniques would be useful as a broad screening tool best used to complement, but not replace, traditional methods. It was also suggested that bioassays might have a better application in PRW than in drinking water, and would be useful in providing evidence that recycled water is clean and safe to use.

Concerns were expressed by a number of interviewees about the cost effectiveness and the difficulties of using such a "high tech" method. It was noted that the amount of verification monitoring currently required is very expensive, and there were concerns that introducing bioassays as an additional diagnostic tool could make it prohibitive to get a recycled project "off the ground". In addition, several interviewees cautioned that conducting more and more detailed tests is not necessarily the best way to improve public confidence. Another interviewee also thought that there would be very few laboratories that are actually capable of using bioassays.

3.1.5. Other Issues

Most participants felt strongly about the importance of science communication, particularly in cases where there has been significant investment. As one interviewee stated:

> "*we've invested in this science (the Bioassays and Risk Communication project) so the important thing then is to make sure that that investment is used in the maximum way by getting it out there*".

Concerns were also expressed that a lot of water related policy and political decisions were being made that were not based on science, and that research results were not having an impact on policy and processes.

It was generally considered by most respondents that effective risk communication about water treatment and safety is a vital element in securing public support. A number of interviewees also considered it important to be able to package up the science in ways that can be used by different audiences.

3.2. Post-Workshop Interviews

3.2.1. General Comments

All participants reported that attending the workshop was beneficial to them in terms of improving their knowledge of bioanalytical tools. The workshop presenters were described as having a high level of technical knowledge and experience, and it was noted that they built a good rapport and interaction with the audience. The presentations were described as informative, organised, well-structured, and aimed at the appropriate level for the range of people in the audience, as well as providing clear messages and the opportunity for feedback.

Most participants reported that it was useful to obtain a broader knowledge of bioanalytical tools and their application and limitations. Other specific information that respondents reported as being valuable were the range of techniques available, the application of human cells, "myth busting" on the multiplier effect, usefulness of bioassays with "unknown unknowns", and the fact that bioassays could provide information on the mode of toxic action. Several respondents felt that bioanalytical techniques could be useful in promoting public confidence in recycling. It was also noted that resources could be saved by conducting broad screening bioassays, rather than running a battery of independent tests.

A number of interviewees were interested in applying bioassays in water quality assessment of coal seam gas water. Several respondents also noted that PRW was not currently a "hot" issue and that coal seam gas water is a more immediate concern. Most respondents reported feeling more confident about to whom or where they could go to obtain further information on bioanalytical tools.

3.2.2. Did Views on Bioassays Change After the Workshop?

Five of the participants reported that since attending the workshop their views had altered more favourably towards the value of bioassays. Examples given of the types of information that influenced their views were the depth and variety of tests available, repeatable results, and the development of a toolbox setting and procedures that can be followed by a great number of different people. As one interviewee said:

> "*I was a bit negative beforehand but now I'm sort of coming around a little bit. I can actually see some advantages, particularly the fact that the drinking water didn't light up like a Christmas tree in the bioassays like I thought it would. So I was quietly impressed and surprised"*.

Several interviewees said that they were already supportive of the use of bioassays prior to the workshop. Other respondents felt that though their views had not necessarily altered, the workshop had helped to improve their understanding and clarify their views about the usefulness of bioassays. Another interviewee reported having a much improved understanding about the application of bioassays, but felt there was still a lot of uncertainty in their application.

3.2.3. Risk Perceptions

When asked if their views about the health risks associated with recycled water had altered since attending the workshop, almost all participants stated that their views had not changed because they were already confident with the treatment processes and safety of recycled water. However, one respondent said he found some of the information confusing and that he now perceived the health risks to be higher than he had thought prior to the workshop. Although one interviewee was "*still not 100 per cent convinced on the human applications of bioassays",* a number of respondents felt that the workshop made them more comfortable with how the risks could be assessed. Others felt that the workshop had showed that bioassays could be used to effectively demonstrate and communicate that the health risks in relation to recycled water are low.

3.2.4. Constructive Comments

The most significant feedback from workshop participants was that the component showing comparisons of different water treatment technologies and water quality needed to be explained in context (regarding the different water sources). Several respondents cautioned that some of the graphics on water quality comparisons could be alarming to some people, and that it was important to provide a clear story behind the water quality results from different techniques. One interviewee felt that this was an area of the presentation that was not well packaged and felt there could be a clearer message to give people confidence in water treatment technologies.

A number of participants mentioned that they found the discussion on dose response to be confusing. It was recommended that this component of the presentation could be clarified and that improved graphics could be useful in achieving this. Several people described the workshop handouts as a useful tool to take away, particularly in terms of being able to show the information to colleagues. However, some were disappointed that some of the detailed information from the power point presentation had been left out and would like to see this included.

Others were keen to know more about how these results could be effectively communicated to the public to provide a more objective picture on the risks. It was noted that more work needs to be done in terms of providing advice for people in the profession on how to communicate risk to the general public.

Most of the participants felt that it would be useful to further develop the workshop for specific audiences to make the information more accessible to a wider variety of people. One recommendation was a series of workshops where the different applications of bioassays could be explored. Other suggestions were: additional topic specific seminars where technical information could be expanded for the scientific people; and creating two separate workshops for environmental water and drinking water. Several interviewees mentioned that it would have been beneficial to have had more industry representatives in the audience.

3.2.5. Key Messages

During the post workshop interviews, participants were asked if they could describe what they perceived as the key messages that they took home from the workshop. These are summarised below.

- *Bioassays are an important tool to expand our understanding of water quality risks. They can be used to do things that traditional analyses have problems doing, for example, the cocktail effect, unknown unknowns and the mode of toxicity.*
- *Bioassays complement the other methodologies and can help to reinforce the results that are obtained through chemical analysis and biological analysis etc.*
- *Applying bioassays will give us a more comprehensive way of targeting our sampling and a more comprehensive view of what might be there rather than just looking for a single compound.*
- *Bioassays have other applications than just recycled water. They have strengths and weaknesses against traditional techniques.*
- *Bioassays are an underutilised and unexplored resource for determining risk, toxicology or the effects and harm of hazards in the environment.*
- *There are a wide variety of bioanalytical tests available and they cover a range of parameters that can be estimated at different levels. The results are repeatable and reliable.*
- *Bioassays may have a substantial contribution to make, there is a lot of work already happening in the area and still a lot more work to be done.*
- *Bioassays are not the silver bullet that will guarantee public acceptance, but they are powerful tools that could be developed to enhance public confidence.*

The feedback regarding these perceived key messages was provided to the workshop presenters and has since been applied in the development of the communication strategy and a series of subsequent workshops presented in Australia, the US and Europe.

3.3. Long-Term Interviews

3.3.1. Key Information Recalled

During the follow-up interviews almost one year after the bioassays workshop, all participants were able to recall specific aspects of the workshop that were particularly useful or of interest to them, and were able to identify at least some of what they felt were key messages. These comments clustered under themes that directly echoed responses during the first post-workshop interviews. Examples of these themes were the ability of bioanalytical tools to quantify the effect of a mixture as well as unknown unknowns; provide information on the mode of toxicity; the depth and variety of tests available; repeatable results; and the development of a toolbox setting. Bioassays were described by most respondents as a viable broad screening tool that was complementary to traditional chemical testing. Several participants recalled that the discussion on the benefits and weaknesses of the different assessment techniques was also very useful to their understanding of water quality assessment.

The bioassays workshop was again described as very professional and useful in informing understanding of bioanalytical tools. As with the first set of post-workshop interviews, participants described the workshop presenters as being extremely knowledgeable in their field, and said that they felt confident about to whom or where they could go to obtain further information on bioassays. In addition, all respondents again reported having a better awareness and improved understanding of bioassays than they did before attending the workshop. A number of respondents stated that they also now had more confidence in the application and usefulness bioanalytical tools.

3.3.2. Viability of Bioanalytical Tools

Possibly the most noteworthy feedback from this phase of the research was reports from several participants that, since the presentation of the workshop, some Queensland water regulators were currently investigating options for how they could apply bioanalytical tools in the regulatory area. It was suggested that, at this stage, bioassays would be likely to be used as an additional "screening tool" rather than as a regulatory tool. A number of respondents described bioassays as being valuable as a screening tool and in providing additional assurance of the safety of the water. As one participant stated:

> "*It gave me an assurance that this is a technique we could use… I think this sort of detail needs to be shared with the regulators and the public".*

It was described as "*only a matter of time*" until bioassays would be incorporated into water quality testing programs.

Participants described bioassays as being useful because they could provide a broad screening test that would negate having to do "*huge suites of chemical testing*". Consistent with the second set of interviews, participants also noted the applicability of bioassays in the area of coal seam gas water. A number of respondents suggested that bioassays would be particularly useful in this area given the unknown unknowns likely to be in the re-injected water.

3.3.3. Perceived Barriers to Uptake

Despite the positive feedback on the applicability of bioassays, when prompted, participants also described some significant barriers to their adoption by regulators and industry. One health regulator cited the time restrains imposed on government as an issue for regulators adopting new techniques.

"*We react to ... policy or parliamentary commitment to do something. So we are very reactionary and we often don't have a lot of lead times leading up to something... So we fall back on traditional methodologies that are quick, simple, and well-known... new and innovative (technologies) often get left behind when you're in a hurry"*.

Another said:

"people have been using traditional methods for a long time now. There are handbooks - people just go to handbooks if they have to – usually until they've memorised it".

Regulators were described as being conservative by nature, with a tendency to stay with tried and true methods of testing. Another participant summed this up by saying that there:

"*could be barriers simply because bioassays are a relatively new science and people are often reluctant to adopt change"*.

Lack of available government funding and costs and turn-around times were also perceived as potential barriers to adoption of bioassays.

"*People want beds and hospitals –they don't want (money spent on) testing water...*"

Several respondents believed that turn-around times for results could be lengthy, while others felt that if numerous samples were required, the expense would be a barrier to profit-making organisations (industry) and to regulators, who:

"*are realistic enough to know that they shouldn't be putting a burden on the people collecting the samples"*.

The way current health guidelines are written (i.e., targeting specific chemical levels) was also described as a barrier to the uptake of bioanalytical tools by regulators.

"*Their (regulators') primary goal is to make sure they are compliant with guidelines and regulations and those are all based around specific chemicals*".

It was suggested that regulatory standards would need to be set for using bioanalytical tools and that there would have to be a consistent methodology for their use.

It was acknowledged that the use of bioanalytical tools was a complex area and that it was important that results are not misinterpreted. It was also noted that some regulators may not have the expertise to correctly interpret the results and/or to share this information with non-technical policy professionals. One regulator said that it could be:

"*difficult to explain to a policy person with no technical knowledge that this research is what we need to get done... some of us technical people don't understand them completely, so that adds another layer of complexity because you're trying to explain something that you don't understand 100 percent to someone who doesn't understand it at all…*"

3.3.4. Thoughts on Science Communication

As with all of the earlier interviews, participants felt strongly about the importance of science communication. It was reported that there were not enough opportunities for people to learn about current research, and to generally interact and network with other industry professionals. A number of respondents stressed that there is a great need for more water related science communication workshops/forums. As one interviewee stated:

"A barrier in general that I find as a professional, is the (lack of) interaction between people. There is obviously, in Queensland, a specific group of people who have tremendous expertise and knowledge about this. But that doesn't always translate to everybody who needs to know it. The workshop was a great forum for that, it was a great outreach effort for them, but I think more needs to be done".

Although it was noted that the publication "Bioanalytical Tools in Water Quality Assessment" was a product of this project, it was recommended that there should be more legacy products from research projects such as "Bioassays and risk communication" (e.g., websites and "user friendly" information sheets for a broader audience to complement the technical reports).

The importance of educating industry and regulators about the use of bioanalytical tools was noted by several respondents. As with the earlier interviews, all interviewees stated that they found attending the bioassays workshop to be beneficial, and all participants said they would be interested in attending more similar workshops. Also consistent with the earlier interviews, a number of participants felt that it would be useful to further develop the workshop for specific audiences to make the information more accessible to a wider variety of people.

4. CONCLUSIONS

This evaluation of the effectiveness of the bioassays workshop has provided vital information for enhancing the development of this and subsequent future workshops as science communication tools. The research addresses the project goal of improving communication about the application and interpretation of bioanalytical tools for industry, policy and regulation in Queensland's water quality monitoring programs. The research also identified key issues that need to be addressed to enhance risk communication, which will provide a practical starting point for addressing communication difficulties between scientists, policy makers and regulators and water industry professionals.

Feedback from workshop attendees, in both the short- and long-term, indicated that participants had a better awareness and improved understanding of bioanalytical tools than they did before attending the workshop, and had more confidence in their application and usefulness. Almost one year after attending the bioassays workshop, all participants were able to recall specific aspects that were particularly useful or of interest to them, and were also able to identify some key messages. Many respondents reported that they felt bioassays could be a viable tool. These results clearly demonstrate the long-term effectiveness of the workshop as an educational tool in promoting the application of bioassays. Significantly, it was reported that, since the presentation of the bioassays workshop, some Queensland health regulators are now investigating options for introducing the application of bioassays in water quality testing.

Another key finding from this research is that there is a strong perceived need for more science communication workshops, both to share current scientific research, and to provide opportunities for water professionals to interact and strengthen professional networks. It is envisioned that the results of this research project will be applied to enhance the development of further science communication workshops and, ultimately, to facilitate the implementation of policies and regulations that are based on the best available science, leading to best practice in the industry.

APPENDIX A: Pre Workshop Questionnaire

- Could you tell me a little about your professional background and your current role?
- How long have you been involved in the water industry?

The next few questions relate to your experiences in the water industry. As with all the questions I'm asking, there are no right or wrong answers - I'm just looking for your perspective.

- Can you tell me about the ways that you currently obtain the scientific information that you need in relation to recycled water, and of these, which do you feel are the most effective? (e.g., formal/informal methods, professional networks, committees)
- Do you ever experience difficulties in locating the scientific information and scientific experts that you need in relation to recycled water?
- What about recycled water terminology? Do you ever experience any difficulties or confusion or with the language or terminology used?

Now I just have a couple of questions to get your perspective on risk perceptions

- Do you think there are differences in how the public, scientists, policy makers/regulators and water managers view the health risks associated with using recycled water? If so, could you describe some of these differences?
- How important do you feel it is for scientists, policy-makers/regulators and water managers to be on the 'same page' in terms of the safety of recycled water quality?

The following questions relate to water quality assessment – remember there are no right or wrong answers – I'm just looking for your perspective

- How would you describe your current level of knowledge about water quality assessment and monitoring techniques?
- Are you able to tell me a bit about what you know about the use of bioassays in water quality monitoring?
- Do you have any particular views about the usefulness of bioassays in providing information about water quality?
- Do think there are any limitations in using bioassays for this purpose?

And now finally I'm just going to ask you a couple of questions about your thoughts on the Bioassay Workshop that our research team is going to run in April.

- How useful do you think this workshop will be to you specifically?
- Is there any specific information that you would like to gain from the workshop?
- How useful do you think the workshop will be useful for water industry professionals in general?
- Are there any other comments you would like to make regarding this workshop, science communication, or any other water related issue?

APPENDIX B: Post Workshop Questionnaire

Explain that the purpose of the interview is to gain participants' feedback on the workshop - want to hear participants' perspectives – both positive and negative.

- Could you tell me what you thought about the bioassays workshop overall, and whether you felt it was beneficial to you?
- Do you think that the workshop has improved your awareness of, or current knowledge about the use of bioassays?
- Was there any specific information that you gained from the workshop that was particularly useful? What were the least useful aspects?
- Has attending the workshop in any way altered your views about the value of using bioassays in water quality assessment? In what ways?
- Would you say that the workshop has had any impact on the way that you perceive the risks associated with using recycled water?
- Since attending the workshop do you feel better equipped to locate the scientific information or scientific experts that you need to find information on bioanalytical tools? What do you think will be the best sources of scientific information to guide decision making in the future?

Now I'd like to ask about your thoughts on the terminology used in the workshop presentation.

- Did you feel that the level of language used was at an appropriate level for the course?

General questions

- Could you tell me what you felt were the key messages about bioassays that you took away from the workshop?
- Do you have any thoughts or suggestions about how the workshop could be improved?
- Are there any other comments you would like to make regarding the workshop, bioassays or risk communication in relation to water recycling?

APPENDIX C: Long-Term Assessment Questionnaire

Explain to participants that although it has been almost a year since they attended the bioassays workshop, we just want them to reflect on the workshop and talk about things that they recall that may have been useful or not, and/or provide comments on any other aspects of the workshop, or the bioanalytical tools themselves.

- Was there any specific information that you recall learning from the workshop that was particularly useful to you? What were the least useful aspects?
- Looking back, do you think that attending the workshop has improved your awareness of, or knowledge about the use of bioassays?
- Do you think attending the workshop in any way altered your previous views about the value of using bioassays in water quality assessment? In what ways?
- Since attending the workshop do you feel better equipped to locate the scientific information or scientific experts that you need to find information on bioanalytical tools? What do you think will be the best sources of scientific information to guide decision making in the future?
- Would you say that the workshop has had any impact on the way that you perceive the risks associated with using recycled water?
- It has obviously been quite some time since the workshop was held, but looking back are you able to recall what you felt were the key messages that you took away from the workshop?
- How likely do you think it is that bioassays could be incorporated into water quality assessment programs?
- Do you see any barriers to the acceptance of bioanalytical results by water regulators? Could you elaborate?
- What about barriers to the uptake of bioanalytical techniques by industry? Could you elaborate?
- Are there any other comments you would like to make regarding the workshop, bioassays or risk communication in relation to water recycling?

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