Water Research AUSTRALIA

Research

Research Report

Project 1118

The Value of Research Phase 1 Report

Collaborate Innovate Impact

The Value of Research Phase 1 Report

Scoping

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WaterRA Project #1118

Executive Summary

The Value of Research project is a Board-endorsed WateRA project to maximise the value of water industry investment in research. The project is phased, with Phase 1 designed to determine the needs of the water industry, identify the scope of work to be undertaken in Phase 2, and determine what later phases may be warranted.

WaterRA engaged with stakeholders from the water industry to understand their current approach to maximising and valuing their research investment and to determine their needs going forward. The engagement highlighted the disparate approaches taken by the industry to date and the strong interest and desire for a more consistent, and water industry tailored technique. Stakeholders identified two main needs: 1) to ensure that their internal processes maximise the value of their research investment; and 2) to provide defensible and accepted valuation techniques for tangible and intangible benefits of research.

In response to the first need, an evaluation of different approaches to identifying value creation opportunities combined with stakeholder discussions, led to the development of the Research Value Elements – a set of high-level requirements applicable to any organisation investing in research which if applied should ensure that value is realised.

In response to the second need, a review of the different approaches in application to case studies demonstrated there is real benefit in generating water industry specific assessment methods, provided several conditions are met: if an assessment does produce a monetary value it must be defensible, that means that assumptions and uncertainties within the analysis are articulated and understood; in the event of too much uncertainty with a monetary evaluation, then a standard qualitative assessment should be developed. By developing a water industry specific assessment approach, methods become much easier to use and understand, and allow for comparison between projects, programs and organisations. For example, a consistent approach within the water sector would allow for high-level organisational benefits, such as an avoided Boiled Water Notice, to be costed and used as the basis for valuing the research investment.

The findings of Phase 1 show that currently there is not a consistent or agreed method to value research investment within the water industry, despite several attempts by different organisations to demonstrate value. Stakeholder engagement identified the need for a method that is consistent, tailored to the water industry, easy to apply, and which provides defensible valuations. A scope for Phase 2 of the project has been developed to address these needs utilising an approach of co-delivery with stakeholders.

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Introduction

1.1 Outline of Phase 1

In early 2018, the Board of WaterRA approved the development of a project plan to address an identified need that the benefits of research are not being fully measured or realised. This led to the creation of the project 'Value of Research' (VoR) and development of a multi-phase project plan.

The objectives of Phase 1 were to: understand the needs of the water industry, and critically review the techniques that are currently available to measure and realise the benefits of research so as to inform the scope of Phase 2 of the project.

Specifically, work undertaken during Phase 1 was to explore how the water sector understands and defines value within its research programs. To achieve this, stakeholders' needs were determined by considering what impacts and types of value should be included within a Research Value Framework (and subsequent Good Practice Guide to Value Creation from Research in the Water Industry - Phase 2 of the project). Stakeholder interviews were used to identify common areas of interest to be summarised as the Research Management Framework Elements. This engagement enabled WaterRA to identify stakeholders within the water industry that are interested in Phase 2 of the project.

Known assessment methods utilised within the water industry, and other sectors, were subsequently reviewed against the Research Management Framework Elements to understand which techniques offer methods useful to the water industry. Different techniques were selected to assess the benefit of WaterRA projects, which was a useful exercise in understanding how the various methods perform and the identification of the benefits of actual WaterRA projects.

The need to communicate and engage with member organisations to obtain sufficient project support was identified as a critical need for this project. This need was met via the development of a Prospectus for Phase 2 to share with potential project partners and interested organisations.

Deliverables from Phase 1 were:

- a report that identifies and demonstrates the value and impact of research (this report);
- case studies of WaterRA projects that showcase value and impact (Appendices to this report); and,
- a Prospectus for Phase 2 of the project (released in October 2018).

2

Stakeholder Engagement

2.1 Purpose and Summary

A critical component of Phase 1 of the Value of Research project was the engagement with industry and academic stakeholders. The purpose of this engagement was to understand:

1. Their needs with regards to their organisations' business practices; and,
2. If previous attempts had been made to evaluate the value of their research investment and their success.

The stakeholder engagement revealed there is a common need to evaluate the value of the research investment, preferably into a monetised value provided it yielded a reasonable, defensible value. Previous attempts to evaluate the intangible benefits often left more questions than answers. If a monetised value wasn't reasonable then there was support to develop a common method of evaluating intangible benefits. The process of managing research, including how to ensure it delivered value to an organisation, varied greatly between organisations. The Research Framework Elements were developed as a means for each organisation to consider the key elements that their process for managing research should include to extract the maximum value.

2.2 Stakeholder Selection and Survey

A broad range of stakeholders were identified from the WaterRA membership. The range included large utilities, with large research programs, small utilities, with limited research budgets and programs, but an interest in research, research organisations, utilities with varying functions (catchment managers, retailers, drinking water and/or waste water treatment) and a consultant. The complete list of stakeholders that were engaged during Phase 1 is contained in Appendix I (Section 7 of this report).

Member representatives and water industry personnel were contacted, mostly by telephone, or face-to-face, if possible, to answer a series of predetermined questions which were:

- What do you need in the Value of Research Project?
- What do you use in your business case justification?
- How do you measure end of project realisation?
- Are you doing anything now, or what has been done before, to measure value?
- What would be the benefit of an industry-wide measure?
- What would be the benefit of a generic benchmarking process?
- Would you say your organisation has a culture of innovation?
- How do you define the problem?

The responses to these questions shaped the objectives of the project plan and formed the initial elements of the Research Value Framework.

2.3 Discussion and Observations

The engagement with stakeholders was informative and provided input to the Research Management Framework Elements outlined below and described in detail in Section 5 of this report. Some of the general observations regarding the stakeholder engagement are listed below:

- Stakeholders prefer that the benefit can be monetised, but not if it creates monetary values that cannot be substantiated. Stakeholders need the valuation to be defensible, even if there is uncertainty regarding the result, but as long as there is sufficient knowledge of the underlying assumptions and how these assumptions influenced the valuation.
- If the benefit cannot be monetised, then establish other metrics that can be consistently applied to certain intangible benefits (e.g. if the benefit was Reputation, what are other approaches or evidence that can be applied), and create a library of techniques.
- There are measures that are consistent across the water industry, and it would be useful to identify the variables (elements to be measured) commonly used.
- It would also be useful to look outside the water industry at different approaches and methods.
- Whatever the technique, it needs to be simple, flexible and allow each business to apply its own processes within the Framework.
- Value is complex, there is a time component and it is viewed differently within each organisation, and the assessment methods need to account for this.

2.4 Input to Research Management Framework Elements

The stakeholder interviews were an important part of this phase of the project in that they revealed many commonalities, but also differences, across organisations. As the discussions evolved, it became clear that an overarching standard or approach needed to be identified that drove value creation from inception, and that identifying value only at project completion was not sufficient. This led to the following elements being identified:

- Governance
- Capability
- Alignment with Corporate Strategy or Business Goals
- Defining the Problem
- Project Development
- Project Execution
- Knowledge Transfer
- Knowledge Adoption
- Tangible Value
- Intangible Assessment

These elements were further refined during subsequent stages of Phase 1 as presented in Section 5 of this report.

3

Review of Methods and Approaches

3.1 Purpose and Summary

This section describes the review of global and water industry approaches used to value research, and describes some of the benefits and limitations of each approach. The review used the Research Management Framework Elements as the basis for comparison, which in turn led to the refinement of these Elements.

During the stakeholder engagement with the water industry a variety of different methods to evaluate research value were shared for review. These included either organisational attempts to value the research or more general approaches.

The review showed that to ensure value is achieved from research, it must fit within the wider organisational goals and be incorporated within its business practices. Secondly, that each different approach provided an outcome but none delivered a complete solution that met the needs described during the stakeholder engagement. Further work is needed to develop water industry assessment techniques for intangible benefits, and it should consider how the benefits could be monetised but recognise when this value becomes too uncertain so that another assessment method could be used.

3.2 Key Documents and Approaches

3.2.1 Water Research Foundation Innovation Framework

Description: The Framework introducing eight disciplines to help an organisation be more innovative, namely: ***Visualise***, ***Focus***, ***Develop***, ***Evaluate***, ***Engage***, ***Reach***, ***Communicate*** and ***Evolve***. Utilities globally were surveyed to identify innovation catalysts and inhibitors; research programs were ranked 2nd out of 10 as an innovation catalyst.

Key findings:

- Research is an enabler of an organisation that has innovation goals.
- The disciplines relate to many points made during the interviews and align to the Research Value Framework.
- Organisational culture is very important in driving innovation, and, by extension, research.

3.2.2 Melbourne Water Research-Practice Partnership Report (Inxure)

Description: The report is a review of Melbourne Water's Research-Practice Partnership that utilised the 'Research Value Chain' that had been incorporated within WaterRA's 'Unlocking the Value' approach. The seven elements of the 'Unlocking the Value Research Value Chain' formed the framework to conduct the review. The authors also developed the 'Research Impact Domain' concept as a non-monetary method to assess the areas across the business that the outcomes from the research are likely to impact, with a relative ranking of the impact.

Key findings:

- Highlights that value creation is across all elements of the value chain.
- Linking value creation to common areas of the business allows for simple comparison.
- Relative ranking is simple to apply, but subjective.
- Lack of monetary benefits realisation may not meet all needs.

3.2.3 UKWIR Research Benefits Spreadsheet

Description: To manage their programs of research, UKWIR use a simple spreadsheet with predefined lists to categorise the benefits of research and associated monetary value.

Key findings:

- Simple to use and to keep track of programs of work.
- Benefits are categorised and aligned to utility needs.
- Monetary range is wide and, as such, it loses the impact of benefit; also it is not clear how this is ascertained, so it is difficult to justify the monetary benefit.

3.2.4 UK Research Excellence Framework

Description: The Research Excellence Framework (REF) is the UK's system for assessing the excellence of research in higher education institutions, which informs the allocation of funding to higher education institutions. Research users review case studies provided by institutions to assess submissions, which consider the quality and impact of the research. Reviews are conducted every 7seven years.

Key findings:

- Case studies, as a means of demonstrating impact, are a considerable effort to complete for each research project to demonstrate impact.
- Requires 'sources to corroborate the impact'.
- The need for evidence drives consideration of likely impact in the early project planning stages.

3.2.5 ARC Centre of Excellence for Environmental Decisions (CEED) – Wrap-up survey

Description: CEED is required to demonstrate the value of its research now that the centre is nearing the end of its funding cycle. Researchers were required to complete a survey and results were collated into a final report. The survey was only considered towards the end of the Centre's life and results are varying in quality due to retrospective nature.

Key findings:

- Survey provided a predefined list for either implementation pathways and academic impact, stronger in academic impact.
- Though, quality was highly variable, as it was a wrap up activity, rather than being built into the program from inception.

3.2.6 ARC Engagement and Impact Assessment Pilot 2017 Report

Description: In 2017, the Australian Research Council (ARC) conducted a pilot of its Engagement and Impact Assessment process (the EI pilot). The objective of the EI pilot was to test its methodology in preparation for the first full Engagement and Impact Assessment in 2018 (EI 2018). This report summarises the findings from the EI pilot and sets out the methodology for EI 2018.

Key findings:

- Engagement and Impact are the targeted measures.
- Engagement is determined by assessing cash support, commercialisation, patents and co-authorship.
- Impact is assessed against social, economic and environmental benefits.
- Unsure if these measures translate into measures that relate to water utilities, very academic focussed in order to meet ARC requirements.

3.2.7 CSIRO Impact Evaluation Guide

Description: The CSIRO Impact Evaluation Guide was developed to provide firm evidence of the effects of CSIRO's research and innovation activities on the economy, environment and society more broadly. It presents a series of tasks that the user should consider when doing an impact analysis. Various economic methods are provided for different situations.

Key findings:

- Comprehensive guidance on various facets of impact evaluation; however, the process doesn't begin until the project outcomes begin, as opposed to considering research valuation from inception.
- The impact evaluation report is extensive.

3.2.8 Water Corporation of WA – Business Case Benefits Calculator

Description: The Social Environment Tool (SET) is a sustainability decision support tool developed for use by Water Corporation. It is an application of the Advanced Cost Benefit Analysis methodology that considers the economic sustainability of a course of action or options by quantifying, in monetary terms (NPV), the value of financial, social and environmental impacts.

Key findings:

- Used for options analysis to justify investment in a research project.
- In its current form only applicable to Water Corporation.
- Relies on data from in-house, literature review, published studies, journals and non-market values databases.

3.2.9 Seqwater - Lessons Learnt Process

Description: Seqwater's research management process requires each research project to conduct a lessons learnt review with operational staff to identify whether the research outcomes met the internal stakeholder needs and what further communication activities are required.

Key findings:

- Only two utilities had formal post-project activities identified within their research management process.
- Linking this review back to the operational part of the business provided greater surety that there would be implementation of outcomes.
- Seqwater resources its research management team to conduct these reviews.
- Monetary benefits are not identified.

3.2.10 Seqwater – Consultancy Benefits Realisation Review

Description: Seqwater contracted a consultant to perform a benefits realisation review of selected projects using the contractor's methodology, which derived a monetary value based on a 20 year period.

Key findings:

- It was difficult to comprehend the derived research value in some cases, resulting in the findings not being utilised within business to justify the benefits of research and the values were difficult to defend without knowing underlying assumptions.
- The overall technique was reasonably easy to follow.

3.2.11 SA Water – Impact Case Study Pathogens

Description: SA Water used an approach that evaluated the impact of research by considering Research Themes – Measuring, Understanding, Controlling and Areas of Impact/Benefit – Knowledge foundation, Managing Risk, Optimising Operations. This approach captures the multitude of ways that research may benefit either a research organisation or water utility.

Key findings:

- Qualitative assessment that is comprehensive and is useful when reviewing programs or themes to understand how outcomes have been implemented.
- Considerable effort to generate and the information that underpins the assessment and it does not include a tangible value.

3.3 Discussion and Observations

The review of different methods, frameworks and approaches from different organisations provided considerable insight. Each method clearly reflected different approaches to measuring value and each method undertook this valuation for different purposes. Some were for retrospective analysis of a program or partnership, another was used to justify a research business case. Each method was specific to the host organisation, was tailored to meet their internal needs, and, as such, would require some effort for any particular method to be applied within other organisations, with the amount of effort required varying between methods. The CSIRO method provided the most monetised value description; however, it is quite a complicated approach for someone without an economics background.

A table comparing the results of the review is presented as Appendix II (Section 8 of this report). The summary below provides the key points that the good practice guide and assessment method in Phase 2 of the project should consider:

- How research projects fit into the wider organisation and its innovation practices, including processes, procedures, approvals and engagement with end users.
- Be simple to use, repeatable and be able to compare benefits in a consistent manner for any type of project, as it measures the benefit to the business.
- Include how to capture the long term benefits.
- Develop further the parameters that are applicable to the water industry, which include utilities, research and regulatory organisations, in order to gain their acceptance of these parameters. Differentiate between stakeholder benefit, as there is overlap, but each sector does have unique requirements that need to be met.
- Accept that monetarised value is not always attainable, and if there is a push to provide a cost benefit then understand the assumptions and uncertainties. The derived benefit must be defensible, otherwise it invalidates the benefit of the project, based on feedback on past experiences from stakeholders.
- The use of case studies or theme reviews performed in a consistent manner is useful when it's difficult to demonstrate cost benefit, or qualitative description, is needed. This includes referencing corroborators of the benefit.
- Consider the balance in the effort required to demonstrate benefit versus the outcomes. There was a marked difference in the level of effort required across these techniques, and it is clear that the water industry needs to decide what is a "reasonable level of effort" under given circumstances during the next phase of the project. Ensure that there is sufficient guidance on using techniques is included in the manual and assessment method.
- Try to avoid retrospective analysis with stakeholders who were not involved in the project or not the intended beneficiary. The quality of the reviews diminished the longer the period between project completion and review, especially if the review is done without consideration of how to measure the benefit throughout the project.

4

Assessment of WaterRA Projects

4.1 Purpose and Summary

WaterRA has produced approximately 100 research projects over the past 10 years across its Drinking Water, Wastewater and Recycled Water programs. Prior to this, the CRC for Water Quality and Treatment (CRCWQT) generated approximately 70 research reports across similar themes, and the intellectual property for these CRCWQT reports now resides with WaterRA.

The purpose of this section was to review a selection of completed WaterRA projects using different techniques described in Section 3 to:

1. Understand which assessment methodologies were useful for incorporation into WaterRA's proposed Research Management Framework; and,
2. Determine the value of selected WaterRA research projects or theme of projects.

A summary is included after each project, and then an overall summary and discussion is included, at the end of this Chapter with considerations for Phase 2 of the project. In general, this review showed techniques that are specific to the water industry are much easier to use, the monetised benefit was harder to determine and was a more useful outcome only if the value was clear. Qualitative assessments and graphics are useful to include in showing benefits.

It is rare that a single research project delivers the full extent of the benefits received; research is built upon previous knowledge developed on other work. This therefore makes it difficult to attribute the benefit of a project. Examination of the *Cryptosporidium* case study showed that the body of work has led to the benefit of avoiding boil water notices, or a 'macro' benefit. One approach maybe to identify other 'macro' benefits to the water industry (i.e. pipe breaks) to understand and relate the value of the research.

4.2 Assessment Methods

Not all the methods described in Section 3 were suitable for trialling in this assessment of methods against completed WaterRA projects. There was either insufficient data, or the technique had only limited purpose. The assessment tools included in the assessment review were:

- Inxure Impact Domain
- SA Water Impact Study
- UKWIR Assessment Spreadsheet
- CSIRO Impact Evaluation
- Consideration of ARC Impact & Engagement

4.3 Project Selection

A range of projects were considered for review, taking into consideration the data available and engagement with stakeholders, and a desire for a range of research topics to be assessed. To meet these needs the following projects were selected for the review:

- Thematic review of *Cryptosporidium* research within SA Water/ AWQC
- Project #1076 – Assessing, Understanding and Influencing Customer Perceptions of Water Quality
- Project # 3023 – Chemical Hazard Assessment of Stormwater Micropollutants (CHASM)
- Project #4525 – Assessing the Impact of Wastewater-Derived Poly- and Perfluoroalkyl Substances (PFAS) on Australian Aquatic Ecosystems (student project)

4.4 Summary of review of Assessment Methods

Detailed results of the assessment of each project using the approaches identified in 4.2 above are presented in Appendix III (Section 9 of this report).

Application of the different assessment methods clearly shows that techniques that are aligned to the needs of the water industry are the simplest to use and highlight a wider range of benefits than other techniques. Four stakeholders from different organisations were able to complete or review these assessments using the Inxure Impact Domain technique with little guidance. The technique is also useful as it can be applied to either programs or themes of research and discrete projects.

The SA Water technique was also useful in describing the benefits of the theme of *Cryptosporidium* research and incorporating graphics provided easy visibility of research impact. Incorporating graphics and other visual techniques should be included in Phase 2. This method does incorporate more for the knowledge creation than the Inxure method, which may be beneficial when considering the needs of academic organisations. Certainly the unique requirements described within the ARC Impact and Engagement review would require modification of any of these techniques to meet these needs, however it would not be insurmountable and there are overlaps.

The CSIRO method required considerable effort to understand and complete. This may be suitable for a large scale themed review but

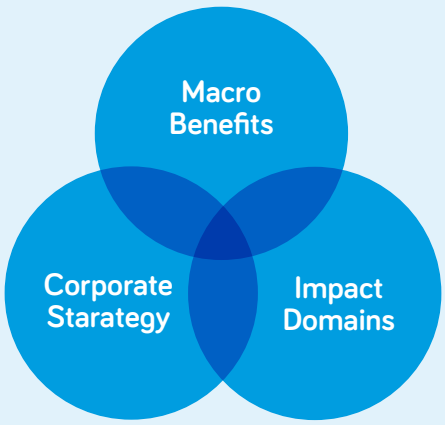
when this is compared to applying the Inxure method for say smaller individual projects the latter method is far more preferable. That said, the CSIRO does incorporate a financial review benefit analysis that Inxure and SA Water Impact study doesn't require. It also included questions that hadn't been considered in other reviews such as attribution and what happens if you do nothing? These are other elements worth considering in the guidance for Phase 2.

The UKWIR method is designed to provide a summary of benefits over a program of work including financial benefits to some extent. When applied to the SA Water project however, it lacked the ability to tease out the range of benefits that such a program of work delivered and while it included a financial summary of benefits did not demonstrate the overall benefits experienced by SA Water. This type of approach is thus not recommended for use in the Australian context but could be used by any UK project participants in Phase 2 for comparative purposes.

The CEED Survey technique is very specific to academic institutions with the expectation that researchers complete this at the end of a project. While it wasn't directly applied to the WaterRA projects feedback from the CEED organisation regarding the survey is that it provided the information required to demonstrate the value of their research, but the quality was dependent on efforts from the researchers. The quality would have improved had researchers been asked to complete this at the start of a project. It is a useful template to consider in Phase 2 to meet academic institutional needs.

A critical question while completing these reviews was 'Does the benefit analysis provide information of use to a utility?' (Note that the focus has been on utility benefit but a similar question is needed for academic and regulator stakeholders to identify their specific needs). It was important to step back after each review and consider this question because in conversations with the stakeholders that assisted they provided overall benefits of each project, and it was important that this be somehow captured in the method. These overall benefits are summarised for each project and in particular the *Cryptosporidium* theme example highlighted this need to consider what information is of benefit to a utility. In this case, the outcomes for all of the research projects now underpins decisions regarding the release of a Boiled Water Notice. Avoidance of Boiled Water Notice is of significant benefit to a water utility and there is an estimated cost avoided that has been calculated by SA Water. (Note that this cost is extrapolated from the Sydney Water 1998 incident and applied to SA). Avoidance of a Boiled Water Notice introduces the concept of the 'utility macro benefit', which are common high level benefits that apply to all utilities. One approach would be to develop a common method that could be determined for a range of macro benefits, possibly linked to the size of population served, and then research projects are linked to these. It is tied to the impact domains but does draw out specific utility cost benefits that any research activity could be linked to, recognising it is only part of a solution.

This is conceptualised in the diagram below that identification of benefits are inputs and outputs of 1) 'macro benefit' (general benefits that apply to the sector eg cost of Boiled Water or number of publications), 2) the water sector impacted domains (consistent areas of all businesses) and 3) corporate strategy (each organisation having its own goals). This could be explored further in Phase 2.



The SA Water Figure 1 Identifying the Benefits

5

Research Management Framework Elements

5.1 Introduction

The results of stakeholder engagement, and the review of different methods and approaches, revealed common elements that contribute to maximising value in a research program or project. These are described in the sub-sections below.

5.1.1 Governance

Governance relates to the overarching control that the research is performed under. It includes:

- Governance structures and organisation – policy; hiring practices
- Culture, motivation and reward
- Research partnerships and relationships
- Succession and long-term planning
- Maintaining corporate knowledge of research programs and outcomes
- Support systems – procedures to manage research program and projects; document control, auditing; management reviews; continuous improvement; contracting; risk management

5.1.2 Capability

Capability considers the ability of the organisation to engage in research, and the staff or researchers that participate on research projects, and include:

- Resources – funding; dedicated personnel; project resources
- Researcher skills
- Project partners skills
- Support systems – processes to enable research partnerships and projects to be instigated, contracted and maintained

5.1.3 Alignment with Corporate Strategy or Business Goals

Alignment with Corporate Strategy or Business Goals is the target that the research program, and therefore the research projects, should be aiming for and includes:

- Corporate strategy that guides the research program
- Research that delivers business needs – over the short, medium and long term – thematic strategy within a corporate strategy
- Research establishes clear aims and objectives
- Intended impact from research is clearly defined – adoption and implementation

5.1.4 Defining the Problem

Defining the problem recognises that understanding what the problem really is, is vital to know before embarking on any research undertaking, otherwise the outcomes will provide reduced value to the organisation; factors include:

- Critical thinking about the problem – knowledge gaps, policy context, regulatory requirements, challenges, business needs
- Key stakeholders that need to be involved
- Determine adoption and implementation pathways
- Customer / citizen engagement and expectations

5.1.5 Project Development

Project development considers the steps involved once a problem is properly understood, in order to create a research project and includes:

- Selection process to guide investment – options analysis; assessing projects
- Information for decision makers
- Determine project delivery method – team; contracting approach; risks (staged approach); funding; schedule

5.1.6 Project Execution

Project execution involves the ongoing management of a research project including:

- Requiring all projects to adhere to common Project management methodologies e.g. PMBOK Communication and Stakeholder management
- Reporting – responsibilities; timelines; performance; risks
- Deliverables management – schedule; review and acceptance; creating a PAC
- Scale

5.1.7 Knowledge Transfer

Knowledge transfer is the act of creating and translating project outputs into material more suitable for update and includes:

- Formal outputs – publications; reports; identified outputs; policy and government submissions
- Communication – success; storytelling; lesson learned; identified stakeholders; media

5.1.8 Knowledge Adoption

Knowledge adoption considers how the project outcomes that have been transferred to the end users are utilised within an organisation and includes:

- Communication and stakeholder management – trusted relationships; outputs available to users; user advocates for change; variation between stakeholders; stakeholder culture
- Implementation pathways and plans – decision process; support policy (new/existing); information for decision makers; further research
- Adoption delivery method – timeframe; Scale – full or partial adoption;

5.1.9 Tangible Value

Tangible value defines the benefits that are quantifiable and measurable, and these include and should consider the points below:

- Common monetisation methods
- Non-market valuation methods
- Sensitivity analysis
- Benefits assessment range
- Cost savings
- Cost avoidance
- Attribution
- Thematic value

5.1.10 Intangible Assessment

Intangible value results from outcomes that provide benefit, but are difficult to measure and may include methods that provide a monetary value or qualitative assessment, such as these below:

- Assessment of meeting research objectives
- Benefits Assessment
- Impact Domains
- Case study
- Engagement indicators
- Impact indicators
- Attribution
- Counterfactual
- Thematic value

6

Reference Materials

WaterRA – Unlocking the Value (page 23 Value Framework)

Science Quality Framework (draft)

ARC Engagement and Impact Assessment Pilot – http://www.arc.gov.au/sites/default/files/filedepot/Public/EI/Engagement_and_Impact_Assessment_Pilot_2017_Report.pdf

Inxure Strategy – Melbourne Waterway Research-Practice Partnership Assessment

CSIRO – Impact Evaluation Guide 2017

RAND – Measuring research: A guide to research evaluation frameworks and tools

Coleman et al RAND – Measuring research, a guide to research evaluation frameworks and tools

Improving waterway management outcomes through collaborative research: insights from the Melbourne Waterway Research-Practice Partnership

Australian Academy of the Humanities Measuring the Value of International Research Collaboration https://www.humanities.org.au/wp-content/uploads/2017/04/AAH_Measuring-Value-2015.pdf

UK Research Excellence Framework – Collecting Research Impact Evidence https://www.ref.ac.uk/

Yarra Valley Water - Integrated Profit and Loss Report - http://gistadvisory.com/admin/pdfs/Yarra%20Valley%20Water%20IPL_November%202016_v2.pdf

7

Appendix I – Stakeholders

Organisation	Who	Initial Contact	Phase 1 contact
SA Water	Paul Monis	F2F interview	Provided substantial SA Water information for review Discussion on information that is useful to business
Melbourne Water	Judy Blackbeard	F2F interview	Call – supportive
Water Corporation	Gabrielle O'Dwyer	Call interview	Provided WC information on current process Supportive of project
Barwon Water	Will Buchanan	Call interview	
Hunter Water	Anna Lundmark Abby Morrow	Call interview	Call – supportive
WaterNSW	Lisa Hamilton Steve Naylor	Call interview	F2F with exec Call – supportive
Seqwater	Michael Bartkow	Call interview	Provided substantial Seqwater information for review Provided funding for Phase 2 Very supportive
SE Water	Li Gao	Call interview	Call – supportive, provided project plan for internal discussion
WIOA	Kathy Northcott	Call interview	Left WIOA
UniSA	Emily Hilder	Call interview	
UNSW	Stuart Khan	Call interview	
Lower Murray Water	Phil Endley	F2F	
Western Water	Rod Curtis	F2F – not sure	
Coliban Water	Raj Mahendrarajah	Call interview	Call – supportive
Grampians Wimmera Mallee	Nigel Binney	F2F – supportive	

8 Appendix II – Detailed Comparison Of Methods

Elements [based on interviews with water industry personnel and researchers]	**WRF Innovation Framework**	**MWRPP – Inxure**	**UKWIR and UK Research Excellence Framework**	**ARC centre of Excellence for Environmental Decisions (CEED)** Wrap-up Survey	**Water Corp and Seqwater**	**ARC Engagement and Impact**	**Other** CSIRO
Why was the technique developed and what is background?	WRF project with WSAA as partner, Oz utilities contributed. Survey, workshops	To evaluate partnership b/w MW and university – comparison against a consistent framework.	UK national requirement to assess higher education research impact. Each Higher Education institution (HEI) required to submit evidence of research achievement.	CEED funding is ending and need to analysis benefit of research.	SEQ – business as usual (BAU).	In 2017 the Australian Research Council (ARC) conducted a pilot of the Engagement and Impact Assessment (the EI pilot). The objective of the EI pilot was to test methodology - examine how universities are translating their research into economic, social and other benefits and to encourage more collaboration between universities and research end-users.	
How does it measure project benefit?	Tangible and intangible improvement aligned with utility performance – no specific techniques.	Value Chain [process] Impact Domains – 6 areas – objectives and descriptors Scored 1-5	Each project impact is described in a formatted case study template, which is graded (and used to formulate funding). UKWIR – predefined Benefits Assessment table with guidance, range of potential $ benefits to select.	Post-project survey – some standardised questions, some open comments.	SEQ – qualitative assessment of whether the business can use the outcomes of the research.	Engagement indicators and narrative and Impact – scored high, mid, low Impact - evidence of well-established mechanisms for helping research within the UoA translate into significant social, economic or environmental benefits.	Economic methods, mostly applied towards the end of a project.

Appendix II – Detailed Comparison Of Methods continued

Elements [based on interviews with water industry personnel and researchers]	**WRF Innovation Framework**	**MWRPP – Inxure**	**UKWIR and UK Research Excellence Framework**	**ARC centre of Excellence for Environmental Decisions (CEED)** Wrap-up Survey	**Water Corp and Seqwater**	**ARC Engagement and Impact**	**Other** CSIRO
How reliable is technique – level of effort required which may diminish results?	About developing an organisational framework for innovation – disciplines of innovative utilities.	Simple to use.	High level of effort to complete, sources that corroborate the impact are required.	Quality is variable – some researchers have provided in depth review while some have provided simple response. The survey was sent in last months of the CEED well after some projects were finished.	SEQ – close out is part of BAU so assessment is always considered.	Currently being trialled with expert panel.	Require significant effort to perform.
What does it take to use this technique – training, organisational?	Considerable – whole of organisation.	Fixed process with the value change, can be applied to project and/or program level. Limited training and tools required.	HEI co-ordinate this with researchers.	No training – simple to answer the survey, clear guidance provided on how to assess criteria.	SEQ – knowledge of business process and relationship with business owner of the research to do the assessment.		Considerable training required in economic methods.
What are the pros of this technique?	Whole of organisation – not just about technology.	Simple to use, able to compare different impacts in consistent manner without needing to bring to $ value. Could provide easy template for a project.	Being a case study the impact can described in any manner. Redefined evidence streams with guidance. Researchers need to have a clear understanding of how their research has been applied (e.g. adopted into policy etc). Impact evidence needs to be built into the project at the start.	Consistent comparison between projects. Does have good questions to select on what factors contributed towards this research having impact, and understands the long term aspect in seeing impact.	SEQ – built into BAU, must be done and must involve business owner, identifies whether research objectives are met which is linked to the business case to approve the project in the first instance.	Simple assessment considering only 2 elements engagement and impact – there is guidance to break it out.	Guidance for assessment using different techniques.

Appendix II – Detailed Comparison Of Methods continued

Elements [based on interviews with water industry personnel and researchers]	**WRF Innovation Framework**	**MWRPP – Inxure**	**UKWIR and UK Research Excellence Framework**	**ARC centre of Excellence for Environmental Decisions (CEED)** Wrap-up Survey	**Water Corp and Seqwater**	**ARC Engagement and Impact**	**Other** CSIRO
What are the cons of this technique?	Whole program, not separate project. High level, about getting utilities to change culture for innovation. Survey of water utilities – could it be expanded to other industry?	No $ value, if that was needed. Need to amend research management process to follow value chain. Impact domain score doesn't provide weighting or size of project. Subjective scoring.	Significant effort to complete the case study, and it is linked to funding so pressure to make it sound better than it possibly is. How does it assess research that doesn't provide impact (fails) but contributes learnings? Difficult to compare as qualitative assessment – only at the graded level can it be compared. Difference between outcomes and impact.	Retrospective review of projects, impact evidence has not been built into the project. Very focussed on academic outcomes, 'real-world' impact is very loose.	SEQ – retrospective analysis, no $$ assigned to intangibles.	Retrospective, not sure how it is built into a continuous process. HEI focussed indicators – Engagement cash-support, commercialisation, patents and co-authorship only chance for industry participation. Impact assessment is against one statement looking at social, economic and environmental benefits – no further .	Complicated and retrospective.

9

Appendix III – Detailed Assessment of WaterRA Projects

9.1 Assessment 1 - Thematic Review of *Cryptosporidium* Research

The reports provided by SA Water on the benefits of the *Cryptosporidium* research provided excellent background information to undertake the task. The project list is detailed in Appendix IV.

9.1.1 Investment and Benefit Summary

WaterRA has invested $0.55M in *Cryptosporidium* research over the past 10 years, for a total value of $3.9M over 11 projects. The projects vary between ARC Linkage, Smart Water Fund, or Water Research Foundation collaborations, as well as WaterRA-led projects. For the purposes of establishing the benefit of this research, the review focuses on the benefit derived by SA Water and AWQC because of the availability of internal reviews conducted by SA Water. AWQC has led $2.4M of the *Cryptosporidium* research WaterRA has invested in.

Benefit summary:

Ongoing Direct Benefits to SA Water:

- Development of tools to measure *Cryptosporidium* risk which are applied when it is detected that *Cryptosporidium* have passed through the treatment process. The outcomes of the investment in *Cryptosporidium* related projects have on several occasion avoided the issuing of a Boil Water Notice (BWN). The estimated cost of issuing a BWN for metropolitan Adelaide is $80M per notice.
- OPEX savings through reduced pumping costs, as *Cryptosporidium* risk is better understood in local catchments and water sources, which has had the unexpected benefit of increasing environmental flows in the River Murray.
- CAPEX savings through the avoided cost of additional UV treatment in circumstances where the *Cryptosporidium* risk was able to be downgraded – approximately $100M.

Benefits Beyond SA Water:

- Tools to measure *Cryptosporidium* risk were applied to an interstate utility to understand the *Cryptosporidium* risk after a high rain event. Five smaller towns were issued with a Boil Water Notice; however, a major capital city avoided the issuing of a Boil Water Notice based on the application of the outcomes of the research portfolio, when combined with a site-specific risk assessment.

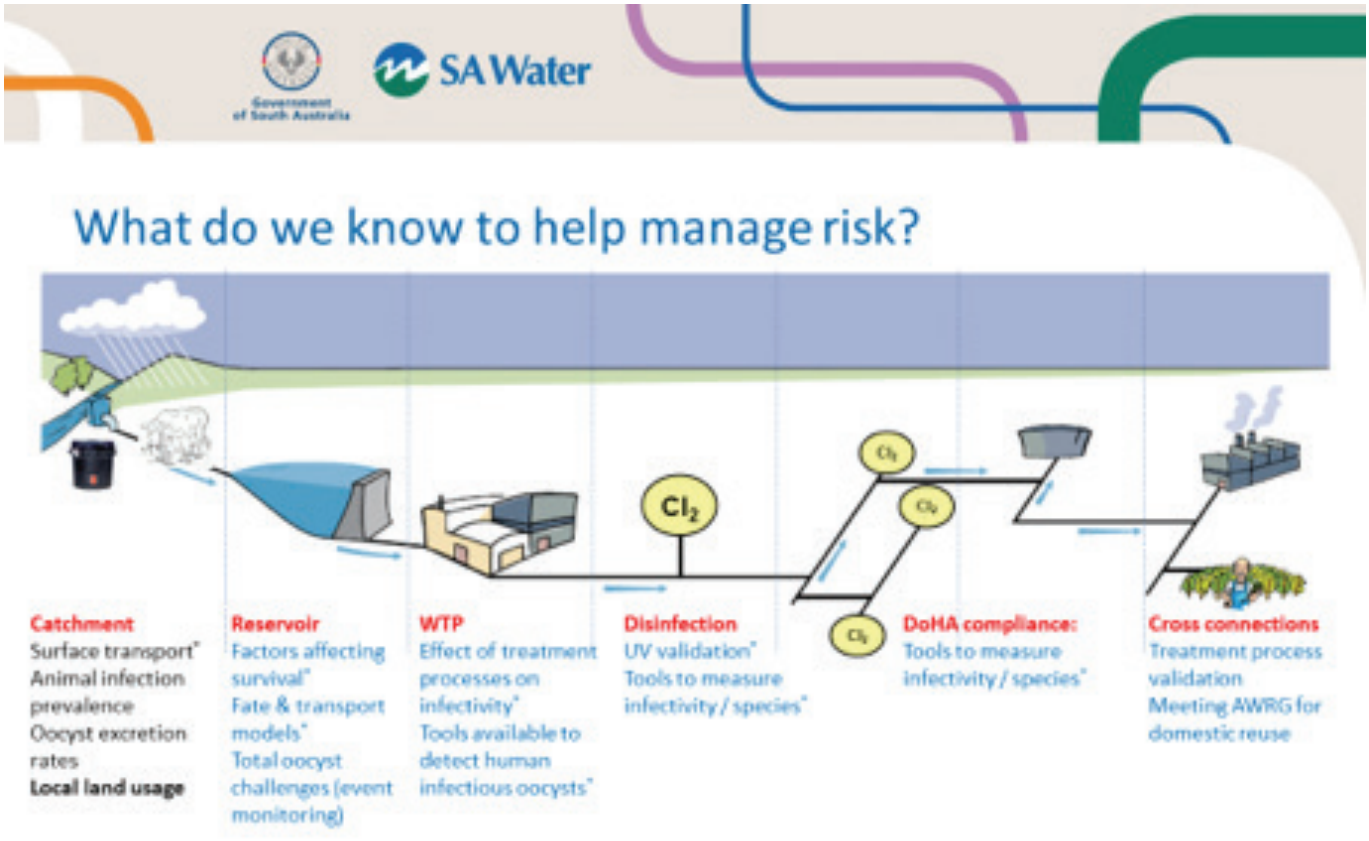
9.1.2 Method – SA Water Impact Study

SA Water had previously undertaken a thematic review of its *Cryptosporidium* research. It is a methodology developed by SA Water (G. Newcombe) and used within the WaterRA report 'Impact of Cyanobacteria Research'. The third column of the methodology – 'Contributed to $' – was included in this review to highlight tangible or intangible benefits.

This technique is useful for thematic reviews, but less valuable at a project level. It is designed to identify an increase in knowledge e.g. 'Knowledge Foundation' and benefits to business e.g. 'Managing Risk' and 'Optimising Operations'. These are both broad categories that a benefit can be attributed to.

Research Outcomes	Implementation	Contributed to $
Knowledge Foundation		
Improved methods for *Cryptosporidium* recovery	NATA accreditation for *Cryptosporidium* testing	Tangible (T) – Revenue from laboratory testing
Molecular methods developed for pathogen identification	NATA methods for *Cryptosporidium* FISH identification and rapid identification of *Naegleria* species, PCR-based methods for the identification of a variety of pathogens in-cluding *Cryptosporidium*, *Legionel-la*, *Vibrio cholerae*	T – Revenue from laboratory testing
New methods for validating treatment technologies, demonstrated effectiveness of UV against *Cryptosporidium* ***CRCWQT**	*Cryptosporidium* infectivity assay established at AWQC, collimated beam testing methodology established at AWQC, applied to validate treatment performance of SA Water systems (UV for drinking water, wastewater treatment)	T – Revenue from laboratory testing
Demonstrated sensitivity of *Cryptosporidium* to solar UV and temperature ***CRCWQT**	Knowledge published and used for modelling *Cryptosporidium* survival in the environment (fate and transport)	Intangible (I) – TOTEX decision making
New knowledge generated regarding *Cryptosporidium* infection process, conversion of slide-based assay to plates for high throughput ***CRC/AWWRF**	Provided the basis to develop an improved infectivity assay (single format assay providing total + infectious oocyst count, typing of infectious *Cryptosporidium*)	T – Revenue from laboratory testing
Treatment requirements determined for meeting health-based performance targets ***WRA**	Provided new input targets for the development of risk assessments and identifying treatment optimisation targets	I – TOTEX decision making
Managing Risk		
Models for hydrodynamic fate and transport of pathogens ***CRC**	Provided the basis for the timing of SA Water's rain event monitoring programs	T – Optimised monitoring
Short circuiting in reservoirs demonstrated for *Cryptosporidium* ***CRC**	Identified barrier unreliability, major driver for *Cryptosporidium* risk assessment project and capital works programs to upgrade / repair filters for Adelaide's water treat-ment plants	T – CAPEX decision making
New methods for *Cryptosporidium* infectivity and typing (single format assay) ***SW with WRA**	Applying method in event-based monitoring projects linked to capital projects to re-evaluate risk / need for capital. Data for infectivity has already been used as a basis for draft guidelines defining infection risk from *Cryptosporidium* in rivers / reservoirs	I – Avoided Boil Water ($80M/event SA)

Optimising Operations		
Demonstration that conventional treatment does not reduce *Cryptosporidium* infectivity ***CRC**	Communicated to stakeholders	I – Reputation; Treatment decision making
Showed that ASP treatment does not reduce infectivity, demonstrated inactivation in lagoon systems ***SW with WRA**	Results confirm treatment removal performance, highlight areas of the treatment train with the potential to provide additional benefit for *Cryptosporidium* inactivation	I – OPEX decision making
MS2 Phage assay implementation via research and consultancy projects	Assay used to validate GAP membrane performance, used in filter media trials as part of Bolivar DAFF upgrade, used to validate performance of SA Water UV system	I – OPEX decision making
Determination of virus Cts for chlorination in wastewater	Allowed reduction in chlorine use to achieve treatment targets, reduced cost of treatment	T – OPEX reduction



Blue text = SAW R&I supported
* = CRCWQT / WQRA supported

The SA Water model included the graphical representation above. As a review of the themes of research it allows the clear benefit to different parts of the business to be shown.

9.1.3 Method - Inxure Impact Domains

The Impact Domains apply to all aspects of the business. A comment from one participant in the review was whether the Impact Domains could be adjusted to suit their business, and, while that is possible, the gain is having a standard approach. This suggests a stakeholder discussion is needed to obtain acceptance of these domains for the wider industry.

Relative ranking provides a simple measure of impact and can be applied easily at a theme or project level. The approach does not allow the financial benefit to be described if it is available. As SA Water can show cost benefits of this work it would be worthwhile considering how financial benefits could be incorporated. The Impact Domains allows project outcomes to show that they have delivered benefits to many parts of a business.

Objective	Assessment Summary – Thematic Review of *Cryptosporidium* Research	Score
Academic and Knowledge Impact		
New and enhanced knowledge	**Surface transport*** – developed	5
	Fate & transport models* – short circuiting	
	Factors affecting survival* – temperature and UV, previously unknown	
	Effect of treatment processes on infectivity* – UV inactivation; inactivation from WWTP processes i.e. ASP, effect of coagulants, age of oocysts and susceptibility to chlorine	
	Tools available to detect human infectious oocysts* – DNA based assay	
	Tools to measure infectivity / species* – oocyst lifecycle and speciation techniques developed over a series of projects – oocyst infection, survival in environment and treatment plants, allowed for the refining of an assay leading to infectivity assay with total counts, infectious oocysts and species level identification	
High-quality publications and reports	42 journal papers in peer reviewed journals	
Policy and Regulation		
Evidence-based policy development		N/A
Evidence-based regulation	**Tools available to detect human infectious oocysts***- shows compliance to Department of Health (DoH) / Australian Drinking Water Guidelines (ADWG) requirements; basis for draft guidelines defining infection risk from *Cryptosporidium* in rivers and reservoirs	3
	Tools to measure infectivity / species* - shows compliance to DoH / ADWG requirements; basis for draft guidelines defining infection risk from *Cryptosporidium* in rivers and reservoirs	

Objective	Assessment Summary – Thematic Review of *Cryptosporidium* Research	Score
Integrated Planning		
Evidence-based strategy development		N/A
More prudent investment	**Surface transport*** – informed rain event monitoring regime	5
	Fate & transport models* – justification of CAPEX upgrade and repair to filters of WTP	
	Factors affecting survival* – informs risk modelling	
	Effect of treatment processes on infectivity* – Results confirm treatment removal performance, highlight areas of the treatment train with the potential to provide additional benefit for *Cryptosporidium* inactivation	
	Tools available to detect human infectious oocysts* – informs risk modelling	
	Tools to measure infectivity / species* – applied to CAPEX decisions to re-evaluate risk	
Service Delivery		
Efficient service delivery	**Tools to measure infectivity / species*** – no capital expenditure for treatment as less risk, validate treatment performance of UV/membrane/media through trials which ensured water was not over treated driving costs and undertreating the impact public health	4
Capability		
Capability building within organisation, partners orgs and key stakeholders	**Tools available to detect human infectious oocysts* & Tools to measure infectivity / species*** – research capacity and expertise developed within SA Water allowed the adoption and refinement of published assays that allow for the detection and identification of *Cryptosporidium* in source water	4
	Expertise allowed development of a guidance document for the management of pathogens in sources water, which was made available to the water industry	
Access to external and international expertise	Development of research alliances nationally and internationally	3
Reputation		
Enhanced reputation across the authorising environment	**Effect of treatment processes on infectivity*** – communication with stakeholders	5
	Tools available to detect human infectious oocysts* – have been the basis of decisions with DoH to not issue a Boil Water notice	
	Tools to measure infectivity / species* – have been the basis of decisions with DoH to not issue a Boil Water notice	
Scale of Impact	**Description of rating for outcomes in Impact Domain**	**Score**
Not Applicable	**The aims and focus of the project mean that it is unlikely to, or not expected to, achieve the outcomes in this domain**	**N/A**
Low	**Relatively low achievement of outcomes**	**1**
Medium	**Meets outcomes expected for project focus and resources**	**2**
High	**Exceed expectation for outcomes**	**3**
Very High	**Very high delivery of outcomes relative to expectation**	**4**
Outstanding	**Significantly beyond expectation**	**5**

9.1.4 Method - UKWIR Benefits Spreadsheet

The standardised benefits allow simple sorting for programs of work within the 'Type of benefits' column. However, only one benefit can be recognised. The value cost benefit range hides the real value of the benefit, and cannot be different between multiple benefits. It is only possible for project review, and difficult to apply to a thematic/program review if there are identified benefits to many parts of a business. It is recommended that this approach not be considered within Phase 2.

#	Project Description	Lead Organisation	WaterRA Cash	Budget Other	In-kind	Total	SA Water $	Level of Use of Outputs	Type of Benefits	Estimated Value of Benefits
1035/10	Rapid molecular methods for microorganism detection & identification	AWQC	$335,686	$0	$293,602	$629.288	0.336	Fully applied within our planning or working practices	Cost avoidance	$10,000 to $100,000
1079/13	Protozoan mimics: *Cryptosporidium* surrogates for validation of GMF	AWQC	$69,238	$105,000	$351,559	$525,797	0.095	Not used	Cost avoidance	$0 to $10,000
1095/16	*Cryptosporidium* factsheet	AWQC	$2,000	$0	$0	$2,000	0.002	Used fairly regularly for info or guidance	Collaboration and influence	$0 to $10,000
2015/09	Inactivation of *Cryptosporidium* across the wastewater treatment train	AWQC	$42,000	$80,000	$68,794	$190,784	0.113	Fully applied within our planning or working practices	Cost savings	$100,000 to $1 million
2017/09	PT2 Quantification of pathogen removal in activated sludge treatment	AWQC	$20,000	$216,097	$44,942	$281,039	0.832	Fully applied within our planning or working practices	Cost savings	$100,000 to $1 million
3013/11	Inactivation of *Cryptosporidium* Project – Phase II	AWQC	$22,905	$237,567	$500,342	$760,814	0.226	Fully applied within our planning or working practices	Cost savings	$100,000 to $1 million
4102-13	Rapid tools for *Cryptosporidium* infectivity assessment and species ID	AWQC	$0	$10,000	$0	$10,000	0.01	Fully applied within our planning or working practices	Cost avoidance	$10,000 to $100,000

9.2 Assessment 2 – #1076 Customer Perceptions of Water Quality

9.2.1 Investment and Benefits Summary

WaterRA invested $100k into the project 'Assessing, Understanding and Influencing Customers Perceptions in Water Quality'. The project was led by SA Water, involved researchers from the University of Queensland (UQ) and Griffith University, and three other utilities provided cash and in-kind support.

The total value of the project was $667k.

Background:

This project responded to the WaterRA call for industry-derived research that recognises the need to understand and engage with customers in a positive manner, and not just be focussed on the measure of regulatory compliance as a determinant of satisfaction. The project developed a tool box of techniques and considered their ability to assess, understand or influence customer perceptions of water quality. The primary tool was the Take the Tap Test (TTT) blind tap water taste testing and survey which forms the basis of this review.

Benefit summary:

Ongoing Direct Benefits to SA Water:

- Results provided an evidence-based input to water supply CAPEX decisions and aesthetic guidelines by providing better knowledge on the aesthetics of drinking water systems and confidence around proposed decisions involving treatment changes.
- The technique is regularly used within SA Water's community engagement program and can be tailored for corporate messaging, or training, as required.
- It is a positive means to engage with community on water preferences (tap/filtered/rain/bottled), quality, safety, treatment challenges and many other areas of importance to the community.
- Cultural and knowledge benefits for staff.

Benefits to WaterRA members:

- Proven technique to use with customers as part of community engagement programs on water quality.
- Technique may be linked with water quality testing to provide satisfaction versus water quality parameter data at a statistically significant level.

9.2.2 Method – Inxure Impact Domains

The technique being tailored to the water industry was useful for this project, given its nature in engaging with customers. Importantly, it has benefits in most categories, some unexpectedly. For example, SA Water now have the data on aesthetic acceptance, which differs from the ADWG guideline values. This may assist in justifying treatment decisions in future pricing submissions. The project required many parts of the organisation to engage with customers, increasing their capability and this was not initially considered within the project as a potential benefit.

Objective	Assessment Summary
Academic and Knowledge Impact	
New and enhanced knowledge	Customer satisfaction data linked to water quality parameters, which provides statistically significant insight into customer preferences.
High-quality publications & reports	In preparation.
Policy and Regulation	
Evidence based regulation	Satisfaction data showing evidence on aesthetic guidelines.
Integrated Planning	
Prudent investment	Used customer satisfaction data within CAPEX decision making for water supplies in regional areas.
Service Delivery	
Efficient service delivery	Interaction with customers is more authentic and meaningful. Encourages open and honest conversations with customers regarding misconceptions, queries, new concepts and treatment options. TTT is cost effective and easy to tailor within the business.
Capability	
Capability building within organisation, partners organisations and key stakeholders	Personnel from across SA Water attend community engagement events using the TTT tool. This is an opportunity for them to engage with customers and understand their concerns and preferences. It enhances line of sight to customers.
Reputation	
Enhanced reputation across the authorising environment	SA Water has been featured on TV, radio, newspaper, as well as in local field days state wide. TTT provides the opportunity to have a fun and interactive presence to discuss water quality with customers.

9.2.3 Method – CSIRO

The CSIRO method follows this template, and is normally produced as a report, but for the purposes of this review, it has been transferred into a table for simplification. The approach is logical, and includes good points to consider in any review. There was not the data to do a cost-benefit analysis, as per their guidelines which are presented in this report's Appendix.

CSIRO Report Requirement	CSIRO Description	Applied to Project #1076
Executive summary	[Taken from report]	
Purpose and audience	Impact Evaluations can be for Accountability, Allocation, Analysis or Advocacy. Each has a different Purpose and Audience. Advocacy was applied to this review - *To demonstrate benefits and 'make the case' for a specific research area under the program of work, including CSIRO's social licence to operate in particular fields.*	To demonstrate the benefit of this project, stakeholders from the customer relation team and senior executive are identified as the targeted audience. The planning managers have an interest in the outcome because of the customer satisfaction data.
Background	[Taken from report]	
Research impacts and pathways	Economic, Social or Environmental Impacts are identified, and they provide a pathway back to CSIRO's work.	Direct pathway between research and incorporation of findings within utility (Note this is similar to the Impact Domains concept used by Inxure).
Clarification of the impacts – counterfactual / attribution / adoption	Consider Counterfactual: • What would have happened without CSIRO's work? • Are there any substitutes that could have led to similar outcomes/impacts? • Have external factors influenced changes in the outcomes/impacts of interest? • Were any collaborating organisations critical to achieving the outcomes/impacts? If yes, determine their proportional effort, establish a defensible share of impacts attributable to CSIRO and then use that share to calculate 'net' impacts in Step 4. For each program of work under consideration, determine: • Whether outputs are being used externally to CSIRO and to what extent; and, • The likely uptake profile for the outputs of the program; and the influence that previous work undertaken by CSIRO may have had on that uptake profile.	Counterfactual – blind testing of customers could still occur or the use of a taste panel, to know preferences, different engagement strategy was trialled at one major engagement event without the same success as the Take the Tap Test (TTT); hence, it was re-instated, change in executive have considered other uses for the TTT. The researchers being in a major utility had simple access to customer service teams to implement the TTT; this would have been much harder if the researchers were external. Research team can be attributed with all effort on this project. Uptake has not extended beyond research team, but efforts are being made to share findings and TTT.

CSIRO Report Requirement	CSIRO Description	Applied to Project #1076
Evaluation of the impacts – benefits / costs / externalities, flow ons / distributional effects	TASK 4.1: Evaluation approaches Are the benefits quantifiable? If yes, which measures are appropriate and which measures have been monitored? Quantify those benefits that you can. If no, use qualitative explanations as core methodology. Can the benefits be translated into monetary values? If yes – and through an observable market price, or changes in a market price – then identify monetised values using observable market prices. If yes, but benefits are not captured by an observable market price, then use methods for non-market valuation to identify monetary values. If no, report using other metrics and/or qualitative techniques.	TASK 4.1 Benefits identified • Results provided an evidence-based input to water supply CAPEX decisions and aesthetic guidelines by providing better knowledge aesthetics of drinking water systems and confidence around proposed decisions involving treatment changes. • Technique is regularly used within community engagement program and tailored for corporate messaging or training as required. • Positive means to engage with community on water preferences (tap/filtered/rain/bottled), quality, safety, treatment challenges and many other areas of importance to the community. • Cultural and knowledge benefits for staff. No attempt has been made to quantify the benefits. Those listed provide good examples of intangible parameters for consideration within Phase 2. If they could show a reduction in bottle water use through this engagement there could be a cost benefit.
	TASK 4.2: Estimating costs Are there input costs incurred by CSIRO and its research partners? If yes, include cost associated with: staff FTE, non-staff FTE, in-kind contributions, equipment/facilities, background IP, etc. Are there any usage and adoption costs borne by clients, external stakeholders, intermediaries and end users? If yes, include the costs of any trials, further development, market tests or factory retooling required, as well as any marketing costs, training costs, extension costs, etc.	TASK 4.2 Cost to run 8 pilot events in one year - $23k + 1000 hours FTE. Included within cost of project $680k.
	TASK 4.3: Externalities and economic flow-on effects on non users Are externalities relevant to this evaluation? If yes, monetise externalities. Are there flow-on effects of interest? If yes, analyse them using a whole-of-economy model.	TASK 4.3 Unsure – would be good to consider this question in Phase 2 to know what it means and how it could be considered.

CSIRO Report Requirement	CSIRO Description	Applied to Project #1076
	TASK 4.4: Distributional effects on users Does the impact differ across groups of final users, industries or regions? If yes, assess impacts across winning and losing groups.	TASK 4.4 Could potentially impact bottled water manufacturers
	TASK 4.5: Discounting Use a 7% real discount rate to convert all costs and benefits to 'present value'. Calculate the present value of the differences between the streams of costs and benefits (NPV). Conduct a sensitivity analysis by re-calculating the NPV with a range of plausible alternative rates (e.g. 3%, 5% and 10%).	TASK 4.5 Consider in Phase 2 what an appropriate Discounting rate is or leave it to be utility specific
	TASK 4.6: Documenting assumptions and decisions Ensure that all assumptions and key decisions made throughout the evaluation process are documented in the final evaluation report.	TASK 4.6 Include in Phase 2, provide greater transparency to all evaluations
Aggregation of research impacts	Where possible, present a benefit-cost ratio indicator derived from the cost-benefit analysis. Where it is not possible to adhere to a rigorous cost-benefit analysis, clearly present the full range of relevant and measurable – monetary and non-monetary – costs and benefits of the work program	Costs and Benefits described above. No attempt made to do a monetary cost-benefit analysis, guidance in the CSIRO Appendix was confusing Project would be a good example to include to determine if intangible benefits can be monetarised.
Sensitivity analysis	What were the key assumptions underlying the cost-benefit analysis? How do the outcomes of the analysis vary with variations to these key assumptions?	Not completed as cost-benefit not done.

9.3 Assessment 3 - #3023 Chemical Hazard Assessment of Stormwater Micropollutants CHASM

9.3.1 Investment and Benefits Summary

WaterRA invested $180k into the project 'Human health risks of chemicals in stormwater' which developed the CHASM tool. The project was led by Griffith University with researchers from AWQC, CSIRO, UQ and UNSW, and one other utility provided cash and in-kind support.

Total value of the project was $680k.

Benefit summary:

Ongoing Direct Benefits to Seqwater:

- Applied during feasibility stage of stormwater scheme development providing greater certainty of potential hazards and allowing more targeted monitoring.
- Access to this tool reduced the amount of time and money spent on an in-depth literature review that would have been required to gain a thorough understanding of chemical risks associated with the full range of land use that could occur in the stormwater catchment.

Benefits to WaterRA Members:

- CHASM tool identifies potential hazards in storm water depending on the land use and output allows optimisation of monitoring regime.

9.3.2 Method – Inxure Impact Domains

Projects shows benefits in several categories. It doesn't reflect the tangible benefits derived by Seqwater that could have been measured with adequate data.

Objective	Assessment Summary
Academic and Knowledge Impact	
New and enhanced knowledge	Combined water quality data in several catchments and assessed against land use activities to determine what micropollutants may be present
High-quality publications & reports	Water journal 'AURA STORMWATER HARVESTING PROJECT – AN INNOVATIVE RISK BASED APPROACH TO IDENTIFYING POTENTIAL WATER QUALITY ISSUES'
Integrated Planning	
Evidence-based strategy development	Applied within development of stormwater harvesting scheme feasibility study
Service Delivery	
Efficient service delivery	Reduced time and effort in assessment of hazards Reduced the monitoring requirements within the scheme Expected to be used for future schemes that are currently in the pipeline
Reputation	
Enhanced reputation across the authorising environment	The application of the tool has been used as an example of how innovative approaches to risk assessment can be utilised to enhance traditional approaches. The use of the tool as part of an overall approach to risk assessment for stormwater harvesting schemes will be published in the water journal.

9.3.3 Method – Tangible Assessment

A tangible assessment could be performed with data from Seqwater based on:

1. The targeted monitoring implemented instead of the wider contaminant monitoring normally needed;
2. The reduced time negotiating with the developer on the list of potential hazards;
3. Application within future schemes; and,
4. Considering other utilities using this tool and their benefits.

9.4 Assessment 4 - #4525 'Assessing the Impact of Wastewater-Derived Poly- and Perfluoroalkyl Substances (PFAS) on Australian Aquatic Ecosystems'

9.4.1 Investment and Benefits Summary

Through its Education Program and sponsor Melbourne Water(MW), WaterRA invested $36k to provide a scholarship for a PhD student to undertake a foundation project gathering novel data on the occurrence and fate of PFAS within Australian municipal WWTPs, and assessing the discharge of PFAS from Australian WWTPs to the environment. The information generated by this project will assist WWTP managers to interpret results of PFAS testing and provide guidance on managing the risks associated with wastewater-derived PFAS emissions to the environment.

Benefit summary:

Ongoing Direct Benefits:

- Generation of data on PFAS occurrence and trends within Melbourne Water's operating WWTPs.
- Enhancement of analytical capabilities for PFAS research at RMIT University for future collaborative projects between RMIT and Melbourne Water (there are now three PFAS related Water RA supported projects in collaboration with MW and RMIT).
- Building world-class expertise on PFAS within Melbourne Water and RMIT University (student and stakeholders have presented at numerous national and international conferences on PFAS).
- Capacity building which allows MW to improve management of PFAS contamination.

Wider benefits:

- Data generated from this project is published in peer-reviewed journals, where it will become available to the industry and regulators as part of a national PFAS inventory.
- This project has positioned Melbourne Water, the student and stakeholders as experts on PFAS, which has become an issue of national importance over the course of the project.

9.4.2 Method – Inxure Impact Domains

Project has benefits across many categories. Given the level of investment by Melbourne Water ($37k) it would be useful to see a leverage or cost benefit ratio as this project has delivered significant outcomes for both Melbourne Water, RMIT and the wider water industry.

Objective	Assessment Summary	
Academic and Knowledge Impact		
New and enhanced knowledge	This project has generated data on PFAS that have not yet been measured in Australia. The data generated has allowed comparison of PFAS removal in Australian WWTPs that employ a range of treatment technologies. Novel analytical techniques have been developed and applied to Australian WWTPs and Aquatic environments.	4
High-quality publications and reports	Produced/planned publications from direct or indirect project work: • Literature review on PFAS in WWTPs (report) • Literature review on PFAS ecotoxicity (report) • PFAS in 19 Australian WWTPs (report & paper in review) • PFAS bioaccumulation in fish (report & paper in prep) • PFAS in Australian WWTPs (report and paper in prep) • PFAS analytical method validation (reports) • Analytical method to determine 53 PFAS in aqueous matrices (manuscript in submission) • levels of 53 emerging and legacy PFAS in Australian WWTPs (manuscript in prep) • Two further planned publications using WWTP data • WWTP-derived PFAS in Port Phillip Bay (paper in prep) • Non-target analysis of anionic PFAS in WWTPs (data collected and being processed)	4
Policy and Regulation		
Evidence-based policy development	As one of the few, and most comprehensive, data sets on PFAS in Australian wastewater, wastewater effluent, recycled water and biosolids, this project will make an important contribution to the development of Australia policy governing PFAS pollution of domestic and industrial wastewaters. Given the national significance of this issue, this will be a remarkable achievement for a PhD student.	5
Capability		
Capability building within organisation, partners orgs and key stakeholders	This project has built PFAS expertise within Melbourne Water and all project stakeholders. Project members have presented PFAS work to industry and academia in various forums. The PFAS analytical capabilities at RMIT University are now world-class and being used for further collaborative projects between Melbourne Water and RMIT University.	4
Access to external and international expertise	The project has fostered association with many national and international PFAS experts through interactions at conferences, workshops and meetings.	3
Reputation		
Enhanced reputation across the authorising environment	As an indication of likely reputational impact, Tim was awarded the best oral presentation at the "What's In Our Water" conference, held recently in Canberra. This important conference is attended by senior people from State and Federal Health and Environment agencies.	4

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Appendix IV – List of *Cryptosporidium* Research

#	Project Description	Lead Organisation	WaterRA Cash	Budget Other	In-kind	Total
1035/10	Rapid molecular methods for microorganism detection & identification	AWQC	$335,686	$0	$293,602	$629,288
1079/13	Protozoan mimics: *Cryptosporidium* surrogates for validation of GMF	AWQC	$69,238	$105,000	$351,559	$525,797
1095/16	*Cryptosporidium* factsheet	AWQC	$2,000	$0	$0	$2,000
2015/09	Inactivation of *Cryptosporidium* across the wastewater treatment train	AWQC	$42,000	$80,000	$68,784	$190,784
2017/09	PT2 Quantification of pathogen removal in activated sludge treatment	AWQC	$20,000	$216,097	$44,942	$281,039
3013/11	Inactivation of *Cryptosporidium* Project - Phase II	AWQC	$22,905	$237,567	$500,342	$760,814
4102-13	Rapid tools for *Cryptosporidium* infectivity assessment and species ID	AWQC	$0	$10,000	$0	$10,000
1037/10	Literature Review: Crypto/Giardia in catchments	Murdoch University	$19,200	$0	$0	$19,200
1068/12	Risk management of *Cryptosporidium* and Giardia in animals in Australian catchment	Murdoch University	$20,000	$424,536	$403,050	$847,586
1036/10	Treatment requirements for Australian Source waters to meet health based targets.	University of NSW	$1,500	$220,500	$0	$222,000
1044/10	Cause of low recovery of *Cryptosporidium* oocysts and Giardia cysts	ALS Global	$18,000	$22,000	$61,090	$101,090
		Total	$548,529	$1,568,911	$1,808,760	$3,926,200

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