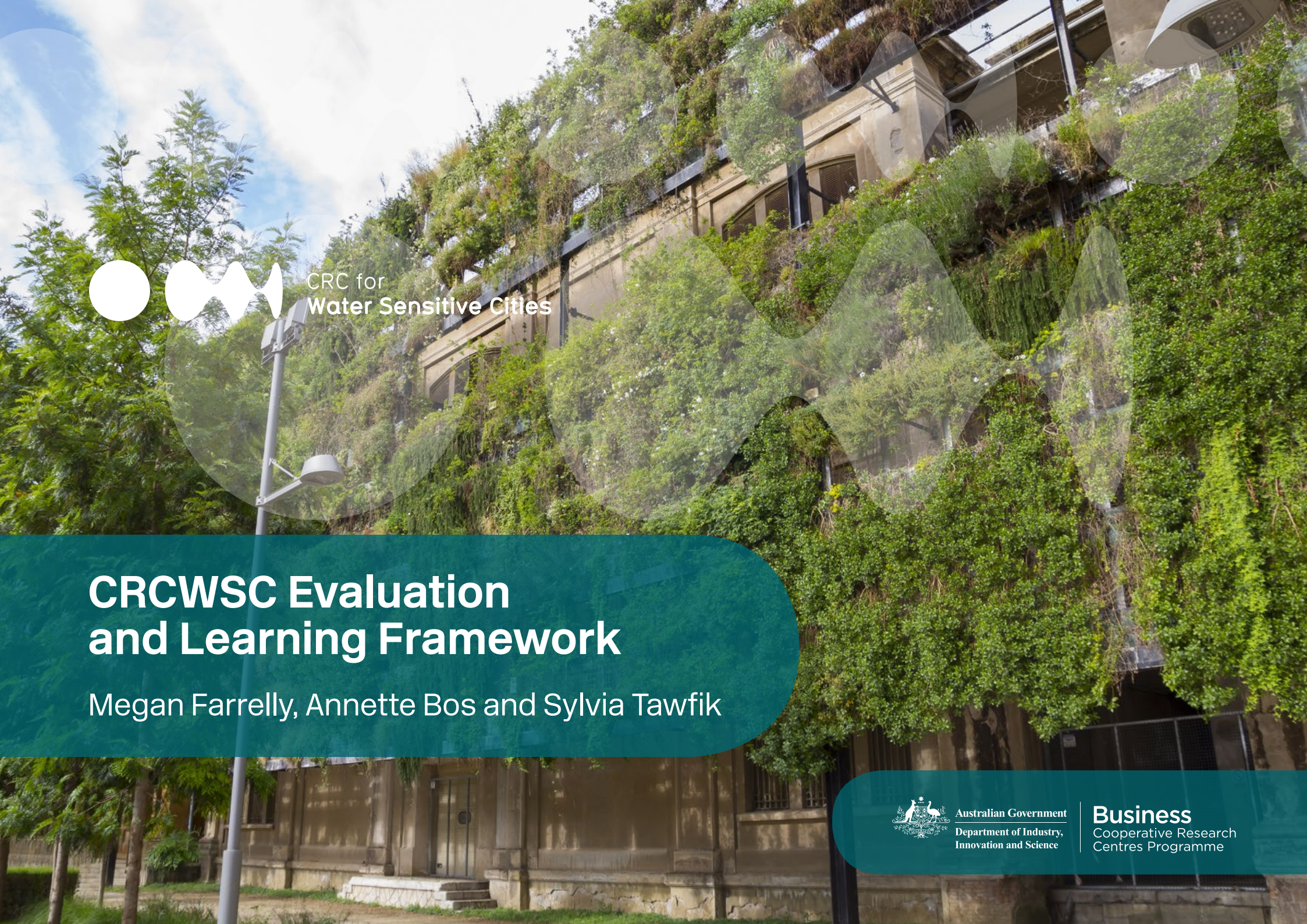

CRC for
Water Sensitive Cities

CRCWSC Evaluation and Learning Framework

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Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Programme

CRCWSC Evaluation and Learning Framework
Development of an evaluation and learning framework to inform CRCWSC impact assessment (Project D6.1)
D6.1 – 1 - 2016

This document should be read in conjunction with the CRCWSC Evaluation Implementation Plan and, where relevant, Appendix I.

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1 Introduction

The Australian government has made the creation of liveable, sustainable and productive cities a national priority and identified reform of urban water systems as a key goal. The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) was established to change the way we build our cities by valuing the contribution water makes to economic growth and development, our quality of life and to the ecosystems of which cities are a part.

As a Commonwealth Government funded and industry supported CRC, the CRCWSC will be required to demonstrate the short-, intermediate-, and long-term level of influence, utilisation and overall impact the investment in research and engagement activities is having on practice change. When called upon, the CRCWSC must be able to justify its activities and demonstrate its broader environmental, social and economic value to industry partners and the public. This requires ongoing data collection, analysis and reflection regarding how industry participants and end-users engage with, utilise and adopt research activities and outputs.

Creating change and generating impact is a complex process, involving a high degree of non-linearity for it involves interactions among and between many actors (individuals/ organisations) and consequently results in multiple research impact pathways that co-evolve over time as learning increases and greater utilisation, adoption and replication occurs (Springer-Heinze et al., 2003; Wiek et al., 2014). Assigning impact, and process and practice change within the urban water sector (and beyond) directly to CRCWSC activities requires a sophisticated understanding of how and where the CRCWSC has influenced practice change from the early stages of program operation.

Traditional impact assessments focus on valuation – estimating net economic benefits from the project or program – and are often aimed at providing evidence for investors that funds have been well spent. This report, however, sets out a learning-orientated evaluation framework for both formative (process-oriented) and summative (impact-oriented) assessments, while also collecting and collating data to support economic impact assessments.

The complexities of current urban water problems require close collaborations with non-academic stakeholders. Therefore, participatory forms of research are required to facilitate inter-disciplinary collaboration among researchers and practitioners from different sectors of society; generate relevant and context-specific knowledge; incorporate normative aspects into the process of research collaboration; encourage diversity; engage participants and end users in the research beyond information and consultation; and encourage mutual accountability, ownership and leadership among project participants (Wiek et al. 2014, p. 118).

Knowledge exchange processes and interactions provide an important indication of how such impact may occur (Spaapen & van Drooge 2011). The uptake of research in policy or practice can be enhanced through well-designed knowledge exchange mechanisms (Phillipson et al. 2012). Given the difficulties of identifying and attributing impact to specific research projects in the long-term (e.g. Molas-Gallart & Tang 2011), research evaluations that focus on the knowledge exchange process itself as they take place may be used to identify and shape longer-term pathways of potential impact (Spaapen & van Drooge 2011). As research utilisation primarily happens among and between combinations of actors involved in the research, it is important to identify the intermediary (individual; organisational and institutional) processes influencing these actor-networks in generating change. The importance of such insights was recently evidenced in the evaluation of the Cities as Water Supply Catchments research program (see Bos and Farrelly, 2015). Therefore, understanding how knowledge exchange occurs (i.e. activities/processes/interactions) within the research-industry collaboration, and how research outputs are utilised to

create change is critical. As Patton (2002, p.159) points out “a focus on process involves looking at how something happens rather than, or in addition to, examining outputs and outcomes”. By understanding the ‘how’, the CRCWSC can endeavour to replicate these processes to generate broader impacts.

This Evaluation and Learning Framework, along with the Evaluation Implementation Plan and associated data collection tools, will provide the CRCWSC with insight regarding the critical knowledge exchange mechanisms and pathways regarding how to best leverage and improve the uptake and replication of CRCWSC research outcomes. The framework draws upon utilisation-focused evaluation processes (see Patton, 2012), which embed monitoring and assessment protocols that go beyond traditional indicators of research output (i.e. number of academic publications) to also capture vital process-related information relevant to determining practice change (often referred to as formative evaluation). Overall, it is expected that by applying this framework the CRCWSC will be able to:

- provide quantitative and qualitative evidence to benchmark impact pathways;
- ensure there is efficiency in overall CRCWSC operations and governance;
- deliver substantial evidence to support direct attribution relating research activities to changes in policy/practice;
- identify early successes, emerging issues and pathways for ongoing improvement in achieving long-term impact;
- improve communications regarding pathways to and examples of impact success and areas for improvement with
    i. the Commonwealth of Australia (major performance reviews);
    ii. the CRCWSC Board (annual/quarterly reporting);
    iii. industry participants (helps maintain value proposition);
    iv. broader sectoral end-users (brand-recognition; encourages greater end-user uptake); and
- inform and support the design of future research and industry partners activities, and the next phase of the CRCWSC business model.

Applying this framework (see separate Evaluation Implementation Plan), complements other important CRCWSC tools –in particular the Economic Impact Assessment Tool. Data collected will provide evidence of how effective the CRCWSC has been in achieving set targets (output delivery and utilisation) and revealing unexpected pathways to impact which raises additional benefits.

This document should be read in conjunction with the CRCWSC Evaluation Implementation Plan and, where relevant, Appendix I.

1.1 Purpose of evaluation

Evaluation is regarded as a critical component of all good program management. Appropriately staged evaluations present an opportunity for embedding reflexivity and adaptation mechanisms into large-scale, complex, long-term research-industry collaborations. Considering the time-lag associated with achieving full-scale research adoption and impact, it is important to acknowledge and recognise the importance of ‘societal impact’ that has occurred as a result of dedicated CRCWSC activities. Indeed, societal impact has come to be regarded as: a product; related to knowledge use, and a formal societal benefit (de Jong et al. 2014; Bornmann, 2013). The complex nature of capturing social impacts renders traditional scholarly impact indicators (i.e. publication totals, citation rates etc.) insufficient for capturing the broader societal impacts and influence that may be achieved over the longer term (e.g. Lang et al., 2012). Indeed, accurately tracking such impacts presents a greater challenge given that they often occur with significant delay; causal relations between

project and impact are typically difficult to establish, particularly where there are many agents and processes interacting through multiple channels and feedback loops; and some important impacts may not be easily measurable (Lang et al., 2012; Penfield et al., 2014) – which raises questions regarding which external conditions and events, if any, may have also influenced the extent to which the impacts arise. For example, the work of the CRCWSC may be one of a number of inputs and/or interventions contributing to the realisation of impact. Additionally, the degree and strength of causality can change as time passes – whereby positive factors early, may become diluted or a limitation later on. Therefore, undertaking monitoring and evaluation throughout the life of the CRCWSC industry-research collaboration is important for generating robust evidence to support cases of attribution in relation to achieving long-term impacts.

This document presents a learning-oriented, formative and summative evaluation plan developed over the last ten months (Sept. 2014 to June 2015). The evaluation and learning framework presented in this document is designed so that when implemented, the CRCWSC will have empirical evidence regarding the value, quality, reach, and impact of the CRCWSCs program of work. This information will be used to: (i) open up an internal (and where appropriate external) discussion regarding elements of the CRCWSC activities which require strengthening, improvement or reconsideration for reaching its desired outcomes; (ii) provide relevant accountability and reporting measures; and (iii) inform economic impact assessments regarding the overall value achieved by the CRCWSC operations.

Given the long time horizon for achieving full-scale impacts, the CRCWSC is dedicated to undertaking formative evaluation, which is primarily an analysis of program implementation with a view to providing advice regarding whether improvements are required within the program's operational and 'on-ground' delivery, but also to collect and collate evidence regarding influence and 'intangible' impacts (i.e. network establishment, trust-building, knowledge exchange etc.) in an effort to build a solid foundation for attribution. Furthermore, as the CRCWSC is currently delivering on outputs and achieving early impacts, ongoing summative evaluation will be undertaken to examine whether the Program is on track towards achieving its intended objectives and outcomes.

1.2 Preparing this evaluation and learning framework

Following on from the important and productive evaluation of the Cities as Water Supply Catchments Program in 2014, the importance of understanding process as both an important program design element and an impact arising from CRCWSC activities, it was decided to prepare a dedicated learning-oriented monitoring and evaluation plan.

In preparing this evaluation and learning framework we have drawn from a range of important information sources, in particular the CRCWSC's Strategic Plan 2014-2017. Much of the work has been informed by a thorough review of key strategic and operational CRCWSC documents including, among others, the original bid, the Commonwealth CRC Program Funding Agreement ('Commonwealth Agreement'), the Research 2012-2016 publication, Annual reports, and Project-based quarterly reports etc.

Following Patton's (2012) utilisation-focused evaluation strategy, extensive engagement with both researchers and industry partners (as outlined in Table 1 below) has been undertaken to assist in preparing this document. The early development of the framework was presented at the first CRCWSC Conference, which provided an important opportunity for reflection and feedback. Of note, the very act of preparing this evaluation plan has: (i) required extensive engagement with both researchers and industry partners (as outlined in Table 1); (ii) contributed towards assisting Program and Project leaders to better understand where their work may generate the greatest impact, and (iii) assisted the CRCWSC in defining future activities with regard to engaging key

industry stakeholders. Figure 1 provides a timeline of key CRCWSC research activities, including those undertaken in preparation of this evaluation and learning framework.

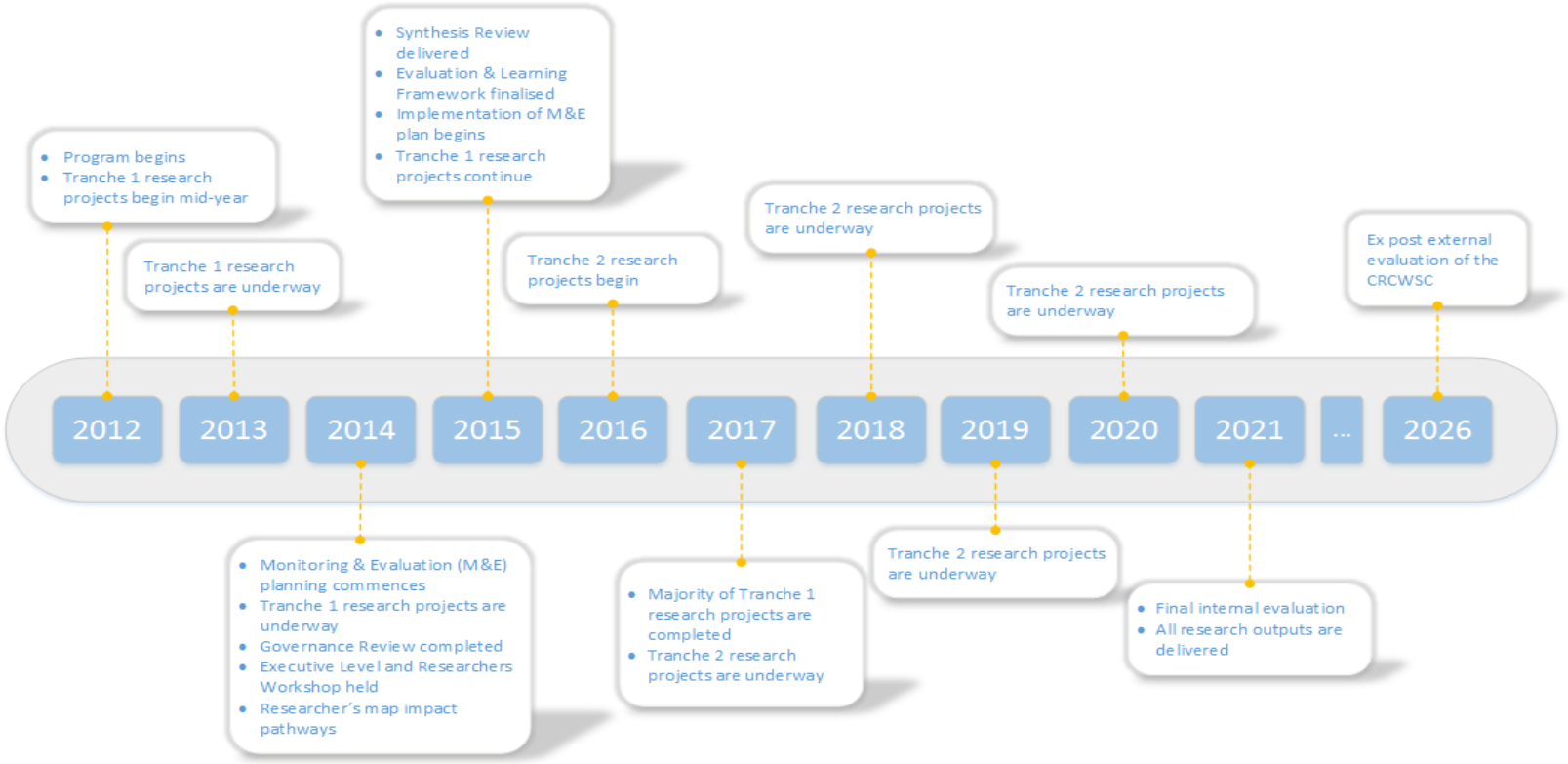

Figure 1. Timeline of key CRCWSC research activities

These activities were complemented by thorough reviews of key CRCWSC documents. Strategic and operational CRCWSC documents were examined to help understand the CRCWSC's program logic and design the CRCWSC's implicit 'theory of change' (see section 2.2). A stakeholder engagement databank, recording interactions between CRCWSC researchers and stakeholders, was created based on the information reported by researchers in project-based quarterly reports. Researchers' impact pathway statements, the Commonwealth Agreement, and the CRCWSC Economic Impact Assessment Tool were reviewed, collated and analysed for the purposes of understanding the nature of expected outputs and the extent of research utilisation. These documents also informed key performance targets for 2017 and 2021 in the CRCWSC Evaluation Implementation Plan. Recently undertaken reviews of two significant aspects of the CRCWSC – the role of Committees and the Research Synthesis Portfolio – allowed for the testing and refinement of key monitoring and

evaluation tools, such as online questionaries and qualitative case study approaches, for application in future monitoring and evaluation activities. Concurrent to the activities, a substantial scholarly review of contemporary literature in the fields of evaluation, research adoption and utilisation, and impact assessment was undertaken with the explicit aim of identifying key design principles and constraints, methodologies, appropriate evaluative criteria, indicators and tools for evaluating large-scale, complex research-industry collaborations. Collectively, these activities have informed the design and form of this evaluation and learning framework.

Table 1. Activities and engagement processes utilised in developing this evaluation and learning framework

Year	Workshop/Activity	Purpose
2014	**Executive Level Workshop: CRCWSC Monitoring and Evaluation workshop** (Melbourne, May 2014)	Leaders of the CRCWSC (Board, Executive members and Program Leaders) were together guided through a process of building a shared understanding of the need for and importance of formative and summative evaluation. Participants were asked to identify and agree upon the overall CRC program logic and determine a series of intended short term and long term outcomes related to this logic. These intended outcomes informed the next workshop which directly engaged researchers in a similar, project-focused process.
	Researchers Workshop (Sunshine Coast, June 2014)	Program Leaders, with the support of their Project leaders and broader research team, were tasked with examining how the scope and scale of their work related to the expected long-term outcomes of the CRCWSC and to identify key 2017 milestones and outcomes. This was a facilitated process whereby Program leaders helped to identify key research outputs and how they might relate to long-term impacts for achieving water sensitive cities.
	Researcher Impact Pathways (Oct-Nov 2014)	A specially designed impact pathways template was first piloted with Program C researchers then, following some improvements, was distributed to all other Program and project leaders. The template was designed to collect information related to each project's expected and/or desired outputs; target end-users, with specific information as to when users will be engaged and for what reason; the short-term outcomes and longer-term impacts that the outputs are expected to support; and the evidence needed to demonstrate that the desired impact(s) arising from each output have been achieved. Collectively, these templates document the potential impact of the CRCWSC.
	Committees Review (November 2014)	To complement the process of developing an evaluation and learning framework, the CRCWSC undertook an assessment of the role and effectiveness of the current (2014) CRCWSC committees. The review involved a comprehensive online survey examining the overall function and relationships between the Executive Committee, Research Advisory sub-Committee, Stakeholder Advisory sub-Committee, Essential Participants Reference Group and Regional Advisory Panels.
2015	**Industry Engagement** (January-February 2015)	Industry workshops were held in Adelaide, Melbourne, and Sydney to better understand the perceptions of industry participants regarding their expectation of the outcomes and impacts that the CRCWSC will deliver by 2021 in relation to their respective cities and individual organisations. The workshops provided insight into the nature of the roles industry participants consider they have in achieving identified outcomes and impact, as well as the role of the wider CRCWSC operational staff and researchers.
	Research Synthesis Portfolio Review (Feb-April 2015)	A formative evaluation sought to identify key strengths and weaknesses of the synthesis processes to inform a series of recommendations on how to strengthen and improve the synthesis process moving forward. This review process provides excellent insights for developing the learning and evaluation framework, but the qualitative case study approach also serves as a technique to apply in future monitoring and evaluation activities. This approach was important for identifying early indications regarding the broader influence and potential impacts arising from CRCWSC synthesis activities.

2 CRC for Water Sensitive Cities

2.1 Introduction to the CRCWSC

The CRWSC was established in July 2012, building upon various successful inter-disciplinary research programs including 'Cities as Water Supply Catchments'. The CRCWSC was established to change the way cities are built by valuing the contribution water makes to: economic growth and development; quality of life; and, to the ecosystems of which cities are part of. Water sensitive cities are expected to be sustainable, resilient, productive and liveable spaces. Such cities would efficiently use diverse water resources; enhance and protect the health of urban waterways and wetlands; and mitigate against flood risk and damage. Water sensitive cities also create public spaces that harvest, clean and recycle water, increase biodiversity and reduce urban heat island effects.

The CRCWSC exists to meet the challenges of three critical drivers affecting Australian cities and towns: population growth and changes in lifestyle and values; climate change and climatic variability; and economic conditions.

2.1.1 What is the CRCWSC aiming to achieve?

Overall, the CRCWSC aspires to enable the Australian urban water sector and community to effectively respond to future uncertainties while fostering attractive, liveable, sustainable, and affordable places to live. By 2030, the CRCWSC will have enabled transformative capacity, and changes in structures and practices to ensure cities and towns can deliver:

- reliable access to water to meet urban demands;
- socio-technical systems and the social capacity to defend, adopt, and recover from episodes of flooding and drought;
- waterway environments that are clean, healthy and support biodiversity;
- plans, systems and social capacity to mitigate against the growing negative impacts on urban heath attributed to changing climate;
- open spaces that are utilised for multiple functions that promote resilience, sustainability and liveability;
- water and water-related features and green spaces that enhance amenity, sense of place and cultural identity;
- optimised servicing of existing and new water infrastructures; and,
- an uncontested business case for creating and sustaining a water sensitive city.

In an effort to deliver the transformative capacity, enabling structures and water sensitive practices required to meet the 2030 goal, the CRCWSC focuses on three key objectives:

- *research* and develop cutting-edge science, technology, design and social-institutional innovations for fostering sustainable and resilient urban water management;
- *synthesise* knowledge across disciplines to formulate socio-technical water sensitive solutions and systems that respond to context; and,
- *influence* and *empower* multi-sectoral stakeholders to shape and manage the transformation of cities and towns into water sensitive cities.

2.1.2 The CRCWSC's collaborative design

Broad stakeholder involvement is critical for the CRCWSC to secure a long-term change in policy and practice to deliver water sensitive cities. The CRCWSC collaborative design involves developing and maintaining relationships between and among multiple stakeholders including: the Commonwealth Government, CRCWSC Board members, end users (both vested in and external to the CRCWSC), Universities and their researchers, and CRCWSC operational staff. At present, the CRCWSC has 85 financial partners from a diverse range of sectors including, among others, local, state and national governments, small to medium private enterprises, water utilities, large-multinational corporations and research organisations. Although these organisations work in different areas of the broader urban water and land development sector, they collectively play a role in supporting the development and delivery of water sensitive cities.

A dedicated design component of the CRCWSC ensures researchers are actively engaging with industry participants, particularly those who are crucial in shaping research activities, by providing support with testing and validating research insights, providing opportunities for synthesis, demonstration, and implementation. In addition, the dedicated engagement strategy of the CRCWSC aims to provide multiple platforms for research dissemination and stakeholder interaction (i.e. through Industry Partner Workshops, Annual CRCWSC Conference, research development, and Regional events). The rationale behind this is to maximise the delivery and use of industry-relevant project outputs for achieving CRCWSC aspirations.

The design of the CRCWSC program, including within its governance structure, embeds a range of relevant industry partners at various levels:

- executive (i.e. essential participants reference group; advisory committee);
- programmatic (i.e. stakeholder advisory committees; regional advisory panels);
- project-scale (i.e. industry partners involved in shaping projects, testing/validating outputs and/or demonstration projects); and,
- extension/capacity building activities (i.e. industry participants workshop, WSC Conference, training and synthesis projects for example).

CRCWSC participant networks are being fostered at multiple scales, across multiple sectors and over a broad range of geographic locations; to date there are 85 CRCWSC participants[1]. For example, there are 34 local governments and 16 State Government Departments, nine water utilities and 13 private companies across Australia, who have invested alongside the National Government and prominent research organisations.

[1] Over the duration of the CRCWSC participant numbers have varied with certain original participants no longer engaged and new participants joining.

2.1.3 Program design (FY12/13 – FY16/17)

Building on the successful program design of the 'Cities as Water Supply Catchments' research-industry collaboration, the CRCWSC has framed the suite of research projects into four thematic Program areas (see Figure 2).

- **Program A: Society** - examines how culture, institutions, and human systems affect the adoption of innovative and alternative practices.
- **Program B: Water Sensitive Urbanism** - examines how changes in the natural environment will impact on and be affected by different ways of planning and building cities and towns.
- **Program C: Future Technologies** - examines what technologies and information are needed to support the delivery of water sensitive cities.
- **Program D: Adoption Pathways** – examines the range and appropriate mix of interventions to translate research outcomes and innovation into practice.

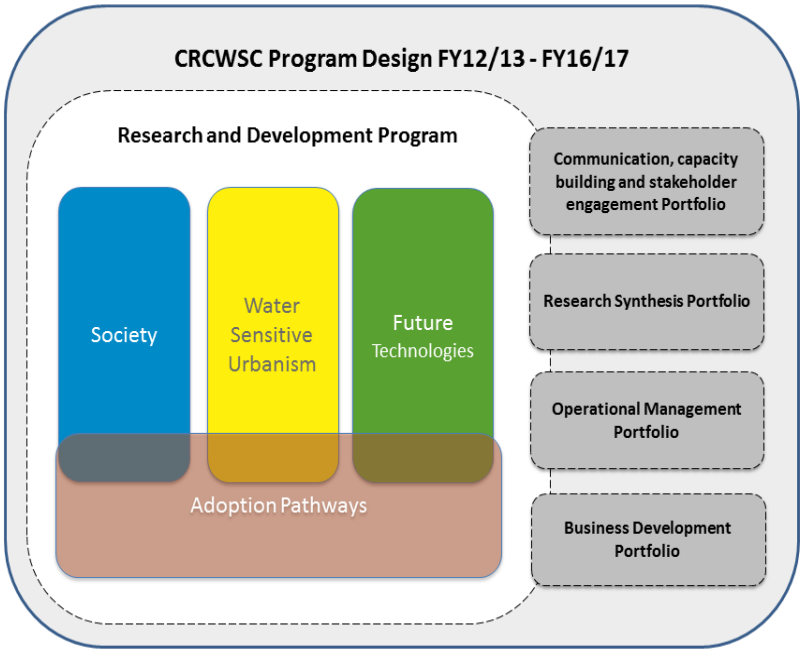

Figure 2. CRCWSC Program Design FY12/13 - FY16/17

The research and development program is complemented by four additional portfolios: Communication and Capacity Building, which aims to deliver an integrated program of timely and tailored communications and marketing strategies related to the CRCWSCs achievements and outputs, research adoption, and education and capacity building. This is complemented by the Research Synthesis Portfolio, which focuses on providing multiple platforms for research-industry interaction and collaboration. The last two Portfolios are concerned with the provision of Operational Management and Business Development. Note that preparations are underway for re-designing the CRCWSC program for FY17/18 – FY20/21, this in part responding to emerging research insights from tranche 1 (FY12/13 – FY16/17) projects, and changing external and internal conditions.

2.2 Program logic

To build a solid foundation for attribution regarding the influence and impact of the CRCWSC program, it is important to understand the internal program logic and assumptions embedded within the Program. Traditional program logics follow linear pathways of inputs/activities which deliver outputs, which are used by various stakeholders to deliver outcomes and impacts. The original CRCWSC conception and description of the Program's logic is depicted in Figure 3. The approach outlined here, is in line with the Economic Impact Assessment Tool (EIAT), which follows the same logic: complete research project and deliver outputs; these outputs are then used by stakeholders who contribute towards delivering short-term (outcomes) and long-term change (impact).

While this overall logic remains sound for the Program specific activities, a level of complexity is introduced when considering the other CRCWSC program design components focused on actively engaging industry participants in research activities and platforms for knowledge exchange (see, for example, the *Draft Adoption Portfolio Plan: incorporating stakeholder engagement, communication and capacity building*). This design feature implicitly acknowledges that if industry participants are involved in research-based activities (i.e. project-specific testing, validating, demonstration) and other knowledge exchange activities (i.e. synthesis processes, industry partner workshops, conferences etc.), then it is likely to lead towards increased probabilities of achieving output utilisation and therefore, overall impact (following the EIAT logic).

When considering the complex design of the CRCWSC program, two key theoretical logics are embedded:

(i) Implementation theory - whereby the CRCWSC acknowledges the important connections (relationships, networks, and engagement activities) required to support the effective communication and translation of research findings (hard and soft outputs) into policy and practice. Further unpacking the CRCWSC design reveals ongoing dedicated efforts towards up-skilling industry participants and delivering capacity building programs. This is captured in Figure 4 which outlines which stakeholders are engaged and how in CRCWSC activities.

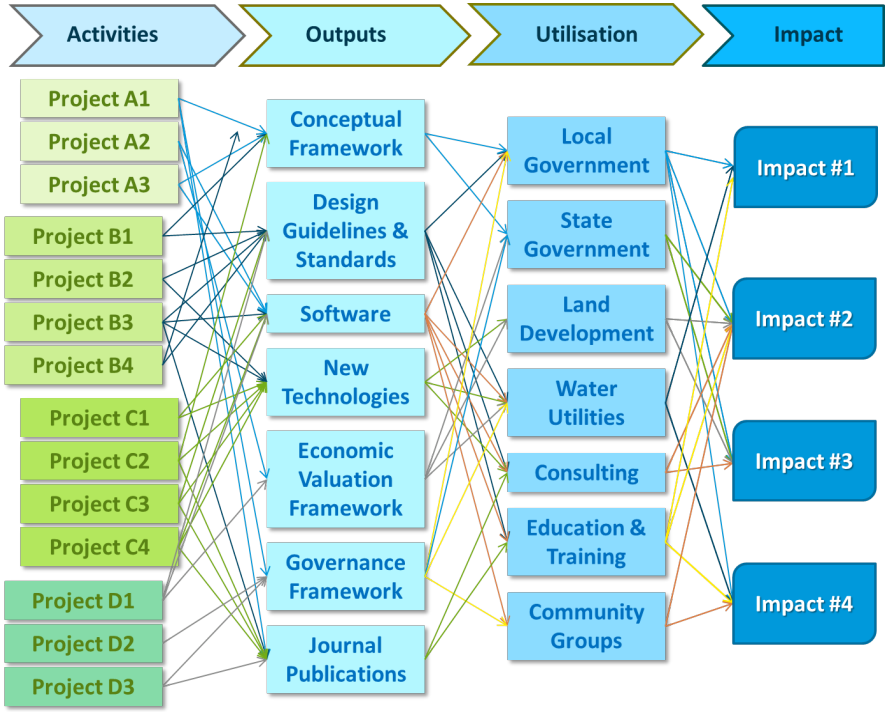

Figure 3. Original CRCWSC Program Logic outline

(ii) The implicit CRCWSC 'theory of change' focuses on building a solid foundation of empirical evidence and showcasing/targeting this towards specific end-users to build appropriate levels of awareness, understanding, skills, capacities and capabilities at multiple levels (i.e. local government through to national government) and across various sectors. This is targeted through three core areas: transformative capacity; on-ground practices; and, enabling structures. By ensuring the CRCWSC targets the 'right audiences' and focusing on these core areas of change, the CRCWSC expects to influence change in a number of different arenas (i.e. improving water security and healthy natural systems for example). This is undertaken by engaging with end users during the research process and providing forums for preliminary research insights (as identified in the implementation theory).

By understanding the assumptions that the CRCWSC design is based upon, the evaluation process can be guided to seek evidence to determine whether the assumed (theorised) links between program activities or processes, and the desired results, have occurred. This allows for comparisons regarding how the program 'will' (i.e. expectations) unfold, with the evaluators assessment/observation of 'how it has' unfolded (experience) (see e.g. Weitzman et al., 2002).

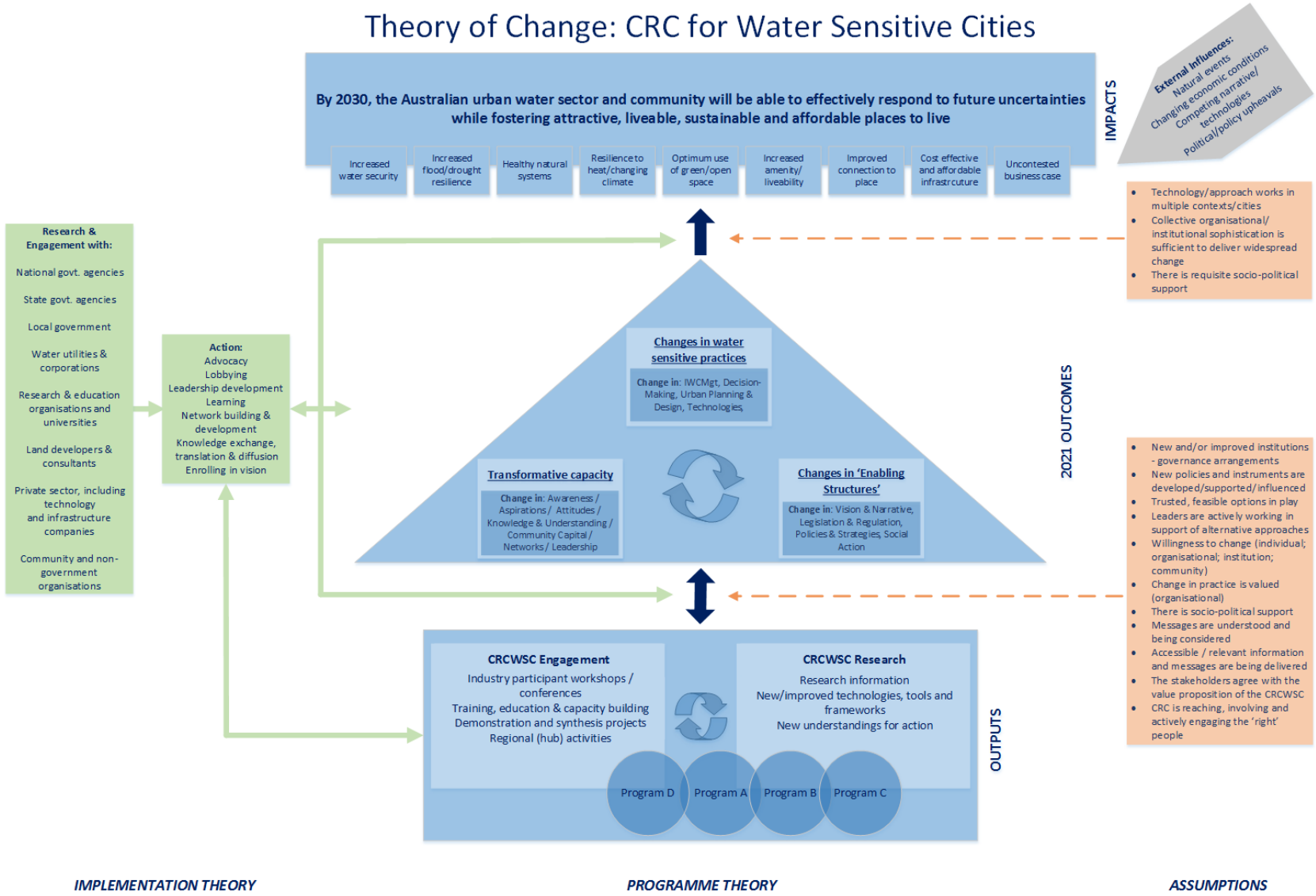

Figure 4. CRCWSC Theory of Change

2.2.1 CRCWSC utilisation pathways to generate impact

The CRCWSC has a comprehensive list of expected research outputs; a result of working in a highly interdisciplinary space. Over time, and during the course of the research process, the description of outputs and the form they may take has changed. To best understand the current expectations regarding output delivery, all project leaders were asked to complete an 'Impact Pathways Template'. This template requires researchers to consider what they were delivering, who (which stakeholders) they were or needed to engage with and when, to assist in delivering utilisation of outputs (i.e. impacts). Table 2 below presents a sample typology of expected major outputs arising from the four thematic research program areas. Following this, Table 3 presents a snapshot of some of the detail delivered by project leaders. The full typology of expected major outputs and the impact pathway statements for each project can be found in Appendix I-A and I-B respectively. Note that as individual researchers from a variety of disciplines completed these statements, the descriptions of outputs may vary between projects and in relation to other statements of outputs by the Commonwealth and found within the EIAT. For example, in preparing this document the expected outputs and their anticipated utilisation as stated in the Commonwealth Agreement, the EIAT, and project leader descriptions (as of 2014) regarding their outputs and expected use (as outlined in the impact pathway statements) were reviewed and collated. These comparisons are presented in full detail in Appendix I-C (outputs) and I-D (usage).

Table 2. Major Output Sample Typology[2]

	Reports (assessments, recommendations etc.)	**Conceptual frameworks or models** (including set of parameters)	**Technology** (including computer models)	**Tools** (includes training and guidelines)
Program A	• Case study economic evaluations of decentralised water supply systems, WSUD technologies and waste water management (1.2) • Best practice recommendations for community engagement programs in sustainable urban water management (2.3) • Assessment of the regulatory factors helping or hindering the achievement of WSC in Vic, WA & Qld (3.2)	• Water sensitive citizen typology identifying groupings of Australian householders based on their water knowledge, water behaviour and demographics (2.1) • Development of a new model for the legal allocation of risk of harms from water sensitive practices (3.2) • Framework identifying personal and professional attributes that influence risk perceptions of alternative urban water practices (4.1)	• DAnCE4Water algorithm capable of modelling the integrated urban water system including feedbacks between the socio-economic system, urban form and water infrastructure (4.3)	• Guidelines for undertaking non-market valuation ('willingness to pay') studies (1.2) • Roadmap capable of guiding behaviour change campaigns/strategies by identifying the potential uptake and impact of a suite of water conservation and water quality protection behaviours (2.2) • Guidelines for optimising the aesthetic design and acceptance of raingardens in suburban settings (4.1)
Program B	• Evaluation of the benefits of improved urban climates on heat-health outcomes and human thermal comfort (3) • Best practice planning policies and standards for applying WSUD to developments at different planning scales (5.1)	• Integrated greenspace framework for determining the essential 'green' components needed to link cities to their regional catchments, focusing on hydrological connections (1.2) • Development of conceptual models and indicators to assess the impact of stormwater harvesting on the hydrology and water quality of streams (2.1)	• Development of stochastic models capable of simulating current and future rainfall for Adelaide, Brisbane, Melbourne and Sydney (1.1) • Development of a dynamic model for stormwater harvesting and treatment technologies (4.1)	• Decision-support framework guiding planners and managers in the repair of urban freshwater ecosystems (2.23) • Development of an online spatial heat vulnerability mapping tool for Australian capital cities (3) • Development of a flood risk modelling tool integrating an economic valuation of physical assets threatened by hydrological hazards (4.1)
Program C			• Development of novel urban wastewater technologies that support resource recovery (2.1) • Novel hybrid biofiltration technologies capable of treating multiple sources of water (4.1)	• Design, operational and maintenance guidelines for improved stormwater biofiltration units (including plant selection advice) (1.1) • Decision-support tools and recommendations for optimising the interactions of centralised and decentralised systems (3.1) • Design, maintenance and operational guidelines for novel hybrid biofiltration technologies (4.1) • Decision-support tools for optimising delivery of multiple water sources (5.1)
Program D	• Documentation of best practice case studies of WSUD (5.1) • Snap-shot formative evaluation of the Synthesis Program (6.1)	• Development of industry engagement models specifically tailored to urban design issues related to WSUD (5.1) • Development of a nested evaluation and learning framework (6.1)		• Development of the Water Sensitive Cities Modelling Toolkit (WSC Toolkit)(1) • A set of structured professional learning programs and courses designed to build the capacity of urban water practitioners to deliver WSC outcomes (4.1) • Development of a WSC Index and indicator framework for assessing the water sensitivity of a place at the metropolitan and sub-metropolitan scales (6.2)

[2] A more detailed typology of expected major outputs can be found in Appendix I-A.

Table 3. Impact Pathways Examples[3]

	Output	**Who** are the users of your research (actors)?	**When** should this user become engaged with your research?	**For what purpose** should there be engagement?	Measurement (**evidence**)
Program A	**A2.2.1 Prioritised roadmap of household water behaviours for change:** The roadmap identifies the impact & potential uptake of a set of water conservation and water quality protection behaviours to provide guidance on which behaviours to target in campaigns	Water utilities; Policy makers in local and state government; NGOs involved with consumers/ communities; Residents	They have been engaged since 2013 when the project started. Results are being disseminated through reports, presentations.	Stakeholders were consulted in creating a behavioural assessment database. This behavioural assessment database developed in consultation with the water professionals will inform the prioritised roadmap of household water sensitive behaviours.	The prioritised roadmap of household water behaviours is used by water professional seeking to change behaviour to make decisions about which behaviours to target.
Program B	**B3.6 Spatial heat vulnerability mapping:** an online tool that maps heat vulnerability of the population for Australian capital cities which can be used to inform heat mitigation approaches.	State government, local governments, consultants, NGOs, emergency services agencies, other (non-CRCWSC) researchers	Currently engaged and users are already applying outputs.	Engagement is required to assist in roll out of WSUD in the community and to assist authorities to manage heat and climate change at a range of spatial scales.	Australia-wide adoption, at the local government level, of our heat vulnerability approach and maps for identification of vulnerable communities and prioritisation of remediation (e.g. WSUD and green infrastructure).
Program C	**C1.1.1 Guidelines for adoption (design, maintenance and operation) of biofiltration systems for stormwater treatment and harvesting:** Revised version of the FAWB guidelines focused on design for harvesting, plant selection and maintenance	Local government; Consulting companies; Water utilities; Land developers; Dept. of planning; Business Developers; Gardening Sector	From the beginning of the project	– To help draft the guidelines – To demonstrate the effectiveness of the new technology on the field.	The new guidelines is accepted as the industry standard (e.g. in the same way as the current FAWB guidelines are). This is measured by: – The requirements by local governments, water utilities, etc. for their staff and external consultants to use the doc in the design and implementation of stormwater bio filters. – Number of downloads of the document. – We can do survey of consulting companies (e.g. in 3 years' time) to see if they have adopted the guidelines.
Program D	**D4.1.4 A set of structured professional learning programs and courses with paying participants** delivered by a mixture of CRCWSC participants and external partners to effectively build capacity in water sensitive city outcome delivery	Australian and international urban water professionals and organisations	From July 2015	To develop the capacity (skills and knowledge) of individual urban water professionals and to learn from leading edge national practice. To enhance their capacity to work on water related tasks overseas, and to transfer knowledge of leading edge Australian practice into different contexts.	– Number of enrolled Australian and international participants on structured professional learning (education and training) products developed – Feedback from participants about the quality and usefulness of the structured professional learning (education and training) products developed.

[3] A complete set of impact pathway statements for each project can be found in Appendix I-B.

2.2.2 Tranche 1 (FY12/13 – FY16/17) - Research Specific Program Logic

Within the overall CRCWSC program design, there are four key research-specific program areas (see Figure 2), each of which have their own internal logic – these are presented over the following pages (Figures 5 to 8). Whilst these research specific program logics follows the 'theory of change' identified above, the research program logics, as identified by Program and Project leaders provide another level of detail regarding how the outcomes expected from utilising research outputs. These Program logics were developed primarily on the basis of the information provided by researchers in their impact pathway statements. The creation of each Program logic involved reviewing and synthesising descriptions of anticipated outputs; target end users; how researchers have and intend to engage with key stakeholders, and for what purpose; and suggested measures (i.e. evidence) of impact. These logics assume that continuous engagement with key industry actors will support the uptake of major CRCWSC outputs and contribute towards delivering intermediate outcomes and long-term impact in line with the CRCWSC's 'theory of change'.

Program A

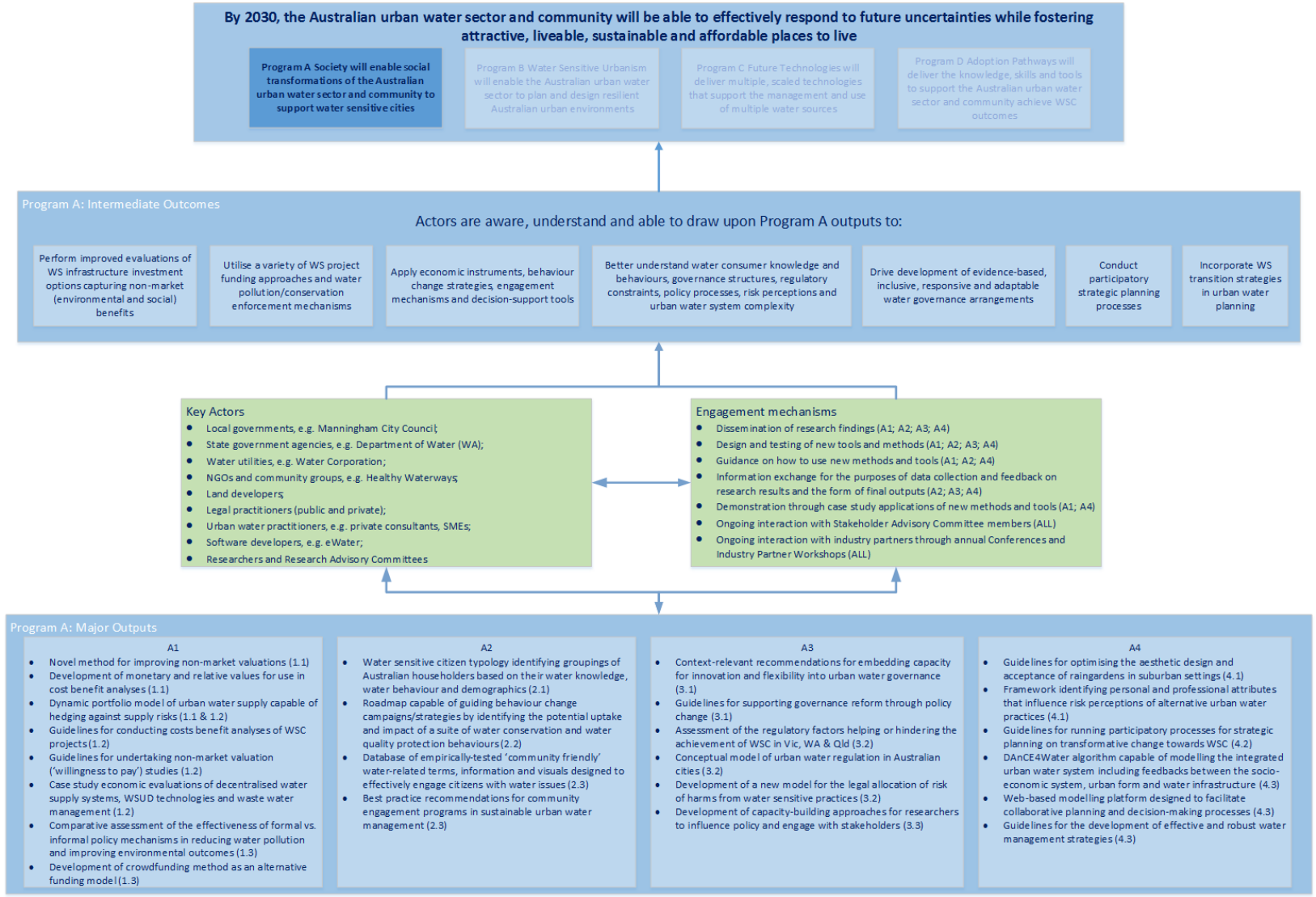

Figure 5. Program A Logic

Program B

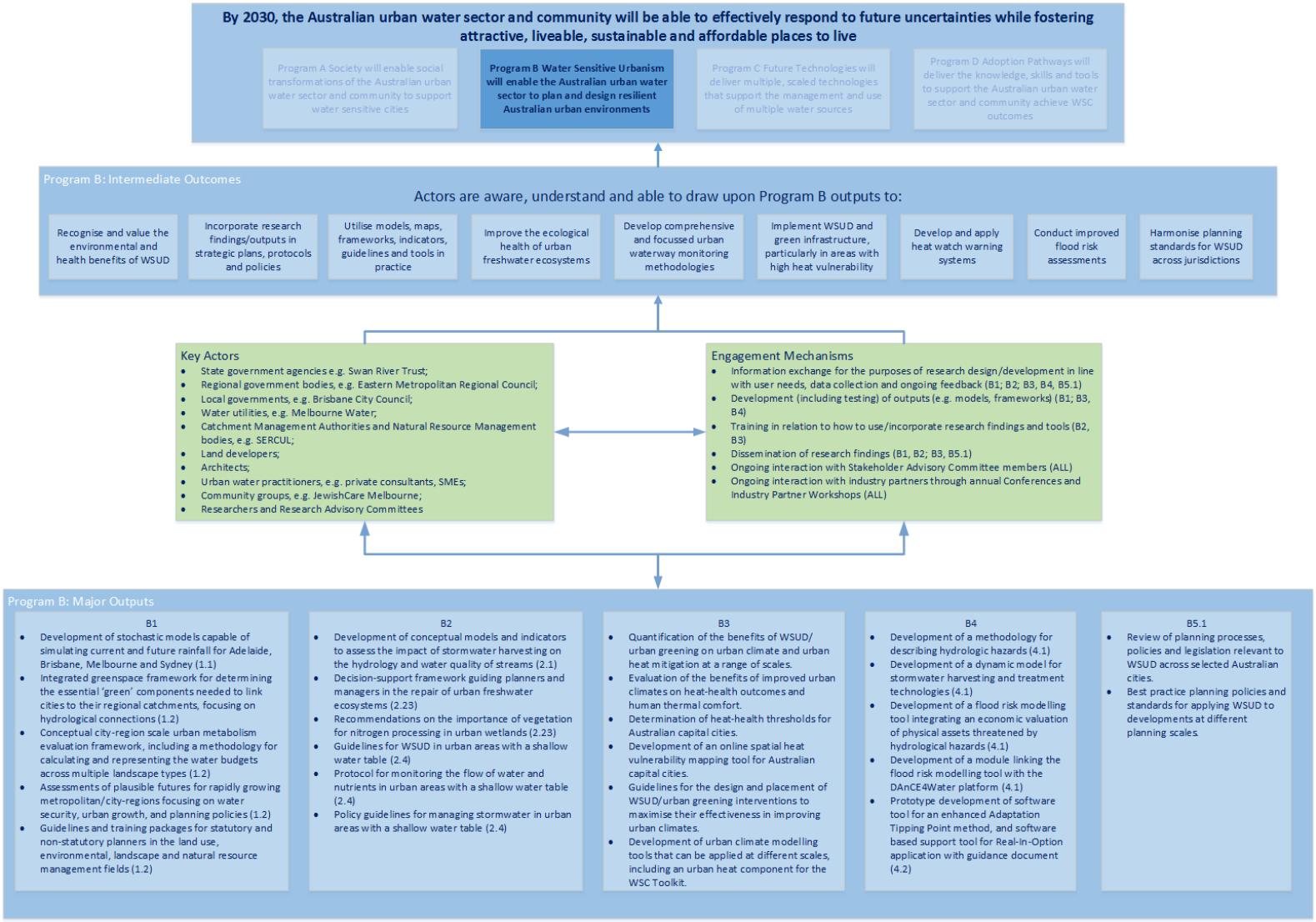

Figure 6. Program B Logic

Program C

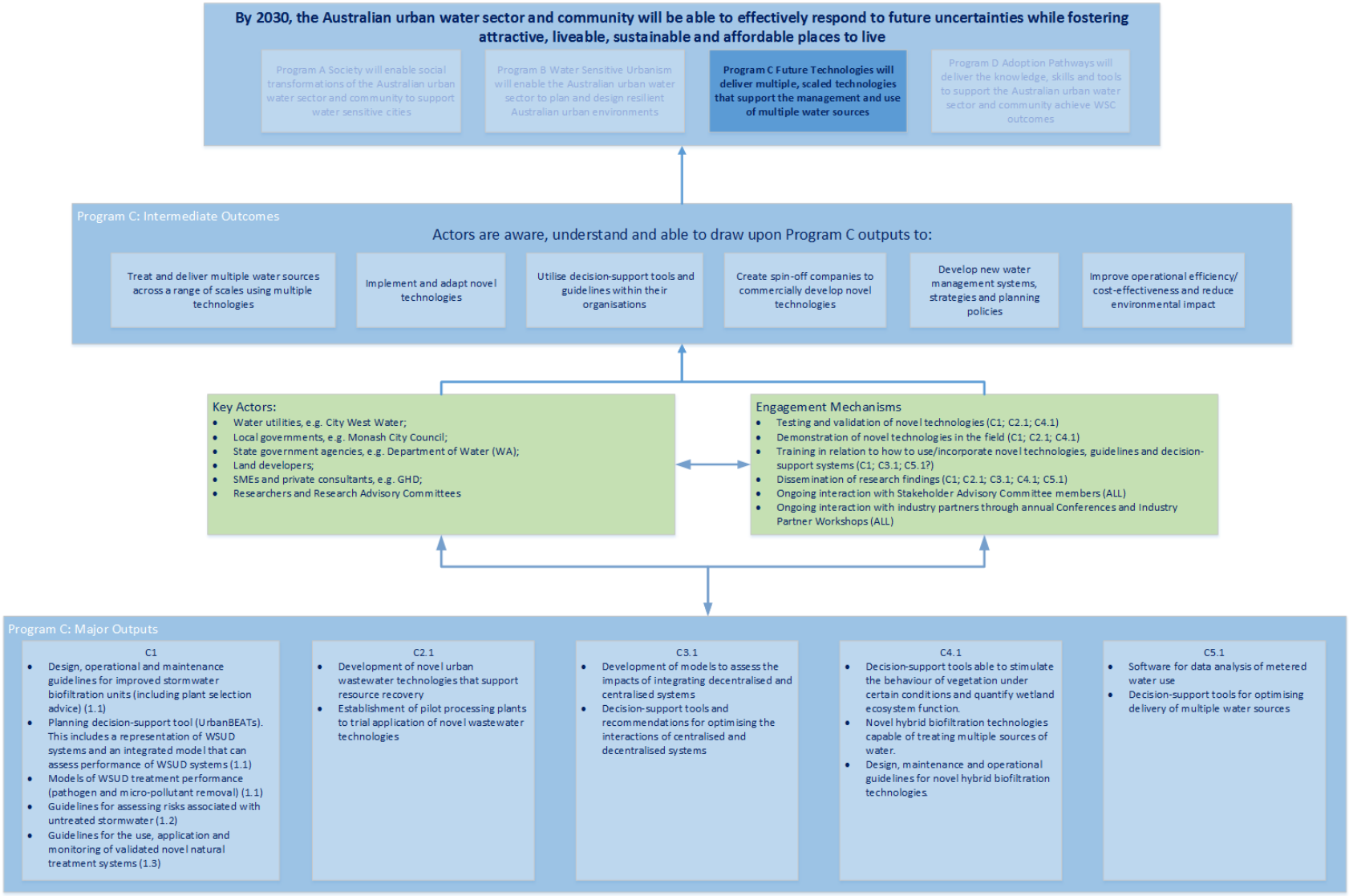

Figure 7. Program C Logic

Program D

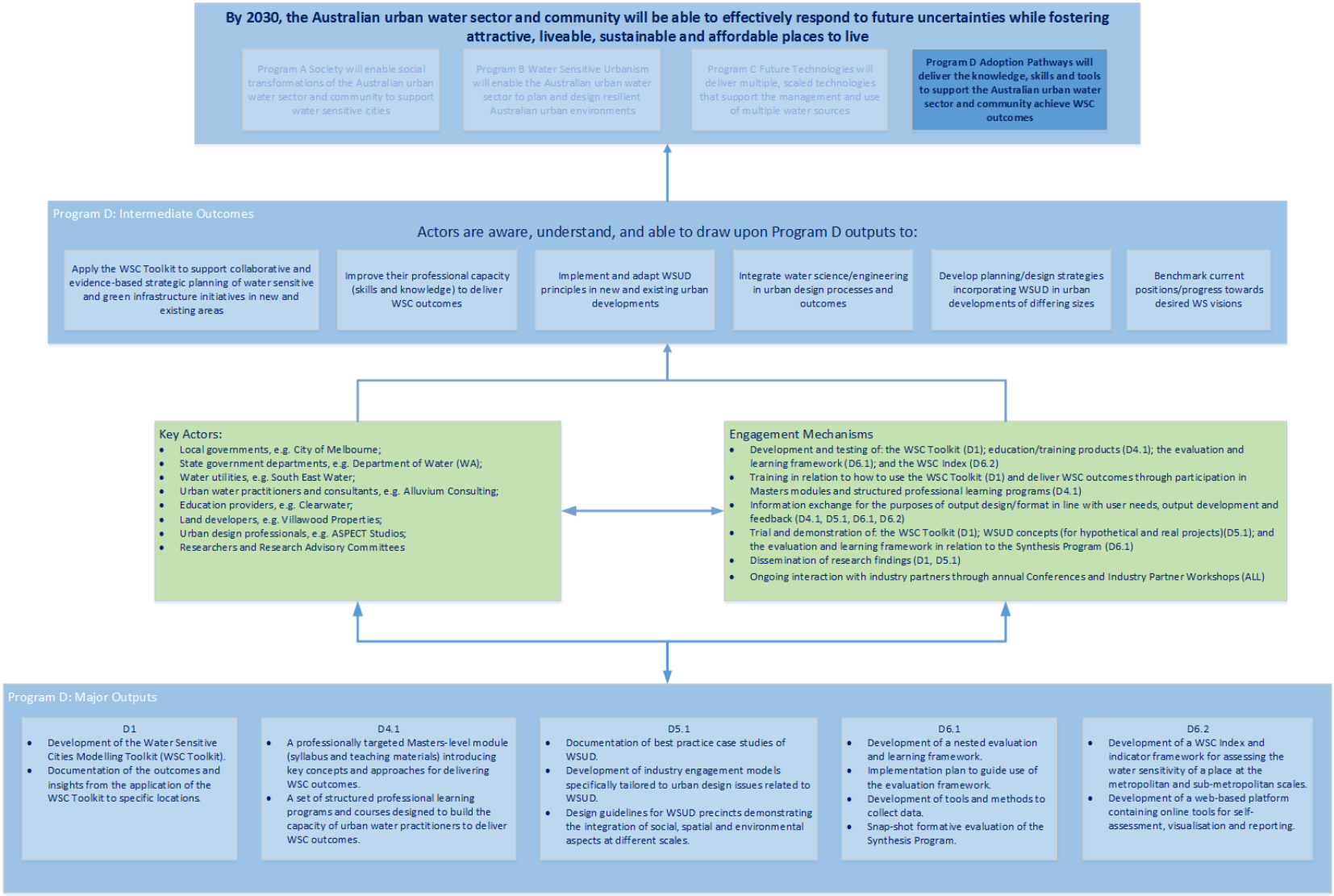

Figure 8. Program D Logic

3 Criteria for success and measurement

A key focus of the CRCWSC is to seed, strengthen and support the conditions for widespread research utilisation to achieve broad-scale impacts. Reflecting on the 'theory of change' (Figure 4) underpinning the CRCWSC program logic, there are series of measures of success, as outlined in the CRCWSC Strategic Plan 2014-2017, and process-related evaluative criteria that need to be met in order to deliver the broad-scale impacts anticipated by 2021 and into the future. Good practice dictates that these measures and criteria involve both indicator-based quantitative measures alongside in-depth, rich qualitative information (e.g. Patton 2002) in an attempt to go beyond the 'what' questions (i.e. quantitative) and ask the 'why' (qualitative) questions – to explore how change/influence has come about.

Considering the time-lag associated with achieving full-scale research adoption and impact, it is important to acknowledge and recognise the importance of 'societal impact' that has occurred as a result of dedicated CRCWSC activities. Indeed, societal impact has come to be regarded as a product, knowledge use, and a societal benefit (de Jong et al. 2014; Bornmann, 2013). The complex nature of social impact renders scholarly impact indicators (i.e. publication totals, citation rates etc.) insufficient for capturing broader societal impacts and influence achieved over the longer term (e.g. Lang et al., 2012). Indeed, accurately tracking such impacts presents a greater challenge given that they often occur with significant delay; causal relations between project and impact are typically difficult to establish, particularly where there are many agents and processes interacting through multiple channels and feedback loops; and some important impacts may not be easily measurable (Lang et al., 2012; Penfield et al., 2014).

Large, complex research-industry collaborations typically encounter issues related to temporality and attribution (e.g. de Jong et al. 2014; Penfield et al., 2014). For instance, attributing sustained impact to programs like the CRCWSC is often mediated and moderated by a variety of external conditions (i.e. variety of actors, events, social and scientific influences)(e.g. de Jong et al. 2014). There is broad consensus within the scholarly fields of evaluation, research adoption and utilisation, and impact assessment to suggest that process-related factors are critical to supporting utilisation of research outputs and delivering long-term impacts (e.g. Brousselle & Champagne, 2011). Of note, process factors are increasingly regarded as *both* a pathway towards delivering an outcome, as well as being an 'impact' (e.g. Cundill & Rodela, 2012; Reed et al., 2010). This suggests that the presence of the more 'intangible' elements of collective action, such as building relational capacity and strengthening networks, are critical to improving the probability of research output utilisation and more broad-scale impacts. Thus, understanding and evaluating impact requires a series of specific, process-related criteria. The following table (Table 4) outlines a series of process-related evaluative criteria that, when tracked, can provide an indication of the likelihood of existing and ongoing impacts generated by the CRCWSC. Drawing on three bodies of literature – evaluation, research adoption and utilisation, and impact assessment – these measures of processes can provide a proxy for societal impact (de Jong et al., 2014) by shifting the focus of evaluation to the quality of interactions and knowledge transfer efforts. By focusing on the critical processes which moderate and modulate impact, such as the role and influence of networks, the quality of partner engagement and the nature of social learning, among others, these criteria provide important justification for attribution and may reveal unanticipated impacts (Spaapen & van Drooge, 2011).

3.1 Process-related Evaluative Criteria

Table 4. Process-related Evaluative Criteria[4]

Criteria	Description	Relevance to CRCWSC
Networks – *informal/formal* – *simple/complex* – *intra/inter-organisational*	Networks are platforms for collective action whereby knowledge (i.e. ideas, information, and research findings) is effectively exchanged and actor-learning is facilitated.	Research-industry networks are important for seeding, building and strengthening networks to facilitate policy and practice change. Determining whether existing networks were strengthened and other networks formed as a result of CRCWSC activities, is important for causal inference of change.
Relational capacity – *trust (reputation/credibility)* – *mutual respect* – *collaboration* – *participation* – *communication*	Successful relationships, sometimes referred to as social capital (emerging through new and existing social networks), require: mutual respect; iterative dialogue; trust in reputation/credibility of program and individuals and relationships; reciprocity (mutual benefits); quality of participation and, length of the relationship.	Influence is a stated mission objective of the CRCWSC. To achieve the level of influence anticipated, the CRCWSC must build a high level of relational capacity among and between researchers, industry participants and broader sector end-users.
Partner engagement – *Inter-personal interaction* – *Frequency and timing* – *Variety of forums* – *Type of interaction* – *Communication*	Multiple, varied, productive, direct and indirect interactions between researchers, industry participants and broader end-users are important for research impact.	The CRCWSC requires multiple stakeholders and beneficiaries will come together, coordinate their organisational behaviours, cultures and policies to implement on-ground and sustained change. Understanding how these interactions are facilitating collective action is an important part of ensuring that industry participants and other end-users are engaged, knowledgeable and ready to undertake/promote research utilisation.
Social learning – *Individual (attitudes)* – *Collective (actions)*	Social learning explores whether collective action has led to a shift in individual and collective understanding (i.e. shared visions/goals and goals, policies and practices) through increased knowledge, awareness and understanding; changes in attitudes; and ongoing cooperative and collaborative approaches.	Learning is a social process and deeply connected to the collective action forged through the CRCWSC Program design. Multiple forums are provided for a variety of interactions and pathways for disseminating new research insights and outputs, while also focusing on dedicated interventions to actively build the skills and knowledge of industry participants. By focusing on these activities/ interventions, the CRCWSC is likely to influence the pathway towards a transformation in the way cities manage and use their water.
Capacity building – *awareness/ understanding* – *skills/ knowledge*	Capacity building interventions support increased awareness/ understanding of research insights and relevant skills, and knowledge for adapting or adopting research insights.	
Quality – *research*	Quality relates to (i) scholarly research publications; (ii) the translation of this information into industry-relevant	Quality within the CRCWSC refers to a number of different arenas: Communication; research design and outputs; collective action; and

[4] This process-related evaluative criteria table is a condensed version of a more detailed and explanatory table located in Appendix I-E.

– *outputs* – *interventions/activities* – *facilitation* – *communication*	publications, guidelines and training for future application and use, and (iii) the quality of productive interactions. Quality also relates to actual and perceived content clarity, relevance and reliability, and high-quality interactions and exchanges between researchers and stakeholders.	stakeholder-based opinions about the quality and relevance of the CRCWSC projects, program design, and outputs.
Accessibility – *of people within an organisation* – *resources* – *researchers/industry participants* – *research findings*	Access to: new research; tools and techniques for the development of new technologies; networks of experts; facilities; and opportunities for public funding often drives industry collaboration. Generating impact through utilisation and adoption is affected by the ease with which users can access research and expertise, and how accessible the information is to a broad variety of end-users.	The CRCWSC encourages stakeholders to interact, so that industry partners may have access to researchers, preliminary research findings and access to/experience using the latest research outputs, while researchers may have access to industry context, relevance and utility of their work.
Leadership/Championing – *quality* – *location (internal or external to an organisation)*	The quality and location of leadership, and the role of champions in driving leadership processes, are important aspects when steering large-scale research-industry collaborations and can influence knowledge transfer activities.	To build support for utilisation of CRCWSC research findings and a shift in practice, the CRCWSC has dedicated activities focused on supporting future research leaders through the PhD Program, and is actively working to enable practitioners to champion the uptake of CRCWSC research within their organisations and more broadly through their professional networks.
Intermediaries	Often referred to as knowledge brokers, facilitators, or bridging organisations – intermediaries support knowledge exchange and dissemination, and their presence has been demonstrated to improve the likelihood of research use and achieving impact.	Whilst building the research evidence base for promoting and delivering a transition to a WSC, the CRCWSC itself can be regarded as an intermediary, working to bring leading researchers and interested practitioners to create a fundamental change in practice.
Opportunities for influence – *Sufficient agency* – *Positional power* – *Access to decision-makers*	Alongside building trust and maintaining relationships, the actors engaged require sufficient agency (i.e. power and influence) to create change. Different actors have different capacities to influence decision-making (policy and practice change), based on their relative positional power within an organisation; their access to policy makers/leaders/executives; and their connection to other sectors/industries, among others.	The CRCWSC is focused establishing trusted relationships by undertaking activities to deliver opportunities for influencing change in a broad range of sectors. How these work will provide important insights for better leveraging of key processes as well as identifying tailored influencing (i.e. lobbying/advocacy) strategies. Here the credibility and quality of research and researchers is also important.
Contextual/External factors – *Political* – *Social* – *Cultural* – *Historical* – *Institutional* – *Organisational* – *Economic*	Being cognisant of contextual and external factors is critical for establishing internal validity arguments which reflect patterns of direct and indirect attribution of research influence and impact. These are factors that independently and collectively influence the pace, direction and scale of change. Acknowledging the different levels of capacity (willingness and readiness) for embracing change in policy and practice is important, thus the absorptive capacity of organisations should be clarified.	Being aware of external conditions beyond the CRCWSCs control requires monitoring to enhance the validity of attributions made regarding the success of interventions, research outputs, and the scale of influence/direct impact on policy and practice change regarding the delivery of water sensitive cities.

3.2 Good Governance and Program Management Evaluative Criteria

Applying good governance principles is a crucial element for ensuring that complex research-industry collaborations function appropriately to deliver maximum research impact. Drawing on the principles of good governance as outlined by Lockwood et al. (2010), a key component is focusing on the quality of interaction to ensure high levels of transparency with regard to key decision-making and connection to research projects; and that project leaders and program leaders, executive and the many councils are accountable for delivering/meeting their expected roles. When dealing with such a complex program directed at delivering change – to a large extent – the problem of interaction is key. The CRCWSC has a complex governance structure in place designed to support, guide and inform the many different inter-related components of the overall CRCWSC. Industry participation is critical to the CRCWSC, and involves industry representation at different levels. It is good practice to periodically review the appropriateness of governance structures supporting the CRCWSC to ensure the Program is being governed the best way possible. While process-related criteria above would be measured continuously, governance and program management measures would be measured at specific intervals (i.e. quarterly reporting, annual reporting etc.). Concurrent with good governance, the CRCWSC requires high quality program and project management, particularly with regard to objective setting, progress monitoring, effective communication and the employment of highly skilled project managers to run the collaboration (see Barnes et al., 2002). High quality, regular and transparent internal (and external) communication is critical to keeping multiple actors engaged and committed towards delivering long-terms impacts. Table 5 outlines the evaluative criteria as for good governance and program management in relation to the CRCWSC.

Table 5. Good Governance and Program Management Evaluative Criteria

CRITERIA	RELEVANCE TO THE CRCWSC
Principles of Good Governance • *Transparency* • *Responsiveness* • *Efficiency* • *Accountability* • *Representation/inclusiveness* • *Adaptability* • *Integration* • *Meeting/exceeding expectations*	The CRCWSC has a complex governance structure in place designed to support, guide and inform the many different inter-related components of the overall CRCWSC. Industry participation is critical to the CRCWSC, and involves industry representation at different levels. It is appropriate and good practice to periodically review the appropriateness of governance structures supporting the CRCWSC to ensure the Program is being governed the best way possible.
Program and Project Management • *Mutually defined:* – *Goals, objectives and agreed plans* • *Risk management* • *Clear, transparent, open communication* • *Cost effectiveness* • *Timely reporting (quarterly/annually)* • *Leadership*	Good program leadership and efficient (cost effective) project management are critical in supporting timely delivery of research outputs. Key processes for approval, monitoring and review of projects are in place. Quarterly progress reports are available to participants, and project updates are regularly provided through industry notes and presentations at CRCWSC events (e.g. Industry partner workshops, conferences etc.). As Industry partners play a key role in the CRCWSC, their involvement in research activities (including objective setting, project design, data collection, access to facilities to test/demonstrate new technologies, and ongoing feedback) is essential to the effective management of (and satisfaction with) the CRCWSC.

3.3 Measures of Success relevant to the CRCWSC

Further to the process-related and good governance and program management criteria above, the CRCWSC Board has set out very clear measures of success for 2021. These were articulated in the Strategic Plan 2014-2017 and define the focus of CRCWSC research and engagement activities over the coming years. We have adopted these key measures, as well as those defined by the Commonwealth Agreement output and utilisation milestones and research Project leaders, into the adjacent diagram. Figure 9 is an attempt to align the expected measures of success against the major components of the 'theory of change': transformative capacity (social capital); enabling structures; and, water sensitive practices (see Figure 4 above). Figure 9 also incorporates, where appropriate the relevant evaluative criteria outlined in Tables 4 and 5.

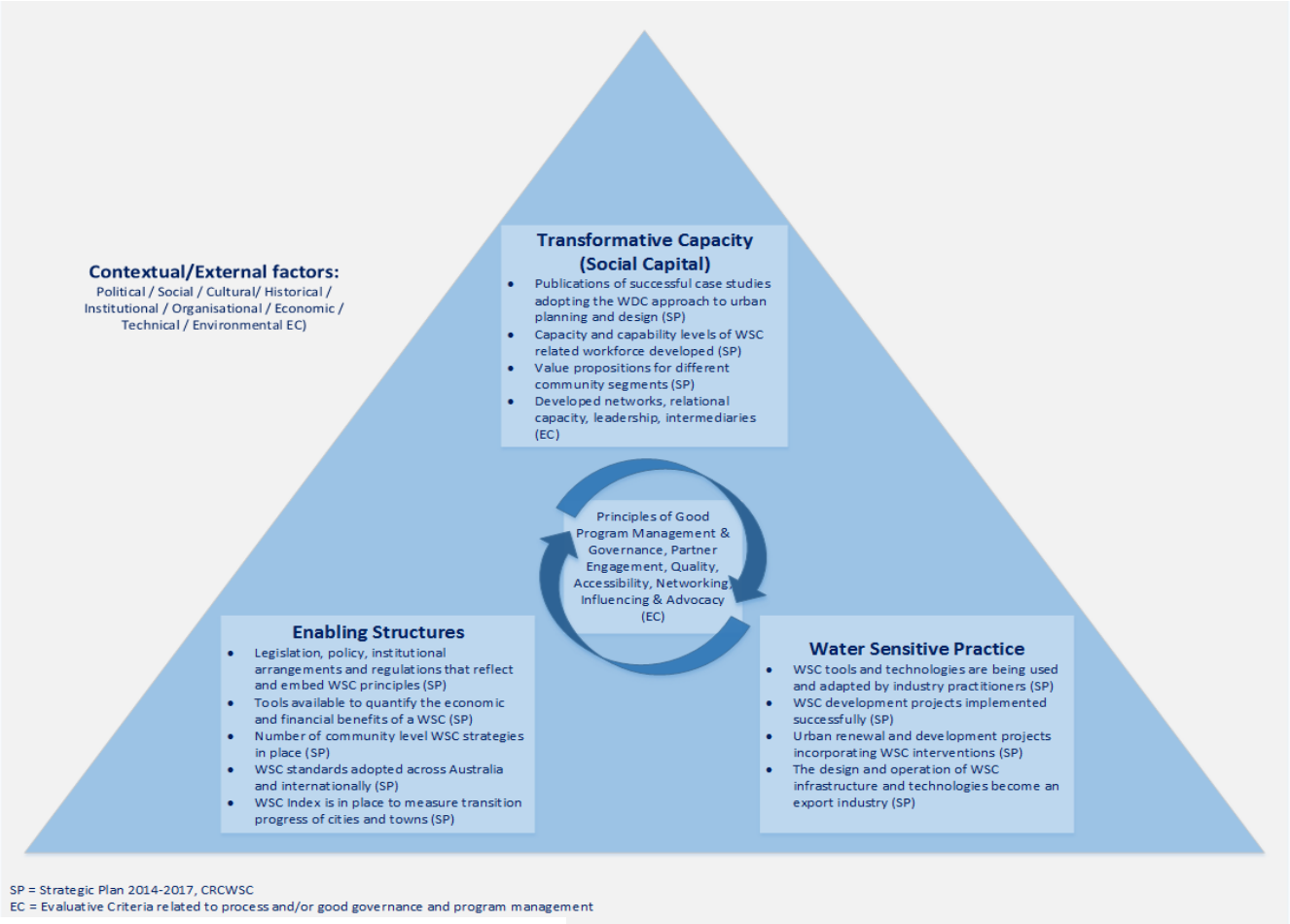

Figure 9. CRCWSC Measures of Success

4 Evaluation Framework

This section presents two tables which underpin the evaluation and learning framework. Table 6 presents both overarching and specific evaluation questions, and identifies their relevance to the CRCWSC based on five domains: appropriateness, effectiveness, efficiency, effectiveness, impact and sustainability, derived from an OECD (2000) report regarding evaluation design for results based management.

- Appropriateness measures whether a program's design is suitable for achieving its immediate and long-term outcomes, and within its given context. This explores whether the type and style of design was suitable to meet stakeholder needs and whether variations were required along the way (and why). The word appropriateness has been used over relevance as it suggests a wider accommodation of the interests and needs of all concerned parties (Markiewicz and Patrick, 2015).
- Effectiveness identifies the extent to which different elements of the CRCWSC program were achieved or are expected to be achieved.
- Efficiency is a measure of how the resources and inputs (i.e. funds, time, expertise etc.) have been used to yield results.
- Impact relates to the positive and negative impacts arising as a direct or indirect, intended or unintended outcome of the CRCWSC and,
- Sustainability reflects the likelihood of the Program and/or its principles/practices being maintained following completion of the CRCWSC funding.

Following this, Table 7 outlines the CRCWSC relevant evaluation questions, the expected evidence to answer these questions, and points to a range of methods and data collection tools for answering the specific evaluation questions. For further details regarding specific indicators, targets and data collection tools, please refer to the CRCWSC Evaluation Implementation Plan.

Table 6. CRCWSC Evaluation Questions

Domain	Description	Relevance to CRCWSC	Overarching key CRCWSC questions	CRCWSC evaluation questions
APPROPRIATENESS	A measure of whether research and operational design and approach is suitable in terms of achieving its desired effect and working in its given context. Suitability may apply regarding whether a program being evaluated is of an appropriate type or style to meet the needs of all identified major stakeholder groups. A measure of whether the governance structure is appropriate and functioning as intended, with reasons for variations.	This establishes whether the CRCWSC still comprises a coherent set of activities with common objectives. This also establishes whether the CRCWSC overall design is perceived to be suitable in addressing identified stakeholder needs[5] and objectives.	• Is the rationale for the program and its design still appropriate in its current context? • To what extent is the CRCWSC design suitable for addressing the programs objectives? • What is the assessment of the overall value of the program to the different stakeholder groups?	• What, if anything, is changing in the program's context that is or could affect operations? • To what extent are the objectives of the CRC program appropriate to achieving its overall aim? • Are there alternative strategies that should be considered? • Are the following appropriately designed to deliver CRCWSC program objectives: 1. Governance 2. Research 3. Engagement processes • To what extent is the CRCWSC program considered of value to the different stakeholders?
EFFECTIVENESS (of research and engagement processes)	The extent to which a Program and broader stakeholder objectives were achieved, or are expected to be achieved. Provides an indication of the overall assessed value (i.e. significance, usefulness, or benefit to stakeholders) and quality (i.e. whether program is meetings its stated objectives) of a program.	This provides the CRCWSC with a measure of what it has delivered and how effective the CRCWSC and its myriad activities (i.e. research, stakeholder engagement and capacity building) were in achieving program intentions.	• To what degree is the CRCWSC able to achieve or contribute to its intended objectives, 'theory of change' and/or program logic? • To what extent does the program achieve or contribute to its intended 'theory of change' • What are the CRCWSC's strengths and weaknesses? • What is the overall assessment of the quality of the CRCWSC?	• To what extent are the CRCWSC's intended objectives, outputs and 'processes of change' being achieved? • To what degree can i) research and ii) engagement activities be assessed as being of good quality? • To what extent and in what ways does the program meet participant's needs? • To what extent has the knowledge and information generated by the CRCWSC been of use to partners? • What lessons are being learned about how the CRCWSC is being implemented? And what processes and activities need improvement?

[5] Stakeholder 'needs' are not clearly defined in Phase 1 of the CRCWSC (FY12/13 – FY16/17), but expect to be clearly addressed in Phase 2 (FY17/18 –FY20/21).

EFFICIENCY (operational efficiency and economic valuation)	A measure of how resources/inputs (funds, expertise, time, etc.) are converted to results. A measure of economic value of the achievements of a Program.	This provides a measure of efficiency while also providing a measure of economic value related to CRCWSC impacts.	• To what degree did the program operate in a cost-effective way? • What is the economic value of the CRCWSC program?	• To what extent was the budget available adequate to deliver the CRCWSC program? • Does the CRCWSC program add value for money?
IMPACT (short-term & long-term)	Positive and negative effects produced by a Program, directly or indirectly, intended or unintended, tangible or intangible.	This helps to specify the different levels of CRCWSC outcomes that have occurred as a consequence of the program and how this these are leading to impacts. It provides understanding of how CRCWSC interventions can be attributed to impacts and how the CRCWSC interventions connect with supporting contextual factors to generate these impacts/effects.	• To what extent has the CRCWSC program seeded short-term and long-term change? • To what extent has the CRCWSC program delivered structural, systemic and or sector changes?	• To what extent have intended outcomes and impacts been attained as a result of the CRCWSC program? • To what degree has the CRCWSC program led to any unintended outcomes? • For whom has the CRCWSC program made a difference? • How have CRCWSC interventions supported the delivery of outcomes and impacts? What role did contextual factors play in this? • To what extent are lessons learned from the CRCWSC applied elsewhere; for example, in the design and delivery of interdisciplinary research programs, use of research findings beyond the CRCWSC? • To what extent has the CRCWSC program built capacity related to its intent?
SUSTAINABILITY	Assesses whether key elements are in place to continue a Program's core concepts and/or principles, and benefits/impacts after its initial funding period.	This provides a measure of the likelihood that the CRCWSC philosophy and outcomes will continue to be realised beyond the life of the CRCWSC. It also helps to estimate future benefits of the CRCWSC program.	• To what degree did the CRCWSC program build potential and capacity for ongoing impact? • Can the program or elements of it be transferred elsewhere? • To what extent is there ongoing demand for a program of nature?	• To what degree is there an indication that there will be ongoing impacts and benefits beyond the life of the CRCWSC program?

Table 7. CRCWSC Evaluation Evidence Required

CRCWSC evaluation questions		Evidence required	Possible methods or data sources
Appropriateness	• What, if anything, is changing in the program's context that is or could affect operations?	Changes in context (i.e. political, social, economic, environmental and/or technical) that may affect the CRCWSC program's ability to deliver overall impacts.	– Media – Interviews with Essential Participants, CRCWSC Board and Executive members. – Formal communications – Australian Government process
	• To what extent are the objectives of the CRC program appropriate to achieving its overall aim?	Description of program development compared with partner and Commonwealth needs and timeframes.	– Annual survey – Program level quarterly report – Interviews (with for example, essential participants, industry stakeholders)
	• Are there alternative strategies that should be considered?	Changes in context and needs requiring alternative strategies to keep program relevant.	– Annual survey – Program level quarterly report – Interviews
	• Are the following appropriately designed to deliver desired CRCWSC program objectives: 4. Governance 5. Research 6. Engagement processes	Quality and applicability of governance structures, research, and engagement processes.	– Governance survey (as required) – Interviews with selected stakeholders. – Annual survey – Various CRCWSC activities/interventions surveys
	• To what extent is the CRCWSC program considered of value to the different stakeholders?	Described stakeholder value propositions and benefit of the overall CRCWSC program.	– Annual survey – Interviews with selected stakeholders – CRCWSC Operational data (i.e. COO reports)
Effectiveness	• To what extent are the CRCWSC's intended objectives, outputs and 'processes of change' being achieved?	Description of objectives, outputs and 'factors of change'. The extent to which research processes meet milestones for delivery of outputs and anticipated utilisation of outputs. The extent to which engagement processes develop capacity for collective action. The extent to which the CRCWSC meets Commonwealth review milestones.	– Annual survey – Interviews – Qualitative case studies – CRCWSC Operational data (i.e. project quarterly reporting) – Output tracking
	• To what degree can i) research and ii) engagement activities be assessed as being of good quality?	The quality of research outputs and immediate outcomes measured against research standards and targets. The quality of engagement activities from a partner perspective. The quality of the relationships between partners and their methods of communication. Extent of stakeholder participation in research and engagement activities. Quality of information exchanged (e.g. clarity, relevance).	– Research bibliometrics (i.e. Q1 or Q2 journal publications, citations, reach and impact) – Annual survey – Event Surveys (i.e. Industry Partner Workshops) – Interviews with various stakeholder partners – Qualitative case studies – CRCWSC Operational data (i.e. quarterly project reporting; registration data)
	• To what extent and in what ways does the	Description of participants' needs. Participant (industry partner and researchers) satisfaction and	– Annual survey – Activity/Event surveys

	program meet participant's needs?	experience of the overall program and its different components.	– Qualitative case studies
	• To what extent has the knowledge and information generated by the CRCWSC been of use to partners?	Description of what knowledge and information is generated by the CRCWSC and in what format. Accessibility of information produced. Description of the extent to which knowledge and information is being used by partners (could be industry partners or other researchers) and for what purpose. Description of any increase in knowledge, awareness or understanding on the part of industry partners.	– Annual survey – Publication database – download totals, document requests etc.
	• What lessons are being learned about how the CRCWSC is being implemented? And what processes and activities need improvement?	Functionality of governance structures, research and engagement processes. Description of positive and negative lessons learned. Description of necessary feedback loops between lessons learned and CRCWSC process and activities. The extent of enabling internal conditions and support.	– Governance survey (as required) – Interviews with participants and program staff – Annual survey – Event surveys
Efficiency	• To what extent was the budget available adequate to deliver the CRCWSC program?	The extent to which processes met milestones and targets for cost (budget allocation, expenditure and outcome delivery). Perceptions of cost-effectiveness.	– CRCWSC Operational Data (i.e. COO reports, quarterly project reporting)
	• Does the CRCWSC program add value for money?	Quantification of actual and foreseen impacts. Descriptions of benefits and value of CRCWSC program	– Economic impact assessment tool – Qualitative interviews/case studies – Annual survey
Impact	• To what extent have intended outcomes and impacts been attained as a result of the CRCWSC program?	The pattern of uptake, outcomes, and impacts by different participant groups and in different circumstances. The extent to which changes in policy and/or practice occurred as a result of the CRCWSC program i.e. the extent to which CRCWSC outputs are integrated into new policies/strategies and/or lead to changes in organisational processes/decision-making (as well as individual behaviour change). Description of barriers limiting uptake, outcome delivery and/or impact.	– Impact pathways tracking – Quarterly project reporting – Interviews with selection of stakeholders – Evidence from Project D1.4 – Qualitative case studies (i.e. tracking synthesis projects)

	• To what degree has the CRCWSC program led to any unintended outcomes?	Description of any unintended impacts (positive and negative)	– Interviews with selection of stakeholders – Annual survey – Event surveys
	• For whom has the CRCWSC program made a difference?	Identification and description of the CRC partners and non-participants that were affected by the CRCWSC program.	– Interviews with selection of stakeholders – Annual survey – Event surveys
	• How have CRCWSC interventions supported the delivery of outcomes and impacts? What role did contextual factors play in this?	Mapping of impact pathways. Descriptions of causal attributions or plausible contributions. Description of what external context factors influenced the outcomes.	– Interviews with selection of stakeholders – Annual survey – Impact pathway (output) tracking – Observations
	• To what extent are lessons learned from the CRCWSC applied elsewhere; for example, in the design and delivery of interdisciplinary research programs, use of research findings beyond the CRCWSC?	Descriptions of how lessons from CRCWSC have been translated into other contexts.	– Interviews with selection of stakeholders – Annual survey – Event surveys – Evidence from Project D1.4 – Bibliometrics
	• To what extent has the CRCWSC program built capacity related to its intent?	Number of professionals who have attended courses, training workshops, undertaken PhDs. Description of any new skills learned by industry partners. Description of increased confidence gained by participants. Descriptions of change in practice due to attending capacity developing and other CRCWSC workshops.	– Annual survey – Event/activity survey – CRCWSC Operational data (i.e. workshop/course registration and attendance numbers/lists etc.) – PhD project and alumni database (completions; alumni database etc.).
Sustainability	• To what degree is there an indication that there will be ongoing impacts and benefits beyond the life of the CRCWSC program?	Development of new institutions, partnerships, networks or structures. Creation of innovations and new ideas. Further sharing of knowledge (beyond immediate CRC stakeholders) Extent of changes in policy / practice space. Ongoing availability/applicability of knowledge and information. Spin-off companies (novel technologies, consultancy, etc.)	– CRCWSC Operational data – Governance reviews – Interviews with selection of stakeholders – References to CRCWSC research in government and industry policies/strategies – End of program survey

5 Implementation

Following the challenge raised by evaluation scholars to make evaluation more 'responsive' to the needs of stakeholders (i.e. Chen, 1990; Patton, 2012), the implementation of the CRCWSC Evaluation and Learning Framework will focus on delivering usable information in shorter timeframes and producing results with reliability, generalisability and replicability in the longer-term. The 'theory of change' articulated in section 2.2 has focused attention towards the processes and proximate outcomes, and encouraged greater clarity in program design. Therefore, to accommodate the complex nature of the industry-research collaboration, the implementation of the evaluation requires a blending of research designs and multiple methods of inquiry. Also, throughout this implementation process, the counterfactual question will be routinely asked (i.e. would this [outcome/impact] have happened in the absence of the CRCWSC?)(see e.g. Weitzman et al., 2002).

5.1 Approach (scale and scope)

Capturing monitoring data relevant to achieving key indicators assists in measuring and assessing whether the CRCWSC is on its way to delivering its long-term goals (as identified in the CRCWSC Evaluation and Implementation Plan). This can be undertaken in a number of ways. The breadth of the CRCWSC program spanning six Australian states and territories, five European and Asian countries, and working with local governments through to state policy makers, researchers and private urban water professionals (see Appendix I-F), raises a number of different focal points for an evaluation. For example, a key measure of success is end-user adoption and adaptation of CRCWSC research outputs, which can occur at various scales and levels: individual and collective (organisational) levels; lot-scale to precinct to city-scale; and from local through to national governments. Therefore, key data collection points can be broken down in different ways including, among others, spatial areas, projects or groups of projects; types of intervention/strategies; target stakeholder groups; and intermediate outcomes. Overall the intent is to lead towards some form of causal inference. Therefore, to streamline the approach for the CRCWSC, this implementation design outlines three overarching pathways to evaluation (see Table 8):

(i) ***Research Outputs tracking***: this is primarily undertaken by tracking research project milestone delivery and in-project stakeholder engagement. This requires Project/Program leaders to be mindful of recording involvement and interactions with key end-users and to be aware of where and how their results are being applied or adapted.

(ii) ***Stakeholder tracking***: this approach also involves a further differentiation of data collection approaches. For example, the focus could either be on capturing researcher and industry participant insights, or stakeholder engagement and their application/use of research findings. In turn, these can be broadly and variously grouped, such as by different sectors and/or scales/levels of decision-making (e.g. streetscape, local, regional, state, national).

(iii) ***Activity/events tracking***: measures the influence and impact arising from individual events and activities undertaken by the CRCWSC (e.g. industry partner workshops, training events, conferences etc.). Such an approach presents an opportunity to assess over time how these events/activities have influenced policy/practice.

Table 8. Scale, scope and approach to implementation of the Evaluation & Learning Framework

TRACKING	BY…
Research Outputs	Advice; Guidelines; Training; Literature; Case studies; Technology; Data/database; Model/framework
Stakeholders	Researchers; Industry; Sector; Region; Organisation; State; Local; Level/ Jurisdiction; Network; Public/ Private; POLICY; PRACTICE
Activities	Industry Partner Workshops; Researchers Workshops; Synthesis Projects; Demonstration Projects; Training Programs; Regional (Hub) Activities

By way of illustrating the complexity of tracking one of the three arenas identified in Table 8, the table below provides a sample of demonstration projects, and related stakeholders, currently undertaken by the CRCWSC (see Table 9). Demonstration projects provide an important interface for research-industry collaborations, and are critical to the development and use of outputs. Accordingly, tracking such projects will not only be important in assessing their influence on policy and practice, but also for monitoring stakeholder engagement and adoption of research outputs. However, the many examples of such projects spread out across Australia and overseas highlight the significant extent of resources and capacity required to comprehensively track the development and influence of such activities. Consequently, tracking demonstration projects may need to be limited to a few key examples, selected in consultation with the CRCWSC Operational and Executive staff.

Table 9. Examples of CRCWSC Tranche 1 projects involving testing and demonstration activities[6]

Project	*Organisation/s involved*	*Status*
Project A4.3: Water utilities have been involved in the development and testing of theDAnCE4Water tool, and are also expected to be involved in validating the tool. State and Local Governments are also expected to be involved.	South East Water, Melbourne Water State and Local Governments	Underway
Project B4.2: Local governments will be engaged in the testing and refinement of software tools, to ensure its usefulness to this user group.	City of Rotterdam, City of Dordrecht, City of Hamburg, Hoboken New York, City of Gosnells, City of Can Tho, City of Port Philip (i.e. Elwood)	Underway
Project C1.1: 1. Local governments, water utilities and urban water practitioners have been involved in field demonstrations of advanced biofiltration systems for stormwater treatment and harvesting. 2. The first prototype of Zero Additional Maintenance (ZAM) biofiltration design was built by Manningham City Council. After the tests are completed the Council will build 4 full scale systems as demonstration of the new technology. The Council also applied for funds to build a large number of ZAM systems in their area.	– Monash City Council has been constructing stormwater harvesting systems. – Manningham City Council, Melbourne Water	Underway
Project C2.1*:* Trial application of the novel wastewater technologies. A pilot processing plant is being built as part of the larger innovation centre at Brisbane's Luggage Point Advanced Water Treatment Plant. More pilots are also planned with the support of Victorian utilities.	Queensland Urban Utilities	Underway
Project D5.1: Demonstration projects involving design scenarios in different climactic and density conditions in Australia and internationally (i.e. Kunshan). These include real projects as well as hypothetical and/or CRCWSC research synthesis projects (i.e. Tonsley, Aquarevo, Bentley etc.). More recent demonstration projects include the Elwood Project and City of Melbourne's major redevelopment precinct Arden/Macaulay.	– Planning Bureau of the City of Kunshan – All participating organisations in Synthesis Workshops, for example the Aquarevo Project involved South East Water, Villawood Properties, AECOM etc. – City of Melbourne, Melbourne Metro Rail, and the Melbourne Planning Authority are involved in the Arden/Macaulay redevelopment project.	Underway

[6] A complete table of demonstration activities can be found in Appendix I-G.

In carrying out monitoring and evaluation, the CRCWSC seeks to understand to what extent, and in what ways, the CRCWSC has acted as a catalyst for meaningful change (i.e. seeding cross-sectoral collaborations) in the way urban and regional centres are planned, designed and delivered, in relation to water sensitive practices and policies. Figure 10 below provides suggestions regarding the timing of specific evaluation activities. By staging this process throughout the life of the CRCWSC, a solid evidence base is generated to support causal inferences.

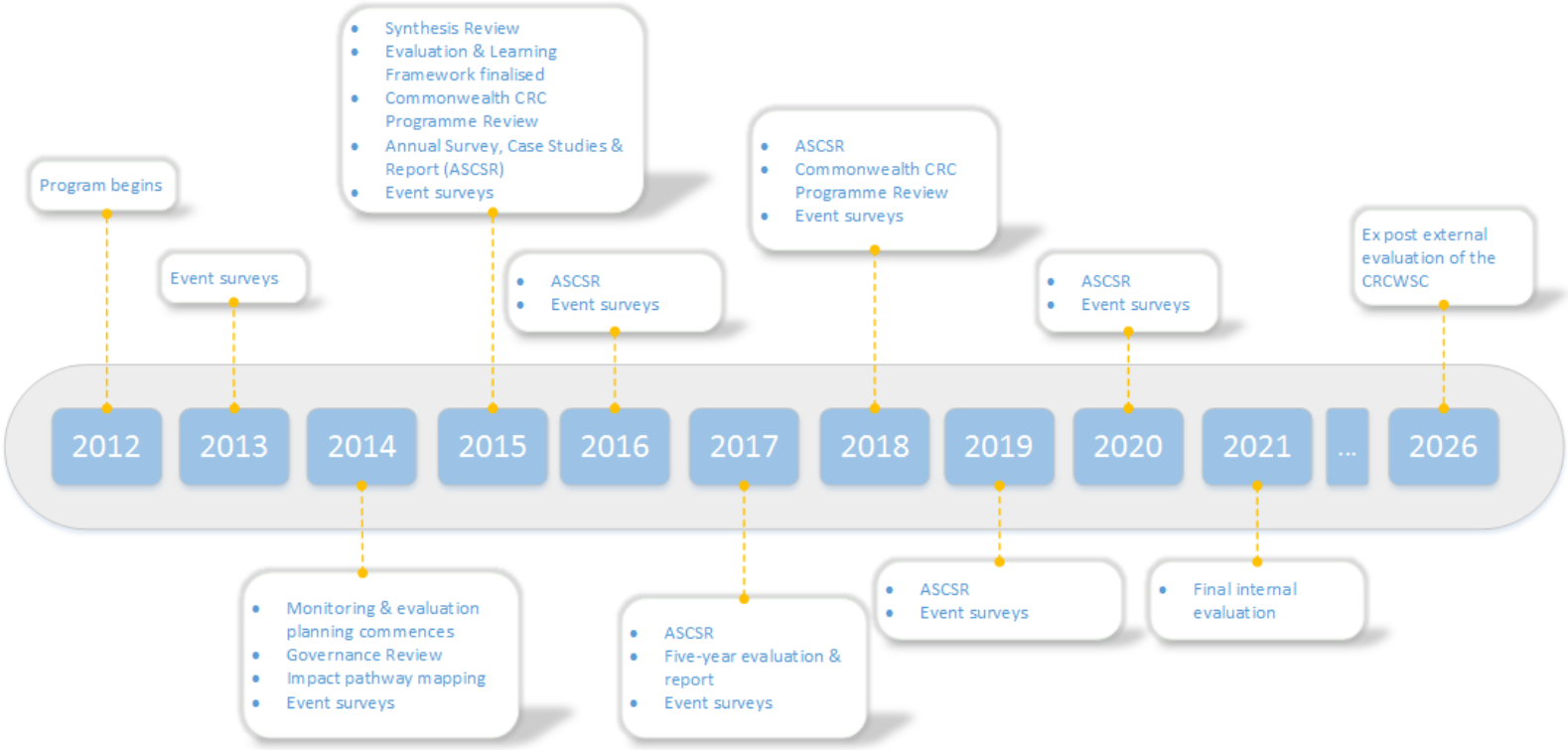

Figure 10. Suggested timeline of key CRCWSC evaluation activities *(Note that 'events' include IPWs, RWs, Conferences, training activities etc.)*

Evaluation is a balancing act between potentially competing objectives of demonstrating value of investment; providing evidence of what works and fostering a learning process. Accordingly, reporting back to stakeholders regarding monitoring and evaluation activities is an important process of reinforcing the research/industry vision, agenda and direction.

5.2 Design and Techniques

Implementation of the Evaluation and Learning Framework will primarily rely on non-experimental descriptive and exploratory designs, drawing on techniques such as cross-sectional designs and case studies, but will also attempt to capture longitudinal data via an annual online survey (see Table 10). The focus of

the implementation design is on accurately describing the process rather than on proving any specific hypothesis or demonstrating relations between specific variables. Rather, the design will include ongoing data collection regarding different elements of CRCWSC activities and tracking of research outputs to improve our evidence base for making claims of causal inference, where appropriate. The design of the Evaluation Implementation Plan is to be exploratory, reflexive and responsive to situations and availability of time, resources and cases for exploring how the CRCWSC has been influenced and/or played a role in different contexts. Importantly the CRCWSC has embedded many of the principles related to social learning (and other key process-related criteria, see Table 4) to ensure that over time, the CRCWSC will have the capacity to articulate how the emerging water sensitive understandings and technologies have influenced a change in policy and practice.

Both quantitative and qualitative evaluation data are useful for providing detailed information regarding how certain outputs (i.e. guidelines, case studies, frameworks) are adopted, adapted and used by stakeholders and what processes/resources supported/helped/encouraged them to do so. Capturing this information helps to a) provide insight into how to encourage/develop other end-user adoption pathways, and b) generate case study evidence regarding utilisation. Therefore, process- and use-related data are intentionally descriptive and draw from a variety of indicators (e.g. see Table 4) to complete the most thorough picture possible regarding successful utilisation of, and impact related to, CRCWSC findings.

Data will be collected through a mixed-methods approach, which is designed to support data triangulation and address limitations of a single method approach (see e.g. Markiewicz and Patrick, 2015):

1) **Quantitative** information will be derived from online surveys – specifically focusing on
    a. CRCWSC events and activities (i.e. Industry Partner Workshops and Researcher Workshops)
    b. Annual stakeholder survey (primary and secondary CRCWSC industry contacts)

2) **Qualitative techniques.** Reflecting on the key process-related criteria identified in Table 4, there is a critical need to place an emphasis on capturing rich, detailed insights regarding the contextual experiences with a range of stakeholders (industry and researchers). The use of semi-structured interviews and group interviews (where appropriate) is likely to yield important information regarding the processes used by various stakeholders in the adaptation and application of CRCWSC research findings.

3) **Operational** CRCWSC material will provide important numerical data regarding the exposure and reach of CRCWSC activities.
    a. Event registration numbers (stakeholders)
    b. Project Management quarterly reporting
    c. Commonwealth review documentation.

4) **External** information: this requires examining ongoing media, political and international influences in the space of water sensitive practices.

This project has involved crafting a range of evaluation tools that could be adopted by the CRCWSC to help monitor project output utilisation. Table 10 below details a range of tools that have been developed; however, it is worth noting that many of the templates developed (see the CRCWSC Evaluation Implementation Plan) will need to be reviewed and tailored to specific events (as required).

The range of tools and techniques identified in this section would ideally all be used to complement, reinforce and verify evidence of research influence and impact; however, given the scale and complexity of the CRCWSC, the scope of monitoring and evaluation activity needs to be tailored to best fit existing resources, while maximising delivery of evidentiary data.

Table 10. Evaluation Tools

Tools	***Brief Description***
Surveys 1. CRCWSC Annual Survey (Industry Partners 2. CRCWSC Annual Survey (Researchers) 3. CRCWSC Industry Partner Workshops Evaluation (Industry Partners) 4. CRCWSC Industry Partner Workshops Evaluation (Researchers) 5. CRCWSC Conference Evaluation 6. CRCWSC Researchers Workshop Evaluation	The *annual survey* aims to obtain the feedback from (i) industry partners and (ii) researchers on: a) how research outputs are being utilised in practice, b) the extent of CRCWSC influence in terms of facilitating change for WSC at an individual, organisational, and sector level, and c) the quality, effectiveness, and strengths and weaknesses of the CRCWSC and its products and processes. The two *Industry Partner Workshop surveys* aim to obtain feedback from industry partners and researchers on each Workshop in order to understand the motivations and benefits of participation, and to identify progress in relation to achieving CRCWSC objectives in order to continually improve CRCWSC methods of collaboration and learning. The *Conference survey* seeks to understand the utility and influence of Conference programs in order to continually improve the content and parameters of future Conference programs. The *Researcher Workshops survey* seek feedback from researchers regarding their level of engagement with stakeholders, and their contribution to the development of high quality and impact-oriented research outputs.
Interview Questions 1. Impact & Pathways Review 2. Activities	The first set of interview questions seeks to unpack impacts and characterise impact pathways. The questions focus on the origin of the researcher-industry collaboration; any outcomes, relevant impacts and the processes related to how they have come about; and the role of the CRCWSC collaboration in achieving those outcomes and maximising impact. The second set of interview questions focuses on understanding the purpose and utility of CRCWSC activities, using the example of Synthesis Projects. The questions focus on the origins of participation in the activity; the benefits and outcomes of the activity; and reflections on the value and utility of the process.
Case Study Design	• Case studies are appropriate for 'how' or 'why' research questions that require some form of explanation. • From the outset, the 'case' to be studied and its boundaries need to be clearly defined. Cases can include individuals, organisations, networks, projects, or specific events as the primary unit of analysis. Bounding the case involves considering which individuals, organisations etc. to cover, the specific time period and geographic area/s delimiting the case study. The CRCWSC case studies will ultimately focus on tracking stakeholders, but such a focus will also provide an opportunity to monitor CRCWSC output use. Given the multiple ways in which stakeholder tracking can occur (see Table 8), consultation with

	the CRCWSC Executive will be required to agree upon the best approach. Specific case studies in relation to CRCWSC activities will also need to be undertaken, like the recently completed Synthesis Review. • Case studies require careful design. Each case should consider: the key research questions; its propositions (if any); its unit/s of analysis; the logic connecting the data to the propositions; and the criteria for interpreting the findings (Yin 2014, p. 29). The first three considerations will help identify the data to be collected whilst the last two considerations will help inform the approach to case study analysis (Yin 2014, pp. 38-37). • Whilst a single case study approach can be useful to test an existing theory or 'unusual' circumstances and for longitudinal purposes, the CRCWSC will ultimately benefit from a multiple case study design. Such an approach typically offers more compelling evidence and improves the overall robustness of the study/evaluation. Multiple-case designs must follow a replication, not a sampling, logic. This requires careful selection of cases to ensure similar results ('literal replication') or contrasting results ('theoretical replication') in line with explicit predictions made at the beginning of the investigation. As with single case-designs, individual cases within a multiple-case study design may involve a single unit of analysis (holistic design) or multiple units of analysis (embedded design). See Yin (2014) Chapter 2 for further detail. • The quality of the chosen case study research design can be judged according to four logical tests: 1. *Construct validity* – do data collection procedures identify the correct operational measures for the concepts being studied? E.g. will multiple sources of evidence be used? Will a chain of evidence be established? 2. *Internal validity* – does the data analysis approach specified in the research design seek to establish a causal relationship, whereby certain conditions are believed to lead to other conditions? E.g. does the data analysis approach incorporate pattern matching, explanation building, address rival explanations, and use logic models? 3. *External validity* – does the research design appropriately define the domain in which the study's findings can be generalised? E.g. will a theory be used in single-case studies? Will replication logic be used in multiple-case studies? 4. *Reliability* – can the operations of the study, e.g. data collection procedures, be repeated with the same results? E.g. will a case study protocol be used? Is a case study database going to be developed?
Quarterly Report Template	The Quarterly Reports currently provide updates on the progress of CRCWSC research projects. The template has been modified to further capture researcher-stakeholder interactions and evidence of actual and potential impacts.

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Notes

Appendix I-A: Major Tranche 1 Output Typology

	Reports *(assessments, recommendations etc.)*	***Conceptual frameworks or models*** *(including set of parameters)*	***Technology*** *(including computer models)*	***Tools*** *(includes training and guidelines)*
Program A	• Comparative assessment of the effectiveness of formal vs. informal policy mechanisms in reducing water pollution and improving environmental outcomes (1.3) • Case study economic evaluations of decentralised water supply systems, WSUD technologies and waste water management (1.2) • Best practice recommendations for community engagement programs in sustainable urban water management (2.3) • Context-relevant recommendations for embedding capacity for innovation and flexibility into urban water governance (3.1) • Assessment of the regulatory factors helping or hindering the achievement of WSC in Vic, WA & Qld (3.2)	• Development of monetary and relative values for use in cost benefit analyses (1.1) • Water sensitive citizen typology identifying groupings of Australian householders based on their water knowledge, water behaviour and demographics (2.1) • Conceptual model of urban water regulation in Australian cities (3.2) • Development of a new model for the legal allocation of risk of harms from water sensitive practices (3.2) • Framework identifying personal and professional attributes that influence risk perceptions of alternative urban water practices (4.1)	• DAnCE4Water algorithm capable of modelling the integrated urban water system including feedbacks between the socio-economic system, urban form and water infrastructure (4.3)	• Novel method for improving non-market valuations (1.1) • Dynamic portfolio model of urban water supply capable of hedging against supply risks (1.1 & 1.2) • Guidelines for conducting costs benefit analyses of WSC projects (1.2) • Guidelines for undertaking non-market valuation ('willingness to pay') studies (1.2) • Development of crowdfunding method as an alternative funding model (1.3) • Roadmap capable of guiding behaviour change campaigns/strategies by identifying the potential uptake and impact of a suite of water conservation and water quality protection behaviours (2.2) • Database of empirically-tested 'community friendly' water-related terms, information and visuals designed to effectively engage citizens with water issues (2.3) • Guidelines for supporting governance reform through policy change (3.1) • Development of capacity-building approaches for researchers to influence policy and engage with stakeholders (3.3) • Guidelines for optimising the aesthetic design and acceptance of raingardens in suburban settings (4.1) • Guidelines for running participatory processes for strategic planning on transformative change towards WSC (4.2) • Web-based modelling platform designed to facilitate collaborative planning and decision-making processes (4.3) • Guidelines for the development of effective and

				robust water management strategies (4.3)
Program B	• Assessments of plausible futures for rapidly growing metropolitan/city-regions focusing on water security, urban growth, and planning policies (1.2) • Quantification of the benefits of WSUD/urban greening on urban climate and urban heat mitigation at a range of scales (3) • Evaluation of the benefits of improved urban climates on heat-health outcomes and human thermal comfort (3) • Determination of heat-health thresholds for Australian capital cities (3) • Identification of opportunities for synergistic enhancement of flood resilience (4.2) • Review of planning processes, policies and legislation relevant to WSUD across selected Australian cities (5.1) • Best practice planning policies and standards for applying WSUD to developments at different planning scales (5.1)	• Integrated greenspace framework for determining the essential 'green' components needed to link cities to their regional catchments, focusing on hydrological connections (1.2) • Conceptual city-region scale urban metabolism evaluation framework, including a methodology for calculating and representing the water budgets across multiple landscape types (1.2) • Development of conceptual models and indicators to assess the impact of stormwater harvesting on the hydrology and water quality of streams (2.1) • Development of a methodology for describing hydrologic hazards (4.1)	• Development of stochastic models capable of simulating current and future rainfall for Adelaide, Brisbane, Melbourne and Sydney (1.1) • Development of urban climate modelling tools that can be applied at different scales, including an urban heat component for the WSC Toolkit (3) • Development of a dynamic model for stormwater harvesting and treatment technologies (4.1) • Development of a module linking the flood risk modelling tool with the DAnCE4Water platform (4.1)	• Guidelines and training packages for statutory and non-statutory planners in the land use, environmental, landscape and natural resource management fields (1.2) • Decision-support framework guiding planners and managers in the repair of urban freshwater ecosystems (2.23) • Guidelines for WSUD in urban areas with a shallow water table (2.4) • Protocol for monitoring the flow of water and nutrients in urban areas with a shallow water table (2.4) • Policy guidelines for managing stormwater in urban areas with a shallow water table (2.4) • Development of an online spatial heat vulnerability mapping tool for Australian capital cities (3) • Guidelines for the design and placement of WSUD/urban greening interventions to maximise their effectiveness in improving urban climates (3) • Development of a flood risk modelling tool integrating an economic valuation of physical assets threatened by hydrological hazards (4.1) • Prototype development of software tool for an enhanced Adaptation Tipping Point method, and software based support tool for Real-In-Option application with guidance document (4.2)
Program C			• Models of WSUD treatment performance (pathogen and micro-pollutant removal) (1.1) • Development of novel urban wastewater technologies that support resource recovery (2.1) • Establishment of pilot processing plants to trial application of novel wastewater technologies (2.1) • Development of models to assess the impacts of integrating decentralised and centralised systems (3.1)	• Design, operational and maintenance guidelines for improved stormwater biofiltration units (including plant selection advice) (1.1) • Planning decision-support tool (UrbanBEATs). This includes a representation of WSUD systems and an integrated model that can assess performance of WSUD systems (1.1) • Guidelines for assessing risks associated with untreated stormwater (1.2) • Guidelines for the use, application and monitoring of validated novel natural treatment systems (1.3) • Decision-support tools and recommendations

			• Novel hybrid biofiltration technologies capable of treating multiple sources of water (4.1) • Software for data analysis of metered water use (5.1)	for optimising the interactions of centralised and decentralised systems (3.1) • Decision-support tools able to stimulate the behaviour of vegetation under certain conditions and quantify wetland ecosystem function (4.1) • Design, maintenance and operational guidelines for novel hybrid biofiltration technologies (4.1) • Decision-support tools for optimising delivery of multiple water sources (5.1)
Program D	• Documentation of the outcomes and insights from the application of the WSC Toolkit to specific locations (1) • Documentation of best practice case studies of WSUD (5.1) • Document outlining case study impacts arising from the Cities as Water Supply Catchments Program (6.1) • Snap-shot formative evaluation of the Synthesis Program (6.1)	• Development of industry engagement models specifically tailored to urban design issues related to WSUD (5.1) • Development of a nested evaluation and learning framework (6.1)		• Development of the Water Sensitive Cities Modelling Toolkit (WSC Toolkit)(1) • A professionally targeted Masters-level module (syllabus and teaching materials) introducing key concepts and approaches for delivering WSC outcomes (4.1) • A set of structured professional learning programs and courses designed to build the capacity of urban water practitioners to deliver WSC outcomes (4.1) • Design guidelines for WSUD precincts demonstrating the integration of social, spatial and environmental aspects at different scales (5.1) • Implementation plan to guide use of the evaluation framework (6.1) • Development of tools and methods to collect data (6.1) • Development of a WSC Index and indicator framework for assessing the water sensitivity of a place at the metropolitan and sub-metropolitan scales (6.2) • Development of a web-based platform containing online tools for self-assessment, visualisation and reporting (6.2)

Appendix I-B: Researchers' Impact Pathway Summaries

Project A1.1 Economic evaluation				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A1.1.1 Preferences for attributes of stormwater management: The study conducts choice and field experiments across local councils in metropolitan areas of New South Wales and Victoria. The analysis estimates preferences for five attributes of water management, and determine how preferences vary across socioeconomic and geographic determinants.	Water Utilities; Departments of Water; Local governments	From the current time	End-users have been engaged to help interpret the results. We have also advised end users on how to use the results in policy analysis and what work needs to complement the research.	– Water utilities and local governments are incorporating non-market values into cost benefit assessments and policy decisions. – Portfolio analysis is formally recognised by water utilities and economic regulation agencies as a valid approach to evaluating water supply investment decisions.
A1.1.2 Salient method: A novel method to improve non market valuation with choice experiments using financial incentives.	All levels of governments; water utilities; developers	From the current time	To communicate the findings regarding the appropriate public policy	
A1.1.3 Monetary and Relative Values: Values from a choice experiment and a hedonic market study, that can be directly used in Cost Benefit Analysis and are used in the toolkit.	Local councils; OLV; Water Companies; other CRC researchers	Currently, and as additional modelling assumptions are tested	Policy-makers have and will continue to use the monetary values directly and as inputs to other tools such as the Toolkit.	
A1.1.4 Hedging supply risks: An optimal urban water portfolio model: Dynamic portfolio model of urban water supply that hedges against supply risks from all potential water assets, by taking into account uncertainties of water flows as well as differences in supply costs.	Water utilities; economic regulators	From the current time	To engage with decision makers to encourage the diversification of the water supply portfolio as a way to deal with flow risk from natural water sources (reservoirs, stormwater etc.) and to think of water production and consumption as interrelated.	
A1.1.5 Policy recommendations regarding attribute ranking: Policy recommendations (through industry notes, the blueprint, and our publications) about how we can rank the various attributes.	State and Local government	From the current time	Policy can be made taking the community's preferences into account.	

Project A1.2 Valuation of economic, social and ecological costs and benefits				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A1.2.1 Collation and systematic documentation of existing knowledge on non-market values for WSUD: Structured literature review of existing knowledge & indexing of values into a data base	Water Utilities; Departments of Water; Local governments	From the current time	To check that users can readily interpret the information	– Water utilities and local governments are formally incorporating non-market values into cost benefit assessments – Portfolio analysis is formally recognised by water utilities and economic regulation agencies as a valid approach to evaluating water supply investment decisions – Local government are actively using the tools provides to rank investment projects and undertake non-market value studies.
A1.2.2 Case studies on decentralised water supply systems: (1) Estimation of private benefits from rainwater tank installations & subsequent application of a public-private benefit cost framework to evaluate policy responses. Case study (2) Integrated project evaluation of local government water recycling scheme to use treated wastewater on parks, open spaces, schools & playing fields	(1) Water utilities and State Government Departments of Water (2) Local Government Authorities	(1) Once the final version of the paper has been published (2) Nedlands during the project, and other LGAs once the final report has been completed	(1) To communicate findings on appropriate public policy (2) So that LGAs have a clear understanding of likely costs and benefits of local scale decentralised water recycling systems	
A1.2.3 Case studies on WSUD technologies: (1) An economic evaluation of rain gardens. (2) An economic evaluation of a living stream project. (3) The amenity value, recreational value, and ecosystem value of two CRC researcher designed constructed wetlands (Melbourne and China).	(1) Local governments (2) & (3) Local governments; Water utilities; economic regulators	Once a working paper has been completed	To communicate the findings so the information can be used in local decision making	
A1.2.4 Hedging supply risks: An optimal urban water portfolio model (Note from researcher - this is an overlapping output for A1.1): Dynamic portfolio model of urban water supply that hedges against supply risks from all potential water assets, by taking into account uncertainties of water flows as well as differences in supply costs.	Water utilities; economic regulators	In 2015 this research will form part of a Western Economic Forum	To engage with decision makers to change thinking regarding the identification of water supply investment priorities	
A1.2.5 Guidelines for Cost Benefit Assessment of Water Sensitive City Projects Practical guide to the process of cost benefit analysis: Guide, worked examples, and excel spreadsheets.	Local governments	Once the guidelines and support material are complete	To explain to stakeholders how to use the templates	
A1.2.6 Case studies on managing the waste water treatment plant and urban population interaction: Case study (1) Determine the non-market values and preferences for beneficial land uses in the odour buffers of Wastewater treatment plants and pumping stations. Case study (2) Identification and quantification of potential onsite and offsite impacts from cyanobacterial events for regional towns.	Water utilities in general and water corporation in particular	Throughout the project	To develop the modelling approach and communicate findings	
A1.2.7 Guidelines for how to undertake a non-market valuation study: Practical guide to conducting a willingness to pay study: Guide, example, open source code to estimate, support mp4 file	Local government	At the testing stage for the guide	To road test instruction manual and then to provide guidance on how to use the tool	
A1.2.8 Adaption of UK green infrastructure online toolkit: The adaption of an existing UK based online tool for evaluating green infrastructure nonmarket values.	Local governments	In 2016	To communicate how to use the tool	

Project A1.3 Economic incentives and instruments				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A1.3.1 Formal vs. informal policy mechanisms for monitoring pollution and improving environmental outcomes: The study on policy mechanisms compares a formal regulatory mechanism with informal peer monitoring and social sanctions and examines its effectiveness in reducing pollution in waterways as compared to formal regulatory approaches.	Departments of environmental protection (ex: DEPI); Local Governments	From the current time	To examine existing enforcement activities and think of new methods of enforcement. There is potential for conducting field experiments on different monitoring and enforcement policies.	– Water utilities and local governments are incorporating non-market values into cost benefit assessments and policy decisions. – Portfolio analysis is formally recognised by water utilities and economic regulation agencies as a valid approach to evaluating water supply investment decisions. – Local government are considering the crowdfunding mechanism.
A1.3.2 Social norms for water conservation: Analyses data on using social comparisons as a tool for water conservation from three randomized trials.	Water utilities	From the current time	Test out new methods for engaging with water customers. There are also interactions between social comparisons and other conservation programs (rebates, home water audits)	
A1.3.3 The cost-benefit analysis comprises a case study in Western Australia's Southern River catchment: The purpose of this work is to measure the rate at which emissions are changing. The case study will also assess the cost and benefits of different policies for reducing emissions including behaviour change among households, local authorities' policies and restrictions on developers.	Researchers; Local/State governments; water utilities; developers	From the current time	Policy interventions can include modifying existing garden styles which has an effect on housing values or requiring that housing estates have bio-filters to reduce the level of emissions.	
A1.3.4 Crowdfunding method: Crowdfunding establishes a new methodology for nonmarket valuation by creating markets for ecosystem services. The project makes a business case for WSUD by raising money from the community, and creates an adoption pathway for CRC research.	Local governments; developers; non-profits; other CRC researchers	Discontinued based on feedback from the CRC Program A leaders.	Many forms of communication have informed CRC partners about how crowdfunding works in practice. Several partners are interested in testing crowdfunding but need to find an appropriate project.	
A1.3.5 Policy recommendations about the use of incentives: Policy recommendations about the use of incentives to solve social dilemmas such as provision of public goods (urban water management being a good example of these).	State and Local governments	Currently for research design and participation, from 2016 for results	To inform state and local governments about ways that crowdfunding and other incentive mechanisms can be used successfully as alternative funding models.	

Project A2.1 Understanding social processes to achieve water sensitive futures				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A2.1.1 Report on history of water use in Australia: A historical analysis of water use in Australian households from 1788 – 2014 that identifies the social, physical, institutional, and cultural factors that have influenced water use during this period.	(1) Water utilities; policy makers in local and state government (2) Researchers within the CRC – Urban historians	The report will be distributed to partners when it is completed in September 2015	(1) Partners in Melbourne, Brisbane or Perth will be invited to request a presentation of the findings from the history project if they are interested. (2) The report will be useful for CRC researchers involved in the implementation of new technologies and policies so they can learn from the past.	
A2.1.2 Water sensitive citizen typology: A typology that identifies groupings of Australian householders that differ on their water knowledge, water behaviour and demographics.	Water utilities working with the local community; policy makers in local and state government; NGOs involved with consumers/communities	Some partners have been engaged since 2013 when the project started particularly through identification of behaviours included in the national survey. We have invited partners via email to provide input into the quantitative typology as it was developed in 2014 and early 2015.	Workshops were conducted with the industry partners to identify household consumer behaviours, which has informed subsequent phases of research on water behaviour. We invited selected partners to provide feedback via email on the content of the typology and how it fits with their own typologies. A report on the typology will be prepared for partners and distributed in September 2015.	– Water sensitive citizen typology is used by industry partners e.g., water managers working with communities and policy makers to target audiences (groups) for behaviour change. – Water managers use the water sensitive citizen typology to devise marketing strategies accordingly. – The water sensitive typology is used as a basis for funding decisions in terms of who to target to roll out new water sensitive design/technology (e.g., rain gardens)

Project A2.2 Accelerating transitions to water Sensitive cities by influencing behaviour				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A2.2.1 Prioritised roadmap of household water behaviours for change: The roadmap identifies the impact & potential uptake of a set of water conservation and water quality protection behaviours to provide guidance on which behaviours to target in campaigns	Water utilities; policy makers in local and state government; NGOs involved with consumers/communities; residents	They have been engaged since 2013 when the project started. Results are being disseminated through reports, presentations.	Stakeholders were consulted in creating a behavioural assessment database which assesses water sensitive behaviours for the impact that they can make on the problem (i.e. flooding risk, drought susceptibility and pollution) as well as the likelihood that people will take them up if asked. This database can be used by the water industry to assess target behaviours before attempting to influence them. This behavioural assessment database developed in consultation with the water professionals will inform the prioritised roadmap of household water sensitive behaviours.	The prioritised roadmap of household water behaviours is used by water professional seeking to change behaviour to make decisions about which behaviours to target.
A2.2.2 Recommendations for effective behaviour change strategies: Evidence–based behaviour change strategies that can be used to promote more water conservation or water quality protection in households	Water utilities; policy makers in local and state government	They have been engaged since 2013 when the project started. Results are being disseminated through reports, presentations.	Test the efficacy of market, social marketing and regulatory tools for influencing behaviour.	– Policy-maker and NGOs tasked with promoting more water sensitive behaviours are guided by these recommendations, that is, they use the recommended strategies in their programs and campaigns. – There is greater uptake of water sensitive behaviours (and therefore decreased water use and increase engagement in water quality protection behaviours) when these recommendations are followed.

Project A2.3 Engaging communities with water sensitive cities				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A2.3.1 Report on Australian water literacy: An assessment based on a national survey of current levels of knowledge about key water issues amongst Australian citizens.	Water utilities; Local government; water utilities; & NGOs involved in community engagement	They have been engaged from the beginning of the project and results are being sent through as they become available	Initial interviews with a range of actors from these sectors fed into water literacy questions; ongoing engagement increases the likelihood that findings can inform programs	Report used to guide decisions about what engagement activities should be focused in and funded by local government, water utilities, & NGOs.
A2.3.2 Database of community friendly water terminology and visuals: An empirically tested set of water-related terms, information, and visuals that are comprehensible and engage citizens with water issues.	(1) Local government; water utilities; & NGOs involved in community engagement (2) Biophysical water researchers in the CRC & beyond	(1) They have been engaged from the beginning of the project (2) As the results become available	(1) Initial interviews were conducted to gain an understanding of the education & engagement programs that are currently being conducted in the sector (2) To gain feedback on results & disseminate our findings	– The terms & visuals are incorporated into engagement and education programs within local government, water utilities, & NGOs – Engagement and education programs are shown to be more effective with the incorporation of the terminology/visuals – Engagement and education programs increase citizens' connection to their community.
A2.3.3 Best practice recommendations for community engagement about sustainable urban water management: A set of recommendations informed by systematic review of the national & international literature and project-based experimental studies.	Local government; water utilities; & NGOs involved in community engagement	They have been engaged from the beginning of the project and results are being sent through as they become available (N.B. results still to be shared pending approval of report)	To gain feedback on results & disseminate findings	– The recommendations are used to guide community engagement programs run by local government, water utilities and NGOs – Local government, water utilities and NGOs report better outcomes when following the recommendations – Effective community engagement programs result in increases in citizens' connection to their community

Project A3.1 Better governance for complex decision making				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A3.1.1 New knowledge of urban water governance systems (both in Australia and beyond)	State government policy makers and regulators from relevant departments and agencies; Local government water, environment and planning staff; Water utilities	These users may find preliminary results of interest. These results will be related to levels of government but not to specific organisations.	There should be engagement to test insights into the realities of urban water governance in different Australian jurisdictions	– New governmental policies and regulations incorporate identified mechanisms to support innovation, increase flexibility, and require collaboration. – Policy processes are designed based on the project's recommendations for incorporating evidence-based and inclusive processes. – Water governance objectives in each jurisdiction are supported by integrated administrative and regulatory frameworks, with monitoring and evaluation components. – Water governance arrangements demonstrate responsiveness and adaptability in the face of change in operational conditions.
A3.1.2 Context-relevant recommendations of governance structures and strategies to support innovation and adaptability: Success-factors and best practice approaches to embed capacity for innovation and flexibility into urban water governance	State government policy makers and regulators from relevant departments and agencies; Industry associations	This evidence will not be available or tested till the later stages of the research project	These users will need to be engaged to test (using their expertise and experience) where particular recommendations will be relevant, and under what conditions	
A3.1.3 Guidelines to support governance reform through policy change: to help industry partners identify barriers and opportunities for change within their policy context, and design collaborative strategies to pursue change agendas	State government policy makers from relevant departments and agencies; Local government water, environment and planning staff; Water utilities	Engagement on this output of the research will be sought in the later stage of the research from early 2016	Engagement will be needed to test and refine the guidelines developed, to ensure their usefulness to this audience	

Project A3.2 Better regulatory framework for water sensitive cities				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A3.2.1 Legislative Stocktake Reports - Victoria, Western Australia and Queensland: A review of the existing legislation based regulatory frameworks across three Australian jurisdictions and an assessment of the capacity of such frameworks to help or hinder WSC	Water utilities; government departments; and legal practitioners in the urban water sector and researchers in other CRCWSC projects.	A sub-project level stakeholder reference group (comprising of representatives from water utilities, independent regulators and government departments) has been engaged in this research since October 2013.	To inform stakeholders and the wider industry community about the findings of this research.	The stocktake regulatory reports and the comparative report provide tools for understanding existing regulatory influences on the urban water sector and thus the context for well-informed change.
A3.2.2 Conceptual model of Australian urban water regulation: A conceptual model of urban water regulation in Australian cities and a detailed mapping of the systems for such regulation in Melbourne	Water utilities; government departments; other practitioners in the urban water sector; and researchers in other CRCWSC projects		To inform stakeholders and the wider industry community about the findings of this research and to test this against the practices of water practitioners.	The conceptual model of regulation supports new insights into the existing regulatory system and the generation of a new language with which to discuss these influences
A3.2.3 Comparative analysis of Australian regulatory frameworks report: A multi-jurisdictional comparative analysis of current regulatory frameworks for urban water regulation with recommendations			To inform stakeholders and the wider industry community about the findings of this research.	As per Output **A3.2.1**
A3.2.4 Case Study reports on regulation: Report case study which explores how current regulatory frameworks influence and impact upon actual attempts to implement water sensitive innovations			To inform case study selection and to inform stakeholders and the wider industry community about the findings of this research.	Case study analyses, which demonstrate the enabling environment required for evidence-based innovation, will inform public debate and decision-making.
A3.2.5 Risk allocation model: The development of a new model for the legal allocation of the risk of harms from water sensitive practices	Water utilities; government departments; other practitioners in the urban water sector; and researchers in other CRCWSC projects	A sub-project level stakeholder reference group (comprising of representatives from water utilities, independent regulators and government departments) has been engaged in this research since November 2014.	Initially, the researchers will be consulting with key industry stakeholders to test the conceptual frame and to inform illustrative examples of successful and unsuccessful risk allocation to support development of the new model. Future engagement will involve testing of the model with targeted stakeholders.	The risk allocation model generates a new model for the legal allocation of the risks of harms from water sensitive innovation. Adoption of the model by practitioners would demonstrate such achievement.

Project A3.3 Strategies for influencing the political dynamics of decision-making				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A3.3.1 Literature reviews and industry notes on political dynamics, policy frameworks, tactics and strategies for researchers to influence policy: A two-part literature review, focusing on: (1) policy frameworks and theoretical aspects of political dynamics; and (2) tactics and strategies for influencing policy. Industry notes will summarise key aspects for simpler communication.	Researchers in other CRCWSC projects; water utilities; government departments; and other practitioners in the urban water sector	Users should become engaged once final versions are published	As an input to further engagement on policy processes	Researchers and practitioners will refer to this output when engaging with policy-makers.
A3.3.2 Case study reports of urban water policy development in Victoria, Queensland and Western Australia: Reports of case study research, focusing on Victoria (the establishment of the Office of Living Victoria), Queensland (to be finalised) and Western Australia (to be finalised). The core of this report will be an extended analysis of the Victorian case, with Queensland and WA cases being used for comparative purposes, rather than being as fully developed.	Researchers in other CRCWSC projects; water utilities; government departments; and other practitioners in the urban water sector	During the interview phase and once reports are published	To ensure that the picture of each case study context is accurate and representative of different perspectives. To learn from these examples of contemporary urban water policy development.	Users in these case study contexts will reflect on lessons learned and look to improve policy-development processes.
A3.3.3 Development and testing of capacity-building approaches for researchers to influence policy: Design and testing of capacity-building approaches (e.g. interactive workshops, panels, etc.) for researchers to influence policy and engage with stakeholders (e.g. media, policy, etc.). It is now proposed that outputs will be rolled out on-line, starting now and running though to June 30, 2015, the object being an integrated set of on-line tools that can also be issued if needed as a hard-copy manual for CRC researchers and stakeholders.	Researchers in other CRCWSC projects	In the months leading up to a capacity-building workshop in July 2015, then following the event	To develop clear proposals from researchers pitched to policy-makers that would see CRCWSC research adopted. To provide professional development opportunities to researchers in providing advice to policy-makers. To enhance the understanding of policy and political processes among researchers	Researchers will actively advocate research to policy.

Project A4.1 Society and institutions				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A4.1.1 Aesthetic design guidelines for raingardens: Design guidelines for optimising aesthetic appreciation and acceptance of raingardens in suburban settings.	Local government; water utilities; consultants	Once the guidelines have been developed in draft form, early in 2015	This engagement will reveal any inconsistencies between what is desirable in the design of raingardens and what is practically possible. These users will also have tacit knowledge about the design of raingardens, which can complement empirically derived guidelines.	Incorporation of the raingarden design guidelines into operation manuals within local government, water utilities, etc.
A4.1.2 Analytical framework for risk perceptions: Framework identifying personal and professional attributes that might influence perceived risk of alternative urban water systems and sources, in order to understand and anticipate possible risk perceptions.	State government; local government; water utilities; NGOs; private enterprise; community groups	These users have been engaged with the research from its inception, early in 2010.	This framework was developed from the literature, as background to an empirical study of Australian urban water practitioners risk perceptions of alternative urban water systems and sources. See Output 3. Further input would be desirable, to validate the framework through discussions with representatives of the various users.	Incorporation of the framework into urban water management guidelines used by Federal government, State government, local government and water utilities.
A4.1.3 Report on current risk perceptions of Australian urban water practitioners towards alternative urban water systems, technologies and sources: Report drawing together conclusions from empirical study of risk perceptions of Australian urban water practitioners towards alternative urban water systems, technologies and sources, highlighting barriers to their implementation in the WSC.	State government; local government; water utilities; NGOs; private enterprise; community groups	These users have been engaged with the research from its inception, early in 2010.	These users were engaged from the start as they are the subject of the research as well as its target audience. They were engaged: i) to recruit participants in a national online survey; ii) to participate in the survey; iii) to validate the preliminary results of the analysis.	– Acknowledgement by Federal government, State government, local government, water utilities, and other stakeholders as appropriate, of the importance of risk perceptions in urban water management, evidenced by reference to these risk perceptions in relevant decision-support tools. – Incorporation in best-practice manuals activities to identify and manage perceived risks of stakeholders involved in urban water management.
A4.1.4 Benchmarking Water Sensitive Cities: Industry report providing guidance on benchmarking and building transition pathways.	Urban water policy and planning strategists	Once the guidance manual has been developed in draft form	This output will aid end-users to identify needs to support a transition pathway.	Incorporation of the guidance manual into policy and planning guidelines used by Federal, State and local government.

A4.1.5 Project Synthesis Report: This report will bring together in one platform the many but inter-related outputs arising from the different sub-projects. It will provide insights from A4.1 on the uptake and mainstreaming of decentralised technologies from the perspective of governance, risk and risk perception.	Broad range of stakeholders from local and state government, and private industry	Once the report has been developed in draft form	This output will provide end-users with a descriptive snapshot of the full suite of reports and tools that have emerged from this project, and will also provide guidance on how to use them.	Number of downloads of the report

Project A4.2 Mapping water sensitive city scenarios				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A4.2.1 Guidance manual: Guidelines for facilitating participatory processes with community and professional stakeholders to guide WSC transition planning, drawing on envisioning and backcasting techniques.	Government agencies; local governments; and water utilities		To participate in the process, become familiar with it and recognise the value in such processes	
A4.2.2 Report on Elwood water sensitive city transition scenarios: Report documenting a local community vision and transition strategy Elwood for Melbourne.	Government agencies; water utilities; local governments; and local community members	City of Port Phillip is engaged as participants in the local community workshop series (Elwood).	To provide contextually relevant insight into the process and workshop discussions	– Formal strategic planning by government agencies, water utilities and local governments explicitly incorporate transition scenario processes – Transition scenario content (visions and strategies) for each city are utilised by relevant actors in framing strategic thinking and planning documents
A4.2.3 Report on Perth water sensitive city transition scenarios: Report documenting a metropolitan scale vision and strategic transition framework for Perth.		Perth stakeholders are engaged as participants in the metropolitan-scale professionals' workshop series (Perth).		
A4.2.4 Report on other water sensitive city transition scenarios: Report documenting transition scenarios for other cities, integrating different stakeholder perspectives.		Other city stakeholders to be engaged with once focus locations are decided		

Project A4.3 Socio-technical modelling tools to examine urban water management scenarios				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
A4.3.1 Computational algorithms modelling the integrated urban water system including socio-economic system, urban form and water infrastructure systems: DAnCE4Water's algorithms will produce detailed insight into the dynamic feedbacks between the socio-economic system, urban form and water infrastructure in response to water management strategies. These strategies may be structural (involving the placement of centralised or decentralised water infrastructure systems within the urban form), or non-structural (such as financial incentives, water restrictions or planning regulations)	1. Water Utilities 2. Government Agency 3. Planning agencies (Growth authorities) 4. Local Government 5. Planners 6. Researchers within the CRC 7. Software Developers 8. Community	1. Early 2. Early 3. Late 4. Mid 5. Mid 6. Mid 7. Mid 8. Late	1. Some utilities are engaged in the development and testing phase of the tool particularly of the biophysical components of the planning tool. Further to validate the tool and build trust as basis for wide spread adaptation 2. Key government agencies should be engaged in the development phase of to test and refined the strategic planning process and algorithms that model the interactions between different aspects of the urban system. Later to apply the tool to enhance existing planning processes to support wide spread adaptation through industry. 3. Participation in industry courses to communicate results and to refine the guidelines and recommendations as outcomes of the case studies. 4. Local government will be involved in a participatory process the test and refine the strategic planning process to identify robust solutions 5. Engagement late in the project the refine the communication of results and the validation the developed algorithms 6. During the development phase of the strategic planning process to identify opportunities for integrative case studies to apply and demonstrate the tool. (e.g. currently Ellwood) 7. During the development of particularly the biophysical components to integrate existing software tools into the platform. 8. Engagement during workshops and through the website itself to refine the use of the tool and the communication of results	– Tool is used by government organisations, water utilities local authorities and planners – Collaborative strategic planning processes are used by organisations. – Good attendance of training workshops – Tool is further developed by the wider community
A4.3.2 A web-based platform to facilitate collaborative planning and decision-making processes: Outputs and insights from the project will be consolidated on a user friendly web-based modelling platform designed to facilitate collaborative planning and decision-making processes. Users from different organisations will be able to access common sets of urban data, future scenarios and management strategies via the DAnCE4Water platform, enabling planners and decision-makers to explore water management opportunities and implications across organisational boundaries and at multiple scales.				
A4.3.3 Demonstration and application of DAnCE4Water in regional and community scale case studies: Application of DAnCE4Water to a regional case study in Melbourne, in which the dynamic responses of the integrated urban water system to different water management strategies will be tested.				
A4.3.4 Guidance and recommendations of how to develop effective and robust water management strategies: Guidance and recommendations of how to develop water management strategies that are effective and robust under a variety of climate change, population growth and societal change scenarios to increase the resilience of the water system.				
A4.3.5 Industry short-courses to facilitate widespread industry uptake of the tool: The DAnCE4Water platform will be supported by a software manual, tutorials and industry short-courses to facilitate widespread industry uptake. It will be developed as an open source product and will incorporate interfaces with commonly used water industry models (e.g. MUSIC, SWMM) to complement and add value to the existing set of tools available to support decision-making in the Australian water industry.				

Project B1.1 Urban rainfall in a changing climate				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
B1.1.1 A stochastic model appropriate for downscaling rainfall to scales relevant for the design of water harvesting technologies: Development of a model based on multi-fractal cascades suitable for high-resolution ensemble simulation along with a reliable estimate of the uncertainty.	CRC WSC Program D2a	Throughout the lifetime of the project.	The project team will be working with Project D2a on the required rainfall data.	The National University of Singapore has become very interested in this work and has signed a research collaboration contract with the CRC WSC. The stochastic model is currently being implemented in Singapore.
B1.1.2 Stochastic rainfall simulation of the current climate: Simulation of statistical properties of the current rainfall in Adelaide, Brisbane, Melbourne and Sydney.	CRC WSC Program D2a	Throughout the lifetime of the project.	The project team will be working with Project D2a on the required rainfall data.	The direct impact of the work would be that the data are incorporated into the integrated software tool for strategic planning and conceptual design of stormwater harvesting and use systems, and that the integrated software tools was used by local government etc.
B1.1.3 Stochastic rainfall simulation of future climates: High-resolution projections of the future rainfall for Adelaide, Brisbane, Melbourne and Sydney together, along with reliable estimates of the uncertainty in these projections.	CRC WSC Program D2a	Throughout the lifetime of the project.	The project team will be working with Project D2a on the required rainfall data.	
Project B1.3 Impact of climate change on extreme rainfall and drainage design				
B1.3.1 Stochastic rainfall simulation of future climates in Singapore	National University of Singapore and Singapore National Environment Agency	Throughout the lifetime of the project	To transfer the technology from the CRSWSC to the Singapore partners.	The National University of Singapore is funding part of this work through a research collaboration contract with the CRC WSC. The stochastic model has been implemented in Singapore.

Project B1.2 Catchment-scale landscape planning for water sensitive city-regions in an age of climate change				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
B1.2.1 Statutory & non-statutory planning systems assessment: Comparative assessment of the statutory and non-statutory planning systems for the case study regions (i.e. SEQ, Greater Melbourne and Greater Perth).	State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB), Land Developers, Consultants, General public	Continual engagement throughout the project. Formal engagement of key stakeholders is through the Project Reference Group (PRG)	To be informed of user's key issues and priorities relevant to project. To access data and insights from user networks. To convey research findings to users. To confirm appropriate forms of output to meet user.	Users (e.g. State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities and Natural Resource Management bodies, Land Developers, Consultants) utilise and incorporate findings into their respective plans. General public become increasingly articulate in the subject matter documented in outputs.
B1.2.2 An integrated greenspace framework: Determination of the essential components of an integrated greenspace framework (incorporating natural ecosystems and green infrastructure) linking the city to its regional catchments with emphasis on critical surface and subsurface hydrological connections (to be subsequently refined as outputs from other Program B projects become progressively available).				
B1.2.3 A conceptual city-region scale urban metabolism evaluation framework: Conceptualisation of a city-region scale urban metabolism evaluation framework including a methodology for calculating and representing the water budgets across multiple landscape types in the three case study city-regions.	State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB)	From January 2014. Formal engagement of key stakeholders is through the Project Reference Group (PRG)		Planning agencies, water utilities, CMAs and NRMBs incorporate city-region scale urban metabolism thinking in the preparation of their statutory and non-statutory plans, Catchment Action / NRM Plans.
B1.2.4 Scenarios of plausible futures for rapidly growing metropolitan/city-regions (i.e. three case study regions): These scenarios will provide decision makers with a 'test bed' for their intended policies, thus assisting them to address water sensitive urbanism issues in an environment characterised by high degree of uncertainty and inconclusive science associated with climate change and population growth.	State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB), Land Developers, Consultants, General public	From June 2015.Formal engagement of key stakeholders is through the Project Reference Group (PRG)	To engage key stakeholders in the development of the case study related scenarios	Users (e.g. State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities and Natural Resource Management bodies) utilise and incorporate thinking into their respective planning processes.
B1.2.5 Water security assessment of the three case study city-regions: A strategic assessment of the future of each case study region in terms of water security utilising a city-region / whole-of-catchment systems model incorporating a modified urban metabolism framework to evaluate regional	State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource	Continual engagement throughout the project. Formal engagement of key stakeholders is through the Project Reference Group	To be informed of user's key issues and priorities relevant to project. To access data and insights from user networks. To convey research findings	Users (e.g. planning agencies, water utilities, CMAs and NRMBs) incorporate outputs into their statutory and non-statutory plans, Catchment Action / NRM Plans

scale water budgets across multiple landscape types.	Management bodies (NRMB)	(PRG)	to users. To confirm appropriate forms of output to meet user.	
B1.2.6 Growth scenarios report detailing methods for incorporating ecological and water science into statutory planning: Documentation of scenarios for rapidly growing metropolitan regions utilising whole-of-landscape regional scale to ecologically and hydrologically link cities to their regions.	State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB), Land Developers, Consultants, General public	From June 2015.Formal engagement of key stakeholders is through the Project Reference Group (PRG)	To engage key stakeholders in the development of the case study related scenarios	Users (e.g. State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities and Natural Resource Management bodies) utilise and incorporate findings into their respective plans. Land Developers, Consultants and General public become increasingly articulate in the subject matter documented in outputs and commence to utilise science informed planning in their activities.
B1.2.7 Assessment of planning policies under various growth scenarios for three case study city-regions: Documentation of initial policy 'test bed' model which allows planners/policy makers to test policy impacts under multiple plausible growth scenarios has been provided to end users from city regions.		From June 2015.Formal engagement of key stakeholders is through the Project Reference Group (PRG)	To engage key stakeholders in the assessment of planning policies within the context of the scenarios with respect to the case study regions	Users (e.g. State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities and Natural Resource Management bodies) utilise and incorporate findings into their respective plans. Land Developers, Consultants and General public become increasingly articulate in the subject matter documented in outputs in their activities.
B1.2.8 Guidelines: Guidelines and training packages for statutory and non-statutory planners in the land use, environmental, landscape and natural resource management fields.		Continual engagement throughout the project. Formal engagement of key stakeholders is through the Project Reference Group (PRG)	To access user networks in order to facilitate dissemination and uptake. To convey research findings to users. To confirm appropriate forms of output to meet user.	Users (e.g. State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities and Natural Resource Management bodies, Land Developers and Consultants) utilise and incorporate guidelines into their respective planning practices. General public become increasingly articulate in the subject matter documented in guidelines.

Project B2.1 Stream ecology				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
B2.1.1 Conceptual models and indicators to underpin stormwater harvesting operating guidelines: Indicators, such as runoff frequency or rainfall retention capacity, were developed and used to assess the impact of stormwater harvesting on the hydrology and water quality of streams. This was followed by the development of predictive models of likely ecological and geomorphic responses.	Local and state government departments responsible for managing urban stream health and stormwater; urban planners and catchment managers	Ongoing development with authorities (specifically Melbourne Water and Department of Environment, Land, Water and Planning)	To co-develop, and test, concepts and indicators that assist in managing stormwater for the benefit of receiving waters.	
B2.1.2 Case studies: Case studies of hydrologic restoration using stormwater harvesting and other stormwater retention strategies.		Ongoing development with authorities (specifically Melbourne Water)	To test stormwater control measures and develop design guidelines	

Project B2.23 Planning, design and management to protect and restore receiving waters				
Output	***WHO** are the users of your research (actors)*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
B2.23.1 Decision support framework for the repair and protection of urban freshwaters. A tool that presents a decision support framework to guide urban planning and urban stream management, about how best to repair or maintain ecologically important drivers of stream health and prioritise on-ground effort to achieve desired ecological goals.	1) Environmental Policy Developers (Department of Water, Melbourne Water, Water Corp., WA Dept. Planning) 2) River Managers (Swan River Trust), 3) Local Government, 4) Developers and Consultants including community groups (e.g. SERCUL)	1) Environmental Policy Developers have been engaged since the start of the project (dominant engagement partner) 2) River Managers have been engaged since the start of the project. 3) Local Government Agencies should be engaged during the review of the framework for their feedback 4) Developers and Consultants should be engaged during the review of the guidelines for their feedback. SERCUL has been engaged since the start of the project. All of these end users have been engaged since the commencement of the project in a formal project reference group and informally on an as needs basis throughout the project.	1)To identify policy needs and to understand the limitations surrounding the restoration of urban freshwaters – so that the guidelines are relevant and informative 2)To understand the format that is most easily understood and digestible by the target audience 3)To understand the level of complexity/simplicity that is appropriate for adoption of the guidelines 4)To be informed of documents currently used by managers and their benefits/limitations All) To share ideas and knowledge. To identify the spatial scale at which variation in management is relevant. To ensure that conceptual models match with regional knowledge. To ensure the tool is useful for management.	– The intended users of the research are using the framework as part of their planning and repair of urban freshwaters. – Greater ecological benefits achieved by on-ground restoration of urban freshwaters (long term goal may be difficult to measure over short term) – The actors undertaking local restoration projects are aware of landscape-scale issues which may affect the success of their work – State policy agencies consider city-wide (landscape) biodiversity goals when planning future urban development and when planning the location of urban restoration effort
B2.23.2 Recommendations on the importance of vegetation for nitrogen processing in urban wetlands. A report that outlines how vegetation can alter the rates of nitrogen transformations, including denitrification, in urban wetlands.	As per Output **B2.23.1**	From the commencement of this project.	To ensure that the major findings are understood and can be framed in terms of realistic management actions and strategies. To share ideas and knowledge.	Urban wetland management includes direct consideration of the role of vegetation in nutrient reduction strategies.

Project B2.4 Hydrology and nutrient transport processes in groundwater surface water systems				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
B2.4.1 Meta-analysis: A meta-analysis of existing urban water monitoring datasets from the Swan Coastal Plain in Western Australia, and other areas around the globe with a shallow water table (2 – 4 m below ground).	1) Local Government (LGA) 2) Australian and International researchers (AIR) 3) Environmental Policy Developers (EPD, e.g. Department of Water, Water Corporation) 4) River Managers (RM, e.g. Swan River Trust)	1) LGAs have been engaged since project start in July 2013 2) AIRs have been engaged since project start in July 2013 3) EPDs have been engaged since project start in July 2013 4) RMs have been engaged since project start in July 2013	Excellent knowledge base in this sector. Project needs to tap into this knowledge base. Project was provided with minimal operating budget from CRC. It was critical to engage with all stakeholders to ensure dovetailing to on-going projects to keep monitoring costs down. Engagement ensures rapid dissemination of preliminary findings and research outcomes.	More comprehensive monitoring is undertaken by regulatory agencies and LGAs, Less tick-the-box monitoring.
B2.4.2 Report on data and knowledge gaps: An identification of urban water data and knowledge gaps for urban systems impacted by groundwater.				More focussed monitoring to address data gaps.
B2.4.3 Mass balances: Event-based and seasonal water and nutrient mass balances for WSUD elements impacted by a shallow water table (2 – 4 m below ground), e.g. infiltration coefficients urban areas with shallow water table.				LGAs developing guidelines that encompass operational challenges in areas of shallow water table, including groundwater flood mitigation.
B2.4.4 Nutrient load quantification: Quantification of groundwater-borne nutrient load to receiving water bodies.				Re-focus of monitoring requirements to include quantification of groundwater nutrient loads, as well as surface stormwater nutrients.
B2.4.5 Guidelines: Guidelines for WSUD design in urban areas with a shallow water table (2 – 4 m below ground).	As above with the addition of: Industry/Consultants (IC, e.g. land developers, urban land care groups	ICs have been engaged since project start in July 2013		Guidelines re-focussed to include management groundwater nutrients, as well as surface stormwater nutrients.
B2.4.6 Protocol: A protocol for urban water monitoring of flow and nutrients in areas with a shallow water table (2 – 4 m below ground).	As per B2.4.5 minus AIRs	As per B2.4.5 minus AIRs		Protocols established to monitor shallow water tables, and groundwater surface water interactions.
B2.4.7 Policy: Input to policy frameworks for management of stormwater in urban areas with a shallow water table (2 – 4 m below ground).	As per B2.4.5 minus AIRs	As per B2.4.5 minus AIRs		Policy established to require management of groundwater surface water interactions in the urban setting.

Project B3.1 'Green cities and microclimate' & Project B3.2 'The design of the public realm to enhance urban microclimates'				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
B3.1 Quantification of the benefits of water sensitive urban design and urban greening on the urban climate and urban heat mitigation at a range of scales: A combination of observational (including remote sensing) and climate modelling approaches is used to quantify the potential air temperature reductions and changes to human thermal comfort from the implementation of WSUD and urban greening. The focus moves through a process of observations → model validation → scenario modelling. Focus moves from the micro-scale (street) → local-scale (neighbourhood) → meso-scale (city).	Local and State Government, Water utilities, Developers, Urban Planners, Consultants, General public	Currently engaged and will continue throughout the project.	To convey research findings to users. To help refine research objectives to meet the needs of users. To provide insight on 'on the ground' issues not considered by researchers.	Users (e.g. Local and State Government, Water utilities, Developers, Urban Planners, Consultants) are incorporating evidence of the cooling effect of WSUD and urban greening into policy and planning (e.g. Local Government Urban Forest Strategies).
B3.2 Evaluation of the benefits of improved urban climates on *heat-health outcomes*: This output has two components: 1) Documenting heat-health thresholds for Australian capital cities and the spatial variability in heat vulnerability throughout cities; and 2) Determining the effect on heat-health outcomes of urban heat mitigation (air temperature reductions) from WSUD and urban greening.	Government health departments, community health organisations, disability services, emergency services, Local Government, State Government, general public	Currently engaged and users are already applying outputs.	To promote the work and uptake of the research findings to ensure broad dissemination across industry.	Authorities responsible for *heat-health outcomes* are promoting WSUD and urban greening as a means of proactively reducing heat exposure.
B3.3 Evaluation of the benefits of improved urban climates on *Human Thermal Comfort*: This output has two components: 1) Documenting levels of Human Thermal Comfort in Australian Cities 2) Determining the effect of WSUD and urban greening on human thermal comfort (including air temperature, humidity, wind speed and mean radiant temperature)	Urban planners, architects, local government, developers, water authorities, general public	Currently engaged and will continue throughout the project.	To promote the work and uptake of the research findings to ensure broad dissemination across industry.	Local government are actively using the tools provides to rank investment projects and undertake non-market value studies.
B3.4 Framework for the implementation of WSUD and urban greening for improved urban climate: Develop a framework for the strategic implementation of WSUD and urban greening	Local Government, urban planners and developers	Users were engaged in the development of the framework.	Engagement helped inform the development of the framework and the sharing of data throughout its development	Users apply the implementation framework when planning and rolling out WSUD and urban greening. The framework is used as a basis for

based on research to maximise the cost-effectiveness of interventions and minimise the negative impacts of urban climates				prioritising investment.
B3.5 Guidelines on the design of WSUD and urban greening for improved urban climate: Provide practical guidance on the design and placement of WSUD and urban greening interventions to maximise their effectiveness in improving urban climates. Guidance stems from both the observational research and the climate modelling research.	Local governments, engineers, stormwater industry, urban planners and architects, water authorities	Used should engage during the analysis and interpretation of results, and in design recommendations.	To disseminate information, and to highlight design considerations and complexity.	Users apply the design guidelines for improved urban climate when the implementation of WSUD and urban greening *specifically targets* urban heat mitigation and human thermal comfort.
B3.6 Spatial heat vulnerability mapping: Develop an online tool that maps heat vulnerability of the population for Australian capital cities which can be used to inform heat mitigation approaches.	State government, local governments, consultants, NGOs, emergency services agencies, other (non-CRCWSC) researchers	Currently engaged and users are already applying outputs.	Engagement is required to assist in roll out of WSUD in the community and to assist authorities to manage heat and climate change at a range of spatial scales.	Australia-wide adoption, at the local government level, of our heat vulnerability approach and maps for identification of vulnerable communities and prioritisation of remediation (e.g. WSUD and green infrastructure).
B3.7 Heat threshold for Australian capital cities: Determine climatic based thresholds (e.g. air temperature, apparent temperature) for Australian capital cities at which impacts on human health increase. These thresholds can act as a target for urban heat mitigation through WSUD and urban greening.	State government departments, consultants, emergency services, World Health Organisation/World Meteorological Organisation, other (non-CRCWSC) researchers	Currently engaged and users are already applying outputs.	To reduce adverse health impacts and death in Australian populations and to provide benchmarks against which we can usefully measure heat reductions using WSUD and green infrastructure.	Australian and international recognition of the utility of our heat-health threshold approach for developing heat watch warning systems and benchmarking for heat mitigation by WSUD and green infrastructure.
B3.8 Urban heat component of the Water Sensitive Cities Toolkit: Incorporate a simple approach for assessing the benefit of WSUD and urban greening into the Water Sensitive Cities Toolkit to assist users in planning and decision-making. Ongoing contributions will be made throughout the project.	Water authorities, Local governments, urban planners and developers, State government departments (planning, water, environment)	Currently engaged.	To learn how to use the tool, and to apply the tool to their individual circumstances. This tool is directly usable by industry.	Evidence of the use of the WSC toolkit and the consideration of urban heat mitigation in designing urban spaces.
B3.9 Urban climate modelling tools: Review, select, validate and apply urban climate models that are appropriate to scale (micro-, local- and meso-scale). Develop and/or improve models where necessary.	Water authorities, Local governments, urban planners and developers, State government departments (planning, water, environment)	Engagement can begin following the completion of model validation.	The purpose is to help inform scenario modelling to ensure scenarios are realistic and information is useable. These tools need to be applied in collaboration with researchers.	Evidence of the application of urban climate modelling in developing practical and relevant scenarios for users and stakeholders to inform decision-making.

Project B4.1 Social-technical flood resilience in water sensitive cities –quantitative spatio-temporal flood risk modelling in an urban context				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
B4.1.1 Hydrological hazards methods: Methods for describing concurrent hydrologic hazards are developed and applied on Danish and Australian case studies.	State and local government, land planning departments	Primarily after the methods have been tested and validated in an Australian context.	As users, to compare the impacts of a combined risk assessment and a state-of-the-art single hazards assessment.	The methods are being applied where concurrent hazards may be an important aspect of the overall flood risk assessment.
B4.1.2 Stormwater technologies model: A dynamic model for stormwater harvesting and treatment technologies with focus on describing how the technologies should be modelled as part of flood risk assessments.	1) Water utilities and planners 2) Urban Drainage modellers	1) As tools become available 2) During development of code of conduct and as a dialogue after release.	1) Understanding of key processes and limitations of modelling capability 2) The engagement is mutually beneficial as research and practitioners both influence the code of conduct.	The need for better models and a code of conduct has been recognized by at least three local governments.
B4.1.3 Flood risk modelling tool: A flood risk modelling tool which integrates an economic valuation of physical assets threatened by these hydrological hazards	State and local government	As soon as first versions have been developed.	To provide feedback on the implemented methodologies (applicability in practice, potential issues that are known by the practitioners but have not been addressed in the framework), and to test the framework for the development of adaption strategies.	The framework is applied in flood risk assessment and the results incorporated into city planning practices in at least one local government.
B4.1.4 Module linking flood risk modelling tool with DAnCE4Water: A module that dynamically links the integrated flood risk modelling tool with the DAnCE4Water platform (Dynamic Adaptation for enabling City Evolution for Water) with the purpose of testing strategies for ensuring urban flood resilience.	1) Local governments and utilities 2) Researchers	1) During development, by helping in defining and quantifying costs and benefits of risk mitigation, and by using the tool, once developed into an easy-to-use program. 2) Throughout development and testing of tool	1) To provide feedback on the implemented methodologies (applicability in practice, potential issues that are known by the practitioners but have not been addressed in the framework), and to test the framework for the development of adaption strategies. 2) There is mutual benefit in aligning needs and possibilities of specific aspects of the water sensitive city.	– Local and / or state governments recognize the need to identify adaptation strategies that are adaptive and can be used in a multitude of future scenarios. – The tool has been applied in at least one Australian case study, and concrete suggestions based on the modelling, has been incorporated into strategic planning documents.

Project B4.2 Socio-technical flood resilience in water sensitive cities −Adaptation across spatial and temporal scales				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
B4.2.1 Policy recommendations for social and technical flood resilience: Guidance in report format for enhancing resilience to flooding (and associated services and utilities) in the context of an Australian water sensitive city.	State and local government planning agencies, engineers and consultants	From the outset working with the case studies below and also in formulating the vision for flood resilience (CRC and IWA)	To test the approach and further refine it in an Australian context	1. Policy makers and urban planners are guided by these recommendations, that is, they consider all 4 domains of interest to total water cycle management in their strategy development. 2. Policy makers and urban planners use the overarching framework (retreat, adapt, defend) to identify priority actions for building flood resilience.
B4.2.2 Software tool for an enhanced ATP method: Prototype software tool for an enhanced Adaptation Tipping Point (ATP) method	State and local government planning agencies, engineers and consultants	LGAs in Rotterdam and Dordrecht have been engaged from the start date and now with City of Perth.	LGAs (eg. City of Rotterdam, City of Port Philip and City of Perth) are and will be further engaged in the testing and refinement of the tool, to ensure its usefulness to this user group.	Software tool for an enhanced ATP method is being used by or referred to by policy makers, engineers and consultants.
B4.2.3 Report on mainstreaming approaches to achieving flood resilience: Report on opportunities for synergistic enhancement of flood resilience with mainstreaming opportunities for urban regeneration, multi-functional land use, ecosystem services, asset management and other urban developments in Australia.	State and local government planning agencies	LGAs have been engaged from the start date in case studies for Rotterdam and Dordrecht and now with Elwood.	LGAs (eg. City of Rotterdam and Dordrecht) have/are being engaged to develop ideas/methodology and raise their awareness of appropriate financial instruments for different contexts related to mainstreaming (eg. types of projects). Australian case studies will further develop.	Report is being used by policy makers to customise the use of financial instruments to their context.
B4.2.4 Guidance manual for linking ATPs and adaptation opportunities: Guidance and best practice for linking ATPs and AMOs in report format supported by spreadsheet or equivalent software.	State and local government planning agencies, engineers, consultants and urban designers.	Guidance is being developed with Rotterdam, Dordrecht, Ho Chi Minh city cases and now with Elwood.	To develop the guidance further in the context of Australian cities.	Adaptation pathways are being developed based on the guidance manual for linking ATPs and adaptation opportunities.
B4.2.5 Support tool for RIO application, with guidance document: Prototype Real-In-Option (RIO) accounting tool with a user guide recommendations for the application of the enhanced ATP method and RIO accounting tool for flood risk management in Australian cities.	State and local government planning agencies, engineers and consultants.	LGAs (eg. City of Can Tho and City of Port Philip) will be engaged in the testing and refinement of the tool, to ensure its usefulness to this user group.	To verify applicability in Australian context.	Support tool for RIO application is being used by or referred to by policy makers, engineers and consultants.

B4.2.6. Case studies on ATP-Opportunities and RIOs: Output with Program A to develop capacity in decision makers to utilise the new methods above and to inform policy making and the regulatory approach – policy recommendations	State and local government planning agencies, engineers, consultants and urban designers.	City of Rotterdam; Dordrecht; City of Can Tho; City of Port Philip; Perth WA already engaged	LGAs and others are being engaged to define the policy objectives, adaptation options and investment costs. Required also to communicate the findings regarding the durability of current flood risk management strategies, and to identify alternative strategies. Ultimately they will be needed to validate the approaches.	The adaptation pathways developed for the different cities are being used to inform the policy-making processes.

Project B5.1 Statutory planning for water sensitive urban design				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
B5.1.1 Preliminary report on the experience of key decision makers and stakeholders in the application of Water Sensitive Urban Design in the planning system: The PHD student (Don Williams has carried out interviews with stakeholders and has prepared a short written report on experiences with WSUD in the planning system.	Project B5.1 team	N/A	N/A	The project will use this document to target and refine further research.
B5.1.2 Comparative survey of statutory planning legislation, regulation and processes across five cities (Brisbane, Sydney, Melbourne, Adelaide and Perth): This output has been subsumed into B5.1.3 as the survey was for the purposes of scoping the literature review.	Project B5.1 team	Throughout project	Throughout project. The engagement is for the purpose of ensuring that the policy analysis is comprehensive and ensuring the needs of CRC participants are being addressed	The project will use the survey as an input into subsequent project outputs. This has been incorporated into B5.1.3
B5.1.3 Comprehensive Literature review of planning policy and legislation relevant to WSUD: This is a necessary input into B5.1.4 and B5.1.5 and will assist in identification of key issues.				– The literature review will be a useful tool in the development of B5.1.4 & B5.1.5. – CRC stakeholders and governments may use the literature review as a reference document. The level of use would be indicia of success. But this is not its primary purpose.

B5.1.4 Issues paper on current application of WSUD and options for reform and draft recommended model of planning regulation for WSUD: Identification and assessment of key opportunities and constraints in planning systems relevant to the implementation of WSUD and integrated water management	1) Local Government 2) State governments 3) Commonwealth government 4) Water Utilities and Department of Water	– Shortly after the Issues paper has been released for consultation. – From early on in project. Project has started in July 2014.	The engagement should assist in refining the content and form of the Final Report, to ensure that key issues of interest to the State and Commonwealth governments are addressed, where relevant and practicable (It is expected that this will be through Departmental representatives)	– The Issues Paper will be successful if it sparks useful engagement with stakeholders, industry and government, which will be addressed in subsequent outputs. – If there is engagement with stakeholders about the issues paper then this will assist in validating the hypothesis, or identifying issues requiring further attention, which will help to improve the rigour of the final report.
B5.1.5 Final report on current application of WSUD and options for reform and recommended model of planning regulation and policy benchmarks for WSUD: The Final Report will identify best practice planning policies and standards for applying WSUD to developments of different planning scales.	1) Local Government 2) State governments (including Water Departments) 3) Commonwealth government	– Once the Issues Paper has been published – After a draft of the Final Report has been prepared.	– Engagement should be both prior to the completion of the Final Report and after (as part of the Adoption phase of the CRC) – To ensure that the Final Report addresses key issues identified by Local, State and Commonwealth government agencies, if relevant and practicable.	– We will know the Final Report is successful if (i) CRC Stakeholders use it, (ii) if government and decision makers apply it; and (iii) if the Final Report is referred to as a basis for altering policy of governments and planning authorities in future. – If the Commonwealth government uses the Final Report, and local government representative bodies or industry bodies promote harmonisation of standards for WSUD across jurisdictions – this will be evidence of success. For example, the model framework may be endorsed or adapted as a basis to evaluate policy frameworks applied by State and local governments. – If planning arbiters, tribunals and panels use the report as a valuable aide; this would be evidence of success. – The project succeeds if at least one council in each jurisdiction applies the Final Report as a reference point in future policy development.

Project C1.1 Sustainable technologies				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
C1.1.1 Guidelines for adoption (design, maintenance and operation) of biofiltration systems for stormwater treatment and harvesting: Revised version of the FAWB guidelines focused on design for harvesting, plant selection and maintenance **C1.1.2 Passive filters and biofilters for pathogen removal in urban stormwater:** New generation biofilters to remove more pathogens	Local government; Consulting companies; Water utilities; Land developers; Dept. of planning; Business Developers; Gardening Sector	From the beginning of the project	– To help draft the guidelines – To demonstrate the effectiveness of the new technology on the field.	The new guidelines is accepted as the industry standard (e.g. in the same way as the current FAWB guidelines are). This is measured by: – The requirements by local governments, water utilities, etc. for their staff and external consultants to use the doc in the design and implementation of stormwater biofilters. – Number of downloads of the document. – We can do survey of consulting companies (e.g. in 3 years' time) to see if they have adopted the guidelines.
C1.1.3 UrbanBeats conceptual representation of WUSD systems within a city-wide model, to allow for the setup of virtual case studies for assessment of performance of decentralised water infrastructure **C1.1.5 Integrated model that can assess performance of WSUD systems for pollution, flooding and stormwater harvesting**	Local government; Consulting companies; Water utilities; Land developers; Software companies		To help support long term planning.	– The number of CRC partners who are using the model – The number of software tools that incorporated Urban BEATS: at present it is part of both the CRC WSC tool-kit (developed with CRC D1.1 Project) and DAnCE4Water (developed by CRC A4.3 Project)
C1.1.6 Model of micropollutant behaviour in WSUD systems: The model will simulate the key treatment processes within stormwater biofilters/wetlands and bio-chemical degradation. Coupled with MUSIC hydraulic model (insitu tested) **C1.1.4 Model of faecal microorganism removal in existing stormwater biofilters:** A very simple algorithm that can predict removal of most widely used pathogen indicator E.coli.	Local government; Consulting companies; Water utilities; Land developers; Business Developers; Material Manufacturing			– The number of systems that have been implemented in practice. The first system will be implemented in 2015 in Melbourne – The number of spin off businesses or manufacturing operations that are benefiting from the technology invention

Project C1.2 Risk and health: understanding stormwater quality hazards				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
C1.2.1 Chemical and microbial characteristics of stormwater: Characterisation of the chemical and microbial qualities of untreated stormwater	Policy developers; Local government; Land developers; Researchers	From the beginning of the project	To help with sampling and analysis of data	Data from CRCWSC referred to in national guidelines for stormwater reuse.
C1.2.2 Prioritisation of human health risks associated with untreated stormwater: Prioritisation of human health risks associated with chemical and microbial hazards in untreated stormwater	Policy developers; Local government; Land developers; Researchers			– CRCWSC stormwater risk assessment referred to in national guidelines for stormwater reuse. – CRCWSC stormwater risk assessment referred to in local government risk assessments for stormwater reuse in their catchments.
C1.2.3 Influence of catchment characteristics on stormwater quality: Commentary on the influence of catchment characteristics on the chemical and microbial quality of untreated stormwater	Policy developers; Local government; Land developers	From the beginning of the project	To help with sampling and analysis of data	CRCWSC research findings referred to in national guidelines for stormwater reuse.
C1.2.4 Risk assessment process recommendations: Recommendations for assessing risks associated with untreated stormwater incl. the role of chemical surrogates	Policy developers; Local government			– CRCWSC recommendations for assessing human health risks in untreated stormwater referred to in national guidelines for stormwater reuse. – CRCWSC recommendations for assessing human health risks in untreated stormwater incorporated into local government risk assessment procedures for stormwater harvesting and reuse schemes.

Project C1.3 Fit-for-purpose water production				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
C1.3.1 PMA-NGS method: Development and validation of a molecular-based method that combines next generation sequencing (NGS) techniques with PMA (propidium monoazide). This will provide information on the active (or viable) microorganisms and microbial communities before and after urban water treatments.	Scientific community			– Mainly through publication of the new methodology and the results obtained in good scientific journals. – Through presentation of the work done in conferences and/or workshops.
C1.3.2 Assessment of health risks using new PMA-NGS methods	Water utilities; Local government; Scientific community			– Reports and/or publications on the reliability of water treatments (using the validated PMA-NGS approach). – Regulations and the practices of water utilities could occur depending on the information and the findings made.
C1.3.3 Literature review of current and novel treatment technologies for recycling water treatment. The review will examine the benefits and limitations of existing and possible future systems for treatment of recycling water. Key factors considered in this review will be: installation and operating costs, energy consumption, scalability, maintenance requirements, environmental and other external benefits, novelty, etc.	Scientific community; Stakeholders			– Review of technologies could be transferred into a conference publication. – Monitor uptake of the report by CRC stakeholders.
C1.3.4 Development of novel treatment systems: Deliver low-cost and low-energy consuming filtration systems for treatment and reuse of reclaimed water	Scientific community; Water utilities; Consultants			– Reports of the novel systems would be published in Scientific Journals and conference presentations. – Uptake of the novel systems into pilot-scale and eventual full-scale application into decentralised water treatment systems.
C1.3.5 Guidelines for the use and application of novel treatment systems: Supporting technical information for novel treatment system	Research community; Water utilities			The guidelines could be distributed within government authorities and water management companies. Registration could be required as a means to measure the use of the guidelines.
C1.3.6 Validation and operational monitoring methodologies for passive water treatment systems: This output aims to provide 1) validation methodologies to ensure natural treatment systems perform their desired function and 2) operational monitoring regimes which demonstrate performance	Scientific community; Water utilities; Councils & all who design/maintain water infrastructure; SMEs/ treatment system developers			– Validation framework published in Scientific Journals and conference presentations. – Inclusion of the validation framework in any future Victorian Policy documents on water recycling. – Uptake of the validation framework by SMEs, local councils and water authorities for validating novel treatment systems

Project C2.1 Resource Recovery from Wastewater				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
C2.1.1 Novel Urban wastewater technologies: Cost effective technologies that replace existing technologies and recover resources	Technology suppliers; Consultants; Water utilities; Agroindustry	From the beginning of the project	To assist in the development of these new resource recovery technologies, and help design and construct pilot processing plants	- Technology provides developed products based on technology (possibly through joint patents) - Products based on technology penetrate wastewater treatment market in existing and greenfield applications - Derivative research conducted into accumulative wastewater technologies.
C2.1.2 Demonstration processes: Trial application of the novel wastewater technologies				

Project C3.1 Managing interactions between decentralised and centralised water systems				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
C3.1.1 Characterising interactions between centralised and decentralised water delivery systems: Literature review/report on centralised and decentralised water delivery systems	Water Utilities; Local Government; CRC researchers		- To discuss challenges with implementing decentralised water systems in urban areas and key research requirements - To establish on site facilities for use as pilot scale research facilities - To enhance the technical capacity of practitioners through industry short courses	- Downloads of the document by CRC partners and researchers. - Feedback from CRC partners and researchers regarding the report.
C3.1.2 Models developed for the assessment of the impacts of changes in water use practice on downstream collection system (odour and corrosion, GHG emissions and sedimentation): Models to describe the impacts of implementation of decentralised systems onto centralised systems. The models will provide support minimising the impacts and optimising function of the sewer networks.	Water Utilities; Consultants			- Take up of knowledge/tools by water utilities/consultants - Inclusion of models into management and planning. This could be measured by counting the number of request for the model, and downloads if freely available.
C3.1.3 Report of modelling and recommendations for integration of decentralised systems: Overall water balance model described - combination of 3 models. Including reports on case studies	Water Utilities; Researchers			- Water Utility adapts planning and design recommendations made from case studies. - Journal publications
C3.1.4 Report on overall recommendations: Recommendations to improve interactions of central and de-central systems	As per C3.1.3, plus Local Government; Consultants			- Adaption of recommendations into guidelines for policy development - Adaption by Water Utilities for planning and design.
C3.1.5 Decision Support Tools: Release of Decision support tools and support material in an integrated package	As per C3.1.4			- Adaption of tools by Water Utilities and CRC - Utilisation for development of guidelines and policy. - Possible development as a commercial product. - Industry survey to evaluate the use of tools and derived benefits from its use

Project C4.1 Integrating multi-functional urban water systems				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
C4.1.1 Decision support tool for quantifying wetland ecosystem function: A wetland eco-hydrological model able to simulate vegetation response to water balance variability and associated changes in biogeochemical cycles, and validated against above data.	Local governments; waterways manager; water utilities; land developers; and consultants			For the wetland decision support tool, assessing how stakeholders are using the decision support tool and monitoring recommendations when implementing wetlands for stormwater.
C4.1.2 New hybrid biofiltration technologies: *T1 - Living walls for greywater treatment:* Prototype of green technology that treats greywater while improve micro-climate and provide amenity to public space *T2- Green walls for greywater treatment:* Prototype of green technology that treats greywater while improve micro-climate and provide amenity to public space *T3: Living walls for stormwater and greywater treatment*: Prototype of green technology that treats greywater and stormwater (two different sources of water) while improve micro-climate and provide amenity to public space.	Local governments; water utilities; land developers; consultants; business developers; and manufacturing companies			For hybrid biofilters: – The number of systems that have been implemented in practice. The first two living wall systems will be implemented in 2015 in Melbourne and we are in the discussions to implement a system in Sydney – The number of spin off businesses or manufacturing operations that are benefiting from the technology invention
C4.1.3 Adoption guidelines for new technologies: Design, maintenance and operational guidelines for green and living walls technologies	Local governments; water utilities; land developers; consultants; business developers; and manufacturing companies			
C4.1.4 Demonstration and testing of new green technologies: Results from monitoring new technologies	Local governments; water utilities; land developers; and consultants			

Project C5.1 Intelligent urban water systems				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
C5.1.1 Data analytics for smart metering: Algorithms and software for data mining analysis of metered water use	Water Utilities; Research colleagues	Continuing. Internal workshop at Water Corp June 2015; Industry tech report Aug 2015	To collect data and discuss latest research outcomes.	- Water use demand profiles generated from smart metering algorithms are utilised by (one or more) water utilities to inform infrastructure planning to increase water security - Smart metering analytics are used by (one or more) water utilities to inform customer engagement strategies to maintain or improve amenity and also reduce consumption. - Smart metering case studies provide evidence and guidelines to inform business cases (i.e. when and when not to employ smart metering).
C5.1.2 Decision support for pumping optimisation with multiple water sources: Decision Support Tools for multi-objective optimisation of pumping with multiple water sources	Local Government; Water Utilities; Regulators	Case studies with end-users currently underway	To develop case studies and provide useful software tools for optimisation of pumping to enable cost savings.	- Knowledge, tools and technologies to enable water utilities, local government and regulators to provide secure and appropriate water yield at minimum cost and minimum greenhouse gas emissions from pumping operations from multiple-alternative-water sources at various scales. - Evidence-based guidelines for incorporating non-traditional water sources (e.g. storm water, treated waste water, aquifer storage and recovery) into local water systems to respond to climate change.

Project D1.1 & 1.4 Integration and demonstration through urban design				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
1 - D1.1.1 WSC Toolkit (Version 2 beta): A second beta version (for testing and validation) of the Water Sensitive Cites Modelling Toolkit (the Toolkit) (D1.1), with supporting preliminary user guidance. **1 - D1.1.2 Seminars and Training**: Engagement with practitioners interested / involved in development and testing of the Toolkit, including the dissemination and discussion of research knowledge from research projects represented in the Toolkit (D1.1).	Local Governments, Water Utilities (and their consultants)	Throughout the development phase (since Oct 2011)	To: (i) understand industry and practitioner needs in relation to tools to support strategic planning of water-sensitive and green-infrastructure initiatives by local governments and distributed water servicing initiatives by water utilities (ii) obtain feedback on the Toolkit as it is developed, and (iii) build trust and acceptance of the Toolkit and the underpinning research through a transparent development process to support its future adoption and application.	– *Healthy natural systems:* The Toolkit is able to quantify the influence of water-sensitive and green-infrastructure initiatives on ecological-health indicators for urban streams. – *Resilience to heat /changing climate*: The Toolkit is able to quantify the impacts of water-sensitive and green-infrastructure initiatives on land surface temperatures under average summertime and extreme heat conditions. – *Uncontested business case:* The Toolkit is able to quantify multiple impacts and benefits of water-sensitive and green-infrastructure initiatives to support more robust business cases.
2 - D1.1.3 Demonstration Project Seminars, Reports, and Site Visits: Knowledge sharing seminars, presentations, reports and site visits focussed on CRCWSC research engagement, outcomes and insights for the Officer (Vic) and Marrickville (NSW) demonstration projects (D1.1). **2 - D1.1.4 blueprint Chapter: Research Adoption and Implementation (Officer):** Revised and updated chapter in blueprint 2014: stormwater management in a water sensitive city, describing the adoption, adaptation and implementation of research insights as part of Places Victoria's Officer development (D1.1).	Water-sensitive urban development consultants, Local Governments (Waterway Management, Urban Development), Water Utilities (Stormwater Harvesting, Stormwater Management)	Participating organisations (direct users): from start of demonstration projects – Feb 2010 (Officer), Dec 2011 (Marrickville) Interested organisations (indirect users): as research initiatives are developed and implemented.	Knowledge sharing: (i) demonstration of implementation and/or proof-of concept of water sensitive initiatives; (ii) insights/process learning through the adoption and implementation of CRCWSC research; and (iii) support the wider implementation and/or adaptation of these initiatives.	– *Healthy natural systems*: Demonstration project outputs (seminars, site visits, reports) provide an adoption pathway for the wider implementation and/or adaptation of water-sensitive intiatives incorporated in the projects (e.g. biosponges for reducing stormwater impacts on local waterways). – *Uncontested business case*: Demonstration project outputs (seminars, site visits, reports) provide information and examples of how water-sensitive initiatives have been developed and implemented to support more robust business cases for subsequent water-sensitive initiatives undertaken by the project proponent and/or other organisations.

3 - D1.4.1 Case Study Applications of Toolkit: Documentation of application (testing and validation) of the Toolkit to specific locations (D1.1/D1.4) **3 -D1.4.2 Seminars and Training (Toolkit Application):** Engagement with practitioners' interested / involved in application of the Toolkit, including the dissemination and discussion of research knowledge from research projects represented in the Toolkit (D1.4).	Local Governments, Water Utilities (and their consultants)	Throughout the application phase coinciding with the start of D1.4 (from Jan 2015).	To: (i) understand industry and practitioner needs in relation to how Toolkit outputs are presented; (ii) build trust and acceptance of the Toolkit and the underpinning research through a transparent testing, validation and case study application process to support its adoption and application; and (iii) share generalised insights and outcomes from case study applications.	– *Increased water security*: Case study applications of UrbanBEATS and the Toolkit and associated seminars/training demonstrate the contribution of stormwater harvesting and use to water (supply) security for a range of contexts. – *Healthy natural systems*: Case study applications of the Toolkit and associated seminars/training demonstrate the influence of water-sensitive and green-infrastructure initiatives on ecological-health indicators for urban streams. – *Resilience to heat /changing climate*: Case study applications of the Toolkit and associated seminars/training demonstrate how the impacts of water-sensitive and green-infrastructure initiatives on land surface temperatures under average summertime and extreme heat conditions can be quantified, and the heat-mitigating impacts of different green-infrastructure coverage and distribution within urban areas. – *Uncontested business case:* Case study applications of the Toolkit and associated seminars contribute to the body of evidence supporting water-sensitive and green-infrastructure initiatives through the quantification of multiple impacts and benefits.

Project D4.1 Strengthening educational programs to foster future water sensitive cities leaders				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
D4.1.1 Masters level modules on delivering water sensitive cities: A professionally targeted high level module syllabus and teaching materials to introduce water sensitivity and how to deliver it through innovations in governance, technology and economics implemented through the IWC and UNESCO-IHE Masters.	Australian and international urban water professionals and organisations	Since July 2013 for IWC Masters and from 2016 in UNESCO-IHE Masters	To develop the capacity (skills and knowledge) of individual urban water professionals, to learn from leading edge national practice, and to transfer knowledge of leading edge Australian practice into different contexts.	– Number of enrolled Australian and international participants taking the Masters module – Feedback on the effectiveness of the module from participants
D4.1.2 Australian and international skills and knowledge needs assessment report: An assessment of the skills and knowledge needed to deliver water sensitive city outcomes across local government, state government, utilities and the private sector in Australia, the Netherlands and a selected set of Asian cities.	1) CRC University participants and Executive 2) CRC Industry participants and other industry organisations	1) In 14/15 Q3 2) In 14/15 Q3 and Q4	1) To help the D4.1 team develop education and training product outlines to then market test as part of the process of developing investment and partnering recommendations for the Executive 2) To help the D4.1 have confidence in the skills and knowledge needs identified, to help develop education & training product outlines, and to provide views on those through a market research survey	Linking the skills and knowledge needs assessed to the 2012 impact areas, and then showing, in relation also to outputs 3 and 4, how those impact areas have been targeted with structured professional learning products
D4.1.3 A structured professional learning vision and set of recommendations for delivering water sensitive city outcomes: A report identifying and recommending opportunities for the CRCWSC to (i) invest in the development of new structured professional learning programs and courses (education and training) where gaps and sufficient demand exists, and (ii) partner where existing provision or capacity exists to deliver on identified skills and knowledge needs.	1) CRC Executive 2) CRC research participants 3) Urban water sector organisations	1) FY 15/16 Q1 2) FY 15/16 Q2 3) FY 15/16 Q2	1) To help inform the framing and development of the structured professional learning vision, to engage in education and training outline product development, and to then read the recommendations report and act upon it 2) To participate in education and training outline product development across FY 14/15 Q3 and Q4 3) To help inform the framing and development of the structured professional learning vision, to engage in education and training outline product development, and to then read the recommendations report and act upon it	Demonstrated investment support from CRCWSC and/or from industry into developing the recommended education and training products, and (for industry) paying for staff to participate in those products
D4.1.4 A set of structured professional learning programs and courses with paying participants: A set of structured professional learning programs and courses with paying participants delivered by a mixture of CRCWSC participants and external partners to effectively build capacity in water sensitive city outcome delivery	Australian and international urban water professionals and organisations	From July 2015	To develop the capacity (skills and knowledge) of individual urban water professionals and to learn from leading edge national practice. To enhance their capacity to work on water related tasks overseas, and to transfer knowledge of leading edge Australian practice into different contexts.	– Number of enrolled Australian and international participants on structured professional learning (education and training) products developed – Feedback from participants about the quality and usefulness of the structured professional learning (education and training) products developed.

Project D5.1 Urban intensification and green infrastructure: Towards a water sensitive city				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
D5.1.1 Case Study Document (International and National): The group will collect national and international best practice case studies of WSUD and its impact to urban development/ form. Selection criteria will be based on urban impact and outcome as a holistic approach, not only on WSUD technologies. The document focuses on integrated outcomes of WSUD within existing suburbs and new urban development (greenfield). The case studies will inform and be part of the final design guidelines.	1. Local Government; State Government Departments and Authorities 2. Water utilities 3. Urban design and architecture professionals	1. LGAs and State Government engaged in 2015-2016 2. WUs engaged in 2015-2016 3. Design professionals will be engaged in 2016	1. To understand the format and type of information that would be most useful to State Government Departments and Authorities, and LGAs in the context of new development. This research is important for the purposes of regulatory control to bring about agreed WSUD outcomes 2. To understand the format and type of information that would be most useful to water utilities in the context of new development 3. Design professionals inside government departments will be engaged after the case study selection is made. The purpose of this engagement is to enable the championing of WSUD within government decision-making bodies.	When case study outcomes/ design concepts are included by the Local Government, Water utilities, and Urban design & architecture professionals as benchmark projects and WSUD is explored as an integrative approach to urbanisation issues in Australia.
D5.1.2 Models of industry engagement: Development models for engagement with industry and stakeholders specific to urban design issues related to WSUD (such as design workshops, charrettes, etc.).	CRCWSC Researchers	Ongoing	To facilitate knowledge integration into urban design projects.	When researchers and CRCWSC can use the outcome as a facilitator to achieve adoption of WSC urban design agenda by industry partners, stakeholders and researchers.
D5.1.3 Design guidelines: Development of design guidelines for WSUD precincts with a focus on the integration of social, spatial and environmental aspects of an urban precinct. This integration will be demonstrated via different scales and components of a precinct from the scale of the lot and the dwelling, to the scale of the street, block and neighbourhood and ultimately whole of catchment.	1. Local Government; State Government Departments and Authorities 2. Water utilities 3. Developers 4. Urban design and architecture professionals	Ongoing throughout project	1. Following consultation with State Government some LGAs will be more actively engaged in the development and documentation phase, others will be invited to comment on draft guidelines. 2. Some WUs will be actively engaged in the development and documentation phase, others will be invited to comment on draft guidelines. 3. Some developers will be actively engaged in the development and documentation phase, others will be invited to comment on draft guidelines. 4. Some designers in State departments will be actively engaged in the development & documentation phase, others will be invited to comment on draft guidelines.	When design guidelines are adopted by Developers, Local Government, Water utilities, and urban design & architecture professionals to demonstrate good quality urban design and WSUD is explored as an integrative approach for urbanisation in Australia.

D5.1.4 Demonstration projects: Design scenarios in different climactic and density conditions in Australia and internationally (i.e. Kunshan) are developed to inform the design guidelines. These scenarios will include real projects as well as hypothetical and/or CRCWSC research synthesis projects, including Elwood Integrated Study, Arden-Macaulay Precinct, City of Canning and Bentley CRC Synthesis Project.	1. Local Governments in Australia 2. Kunshan Bureau of Planning 3. Water utilities 4. Developers 5. Urban design professionals 6. State government departments and authorities	1) & 3-6) Ongoing from 2015 2) 2014 – 2015	– Toward the development of WSUD precinct demonstration projects – To achieve a culturally specific & viable model for development of a WSUD outcome in development area	When design demonstration projects are picked up by Developers, Local Government, Water utilities, and Urban design & architecture professionals as benchmarks for discussion with their own projects & WSUD is explored as an innovative integrative approach to urbanisation

Project D6.2 Developing a water sensitive cities index				
Output	***WHO** are the users of your research (actors)?*	***When** should this user become engaged with your research?*	***For what purpose** should there be engagement?*	*Measurement (**evidence**)*
D6.2.1 WSC Index/ Indicator Framework: Index and indicator framework to assess the Water Sensitivity (WS) of a place (metropolitan/sub-metropolitan scale)	1. LGAs/ State agencies/ Utilities 2. Developing nations	1. From the onset 2. From February 2016, resulting from the Asia Development Bank funding for a trial in Indonesia, however this will be delivered as a separate project in conjunction with D6.2	1. LGAs (e.g. Port Phillip and Knox) have been engaged in the development and testing phase. At least two Perth-region municipalities (Subiaco and Swan) and partners in metropolitan Perth will be invited to trial draft use of the output before mainstream application. Activities will include creating a user base, legitimacy of the tool, data requirements, development of the assessment methods, making sure the tool is user friendly etc. 2. Helps CRCWSC have impact in transitioning cities in developing world to greater water sensitivity and provides greater insight into the global applicability of the framework.	– How often the WSC Index/ tool is referred to in policy or business cases for WSC. – Number of cities/jurisdictions that are using the tool and moving up the rating scale.
D6.2.2 Web-based Platform: Online tools on a website with secure login providing the means for self-assessment, visualisation, reporting templates etc.	As above	As above	As above	As above

Appendix I-C: Output Comparisons

Society Projects			
CRCWSC Impact Tool (Economic Valuation)	***Cth Agreement Outputs***	***Outputs as defined by researchers per Impact Pathways template and/or Research 2012-2016 Report (RR)***	***Delivery Dates***
1.01 Guidelines for the economic cost/benefit analysis of water-sensitive technologies and systems. • This output will include reports and papers on the intangible values for: water-sensitive infrastructure; water-supply portfolios; and, decentralised water-supply systems. • It will also include reports and papers from empirical economic modelling of: new technologies and systems; and, extreme weather events. • The final full set of guidelines for the economic cost/benefit analysis of water-sensitive technologies and systems will include specific adoption recommendations for planning authorities, departments of water and water utilities along with materials to guide/support effective use of the new analysis tools. **1.02 Cost/benefit analyses of the new technologies developed in Program 3, resulting in recommendations to planning authorities and departments of water and information papers for a wide 'lay-person' audience**. The new cost/benefit analysis tools developed in Program 1 (i.e. Output 1.01) will be applied to the assessment of the	**Output 1.1 Guidelines and accompanying tools for the economic assessment of water-sensitive technologies and systems.**	**Project A1.1 – Cities as water supply catchments – economic valuation**	
		A1.1.1 Preferences for attributes of stormwater management: The study conducts choice and field experiments across local councils in metropolitan areas of New South Wales and Victoria. The analysis estimates preferences for five attributes of water management, and determine how preferences vary across socioeconomic and geographic determinants.	Complete
		A1.1.2 Salient method: A novel method to improve non market valuation with choice experiments using financial incentives.	Complete
		A1.1.3 Monetary and Relative Values: Values from a choice experiment and a hedonic market study, that can be directly used in Cost Benefit Analysis and are used in the toolkit.	March 2015
		A1.1.4 Hedging supply risks: An optimal urban water portfolio model: Dynamic portfolio model of urban water supply that hedges against supply risks from all potential water assets, by taking into account uncertainties of water flows as well as differences in supply costs.	Complete
		A1.1.5 Policy recommendations regarding attribute ranking: Policy recommendations (through industry notes, the blueprint, and our publications) about how we can rank the various attributes.	June 2014
		Project A1.2 – Valuation of economic, social and ecological costs and benefits	
		A1.2.1 Collation and systematic documentation of existing knowledge on non-market values for WSUD: Structured literature review of existing knowledge and indexing of values into a data base	Complete
		A1.2.2 Case studies on decentralised water supply systems: Case study (1) Estimation of private benefits from rainwater tank installations and subsequent application of a public-private benefit cost framework to evaluate policy responses. Case study (2) Integrated project evaluation of local government water recycling scheme to use treated wastewater on parks, open spaces, schools and playing fields	Case study 1 complete. Case study 2 by June 2015
		A1.2.3 Case studies on WSUD technologies: Case study (1) is an economic evaluation of rain gardens. Case study (2) is an economic evaluation of a living stream project. Case study (3) The amenity value, recreational value, and ecosystem value of two CRC researcher designed constructed wetlands (Melbourne and China).	Case study 1: June 2015. Case study 2: January 2015. Case study 3: June 2016

Program 3 generated technologies and systems. The real world application of the new tools as they are being developed will in turn provide a feedback loop into the further refinement of the tools.		**A1.2.4 Hedging supply risks: An optimal urban water portfolio model (Note from researcher - this is an overlapping output for A1.1):** Dynamic portfolio model of urban water supply that hedges against supply risks from all potential water assets, by taking into account uncertainties of water flows as well as differences in supply costs.	Complete
		A1.2.5 Guidelines for Cost Benefit Assessment of Water Sensitive City Projects Practical guide to the process of cost benefit analysis: Guide, worked examples, and excel spreadsheets.	Jun-2015
		A1.2.6 Case studies on managing the waste water treatment plant and urban population interaction: Case study (1) Determine the non-market values and preferences for beneficial land uses in the odour buffers of Wastewater treatment plants and pumping stations. Case study (2) Identification and quantification of potential onsite and offsite impacts from cyanobacterial events for regional towns.	Case study 1: December 2015. Case study 2: June 2015.
		A1.2.7 Guidelines for how to undertake a non-market valuation study: Practical guide to conducting a willingness to pay study: Guide, example, open source code to estimate, support mp4 file	Dec-2015
		A1.2.8 Adaption of UK green infrastructure online toolkit: The adaption of an existing UK based online tool for evaluating green infrastructure nonmarket values.	Jun-2016
		Project A1.3 – Economic incentives and instruments	
		A1.3.1 Formal vs. informal policy mechanisms for monitoring pollution and improving environmental outcomes: The study on policy mechanisms compares a formal regulatory mechanism with informal peer monitoring and social sanctions and examines its effectiveness in reducing pollution in waterways as compared to formal regulatory approaches.	July 2016
		A1.3.2 Social norms for water conservation: Analyses data on using social comparisons as a tool for water conservation from three randomized trials.	July 2015
		A1.3.3 The cost-benefit analysis comprises a case study in Western Australia's Southern River catchment: The purpose of this work is to measure the rate at which emissions are changing. The case study will also assess the cost and benefits of different policies for reducing emissions including behaviour change among households, local authorities' policies and restrictions on developers.	July 2016
		A1.3.4 Crowdfunding method: Crowdfunding establishes a new methodology for nonmarket valuation by creating markets for ecosystem services. The project makes a business case for WSUD by raising money from the community, and creates an adoption pathway for CRC research.	July 2016
		A1.3.5 Policy recommendations about the use of incentives: Policy recommendations about the use of incentives to solve social dilemmas such as provision of public goods (urban water management being a good example of these).	July 2016

1.03 Behaviour assessment database and behavioural roadmap/guidelines/ policy recommendations to support effective behaviour-change strategies. • The behaviour assessment database will evaluate ideal/new behaviours for reducing individual and collective water footprints against two key criteria: greatest improvement for water sensitivity; and, ease of influence. • Once behaviours have been evaluated to determine which behaviours can be influenced with the highest impact to effort ratio, a roadmap will be prepared that provides a prioritised and sequenced list of behaviours to be targeted. • Finally, supporting guidelines and policy recommendations will be prepared that set out the optimal mix of market, social marketing and regulatory tools appropriate for use in influencing the priority behaviours set out in the roadmap.	**Output 1.2 A behaviour assessment database and behavioural roadmap/guidelines/ policy recommendations to support effective behaviour-change strategies.**	**Project A2.1 Understanding social processes to achieve WSC**	
		A2.1.2 Water sensitive citizen typology: A typology that identifies groupings of Australian householders that differ on their water knowledge, water behaviour and demographics	Initial typology using survey data: 30 June 2015 Completed typology integrating survey, focus group and historical data 30 June 2016
		Project A2.2 Accelerating WSC by influencing behaviour	
		A2.2.1 Prioritised roadmap of household water behaviours for change: The roadmap identifies the impact & potential uptake of a set of water conservation and water quality protection behaviours to provide guidance on which behaviours to target in campaigns	30-Jun-2016
		A2.2.2 Recommendations for effective behaviour change strategies: Evidence–based behaviour change strategies that can be used to promote more water conservation or water quality protection in households	30-Jun-2016
		(RR) *Behavioural assessment database*: Stakeholders will be provided with a behavioural assessment database documenting prioritised behaviours and assessing them for the impact they can have on, for example, flooding risk or pollution. This database can be used by the water industry to assess desirable target behaviours before attempting to influence them.	February 2015
1.04 Review and assessment reports relating to current regulatory frameworks and recommendations for the improvement of them. • The review and assessment reports will include: analysis of the strengths and limitations of hierarchical, market and network approaches to complex systems regulation; review of innovation models linked to multi-level policy and planning systems; assessment of governance frameworks in	**Output 1.3 Review and assessment reports relating to current regulatory frameworks for Water Sensitive Cities and recommendations for their improvement.**	**Project A3.1 Better governance for complex decision-making**	
		A3.1.1 New knowledge of urban water governance systems (both in Australia and beyond)	Ongoing
		A3.1.2 Context-relevant recommendations of governance structures and strategies to support innovation and adaptability: Success-factors and best practice approaches to embed capacity for innovation and flexibility into urban water governance	From mid-2015
		A3.1.3 Guidelines to support governance reform through policy change: to help industry partners identify barriers and opportunities for change within their policy context, and design collaborative strategies to pursue change agendas.	During 2015-2016

relation to models for transition towards water sensitive urban design, policy and planning; assessment of best practice in relation to linking local and regional scales for planning and program implementation. • Supporting the development of the review and assessment reports will be a series of forums and workshops for planners, policy makers, managers and designers. These workshops will be held in conjunction with Program 4.		**Project A3.2 Better regulatory framework for WSC**	
		A3.2.1 Legislative Stocktake Reports - Victoria, Western Australia and Queensland: A review of the existing legislation based regulatory frameworks across three Australian jurisdictions and an assessment of the capacity of such frameworks to help or hinder WSC	Victorian report Dec 2013; WA report June 2014; Q'land report Dec 2014
		A3.2.2 Conceptual model of Australian urban water regulation: A conceptual model of urban water regulation in Australian cities and a detailed mapping of the systems for such regulation in Melbourne	Report containing conceptual model completed February 2014
		A3.2.3 Comparative analysis of Australian regulatory frameworks report: A multi-jurisdictional comparative analysis of current regulatory frameworks for urban water regulation with recommendations	Expected completion June 2015
		A3.2.4 Case Study reports on regulation: Report case study which explores how current regulatory frameworks influence and impact upon actual attempts to implement water sensitive innovations	First case study December 2014. Further case study reports expected during 2015
		Project A3.3 Strategies for influencing the political dynamics of decision making	
		A3.3.1 Literature reviews and industry notes on political dynamics, policy frameworks, tactics and strategies for researchers to influence policy: A two-part literature review, focusing on: (1) policy frameworks and theoretical aspects of political dynamics; and (2) tactics and strategies for influencing policy. Industry notes will summarise key aspects for simpler communication.	First literature review drafted, second completed by December 2014. Industry notes in early 2015
		A3.3.2 Case study reports of urban water policy development in Victoria, Queensland and Western Australia: Reports of case study research, focusing on Victoria (the establishment of the Office of Living Victoria), Queensland (to be finalised) and Western Australia (to be finalised). The core of this report will be an extended analysis of the Victorian case, with Queensland and WA cases being used for comparative purposes, rather than being as fully developed.	Victoria case study drafted by end 2014, Queensland and Western Australia in 2015
		A3.3.3 Development and testing of capacity-building approaches for researchers to influence policy: Design and testing of capacity-building approaches (e.g. interactive workshops, panels, etc.) for researchers to influence policy and engage with stakeholders (e.g. media, policy, etc.). It is now proposed that outputs will be rolled out on-line, starting now and running though to June 30, 2015, the object being an integrated set of on-line tools that can also be issued if needed as a hard-copy manual for CRC researchers and stakeholders.	Workshop design to be tested in March 2015 June 2015?

1.05 A new model for risk assessment and risk diversification. The new models for risk assessment and diversification developed in this output will focus on enabling state and local authorities to build their capacity to develop and use evidence based risk -weighted decision frameworks and to more proactively manage risk issues - including communication strategies, monitoring strategies and regulatory strategies -across both centralised and decentralised water systems.	**Output 1.4 A new model for risk assessment and risk diversification for the water sector.**	**Project A3.2 Better regulatory framework for WSC**	
		A3.2.5 Risk allocation model: The development of a new model for the legal allocation of the risk of harms from water sensitive practices.	Literature review completed 2014. Preliminary new model for risk allocation will be developed during 2015 and tested with stakeholders
		Project A4.1 Society and institutions - Risk Perception	
		A4.1.1 Aesthetic design guidelines for raingardens: Design guidelines for optimising aesthetic appreciation and acceptance of raingardens in suburban settings	Mar-15
		A4.1.2 Analytical framework for risk perceptions: Framework identifying personal and professional attributes that might influence perceived risk of alternative urban water systems and sources, in order to understand and anticipate possible risk perceptions	Completed
		A4.1.3 Report on current risk perceptions of Australian urban water practitioners towards alternative urban water systems, technologies and sources: Report drawing together conclusions from empirical study of risk perceptions of Australian urban water practitioners towards alternative urban water systems, technologies and sources, highlighting barriers to their implementation in the WSC	Jun-15
		(RR) *Assessment Report*: Assessment of the relative strengths and weaknesses of existing urban water governance strategies to determine whether they are fulfilling their intended purpose **(RR) *Co-governance Report:*** Report examining the emergence and operation of co-governed decentralised urban water systems, and guidance to enable co-governance of combined centralised and decentralised water systems operating at different scales and with different sources	?
4.02 Socio-technical modelling software package to examine urban water management scenarios. This software tool will enable users to simulate the interactions between social acceptance, urban form, economics and technical feasibility to examine possible urban water management scenarios. The tool will be progressively developed and refined and will over time incorporate research outcomes from Programs 1, 2 and 3.	**Output 1.5 Socio-technical modelling software package to examine urban water management scenarios.** This software tool will enable users to simulate the	**Project A4.2 Mapping water sensitive city scenarios**	
		A4.2.1 Guidance manual: Guidelines for facilitating participatory processes with community and professional stakeholders to guide WSC transition planning, drawing on envisioning and backcasting techniques.	31-Jun-2017
		A4.2.2 Report on Elwood water sensitive city transition scenarios: Report documenting a local community vision and transition strategy Elwood for Melbourne.	31-Dec-2015
		A4.2.3 Report on Perth water sensitive city transition scenarios: Report documenting a metropolitan scale vision and strategic transition framework for Perth.	31-Dec-2016
		A4.2.4 Report on other water sensitive city transition scenarios: Report documenting transition scenarios for other cities, integrating different stakeholder perspectives.	31-Dec-2016

	interactions between social acceptance, urban form, economics and technical feasibility to examine possible urban water management scenarios.	**Project A4.3 Socio-technical modelling tools to examine urban water management scenarios**	
		A4.3.1 Computational algorithms modelling the integrated urban water system including socio-economic system, urban form and water infrastructure systems: DAnCE4Water's algorithms will produce detailed insight into the dynamic feedbacks between the socio-economic system, urban form and water infrastructure in response to water management strategies. These strategies may be structural (involving the placement of centralised or decentralised water infrastructure systems within the urban form), or non-structural (such as financial incentives, water restrictions or planning regulations)	Jun-16
		A4.3.2 A web-based platform to facilitate collaborative planning and decision-making processes: Outputs and insights from the project will be consolidated on a user friendly web-based modelling platform designed to facilitate collaborative planning and decision-making processes. Users from different organisations will be able to access common sets of urban data, future scenarios and management strategies via the DAnCE4Water platform, enabling planners and decision-makers to explore water management opportunities and implications across organisational boundaries and at multiple scales.	Jun-16
		A4.3.3 Demonstration and application of DAnCE4Water in regional and community scale case studies: Application of DAnCE4Water to a regional case study in Melbourne, in which the dynamic responses of the integrated urban water system to different water management strategies will be tested.	June 2016
		A4.3.4 Guidance and recommendations of how to develop effect and robust water management strategies: Guidance and recommendations of how to develop water management strategies that are effective and robust under a variety of climate change, population growth and societal change scenarios to increase the resilience of the water system.	June 2016
		A4.3.5 Industry short-courses to facilitate widespread industry uptake of the tool: The DAnCE4Water platform will be supported by a software manual, tutorials and industry short-courses to facilitate widespread industry uptake. It will be developed as an open source product and will incorporate interfaces with commonly used water industry models (e.g. MUSIC, SWMM) to complement and add value to the existing set of tools available to support decision-making in the Australian water industry	June 2016
		Project D6.2 Developing a Water Sensitive Cities Index	
		D6.2.1 WSC Index/ Indicator Framework: Index and indicator framework to assess the Water Sensitivity (WS) of a place (metropolitan/sub-metropolitan scale). The WSC Index and accompanying tools will be piloted in Brisbane, Melbourne and Perth to develop contextualised indicators for local water sensitive visions. The local assessments will be validated through participatory workshops that reflect on the accuracy and reliability of the tool's results, as well as on comparisons across cities. Lessons from these pilots will be	September 2016

		incorporated to refine the indicators, analytical and process methodologies and the web-based platform.	
		D6.2.2 Web-based Platform: Online tools on a website with secure login providing the means for self-assessment, visualisation, reporting templates etc.	September 2016
		(RR) *User manuals*: The refined WSC Index and tools will be rolled out with a manual that guides end users through the methodologies for their effective use.	September 2016
4.04 Database of community water literacy and community-friendly water terminology and recommendations for effective community engagement strategies. An initial report to establish a baseline for current community understanding of water terminology will be followed by the development of the database. Focus groups and expert interviews will be used to establish community friendly terminology while the development of community engagement strategies will utilise experimental testing of optimal message framing and message delivery modes.	**Output 1.6 Database of community water literacy and community-friendly water terminology and recommendations for effective community engagement strategies**	**Project A2.1 Understanding social processes to achieve WSC**	
		A2.1.1 Report on history of water use in Australia: A historical analysis of water use in Australian households from 1788 – 2014 that identifies the social, physical, institutional, and cultural factors that have influenced water use during this period.	30-Jun-2015
		Project A2.3 – Engaging communities with water sensitive cities	
		A2.3.1 Report on Australian water literacy: An assessment based on a national survey of current levels of knowledge about key water issues amongst Australian citizens.	30-Jun-15
		A2.3.2 Database of community friendly water terminology and visuals: An empirically tested set of water-related terms, information, and visuals that are comprehensible and engage citizens with water issues.	30-Jun-16
		A2.3.3 Best practice recommendations for community engagement about sustainable urban water management: A set of recommendations informed by systematic review of the national & international literature and project-based experimental studies.	31-Dec-16

Water Sensitive Urbanism Projects			
CRCWSC Impact Tool (Economic Valuation)	***Cth Agreement Outputs***	***Outputs as defined by researchers per Impact Pathways and/or Research 2012-2016 Report (RR)***	***Delivery Dates***
2.01 Scenarios of plausible futures for rapidly growing metropolitan regions that adopt a whole of landscape regional scale outlook that links cities ecologically and hydrologically to their regions. These scenarios, **supported by usage guidelines**, will provide decision makers with a 'test bed' for assessing intended policies in an environment of uncertainty and	**Output 2.1 Scenarios of plausible futures for rapidly growing metropolitan regions** that adopt a whole of landscape regional scale outlook that links cities ecologically and hydrologically to their	**Project B1.1 Urban rainfall in a changing climate & Project B1.3 Impact of climate change on extreme rainfall and drainage design**	
		B1.1.1 A stochastic model appropriate for downscaling rainfall to scales relevant for the design of water harvesting technologies: Development of a model based on multi-fractal cascades suitable for high-resolution ensemble simulation along with a reliable estimate of the uncertainty.	End of FY14/15
		B1.1.2 Stochastic rainfall simulation of the current climate: Simulation of statistical properties of the current rainfall in Adelaide, Brisbane, Melbourne and Sydney.	End of 2015
		B1.1.3 Stochastic rainfall simulation of future climates: High-resolution projections of the future rainfall for Adelaide, Brisbane, Melbourne and Sydney together, along with reliable estimates of the uncertainty in these projections.	March 2016

allow for planning policies that take a catchment level approach to management of land use in and around rapidly growing cities.	regions.	**B1.3.1 Stochastic rainfall simulation of future climates in Singapore**	March 2016
		Project B1.2 Catchment-scale landscape planning for water sensitive city regions in an age of climate change	
		B1.2.1 Statutory & non-statutory planning systems assessment: Comparative assessment of the statutory and non-statutory planning systems for the case study regions (i.e. SEQ, Greater Melbourne and Greater Perth)	Completed 2014
		B1.2.2 An integrated greenspace framework: Determination of the essential components of an integrated greenspace framework (incorporating natural ecosystems and green infrastructure) linking the city to its regional catchments with emphasis on critical surface and subsurface hydrological connections (to be subsequently refined as outputs from other Program B projects become progressively available).	Completed 2014
		B1.2.3 A conceptual city-region scale urban metabolism evaluation framework: Conceptualisation of a city-region scale urban metabolism evaluation framework including a methodology for calculating and representing the water budgets across multiple landscape types in the three case study city-regions.	June 2015
		B1.2.4 Scenarios of plausible futures for rapidly growing metropolitan/city-regions (i.e. three case study regions): These scenarios will provide decision makers with a 'test bed' for their intended policies, thus assisting them to address water sensitive urbanism issues in an environment characterised by high degree of uncertainty and inconclusive science associated with climate change and population growth.	June 2016
		B1.2.5 Water security assessment of the three case study city-regions: A strategic assessment of the future of each case study region in terms of water security utilising a city-region / whole-of-catchment systems model incorporating a modified urban metabolism framework to evaluate regional scale water budgets across multiple landscape types.	June 2016
		B1.2.6 Growth scenarios report detailing methods for incorporating ecological and water science into statutory planning: Documentation of scenarios for rapidly growing metropolitan regions utilising whole-of-landscape regional scale to ecologically and hydrologically link cities to their regions.	December 2016
		B1.2.7 Assessment of planning policies under various growth scenarios for three case study city-regions: Documentation of initial policy 'test bed' model which allows planners/policy makers to test policy impacts under multiple plausible growth scenarios has been provided to end users from city regions.	June 2017
		B1.2.8 Guidelines: Guidelines and training packages for statutory and non-statutory planners in the land use, environmental, landscape and natural resource management fields.	Post July 2017
		Project B5.1 Statutory planning for water sensitive urban design	
		B5.1.1 Preliminary report on the experience of key decision makers and stakeholders in the application of Water Sensitive Urban Design in the planning system: The PHD student (Don Williams has carried out interviews with stakeholders and	Substantially Complete. Will be published with the

		has prepared a short written report on experiences with WSUD in the planning system.	literature review. August 2015
		B5.1.2 Comparative survey of statutory planning legislation, regulation and processes across five cities (Brisbane, Sydney, Melbourne, Adelaide and Perth): This output has been subsumed into B5.1.3 as the survey was for the purposes of scoping the literature review.	August 2015
		B5.1.3 Comprehensive Literature review of planning policy and legislation relevant to WSUD: This is a necessary input into B5.1.4 and B5.1.5 and will assist in identification of key issues.	August 2015
		B5.1.4 Issues paper on current application of WSUD and options for reform and draft recommended model of planning regulation for WSUD: Identification and assessment of key opportunities and constraints in planning systems relevant to the implementation of WSUD and integrated water management.	October 2015
		B5.1.5 Final report on current application of WSUD and options for reform and recommended model of planning regulation and policy benchmarks for WSUD: The Final Report will identify best practice planning policies and standards for applying WSUD to developments of different planning scales.	August 2016
2.02 Waterway and wetlands health planning and monitoring/ management toolkit to ensure that urban water runoff into waterways and wetlands is 'clean'. • The toolkit will provide the ecological and hydrological basis for design and management guidelines for urban waterbodies that fulfil recreational and aesthetic expectations, optimise biodiversity values, meet wastewater disposal/recycling functions and minimise undesired impacts. • The toolkit will include: **urban design guidelines and planning guideline**s based upon learnings from focused demonstration projects; **methods and indices** for measuring and improving the resilience of urban	**Output 2.2 Waterway and wetlands health planning and monitoring/manage ment toolkit** which provides the ecological and hydrological basis for design and management guidelines for urban waterbodies that fulfil recreational and aesthetic expectations, optimise biodiversity values, meet wastewater disposal/recycling functions and minimise undesired impacts.	**Project B2.1 Stream ecology**	
		B2.1.1 Conceptual models and indicators to underpin stormwater harvesting operating guidelines: Indicators, such as runoff frequency or rainfall retention capacity, were developed and used to assess the impact of stormwater harvesting on the hydrology and water quality of streams. This was followed by the development of predictive models of likely ecological and geomorphic responses.	December 2014
		B2.1.2 Case studies: Case studies of hydrologic restoration using stormwater harvesting and other stormwater retention strategies.	
		Project B2.23 Planning, design and management to protect and restore receiving waters	
		B2.23.1 Decision support framework for the repair and protection of urban freshwaters. A tool that presents a decision support framework to guide urban planning and urban stream management, about how best to repair or maintain ecologically important drivers of stream health and prioritise on-ground effort to achieve desired ecological goals.	**NOTE B2.2+2.3 Impact Pathways' entry does not provide delivery dates.**
		B2.23.2 Recommendations on the importance of vegetation for nitrogen processing in urban wetlands. A report that outlines how vegetation can alter the rates of nitrogen transformations, including denitrification, in urban wetlands.	

waterbodies; **methods for measuring and communicating** to a broad audience the probable change in systems under future population, land use and climate change scenarios.		**Project B2.4 Hydrology and nutrient transport processes in groundwater/surface water systems**	
		B2.4.1 Meta-analysis: A meta-analysis of existing urban water monitoring datasets from the Swan Coastal Plain in Western Australia, and other areas around the globe with a shallow water table (2 – 4 m below ground).	July 2016
		B2.4.2 Report on data and knowledge gaps: An identification of urban water data and knowledge gaps for urban systems impacted by groundwater.	July 2015
		B2.4.3 Mass balances: Event-based and seasonal water and nutrient mass balances for WSUD elements impacted by a shallow water table (2 – 4 m below ground), e.g. infiltration coefficients urban areas with shallow water table.	July 2016
		B2.4.4 Nutrient load quantification: Quantification of groundwater-borne nutrient load to receiving water bodies.	July 2016
		B2.4.5 Guidelines: Guidelines for WSUD design in urban areas with a shallow water table (2 – 4 m below ground).	July 2016
		B2.4.6 Protocol: A protocol for urban water monitoring of flow and nutrients in areas with a shallow water table (2 – 4 m below ground).	July 2016
		B2.4.7 Policy: Input to policy frameworks for management of stormwater in urban areas with a shallow water table (2 – 4 m below ground).	July 2016
2.03 Public realm landscape design and management toolkit that provides **planning and management guidelines** to improve the level of ecosystem services provided by public realm landscapes. The toolkit will provide guidance on urban design criteria that optimise the ecosystem services role of public realm landscape with particular focus on: biodiversity; water security; carbon storage; water quality; microclimate; food production; and, amenity.	**Output 2.3 Public realm landscape design and management toolkit that provides planning and management guidelines to improve the level of ecosystem services provided by public realm landscapes.**	**Project B3.1 Green cities and microclimate & Project B3.2 The design of the public realm to enhance urban microclimates**	
		B3.1 Quantification of the benefits of water sensitive urban design and urban greening on the urban climate and urban heat mitigation at a range of scales: A combination of observational (including remote sensing) and climate modelling approaches is used to quantify the potential air temperature reductions and changes to human thermal comfort from the implementation of WSUD and urban greening. The focus moves through a process of observations → model validation → scenario modelling. Focus moves from the micro-scale (street) → local-scale (neighbourhood) → meso-scale (city).	Micro- and local-scale observation: **COMPLETE** Micro-scale modelling: **DEC 2015** Local- to meso-scale modelling: **OCT 2017**
		B3.2 Evaluation of the benefits of improved urban climates on *heat-health outcomes*: This output has two components: 1) Documenting heat-health thresholds for Australian capital cities and the spatial variability in heat vulnerability throughout cities; and 2) Determining the effect on heat-health outcomes of urban heat mitigation (air temperature reductions) from WSUD and urban greening.	Component 1: **COMPLETE** Component 2: **DEC 2017**
		B3.3 Evaluation of the benefits of improved urban climates on *Human Thermal Comfort*: This output has two components: 1) Documenting levels of Human Thermal Comfort in Australian Cities 2) Determining the effect of WSUD and urban greening on human thermal comfort (including air temperature, humidity, wind speed and mean radiant temperature)	Component 1: **COMPLETE** Component 2: **DEC 2015**

		B3.4 Framework for the implementation of WSUD and urban greening for improved urban climate: Develop a framework for the strategic implementation of WSUD and urban greening based on research to maximise the cost-effectiveness of interventions and minimise the negative impacts of urban climates	**COMPLETE**
		B3.5 Guidelines on the design of WSUD and urban greening for improved urban climate: Provide practical guidance on the design and placement of WSUD and urban greening interventions to maximise their effectiveness in improving urban climates. Guidance stems from both the observational research and the climate modelling research.	**SEPT 2016**
		B3.6 Spatial heat vulnerability mapping: Develop an online tool that maps heat vulnerability of the population for Australian capital cities, which can be used to inform heat mitigation approaches.	**COMPLETE**
		B3.7 Heat threshold for Australian capital cities: Determine climatic based thresholds (e.g. air temperature, apparent temperature) for Australian capital cities at which impacts on human health increase. These thresholds can act as a target for urban heat mitigation through WSUD and urban greening.	**COMPLETE**
		B3.8 Urban heat component of the Water Sensitive Cities Toolkit: Incorporate a simple approach for assessing the benefit of WSUD and urban greening into the Water Sensitive Cities Toolkit to assist users in planning and decision-making. Ongoing contributions will be made throughout the project.	Version 1: **COMPLETE** Version 2: **DEC 2017**
		B3.9 Urban climate modelling tools: Review, select, validate and apply urban climate models that are appropriate to scale (micro-, local- and meso-scale). Develop and/or improve models where necessary.	**DEC 2016**
		Project B4.1 Social-technical flood resilience in water sensitive cities – Quantitative spatio-temporal flood risk modelling	
		B4.1.1 Hydrological hazards methods: Methods for describing concurrent hydrologic hazards are developed and applied on Danish and Australian case studies.	DEC 14
		B4.1.2 Stormwater technologies model: A dynamic model for stormwater harvesting and treatment technologies with focus on describing how the technologies should be modelled as part of flood risk assessments.	JUN 15
		B4.1.3 Flood risk modelling tool: A flood risk modelling tool which integrates an economic valuation of physical assets threatened by these hydrological hazards	JUN 16
		B4.1.4 Module linking flood risk modelling tool with DAnCE4Water: A module that dynamically links the integrated flood risk modelling tool with the DAnCE4Water platform (Dynamic Adaptation for enabling City Evolution for Water) with the purpose of testing strategies for ensuring urban flood resilience.	DEC 14
		Project B4.2 Social-technical flood resilience in water sensitive cities – Adaptations across spatial and temporal scales	
		B4.2.1 Policy recommendations for social and technical flood resilience: Guidance in report format for enhancing resilience to flooding (and associated services and utilities) in the context of an Australian water sensitive city.	JULY 2014

		B4.2.2 Software tool for an enhanced ATP method: Prototype software tool for an enhanced Adaptation Tipping Point (ATP) method	JAN 2015
		B4.2.3 Report on mainstreaming approaches to achieving flood resilience: Report on opportunities for synergistic enhancement of flood resilience with mainstreaming opportunities for urban regeneration, multi-functional land use, ecosystem services, asset management and other urban developments in Australia.	SEPT 2015
		B4.2.4 Guidance manual for linking ATPs and adaptation opportunities: Guidance and best practice for linking ATPs and AMOs in report format supported by spreadsheet or equivalent software.	OCT 2015
		B4.2.5 Support tool for RIO application, with guidance document: Prototype Real-In-Option (RIO) accounting tool with a user guide recommendations for the application of the enhanced ATP method and RIO accounting tool for flood risk management in Australian cities.	SEPT 2016
		B4.2.6. Case studies on ATP-Opportunities and RIOs: Output with Program A to develop capacity in decision makers to utilise the new methods above and to inform policy making and the regulatory approach – policy recommendations	JULY 2017
2.04 An urban infill development design, planning and implementation toolkit to mitigate the negative water run-off loss and urban heat island consequences associated with current infill development practices and thereby reduce barriers to infill development through increasing community acceptance of such development, which will in turn reduce planning delays (thereby reducing costs for infill development). The toolkit will include: **urban design strategies** that apply WSC principles to infill development; **staged scenarios** for the transformation of existing middle suburban areas into integrated infill precincts; **communication materials and public engagement strategies** (leveraging work in programs 1 and 4) to assist in building community consensus and support for greater infill development.	**Output 2.4 An urban infill development design, planning and implementation toolkit** to mitigate the negative water run-off loss and urban heat island consequences associated with current infill development practices and thereby reduce barriers to infill development through increasing community acceptance of such development which will in turn reduce planning delays (thereby reducing costs for infill development).	**Project D5.1 Urban intensification and green infrastructure: Towards a WSC**	
		D5.1.1 Case Study Document (International and National): The group will collect national and international best practice case studies of WSUD and its impact to urban development/ form. Selection criteria will be based on urban impact and outcome as a holistic approach, not only on WSUD technologies. The document focuses on integrated outcomes of WSUD within existing suburbs and new urban development (greenfield). The case studies will inform and be part of the final design guidelines.	2015
		D5.1.2 Models of industry engagement: Development models for engagement with industry and stakeholders specific to urban design issues related to WSUD (such as design workshops, charrettes, etc.).	2016
		D5.1.3 Design guidelines: Development of design guidelines for WSUD precincts with a focus on the integration of social, spatial and environmental aspects of an urban precinct. This integration will be demonstrated via different scales and components of a precinct from the scale of the lot and the dwelling, to the scale of the street, block and neighbourhood and ultimately whole of catchment.	2017
		D5.1.4 Demonstration projects: Design scenarios in different climactic and density conditions in Australia and internationally (i.e. Kunshan) are developed to inform the design guidelines. These scenarios will include real projects as well as hypothetical and/or CRCWSC research synthesis projects, including Elwood Integrated Study, Arden-Macaulay Precinct, City of Canning and Bentley CRC Synthesis Project.	2017

Future Technologies Projects			
CRCWSC Impact Tool (Economic Valuation)	***Cth Agreement Outputs***	***Outputs as defined by researchers per Impact Pathways template and/or Research 2012-2016 Report (RR)***	***Delivery Dates***
3.01 Novel energy-efficient, low-maintenance and cost effective technologies for distributed water production supported by training, implementation and operation support materials. Multiple technologies will be explored and those assessed as having high promise will rapidly proceed to prototyping, testing, validation, refinement and transfer to industry participants for commercialisation while technologies assessed as lower promise will be dropped from the research program. In this way, program resources will continuously be steered towards projects showing highest potential to deliver practical, cost effective and efficient water treatment solutions	**Output 3.1: Novel energy-efficient, low-maintenance and cost effective technologies for distributed water production, and associated implementation training and support materials, are developed in consultation with CRC Participants.**	**Project C1.1 – Sustainable technologies**	
		1. Advanced biofilter systems • **C1.1.1 Guidelines for adoption (design, maintenance and operation) of biofiltration systems for stormwater treatment and harvesting:** Revised version of the FAWB guidelines focused on design for harvesting, plant selection and maintenance • **C1.1.2 Passive filters and biofilters for pathogen removal in urban stormwater:** New generation biofilters to remove more pathogens	**C1.1.1:** Draft 1/12/2014 & Final 1 April 2016 **C1.1.2:** Launch of tech report Oct 2013
		2. Urban Beats Model • **C1.1.3 UrbanBeats conceptual representation of WUSD systems within a city-wide model** • **C1.1.5 Integrated model that can assess performance of WSUD systems for pollution, flooding and stormwater harvesting**	**C1.1.3**: Beta version 2013 **C1.1.5**: Final version Dec 2014
		3. Model of Micropollutants and Microorganism • **C1.1.6 Model of micropollutant behaviour in WSUD systems:** The model will simulate the key treatment processes within stormwater biofilters/wetlands and bio-chemical degradation. Coupled with MUSIC hydraulic model (insitu tested) • **C1.1.4 Model of faecal microorganism removal in existing stormwater biofilters**	**C1.1.6:** Oct-13 **C1.1.4**: Oct-13
		Project C1.2 – Risk and health: understanding stormwater quality hazards	
		C1.2.1 Chemical and microbial characteristics of stormwater: Characterisation of the chemical and microbial qualities of untreated stormwater	**C1.2.1** Dec-14
		C1.2.2 Prioritisation of human health risks associated with untreated stormwater: Prioritisation of human health risks associated with chemical and microbial hazards in untreated stormwater	**C1.2.2** Dec-14
		C1.2.3 Influence of catchment characteristics on stormwater quality: Commentary on the influence of catchment characteristics on the chemical and microbial quality of untreated stormwater	**C1.2.3** Dec-14

		C1.2.4 Risk assessment process recommendations: Recommendations for assessing risks associated with untreated stormwater incl. the role of chemical surrogates	**C1.2.4** Dec-14
		Project C1.3 – Fit-for-purpose water production	
		C1.3.1 PMA-NGS method: Development and validation of a molecular-based method that combines next generation sequencing (NGS) techniques with PMA (propidium monoazide). This will provide information on the active (or viable) microorganisms and microbial communities before and after urban water treatments.	**C1.3.1**: Jun-16
		C1.3.2 Assessment of health risks using new PMA-NGS methods	**C1.3.2**: Jun-16
		C1.3.3 Literature review of current and novel treatment technologies for recycling water treatment. The review will examine the benefits and limitations of existing and possible future systems for treatment of recycling water. Key factors considered in this review will be: installation and operating costs, energy consumption, scalability, maintenance requirements, environmental and other external benefits, novelty, etc.	**C1.3.3**: Dec-15
		C1.3.4 Development of novel treatment systems: Deliver low-cost and low-energy consuming filtration systems for treatment and reuse of reclaimed water**.** Following laboratory studies, the project will apply developed novel filter materials at the field-scale by incorporating them into existing systems and establishing new pilot plants)	**C1.3.4**: Jun-16
		C1.3.5 Guidelines for the use and application of novel treatment systems: Supporting technical information for novel treatment system	**C1.3.5**: Jun-16
		C1.3.6 Validation and operational monitoring methodologies for passive water treatment systems: This output aims to provide 1) validation methodologies to ensure natural treatment systems perform their desired function and 2) operational monitoring regimes which demonstrate performance	**C1.3.6**: Jun-16
		(RR) *Training programs*: Training programs for asset managers and end users to ensure systems are constructed correctly and continue to function into the future.	
3.02 Cost-effective technology for the recovery of resources (e.g. energy and phosphorous) from waste-water. These technologies will	**Output 3.2 Cost-effective technology for the recovery of resources (e.g. energy and phosphorous)**	**Project C2.1 – Resource Recovery from Wastewater**	
		C2.1.1 Novel Urban wastewater technologies: Cost effective technologies that replace existing technologies and recover resources	**C2.1.1**: Jun-18

include: biological and physical processes (e.g. Algae, Microbial accumulation, Physical separation to concentrate nutrients and energy for dilute wastewater streams; biological and physical processes (e.g. anaerobic digestion) to release and recover nutrients and energy from concentrated wastewater streams; chemical and physical processes to recover nutrient streams as high-value substitutes to existing commercial nutrient products. These technologies will be developed and applied through demonstration projects. The untied nature of CRC participants' contributions will enable a rigorous project gateway process to be implemented in the delivery of these novel technologies (including the use of cost/benefit analyses).	**from waste-water.** These technologies will include: biological and physical processes (e.g. Algae, Microbial accumulation, Physical separation) to concentrate nutrients and energy for dilute wastewater streams; biological and physical processes (e.g. anaerobic digestion) to release and recover nutrients and energy from concentrated wastewater streams; chemical and physical processes to recover nutrient streams as high-value substitutes to existing commercial nutrient products.	**C2.1.2 Demonstration processes:** Trial application of the novel wastewater technologies. A pilot processing plant will be built as part of the larger innovation centre at Brisbane's Luggage Point Advanced Water Treatment Plant. More pilots are also planned with the support of Victorian utilities.)	**C2.1.2**: Jun-18
3.03 Knowledge and software models for decision support for the protection of the central wastewater collection/treatment systems. The models developed will allow for assessment of the interactions between decentralised and central infrastructure to: reduce sewer sedimentation and blockages; predict and mitigate corrosion and odour issues; and, support the optimal integration of these systems and reduce potential negative impacts on central infrastructure due to the growth of decentralised systems.	**Output 3.3 Knowledge and models for decision support for the protection of the centralised wastewater collection/treatment systems**	**Project C3.1 – Managing interactions between decentralised and centralised water systems**	
		C3.1.1 Characterising interactions between centralised and decentralised water delivery systems: Literature review report on centralised and decentralised water delivery systems	**C3.1.1**: Sep-14
		C3.1.2 Models developed for the assessment of the impacts of changes in water use practice on downstream collection system (odour and corrosion, GHG emissions and sedimentation): Models to describe the impacts of implementation of decentralised systems onto centralised systems. The models will provide support minimising the impacts and optimising function of the sewer networks.	**C3.1.2**: Jun-16
		C3.1.3 Report of modelling and recommendations for integration of decentralised systems: Overall water balance model described - combination of 3 models. Including reports on case studies	**C3.1.3**: Dec-16
		C3.1.4 Report on overall recommendations: Recommendations to improve interactions of central and de-central systems	**C3.1.4**: Dec-16
		C3.1.5 Decision Support Tools: Release of Decision support tools and support material in an integrated package	**C3.1.5:** Dec-16
		(RR) ***Training workshop program:*** Training workshops will be offered for the use of the Decision Support Tools	Dec-16?
3.04 Technologies for treatment and	**Output 3.4 Technologies**	**Project C4.1 – Integrated multi-functional urban water systems**	

reuse of multiple water sources within urban landscape supported by suite of training, design, implementation and operation support materials. Building on the research teams experience in stormwater biofiltration systems, biofiltration technologies will be further developed so that in addition to use in treating stormwater during wet weather they can also be used to treat polluted groundwater and wastewater during dry periods within tight urban landscapes. These 'hybrid' biofilters will be able to treat multiple polluted water streams to deliver safe water for human use, protect waterways and ameliorate the urban heat island. The development of the outputs will be influenced by the economic cost/benefit studies that are represented in Output 1.02.	**for treatment and reuse of multiple water sources within urban landscape supported by suite of training, design, implementation and operation support materials.**	**C4.1.1 Decision support tool for quantifying wetland ecosystem function:** A wetland eco-hydrological model able to simulate vegetation response to water balance variability and associated changes in biogeochemical cycles, and validated against above data.	31 Dec 2015
		C4.1.2 New hybrid biofiltration technologies: *T1 - Living walls for greywater treatment:* Prototype of green technology that treats greywater while improve micro-climate and provide amenity to public space *T2- Green walls for greywater treatment:* Prototype of green technology that treats greywater while improve micro-climate and provide amenity to public space *T3: Living walls for stormwater and greywater treatment*: Prototype of green technology that treats greywater and stormwater (two different sources of water) while improve micro-climate and provide amenity to public space.	T1: 31 Dec 2016 T2: 31 Dec 2016 T3: 31 July 2017
		C4.1.3 Adoption guidelines for new technologies: Design, maintenance and operational guidelines for green and living walls technologies	31 July 2017
		C4.1.4 Demonstration and testing of new green technologies: Results from monitoring new technologies	31 July 2017
3.05 Data analysis tools and information presentation systems to better support urban water system optimisation and achievement of "smart urban water systems". The data analysis tools and information presentation systems that will be produced will allow for better utilisation of sensor data to optimise the efficiency and safety of urban water systems. This output will include: methods and software for sensing protocols and context aware data stream mining; frameworks and software for the application of a multi-objective generic algorithm for optimising pumping across the water delivery system; case study reports using field deployed sensors and data systems with smart meters and	**Output 3.5 Data analysis tools and information presentation systems to better support urban water system optimisation and achievement of "smart urban water systems"**	**Project C5.1 – Intelligent urban water systems**	
		C5.1.1 Data analytics for smart metering: Algorithms and software for data mining analysis of metered water use	**C5.1.1:** 2017
		C5.1.2 Decision support for pumping optimisation with multiple water sources: Decision Support Tools for multi-objective optimisation of pumping with multiple water sources	**C5.1.2:** 2017

integrated pipelines; guidelines for sensor placement and operation.			

Adoption Pathways Projects			
CRCWSC Impact Tool (Economic Valuation)	***Cth Agreement Outputs***	***Outputs as defined by researchers per Impact Pathways template and/or Research 2012-2016 Report***	***Delivery Dates***
4.01 Establishment of national learning community alliance and portal. The Alliance will provide a variety of virtual and face-to-face forums where stakeholders can interact, experiment, exchange information and learn together at a national and local level. This national alliance will foster national leadership on water sensitive cities (WSC), influence policy and practice, and assist in the dissemination of the lessons from a range of WSC case studies and demonstration projects. This output is currently being developed by the International Water Centre and will be folded into the CRC for WSC. **4.03 Tutorials and industry short-course materials for practitioner training/upskilling**. These materials will include case studies at the lot, street, precinct and city scales that come out of	**Output 4.1 Establishment and operation of national learning community alliance and portal.** The Alliance will provide a variety of virtual and face-to-face forums where stakeholders can interact, experiment, exchange information and learn together at a national and local level. The objective of the alliance is to ensure all CRC outputs are utilised by state and local govt agencies; water utilities; technology developers; land developers; consultants; and, the community sector **Output 4.2 Tutorials and industry short-courses**	**Project D1.1 Integration and demonstration through urban design**	
		2 - D1.1.3 Demonstration Project Seminars, Reports, Site Visits: Knowledge sharing seminars, presentations, reports and site visits focussed on CRCWSC research engagement, outcomes and insights for the Officer (Vic) and Marrickville (NSW) demonstration projects (D1.1).	February 2015
		2 - D1.1.4 blueprint Chapter: Research Adoption and Implementation (Officer): Revised and updated chapter in blueprint 2014: stormwater management in a water sensitive city, describing the adoption, adaptation and implementation of research insights as part of Places Victoria's Officer development.	December 2014
		Project D1.4 Integration and demonstration through urban design – phase 2	
		3 - D1.4.1 Case Study Applications of Toolkit: Documentation of application (testing and validation) of the Toolkit to specific locations (D1.1/D1.4)	Apr 2015 (D1.1) Jun 2017 (D1.4)
		3 -D1.4.2 Seminars and Training (Toolkit Application): Engagement with practitioners' interested / involved in application of the Toolkit, including the dissemination and discussion of research knowledge from research projects represented in the Toolkit (D1.4).	June 2017
		Project D3.2 Influencing water sensitive cities policy	

the research conducted in Programs 1, 2 & 3. Dissemination of the training materials and delivery of courses will be through the National Learning Community Alliance (Output 4.01).	**materials are developed in consultation with end users for practitioner training/upskilling**	**This Project has no Impact Pathways entry and is not specifically described in 'Research 2012-2016'**	
4.02 Socio-technical modelling software package to examine urban water management scenarios. This software tool will enable users to simulate the interactions between social acceptance, urban form, economics and technical feasibility to examine possible urban water management scenarios. The tool will be progressively developed and refined and will over time incorporate research outcomes from Programs 1, 2 and 3.		**Project D1.1 Integration and demonstration through urban design**	
		1 - D1.1.1 WSC Toolkit (Version 2 beta): A second beta version (for testing and validation) of the Water Sensitive Cites Modelling Toolkit (the Toolkit) (D1.1), with supporting preliminary user guidance.	October 2014
		1 - D1.1.2 Seminars and Training: Engagement with practitioners interested / involved in development and testing of the Toolkit, including the dissemination and discussion of research knowledge from research projects represented in the Toolkit (D1.1).	December 2014
4.05 PhD, Masters and Graduate Certificate completions (from across whole of CRC activities). Following initial market research into demand for new postgraduate course/s, knowledge from the CRC's research activities in Programs 1, 2 and 3 will be utilised in the development of a range of new postgraduate courses.	**Output 4.4 PhD, Masters and Graduate Diploma completions (from across whole of CRC activities)**	**Project D4.1 Strengthening educational programs to foster future WSC leaders**	
		D4.1.1 Masters level modules on delivering water sensitive cities: A professionally targeted high level module syllabus and teaching materials to introduce water sensitivity and how to deliver it through innovations in governance, technology and economics implemented through the IWC and UNESCO-IHE Masters.	June 2013
		D4.1.2 Australian and international skills and knowledge needs assessment report: An assessment of the skills and knowledge needed to deliver water sensitive city outcomes across local government, state government, utilities and the private sector in Australia, the Netherlands and a selected set of Asian cities.	November 2014
		D4.1.3 A structured professional learning vision and set of recommendations for delivering water sensitive city outcomes: A report identifying and recommending opportunities for the CRCWSC to (i) invest in the development of new structured professional learning programs and courses (education and training) where gaps and sufficient demand exists, and (ii) partner where existing provision or capacity exists to deliver on identified skills and knowledge needs.	June 2015

		D4.1.4 A set of structured professional learning programs and courses with paying participants: A set of structured professional learning programs and courses with paying participants delivered by a mixture of CRCWSC participants and external partners to effectively build capacity in water sensitive city outcome delivery	Post June 2015

Appendix I-D: Usage Comparisons

Society Projects			
CRCWSC Impact Tool Usage (Economic Valuation)	***Cth Agreement Usage***	***Usage as defined by researchers per Impact Pathways template and Research 2012-2016 Report (RR)***	
Usage 1.01 **Water utilities and retailers** and **State and Local government water and planning authorities** are all key end users for output 1.01. **Consultants** and **urban land developers** are also important potential users of the improved cost/benefit analysis tools -their usage will be driven by the usage of the water and planning authorities. **Usage 1.02** **Program 3**, outputs 3.01-3.05,		**Project A1.1 – Cities as water supply catchments – economic valuation**	
		A 1.1.1 Preferences for attributes of stormwater management	**Users:** Water Utilities, Departments of Water, Local governments **Why?** The information allows users to infer values for non-market values when primary information is not available. It also allows ranking of various benefits from stormwater management **When?** From the current time
		A1.1.2 Salient method	**Users:** All levels of governments, water utilities, developers **Why?** Improve the confidence of using nonmarket valuation through stated preference methods for policy. **When?** From the current time
		A1.1.3 Monetary and Relative Values	**Users:** Local councils, OLV, Water Companies, other CRC researchers **Why?** The values can be used to provide decision-makers with the knowledge 'to make informed decisions about water infrastructure investment that strike the best balance between economic, social and environmental outcomes so that benefits to the broader community are maximised'.

will use output 1.02 as part of its adoption strategy for its own outputs. Program 3 will refer technologies to Program 1 for cost/benefit assessment and will utilise the resulting cost/benefit assessments to: inform future research activities (for instance, a negative cost/benefit assessment of a technology may lead Program 3 to drop certain lines of research whereas a highly positive cost/benefit assessment of a technology may lead to a ramp up of certain lines of research); and, strengthening the case for adoption of technologies in those cases where the cost/benefit assessment is positive.	**Utilisation 1.1** Water and planning departments, and water utilities		**When?** Currently, and as additional modelling assumptions are tested
		A1.1.4 Hedging supply risks - An optimal urban water portfolio model	**Users:** Water utilities, economic regulators **Why?** We develop a framework to help water utilities determine the optimal mix of water sources (various natural versus manufactured water) to satisfy water demand, taking into account the location and source specific variability in flows and supply costs. **When?** From the current time
		A1.1.5 Policy recommendations regarding attribute ranking	**Users:** State and Local government **Why?** This is a way to implement the findings of the research on preferences and monetary values into practice. **When?** From the current time
		Project A1.2 Valuation of economic, social and ecological costs and benefits	
		A1.2.1 Collation and systematic documentation of existing knowledge on non-market values for WSUD	**Users**: Water Utilities, Departments of Water, Local governments **Why?** The information allows users to infer values for non-market values when primary information is not available. **When?** From the current time
		A1.2.2 Case studies on decentralised water supply systems	**Case study 1 Users:** Water utilities and State Government Departments of Water. **Why?** The framework of analysis used allows the appropriate rainwater tank public policy to be determined **When?** Once the final version of the paper has been published **Case study 2 Users**: Local Government Authorities. **Why?** Findings are directly relevant **When?** Nedlands during the project, & other LGAs once final report has been completed
		A1.2.3 Case studies on WSUD technologies	**Users:** Local governments (Case study 1: economic evaluation of rain gardens); Local governments, Water utilities, economic regulators (Case study 2: economic evaluation of a living stream project AND Case study 3 non market values of constructed wetlands) **Why?** The research provides direct measures of benefits associated with rain gardens/living streams/constructed wetlands not captured in traditional cost benefit studies **When?** Once a working paper has been completed
		A1.2.4 Hedging supply risks: An optimal urban water portfolio model	**Users**: Water utilities, economic regulators **Why?** The framework has a direct impact on how water supply infrastructure investments should be made **When?** In 2015 this research will form part of a Western Economic Forum
		A1.2.5 Guidelines for Cost Benefit Assessment of Water Sensitive City Projects	**Users:** Local governments **Why?** This output is a practical guide to the process of cost benefit analysis: Guide, worked examples and excel spreadsheets. **When?** Once the guidelines and support material are complete
		A1.2.6 Case studies on managing the waste water treatment plant and urban population interaction	**Users:** Water utilities in general and water corporation in particular **Why?** These outputs provide directly relevant information for those managing infrastructure **When?** Throughout the project

		A1.2.7 Guidelines for how to undertake a non-market valuation study	**Users:** Local government **Why?** This will be a step by step guide that will allow local governments to derive locally relevant non-market value information **When?** At the testing stage for the guide
		A1.2.8 Adaption of UK green infrastructure online toolkit	**Users:** Local governments **Why?** The tool will be able to provide indicative values on the value of green infrastructure **When?** In 2016
		Project A1.3 Economic incentives and instruments	
		A1.3.1 Formal vs. informal policy mechanisms for monitoring pollution and improving environmental outcomes	**Users:** Departments of environmental protection (ex: DEPI), Local Governments **Why?** The research guides what type of sanctions is most effective for monitoring and enforcing pollution controls. **When?** From the current time
		A1.3.2 Social norms for water conservation	**Users:** Water utilities **Why?** This highlights a cost effective tool for water conservation. **When?** From the current time
		A1.3.3 The cost-benefit analysis comprises a case study in Western Australia's Southern River catchment	**Users:** Researchers, local/state governments & water utilities, developers **Why?** Measured emission data for Southern River will be used to try to link historical nutrient emission changes with land use changes, especially housing developments. Once this relationship has been estimated, the least cost approach to emission abatement can be estimated and the method can be extended to other catchments. **When?** From the current time
		A1.3.4 Crowdfunding method	**Users:** Local governments, developers, non-profits, other CRC researchers **Why?** Crowdfunding creates a platform for privately funding water sensitive urban design. It also provides an alternative to stated preference methods to elicit preferences for benefits from WSUD. **When?** Discontinued based on feedback from the CRC Program A leaders. Several partners are interested in testing crowdfunding but need to find an appropriate project.
		A1.3.5 Policy recommendations about the use of incentives	**Users:** State and Local government **Why?** This is a way to implement the findings of the research on crowdfunding into practice. **When?** Currently for research design and participation, from 2016 for results
Usage 1.03 This usage relates to Outputs 1.03, 1.04 and 1.05. Outputs 1.03, 1.04 and 1.05 are a related bundle of outputs that are all targeting usage by key end user **CRC participant State and Local Government planning and water**	**Utilisation 1.2** Outputs 1.2 (behavioural assessment database and behaviour change strategy) is utilised by key CRC	**Project A2.1 Understanding social processes to achieve WSC**	
		A2.1.2 Water sensitive citizen typology	**Users:** Water utilities working with the local community, policy makers in local and state government, NGOs involved with consumers/communities **Why?** A classification of different groups across Australia on installation of water efficient appliances and everyday water saving, community values and expectations, and knowledge will be useful for understanding diverse communities, demand forecasting, policy development and marketing. **When?** Some partners have been engaged since 2013 when the project started particularly through identification of behaviours included in the national survey. We have

departments and Water Authorities. It is unlikely that the outputs 1.03,1.04 and 1.05 would be widely used in isolation from one another as they collectively improve the decision making frameworks, tools and structures available to a common end user group (with CRC participants the anticipated early adopters).	Participants		invited partners via email to provide input into the quantitative typology as it was developed in 2014 and early 2015.
		Project A2.2 Accelerating WSC by influencing behaviour	
		A2.2.1 Prioritised roadmap of household water behaviours for change	**Users:** Water utilities, policy makers in local and state government, NGOs involved with consumers/communities, residents **Why?** This behavioural roadmap will be used to gauge where a population currently sits in terms of water sensitivity as well as show the next tranche of behaviours to target in a progression toward greater water sensitivity. **When?** They have been engaged since 2013 when the project started. Results are being disseminated through reports, presentations.
		A2.2.2 Recommendations for effective behaviour change strategies	**Users:** Water utilities, policy makers in local and state government **Why?** Knowing what works, particularly, whether leveraging off existing behaviour can be successful. Assists the water industry in understanding the utility of a spill over approach to communication. **When?** They have been engaged since 2013 when the project started. Results are being disseminated through reports, presentations.
	Utilisation 1.3 Outputs 1.3 (improved regulatory frameworks) is utilised by key CRC Participants.	**Project A3.1 Better governance for complex decision-making**	
		A3.1.1 New knowledge of urban water governance systems	**Users:** State government policy makers and regulators from relevant departments and agencies; Local government water, environment and planning staff; Water utilities **Why?** *For state govt.:* The research will produce new insights into how urban water governance currently functions. This more nuanced view will provide these users with better understanding of their own governance context, as well as the ability to benchmark and borrow ideas from other jurisdictions *For local govt. & WU.*: These users may find the research provides them with a more comprehensive understanding of the constraints they experience at higher levels of government **When?** These users may find preliminary results of interest. These results will be related to levels of government but not to specific organisations.
		A3.1.2 Context-relevant recommendations of governance structures and strategies to support innovation and adaptability	**Users:** State government policy makers and regulators from relevant departments and agencies; Industry associations **Why?** The research will provide the salient evidence these users will need to design governance systems that can support the complexity and uncertainty of future water management needs **When?** This evidence will not be available or tested till the later stages of the research project
		A3.1.3 Guidelines to support governance reform through policy change	**Users:** State government policy makers from relevant departments and agencies; Local government water, environment and planning staff; Water utilities **Why?** *For state govt.:* The research results will provide guidance on how to shift entrenched governance structures and practices toward those more suited to the principles and

			conditions of sustainable urban water management *For local govt. & WU*: While not directly responsible for governance change, these research outputs will help to empower these users to become more actively engaged in driving policy change and governance reform. **When?** Engagement on this output of the research will be sought in the later stage of the research from early 2016
		Project A3.2 Better regulatory framework for WSC	
		A3.2.1 Legislative Stocktake Reports - Victoria, Western Australia and Queensland	**Users:** Water utilities, government departments, legal practitioners in the urban water sector and researchers in other CRCWSC projects. **Why?** This output provides a base line assessment of the current legislation based frameworks across the three states. **When?** A sub-project level stakeholder reference group has been engaged in this research since October 2013.
		A3.2.2 Conceptual model of Australian urban water regulation	**Users:** Water utilities, government departments, other practitioners in the urban water sector and researchers in other CRCWSC projects **Why?** This output provides a conceptual model through which to better understand and discuss the current regulatory frameworks that impact on the Australian urban water sector. The output applies this to the specific case of Melbourne, Victoria and may be of particular interest to Victorian stakeholders. **When?** A sub-project level stakeholder reference group has been engaged in this research since October 2013.
		A3.2.3 Comparative analysis of Australian regulatory frameworks report	**Users:** Water utilities, government departments, other practitioners in the urban water sector and researchers in other CRCWSC projects **Why?** This output will build upon earlier work of Project A3.2 and will provide a multi-jurisdictional analysis of the current regulatory frameworks that impact on the Australian urban water sector. The output will also contain broad recommendations about which aspects of these frameworks appear to help or hinder the adoption of more water sensitive practices. **When?** A sub-project level stakeholder reference group has been engaged in this research since October 2013.
		A3.2.4 Case Study reports on regulation	**Users:** Water utilities, government departments, other practitioners in the urban water sector and researchers in other CRCWSC projects **Why?** This output analyses in detail exactly how current regulatory and risk allocation frameworks hinder or help specific attempts to implement water sensitive innovations in Australia. This will produce new insights into those parts of such frameworks that are of greatest practical significance in helping or hindering the adoption of more water sensitive practices. **When?** A sub-project level stakeholder reference group has been engaged in this research since October 2013.
		Project A3.3 Strategies for influencing the political dynamics of decision making	
		A3.3.1 Literature reviews and industry notes on	**Users:** Researchers in other CRCWSC projects, water utilities, government departments, other and practitioners in the urban water sector

		political dynamics, policy frameworks, tactics and strategies for researchers to influence policy	**Why?** Provides detailed theoretical background and practical guidance for better understanding policy processes. Complements other forms of engagement and capacity-building. **When?** Users should become engaged once final versions are published
		A3.3.2 Case study reports of urban water policy development in Victoria, Queensland and Western Australia	**Users:** Researchers in other CRCWSC projects, water utilities, government departments, other and practitioners in the urban water sector **Why?** Provides useful examples of the complexities of policy development, the way that research can influence policy, and acts as the basis for further learning and improvement in case study contexts. **When?** During the interview phase and once reports are published
		A3.3.3 Development and testing of capacity-building approaches for researchers to influence policy	**Users:** Researchers in other CRCWSC projects **Why?** To enhance the capabilities of CRCWSC researchers in pitching research to policy, acting as the voice of CRC research, and to have a positive impact on current urban water policy development. **When?** In the months leading up to a capacity-building workshop in July 2015, then following the event
	Utilisation 1.4 Outputs 1.4 (risk assessment and diversification models) is utilised by key end users	**Project A3.2 Better regulatory framework for WSC**	
		A3.2.5 Risk allocation model	**Users:** Water utilities, government departments, other practitioners in the urban water sector and researchers in other CRCWSC projects **Why?** The risk allocation model is important because it helps us better understand how legal risks are allocated, and how they may be re-allocated, in relation to water sensitive innovation. **When?** A sub-project level stakeholder reference group has been engaged in this research since November 2014.
		Project A4.1 Society and institutions - Risk Perception	
		A4.1.1 Aesthetic design guidelines for raingardens	**Users:** Local government, water utilities, consultants **Why?** This output (aesthetic design guidelines for raingardens) will guide their design of raingardens to ensure that the raingardens are favourably appreciated by the local residents and the broader community, which in turn will enhance their acceptance **When?** Once the guidelines have been developed in draft form, early in 2015
		A4.1.2 Analytical framework for risk perceptions	**Users:** State government, local government, water utilities, NGOs, private enterprise, community groups, **Why?** This output (analytical framework for perceived risk) identifies possibly different and conflicting risk perceptions of stakeholders involved in urban water management, which unacknowledged can impede the adoption of hybrid water sources and systems, essential to the water sensitive city. **When?** These users have been engaged with the research from its inception, early in

<table>
<tr><td></td><td></td><td></td><td>2010.</td></tr>
<tr><td></td><td></td><td>A4.1.3 Report on current risk perceptions of Australian urban water practitioners towards alternative urban water systems, technologies and sources</td><td>Users: State government, local government, water utilities, NGOs, private enterprise, community groups
Why? This output (report on risk perceptions towards alternative urban water systems within the Australian urban water industry) provides important insight into the risk perceptions of the various stakeholders that are likely to be involved in urban water management in the water sensitive city.
When? These users have been engaged with the research from its inception, early in 2010.</td></tr>
<tr><td rowspan="6">Usage 4.02
State and Local Govt agencies; water utilities; technology developers; land developers; consultants; and, the community sector will all be users of the outputs (4.01, 4.02, 4.03, 4.04, 4.05) of Program 4.</td><td rowspan="6">Utilisation 1.5
Adoption of socio-technical model for scenario planning of water sensitive cities</td><td colspan="2">Project A4.2 Mapping water sensitive city scenarios</td></tr>
<tr><td>A4.2.1 Guidance manual</td><td>Users: State government, local governments and water utilities
Why? Output 1 (guidance manual) would support them to facilitate strategic planning processes from the perspective of transitioning to a water sensitive city</td></tr>
<tr><td>A4.2.2, A4.2.3, & A4.2.4 Reports on Elwood, Perth, and Other water sensitive city transition scenarios</td><td>Users: State and local governments; water utilities; and local community members
Why? Outputs 2, 3 and 4 (transition scenario reports) would provide context-specific insight into strategies for enabling the transition to a water sensitive city
When?
A4.2.2 City of Port Phillip is engaged as participants in the local community workshop series (Elwood).
A4.2.3 Perth stakeholders are engaged as participants in the metropolitan-scale professionals' workshop series (Perth).
A4.2.4 Other city stakeholders to be engaged with once focus locations are decided.</td></tr>
<tr><td colspan="2">Project A4.3 Socio-technical modelling tools to examine urban water management scenarios</td></tr>
<tr><td>A4.3.1 Computational algorithms modelling the integrated urban water system including socio-economic system, urban form and water infrastructure systems

A4.3.2 A web-based platform to facilitate collaborative planning and decision-making processes

A4.3.3 Demonstration and application of DAnCE4Water in regional and community scale case studies</td><td>
<table>
<tr><th>Users:</th><th>Why?</th><th>When?</th></tr>
<tr><td>Water Utilities</td><td>The tool will support decision makers and planners to understand the complexity of the urban water system and to make more robust planning decisions</td><td>Early</td></tr>
<tr><td>Government Agency (OLV)</td><td>To support government agencies in the development of robust policies</td><td>Early</td></tr>
<tr><td>Planning agencies (Growth authorities)</td><td>To understand the implications of urban planning decision on the urban water system and to consider and utilise these implications and to facilitate an more collaborative planning approach E.g. location of growth corridors and polices for growth corridors to tackle problems of urban heat islands</td><td>Late</td></tr>
</table>
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<tr><td></td><td></td><td>A4.3.4 Guidance and recommendations of how to develop effect and robust water management strategies
A4.3.5 Industry short-courses to facilitate widespread industry uptake of the tool</td><td>
<table>
<tr><td>Local Government</td><td>To support collaborative planning approaches and community engagement</td><td>Mid</td></tr>
<tr><td>Planners</td><td>To assess multiple impacts of planning decisions</td><td>Mid</td></tr>
<tr><td>Researchers within the CRC</td><td></td><td>Mid</td></tr>
<tr><td>Software Developers</td><td></td><td>Mid</td></tr>
<tr><td>Community</td><td>Communication of results and learning.</td><td>Late</td></tr>
</table>
</td></tr>
<tr><td></td><td></td><td colspan="2">Project D6.2 Developing a Water Sensitive Cities Index</td></tr>
<tr><td></td><td></td><td>D6.2.1 WSC Index/ Indicator Framework</td><td>Users: LGAs/ State agencies/ Utilities; Developing nations
Why? To assess their position/progress with respect to their WS Vision and possibly with respect to other areas. The tool is to help identify pathways towards desired visions.
When? LGAs/ State agencies/ Utilities – from the onset; Developing nations – From February 2016, resulting from the Asia Development Bank funding for a trial in Indonesia, however this will be delivered as a separate project in conjunction with D6.2</td></tr>
<tr><td></td><td></td><td>D6.2.2 Web-based Platform</td><td>The value of this project lies in equipping CRCWSC's industry partners with the capacity to monitor and evaluate the performance of their water management practices and explore measures that would realise water sensitive potential.
End users will include local and state governments, public agencies and water utilities, consultancies, land developers, community groups, technology providers and research organisations.
Why? When? As per D6.2.1</td></tr>
<tr><td>Usage 4.04
State and Local Govt agencies; water utilities; technology developers; land developers; consultants; and, the community sector will all be users of the outputs (4.01, 4.02, 4.03, 4.04, 4.05) of Program 4.</td><td>Utilisation 1.6
Outputs 1.6 (database of water literacy) is utilised by key end users</td><td colspan="2">Project A2.1 Understanding social processes to achieve WSC</td></tr>
<tr><td></td><td></td><td>A2.1.1 Report on history of water use in Australia</td><td>Users: Water utilities, policy makers in local and state government; researchers within the CRC – Urban historians
Why?
For WU, local & state govt.: Important information on the development of Australian cities and water policies and community practices in different states
For researchers: Useful information on the development of Australian cities and water policies and community practices in different states
When? The report will be distributed to partners when it is completed in September 2015</td></tr>
<tr><td></td><td></td><td colspan="2">Project A2.3 – Engaging communities with water sensitive cities</td></tr>
<tr><td></td><td></td><td>A2.3.1 Report on Australian water literacy</td><td>Users: Water utilities, Local government & NGOs involved in community engagement; Australian water sector broadly; Australian media/society
Why?
For WU, local govt. & NGOs.: This output provides important information to guide the education & engagement programs run by these organisations
For Aust. Water sector: Provides general understanding of knowledge strengths & deficits in the Australian community
For media: This output provides important understanding of Australians in relation to an important environmental issue, that is, water</td></tr>
</table>

			When? *For WU, local govt. & NGOs.:* They have been engaged from the beginning of the project and results are being sent through as they become available *For Aust. Water sector:* Results will be disseminated academic paper is published *For media:* Results will be disseminated after academic paper is published
		A2.3.2 Database of community friendly water terminology and visuals	**Users**: Local government, water utilities & NGOs involved in community engagement; biophysical water researchers in the CRC & beyond **Why?** *For local govt., WU & NGOs*: This output can be used to optimise community engagement & education programs *For researchers*: This output can provide guidance to water scientists about how to talk about their results in a way that is understandable to citizens **When?** *For local govt., WU & NGOs*: They have been engaged from the beginning of the project *For researchers*: As the results become available
		A2.3.3 Best practice recommendations for community engagement about sustainable urban water management	**Users:** Local government, water utilities & NGOs involved in community engagement. **Why?** This output can be used to refine and inform education & engagement programs. **When?** They have been engaged from the beginning of the project and results are being sent through as they become available (N.B. results still to be shared pending approval of report)

Water Sensitive Urbanism Projects			
CRCWSC Impact Tool (Economic Valuation) Usage	***Cth Agreement Usage***	***Usage as defined by researchers per Impact pathways template and Research 2012-2016 Report (RR)***	
Usage 2.01 **Local and state government planning authorities and water authorities** are key end users for Output 2.01, 2.02 and 2.03. Usage of these three outputs has been grouped as they all contribute to the planning and management tools available to government and given the common dissemination strategy for the	**Utilisation 2.1** Outputs 2.1, 2.2 and 2.3 are utilised by local and state government planning and water authorities	**Project B1.1 Urban rainfall in a changing climate & Project B1.3 Impact of climate change on extreme rainfall and drainage design**	
		B1.1.1 A stochastic model appropriate for downscaling rainfall to scales relevant for the design of water harvesting technologies	**Users:** CRC WSC Program D2a **Why?** Among other things, Program D will to produce an integrated software tool for strategic planning and conceptual design of stormwater harvesting and use systems. This tool requires rainfall information at the urban scale. The first step is to produce the mathematical model appropriate for this. **When?** Throughout the lifetime of the project.
		B1.1.2 Stochastic rainfall simulation of the current climate	**Users:** CRC WSC Program D2a **Why?** The stochastic model will be tested on the current climate and the output incorporated into the Program D integrated software. **When?** Throughout the lifetime of the project.

outputs (with Output 4.01 playing a major role) it is likely that all or none of the outputs will be used rather than any one output being adopted in isolation from the others. The usage of Outputs 2.02 and 2.03 will first occur through major demonstration projects before wider adoption of the outputs occurs as efficacy is demonstrated. Output 2.01 will over time be incorporated by planning authorities as part of their standard decision making processes.		**B1.1.3** Stochastic rainfall simulation of future climates	**Users:** CRC WSC Program D2a **Why?** The stochastic model will be applied to future climates. The rainfall simulations will be incorporated into the Program D integrated software. **When?** Throughout the lifetime of the project.
		B1.3.1 Stochastic rainfall simulation of future climates in Singapore	**Users**: National University of Singapore and Singapore National Environment Agency **Why?** The stochastic model will be adapted for use in Singapore. **When?** Throughout the lifetime of the project.
		Project B1.2 Catchment-scale landscape planning for water sensitive city regions in an age of climate change	
		B1.2.1 Statutory & non-statutory planning systems assessment	**Users:** State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB), Land Developers, Consultants, General public **Why?** The output will inform planning agencies and highlight differences and challenges in plan integration. The output will inform CMAs and NRMBs in the preparation of their Catchment Action / NRM Plans and investment strategies. The output will serve as a general resource for all user groups, especially Land Developers, Consultants and general public. **When?** Continual engagement throughout the project. Formal engagement of key stakeholders is through the Project Reference Group (PRG)
		B1.2.2 An integrated greenspace framework	**Users:** State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB), Land Developers, Consultants, General public **Why?** The output will inform planning agencies and highlight differences and challenges in plan integration. The output will inform CMAs and NRMBs in the preparation of their Catchment Action / NRM Plans and investment strategies. The output will serve as a general resource for all user groups, especially Land Developers, Consultants and general public. **When?** Continual engagement throughout the project. Formal engagement of key stakeholders is through the Project Reference Group (PRG)
		B1.2.3 A conceptual city-region scale urban metabolism evaluation framework	**Users:** State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB) **Why?** The output will inform planning agencies, water utilities, CMAs and NRMBs in the preparation of their statutory and non-statutory plans, Catchment Action / NRM Plans **When?** From January 2014. Formal engagement of key stakeholders is through the Project Reference Group (PRG)
		B1.2.4 Scenarios of plausible futures for rapidly growing metropolitan / city-regions (i.e. three case study regions)	**Users:** State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB), Land Developers, Consultants, General public **Why?** The output will inform planning agencies at all levels, CMAs and NRMBs in the preparation of their Catchment Action / NRM Plans and investment strategies.

			The output will serve as a general resource for all user groups, especially Land Developers, Consultants and general public **When?** From June 2015.Formal engagement of key stakeholders is through the Project Reference Group (PRG)
		B1.2.5 Water security assessment of the three case study city-regions	**Users:** State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB) **Why?** The output will inform planning agencies, water utilities, CMAs and NRMBs in the preparation of their statutory and non-statutory plans, Catchment Action / NRM Plans **When?** Continual engagement throughout the project. Formal engagement of key stakeholders is through the Project Reference Group (PRG)
		B1.2.6. Growth scenarios report detailing methods for incorporating ecological and water science into statutory planning	**Users:** State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB), Land Developers, Consultants, General public **Why?** The output will inform planning agencies at all levels, CMAs and NRMBs in the preparation of their Catchment Action / NRM Plans and investment strategies. The output will serve as a general resource for all user groups, especially Land Developers, Consultants and general public **When?** From June 2015.Formal engagement of key stakeholders is through the Project Reference Group (PRG)
		B1.2.7 Assessment of planning policies under various growth scenarios for three case study city-regions	**Users:** State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB), Land Developers, Consultants, General public **Why?** The output will inform planning agencies at all levels, CMAs and NRMBs in the preparation of their Catchment Action / NRM Plans and investment strategies. The output will serve as a general resource for all user groups, especially Land Developers, Consultants and general public. **When?** From June 2015.Formal engagement of key stakeholders is through the Project Reference Group (PRG)
		B1.2.8 Guidelines	**Users:** State, Regional and Local Government planning agencies, Water utilities, Catchment Management Authorities (CMA) and Natural Resource Management bodies (NRMB), Land Developers, Consultants, General public **Why?** The output will inform planning agencies at all levels, CMAs and NRMBs in the preparation of their Catchment Action / NRM Plans and investment strategies. The output will serve as a general resource for all user groups, especially Land Developers, Consultants and general public **When?** Continual engagement throughout the project. Formal engagement of key stakeholders is through the Project Reference Group (PRG)
		Project B5.1 Statutory planning for water sensitive urban design	
		B5.1.1 Preliminary report on the experience of key decision makers and	**Users:** Project B5.1 team **Why?** The preliminary report is intended only to guide future development of project B5.1

		stakeholders in the application of WSUD in the planning system	**When?** N/A
		B5.1.2 Comparative survey of statutory planning legislation, regulation and processes across five cities	**Users:** Project B5.1 team **Why?** The literature review is a necessary input into other project outputs. **When?** Throughout project.
		B5.1.3 Comprehensive Literature review of planning policy and legislation relevant to WSUD	
		B5.1.4 Issues paper on current application of WSUD and options for reform and draft recommended model of planning regulation for WSUD	**Users:** Local Government; State governments; Commonwealth government; Water Utilities and Department of Water **Why?** *LGAs, State governments & WUs* could engage with the Issues Paper as a basis to consult on key issues in developing the Final Report. The *Cth Department of Environment* could use the Issues Paper as a basis to assist in targeting further research and funding and as a basis for development of future water policy. **When?** – Shortly after the Issues paper has been released for consultation. – From early on in project. Project has started in July 2014.
		B5.1.5 Final report on current application of WSUD and options for reform and recommended model of planning regulation and policy benchmarks for WSUD.	**Users:** Local Government; State governments (including Water Departments); Commonwealth government **Why?** *LGAs:* As planning authorities local government are the key focus of the project. Councils will e babel to use the final Report as a resource for future policy development. The project will disseminate existing knowledge and information to a broad audience of local governments and will identify policy best practice. *State govt.* will be able to use the Final Report to benchmark their own planning policies against interstate approaches and best practice *Cth govt*.: The Final Report will be a resource to assist in promoting best practice and harmonisation of town planning approaches to water management across jurisdictions. The Final Report will be a useful resource in assessing the policy framework in each state for the purposes of accrediting future planning policies under any relevant Bilateral Agreement under the EPBC Act, where water management impacts on Matters of National Environmental Significance. **When?** – Once the Issues Paper has been published – After a draft of the Final Report has been prepared.
		Project B2.1 Stream ecology	

		B2.1.1 Conceptual models and indicators to underpin stormwater harvesting operating guidelines	**Users:** Local and state government departments responsible for managing urban stream health and stormwater; urban planners and catchment managers. **When?** Ongoing development with authorities (specifically Melbourne Water and Department of Environment, Land, Water and Planning)
		B2.1.2 Case studies	**Users:** Local and state government departments responsible for managing urban stream health and stormwater; urban planners and catchment managers **When?** Ongoing development with authorities (specifically Melbourne Water)
		Project B2.23 Planning, design and management to protect and restore receiving waters	
		B2.23.1 Decision support framework for the repair and protection of urban freshwaters.	**Users:** Environmental Policy Developers; River Managers, Local Government, Developers and Consultants (including community groups) **When?** *Environmental Policy Developers* have been engaged since the start of the project (dominant engagement partner). *River Managers* have been engaged since the start of the project. *LGAs* should be engaged during the review of the guidelines for their feedback. *Developers and Consultants* should be engaged during the review of the guidelines for their feedback. SERCUL has been engaged since the start of the project. All of these end users have been engaged since the commencement of the project in a formal project reference group and informally on an as needs basis throughout the project.
		B2.23.2 Recommendations on the importance of vegetation for nitrogen processing in urban wetlands.	**Users:** As per Output **B2.23.1** **When?** From the commencement of this project.
		Project B2.4 Hydrology and nutrient transport processes in groundwater/surface water systems	
		B2.4.1 Meta-analysis **B2.4.2** Report on data and knowledge gaps **B2.4.3** Mass balances **B2.4.4** Nutrient load quantification	**Users:** LGAs; Australian and International researchers (AIR); Environmental Policy developers (EPD); River Managers (RM) **Why?** *LGAs:* Need to understand risk of not dealing with groundwater nutrients. Need the research outcomes to inform strategic planning for, and implementation of, on-ground works. Require education of LGA urban water managers. *AIR:* Need to create research knowledge networks on process understanding, optimal management options and best practice in areas of shallow water tables. Shift research funding and activities to include investigations on areas with shallow water tables where groundwater is a major component of storm flows. *EPD:* Need the research outcomes to inform the development of policy that is flexible enough to deal with our varied urban systems. Research outcomes will help produce improve fact sheets to guide interpretation of policy. *RM:* Require data and project analysis to inform design, as up to now design has been based on treating surface stormwater.

			Need separation of treatment for inorganic versus organic nutrients, but management not placed in this framework. **When?** *LGAs* have been engaged since project start in July 2013 *AIRs* have been engaged since project start in July 2013 *EPDs* have been engaged since project start in July 2013 *RMs* have been engaged since project start in July 2013
		B2.4.5 Guidelines	**Users:** As per **B2.4.1 - 4** PLUS land developers, consultants and urban land care groups (the additional users are collectively IC) **Why?** In relation to *ICs*, Better research provides good guidelines and criteria, which engages industry and increase uptake of innovation. Research outcomes will help us manage local surface stormwater AND groundwater. **When?** As per B2.4.1 - 4 PLUS *ICs* have been engaged since project start in July 2013
		B2.4.6 Protocol	As per **B2.4.5** MINUS AIR
		B2.4.7 Policy	As per **B2.4.5** MINUS AIR
		Project B3.1 Green cities and microclimate + Project B3.2 The design of the public realm to enhance urban microclimates	
		B3.1 Quantification of the benefits of water sensitive urban design and urban greening on the urban climate and urban heat mitigation at a range of scales	**Users:** Local and State Government, Water utilities, Developers, Urban Planners, Consultants, General public **Why?** The research demonstrates the effectiveness of WSUD and urban greening for intentionally modifying the urban climate. This evidence can be drawn on by users to advocate for policy change and urban development practices that improve urban climates. **When?** Currently engaged and will continue throughout the project.
		B3.2 Evaluation of the benefits of improved urban climates on heat-health outcomes	**Users:** Government health departments, community health organisations, disability services, emergency services, Local Government, State Government, general public **Why?** Outputs can inform planning prior to, and during, heat events to prevent increased mortality and morbidity. Outputs will demonstrate the potential health benefits of WSUD and urban greening and can be used in cost-benefit analysis. **When?** Currently engaged and users are already applying outputs.
		B3.3 Evaluation of the benefits of improved urban climates on Human Thermal Comfort	**Users:** Urban planners, architects, local government, developers, water authorities, general public **Why?** Outputs will help inform the development of more attractive, sustainable and thermally comfortable urban environments. This could improve liveability, productivity and economic development. **When?** Currently engaged and will continue throughout the project.
		B3.4 Framework for the implementation of WSUD and urban greening for improved urban climate	**Users:** Local Government, urban planners and developers **Why?** The framework provides a step by step guide on how to implement WSUD and urban greening to maximise urban cooling for a given investment. **When?** Users were engaged in the development of the framework
		B3.5 Guidelines on the design of WSUD and urban	**Users:** Local governments, engineers, stormwater industry, urban planners and architects, water authorities

		greening for improved urban climate	**Why?** The output provides direct information on how to design and implement WSUD and urban greening on the ground when one of the key objectives is to mitigate urban heat and improve human thermal comfort **When?** Used should engage during the analysis and interpretation of results, and in design recommendations
		B3.6 Spatial heat vulnerability mapping	**Users:** State government, local governments, consultants, NGOs, emergency services agencies, other (non-CRCWSC) researchers **Why?** Identifies vulnerable communities where actions can be targeted e.g. emergency service provision during heat waves, prioritisation of infrastructure **When?** Currently engaged and users are already applying outputs.
		B3.7 Heat threshold for Australian capital cities	**Users:** State government departments, consultants, emergency services, World Health Organisation/World Meteorological Organisation, other (non-CRCWSC) researchers **Why?** Evidence-based relationship between heat and health allows early alerts/heat watch forecasts on a city-to-city basis. **When?** Currently engaged and users are already applying outputs.
		B3.8 Urban heat component of the Water Sensitive Cities Toolkit	**Users:** Water authorities, Local governments, urban planners and developers, State government departments (planning, water, environment) **Why?** In combination with other modules in the WSC toolkit, the urban heat component can inform decision making at a range of levels (scales) on the effectiveness of different design approaches in improving urban climates **When?** Currently engaged
		B3.9 Urban climate modelling tools	**Users:** Water authorities, Local governments, urban planners and developers, State government departments (planning, water, environment) **Why?** The tools can inform decision-making at a range of levels (scales) on the effectiveness of different design approaches in improving urban climates. **When?** Engagement can begin following the completion of model validation
		Project B4.1 Social-technical flood resilience in water sensitive cities – Quantitative spatio-temporal flood risk modelling	
		B4.1.1 Hydrological hazards methods	**Users:** State and local government, land planning departments **Why?** Typically hazards are studied one at a time. However, one impact of climate change is that concurrency will increase and hence description of individual hazards may not be sufficient. **When?** Primarily after the methods have been tested and validated in an Australian context.
		B4.1.2 Stormwater technologies model	**Users:** Water utilities and planners; Urban Drainage modellers (UDM) **Why?** *WU & planners:* Imprecise and biased modelling of urban drainage may hinder or delay implementation of WSUD *UDM:* A Code of Conduct leads to improved precision and reduced errors in relation to flood modelling and establishing water balances for urban areas. **When?** *WU & planners:* As tools become available

			UDM: During development of code of conduct and as a dialogue after release.
		B4.1.3 Flood risk modelling tool	**Users:** State and local government **Why?** To easily test the influence of various urban development scenarios (resulting from, for example, economic drivers) on flood risk and to develop adaption strategies that can be applied in as many cases as possible and adapted if necessary ("evaluate when and how investments into infrastructure should be made, how their effect can be monitored, and in what cases the strategy needs to be modified in the future"). In addition, consider flood risk as a factor for urban development. **When?** As soon as first versions have been developed
		B4.1.4 Module linking flood risk modelling tool with DAnCE4Water	**Users:** Local governments and utilities; Researchers **Why?** *LGAs & utilities:* To align and mainstream flood risk management with other (water sensitive) city objectives by implementing recent international developments. *Researchers*: To test and identify new linkages between flood risk management and water sensitive objectives and identify relevant stakeholders that enable transformation. **When?** *LGAs & utilities:* During development, by helping in defining and quantifying costs and benefits of risk mitigation. By using the tool once developed to an easy-to-use program. *Researchers*: Throughout development and testing of tool
		Project B4.2 Social-technical flood resilience in water sensitive cities – Adaptations across spatial and temporal scales	
		B4.2.1 Policy recommendations for social and technical flood resilience	**Users:** State and local government planning agencies, engineers, and consultants **Why?** This output will guide urban planners, designers and policy-makers on how to achieve resilient social and technical adaptation to changing flood risks in the most cost-effective and efficient way. **When?** From the outset working with the case studies below and also in formulating the vision for flood resilience (CRC and IWA)
		B4.2.2 Software tool for an enhanced ATP method	**Users:** State and local government planning agencies, engineers and consultants **Why?** The software tool would allow users to identify the durability of current and alternative flood risk management strategies. **When?** LGAs in Rotterdam and Dordrecht have been engaged from the start date and now with City of Perth.
		B4.2.3 Report on mainstreaming approaches to achieving flood resilience	**Users:** State and local government planning agencies **Why?** This output will allow users to identify opportunities for synergistic enhancement of flood resilience. **When?** LGAs have been engaged from the start date in case studies for Rotterdam and Dordrecht and now with Elwood.
		B4.2.4 Guidance manual for linking ATPs and adaptation	**Users:** State and local government planning agencies, engineers, consultants and urban designers.

		opportunities	**Why?** This guidance will allow LGAs to develop adaptation pathways for enhanced flood resilience. **When?** Guidance is being developed with Rotterdam, Dordrecht, Ho Chi Minh city cases and now with Elwood.
		B4.2.5 Support tool for RIO application, with guidance document	**Users:** State and local government planning agencies, engineers and consultants. **Why?** This output will inform users how to include and value flexibility in adaptation pathways. **When?** LGAs (e.g. City of Can Tho and City of Port Philip) will be engaged in the testing and refinement of the tool, to ensure its usefulness to this user group.
		B4.2.6 Case studies on ATP-Opportunities and RIOs	**Users:** State and local government planning agencies, engineers, consultants and urban designers **Why?** These outputs (i.e. adaptation pathways) provide directly relevant information for decision making on adaptation to increasing flood risks **When?** City of Rotterdam; Dordrecht; City of Can Tho; City of Port Philip; Perth WA already engaged
Usage 2.02 An urban infill development design, planning and implementation toolkit: Consultants, infill developers and local and state government planning authorities are all required for usage of output 2.04. Outputs 1.03, 1.04, 1.05, 4.01 and 4.04 will all support usage of Output 2.04.	**Utilisation 2.2** Output 2.4 is utilised by consultants, infill developers and local and state government planning authorities.	**Project D5.1 Urban intensification and green infrastructure: Towards a WSC**	
		D5.1.1 Case Study Document (International and National)	**Users:** Local Government and State Government Departments and Authorities; Water utilities; and Urban design and architecture professionals **Why?** *LG and SG*: to provide a range of innovative integrated design case studies that articulate strategies for adoption in different climatic contexts and built environments. In addition this research is important for the purposes of regulatory control to bring about agreed WSUD outcomes *WUs:* WSUD case study documents currently have a strong emphasis to engineering and maintenance. With Innovative Integrated urban design these can be facilitated and foster integrated design outcomes. *UD professionals:* The case study document will offer designers a way to discuss design quality with clients/ consultants and demonstrate the benefits to be gained from implementation of WSUD. **When?** *LGAs and SGs* engaged in 2015-2016 *WUs* engaged in 2015-2016 *Design professionals* will be engaged in 2016
		D5.1.2 Models of industry engagement	**Users**: CRCWSC Researchers **Why?** This output articulates methods for engagement between researchers and industry to facilitate the integration of water science in design processes and outcomes. **When?** Ongoing
		D5.1.3 Design guidelines	**Users:** Local Government and State Government Departments and Authorities; Water utilities; Land developers; and Urban design & architecture professionals. *LG & SG:* The design guidelines demonstrate WSUD from an integrated design approach to assist LGAs in delivering WSUD outcomes. *Developers*: The design guidelines will provide a one-stop for all documents for

			developers to improve their WSUD outcomes. *UD professionals:* The design guidelines will provide a one-stop for all documents for developers to improve their WSUD outcomes. **When?** Ongoing throughout project
		D5.1.4 Demonstration projects	**Users**: 1) Local Governments in Australia; 2) Kunshan Bureau of Planning; 3) Water utilities; 4) Developers; 5) Urban design & architecture professionals; 6) State Government Departments and Authorities **Why?** Specific projects are either under consideration by a relevant authority; or there has been previous engagement with the particular user **When?** 1) & 3-6) Ongoing from 2015 2) 2014 – 2015

<table>
<tr><th colspan="3">Future Technologies Projects</th></tr>
<tr><th>CRCWSC Impact Tool Usage (Economic Valuation)</th><th>Cth Agreement Usage</th><th>Usage as defined by researchers per Impact Pathways template and Research 2012-2016 Report (RR)</th></tr>
<tr><td rowspan="14">Usage 3.01
Usage of Output 3.01 will in the first instance be in demonstration projects, then it will involve the broader commercialisation of the technology by CRC industry technology partners (including Australian SMEs who will participate in the CRC via the SME engagement mechanism that is based on 43 P/L) before the final usage of the technologies occurs through installation of new decentralised water production systems within new greenfields urban developments</td><td rowspan="14">Utilisation 3.1
Output 3.1 is utilised initially in demonstration projects, then in the broader applications of the urban water management strategy and technologies by CRC industry technology partners (including Australian SMEs), and finally in the installation of new decentralised water production systems within new greenfields urban developments</td><td colspan="2">Project C1.1 – Sustainable technologies</td></tr>
<tr><td colspan="2">1. Advanced biofilter systems</td></tr>
<tr><td>C1.1.1 Guidelines for adoption (design, maintenance and operation) of biofiltration systems for stormwater treatment and harvesting</td><td rowspan="2">Users: Local government; Consulting companies; Water utilities; Land developers; Dept. of planning; Business Developers; Gardening Sector
Why? Similar to FAWB guidelines they will be using the revised version for designing and implementation of next gen biofilters. They will be asking their contractors to comply with the guidelines. Also hoping that business development will occur with new companies spin off i.e. developing a modular system. Gardening sector - given new species have been identified this could lead to new business in sector</td></tr>
<tr><td>C1.1.2 Passive filters and biofilters for pathogen removal in urban stormwater</td></tr>
<tr><td colspan="2">2. Urban Beats Model</td></tr>
<tr><td>C1.1.3 UrbanBeats conceptual representation of WUSD systems within a city-wide model</td><td rowspan="2">Users: Local government; Consulting companies; Water utilities; Land developers; Software companies
Why? LG would use it to support long term planning of SWmgt; used to support development of IUWM strategies (GHD has already included UbanBEATS in one of their tender bids. City West water is already testing the model for a case study in their region! Land Developers can use this to test synergies between development strategies and urban infrastructure. Urban BEATS is open source so could be used by software houses to develop their own products - eWater is talking about possibilities.</td></tr>
<tr><td>C1.1.5 Integrated model that can assess performance of WSUD systems for pollution, flooding and stormwater harvesting</td></tr>
<tr><td colspan="2">3. Model of Micropollutants and Microorganism</td></tr>
<tr><td>C1.1.6 Model of micropollutant behaviour in WSUD systems</td><td rowspan="2">Users: Local government; Consulting companies; Water utilities; Land developers; Business Developers; Material Manufacturing
Why? New technology could be implemented by LGs (i.e. Mulgrave with MCC) first ever field-scale system of the technology as a demonstration site. Also consultants/Land and/or Business Developers could design and implement the new technology.</td></tr>
<tr><td>C1.1.4 Model of faecal microorganism removal in existing stormwater biofilters</td></tr>
<tr><td colspan="2">Project C1.2 – Risk and health: understanding stormwater quality hazards</td></tr>
<tr><td>C1.2.1 Chemical and microbial characteristics of stormwater</td><td>Users: State and Local Governments; Land developers and CRC Industry participants
Why? Will provide data to inform decision-making in the development of future guidelines for stormwater harvesting and reuse; support LG in gaining an understanding about chemical and microbial hazards and provide guidance to ensure consultants are doing their part.</td></tr>
<tr><td>C1.2.2 Prioritisation of human health risks associated with untreated stormwater</td><td>Users: State and Local Governments; Land developers and CRC Industry participants
Why? Provide data for Decision making regarding future guidelines for stormwater harvesting and reuse - helping LG to identify cost-effective fit-for-purpose use of their stormwater that is protective of human health and help them understand the level of treatment required to manage risks for FFP water.</td></tr>
</table>

		C1.2.3 Influence of catchment characteristics on stormwater quality	**Users:** State and Local Governments; Land developers **Why?** Assist policy makers in informing development of future stormwater reuse guidelines with regard to the level of catchment specific knowledge required by developers of Stormwater harvesting and reuse schemes during their risk assessment of and risk management processes.
		C1.2.4 Risk assessment process recommendations	**Users:** State and Local Governments **Why?** Assist policy makers in providing recommendations for assessing site risks associated with untreated stormwater and provide LG with recommendations for assessing human health risks associated with untreated stormwater in their catchments. Risk assessment forms the foundation step for developing risk management strategies to provide FFP stormwater reuse schemes protective of Human Health.
		Project C1.3 – Fit-for-purpose water production	
		C1.3.1 PMA-NGS method	**Users**: researchers **Why?** Provides info for use/implementation by broader scientific community could be applied in numerous fields
		C1.3.2 Assessment of health risks using new PMA-NGS methods	**Users**: Local Government, Water utilities and researchers **Why?** Benefit through improved Decision-making regarding water treatments and water qualities could be influenced based on new info provided
		C1.3.3 Literature review of current and novel treatment technologies for recycling water treatment	**Users**: researchers **Why?** Information related to vulnerability of centralised water management systems and potential opportunities offered by implementation of decentralised water systems and use of recycled water
		C1.3.4 Development of novel treatment systems	**Users:** Water utilities, consultants and researchers **Why?** WU would benefit as a novel low-cost and low-energy consuming water treatment alternative could improve the current centralised water management systems. Considerations in use of different water systems and use of recycling water in decentralised systems.
		C1.3.5 Guidelines for the use and application of novel treatment systems	**Users**: Water utilities and researchers **Why?** Guidelines will provide WS with the relevant technical information and operational methodologies to undertake these systems
		C1.3.6 Validation and operational monitoring methodologies for passive water treatment systems	**Users:** Local govt., Water utilities, researchers and SMEs/other treatment system developers **Why?** Validation framework would help to verify proprietary products performance and employ the use of tested and verified surrogates for testing the systems. Could become an essential part of the development of new treatment technologies.

<table>
<tr>
<td rowspan="3">Usage 3.02
Usage of the new technologies from Output 3.02 is expected to be applied to a smaller demonstration wastewater treatment plant (25,000 person capacity) in year 4 and to a second demonstration plant in year 7. Full application to average size (50000 person capacity) new treatment plants is expected to commence in year 10: with 1 plant in year 10, 2 in year 11, 3 in year 12, 4 in year 13 before settling at 5 plants per annum from year 14 onwards.</td>
<td rowspan="3">Utilisation 3.2
Output 3.2 is initially applied to smaller demonstration wastewater treatments plants, and then is more broadly adopted by various jurisdictions across Australia</td>
<td colspan="2">Project C2.1 – Resource Recovery from Wastewater</td>
</tr>
<tr>
<td>C2.1.1 Novel Urban wastewater technologies
C2.1.2 Demonstration processes</td>
<td>Users: Water utilities, consultants and technology suppliers in the Agroindustry (small industries – private enterprises)
Why? Consultants would evaluate comparative feasibility of novel processes v established practice for specific cases; WU are likely to use technology package to enhance WWT; Agroindustry could adapt technologies to recover nutrients and enhance value of their products; tech suppliers would develop specific reactors and processes to that utilise the novel concepts for WWT identified here.
When? From the beginning of the project</td>
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<td rowspan="6">Usage 3.03
Water utilities are the key end users for Output 3.03 and Water Utilities that are CRC participants are expected to be the 'early adopter' water utilities for the output.
While usage is anticipated to begin with up to 4 Melb Utilities, SA Water, Water Corporation WA and one Qld utility, the more conservative initial usage projected is that just one major bulk utility (Melbourne Water) will be the early adopter of the output.</td>
<td rowspan="6">Utilisation 3.3
Output 3.3 is utilised by various state water utilities</td>
<td colspan="2">Project C3.1 – Managing interactions between decentralised and centralised water systems</td>
</tr>
<tr>
<td>C3.1.1 Characterising interactions between centralised and decentralised water delivery systems</td>
<td>Users: Local govt., water utilities, and CRC Researchers
Why? WU would be interested to implement decentralised systems how do they systems interact, what do they need to consider for this integration; LG in costs and benefits of the implementation; CRC how their projects may fit into ideas from the report.</td>
</tr>
<tr>
<td>C3.1.2 Models developed for the assessment of the impacts of changes in water use practice on downstream collection system (odour and corrosion, GHG emissions and sedimentation)</td>
<td>Users: Water utilities and consultants
Why?
WU: Planning processes, operation and maintenance, manage potential impacts.
Consultants: Planning and design</td>
</tr>
<tr>
<td>C3.1.3 Report of modelling and recommendations for integration of decentralised systems</td>
<td>Users: Water utilities and researchers
Why? For decisions on planning processes and operation. Case study reports initially provided to relevant utilities by may be distributed wider. Insights would contribute to broader research in the field.</td>
</tr>
<tr>
<td>C3.1.4 Report on overall recommendations</td>
<td>Users: Local govt., water utilities, consultants and researchers
Why? For decisions on planning processes and operations. Developing policy; planning and design and currently knowledge in the field.</td>
</tr>
<tr>
<td>C3.1.5 Decision Support Tools</td>
<td>Users: Local govt., water utilities, consultants and researchers
Why? For planning and design; furthering research etc.</td>
</tr>
</table>

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<tr>
<td rowspan="4">Usage 3.04
Consultants (engineering and design), decentralised water system technology manufacturers and service providers, urban land developers, building contractors, local and state planning authorities and water utilities would all need to be involved in the adoption of novel hybrid biofilters.</td>
<td rowspan="4">Utilisation 3.4
Output 3.4 is utilised by consultants (engineering and design), decentralised water system technology manufacturers and service providers, urban land developers, building contractors, local and state planning authorise and water utilities.</td>
<td colspan="2">Project C4.1 – Integrated multi-functional urban water systems:</td>
</tr>
<tr>
<td>C4.1.1 Decision support tool for quantifying wetland ecosystem function</td>
<td>Users: Local Governments, Consultants, Waterway managers, water utilities & land developers
Why? The new technology could be implemented by local governments. Consultants could design the new technology and use the wetland support system. The wetland decision support tool can be used by waterways managers (e.g. Dept of Water in WA etc). Water utilities and land developers could implement the new technology.</td>
</tr>
<tr>
<td>C4.1.2 New hybrid biofiltration technologies</td>
<td>Users: As per C4.1.1 (minus waterway managers), plus: business developers and manufacturing.
Why? We are hoping that, as it was the case with stormwater biofilters, the technology could be adopted and marketed by business developers. It is anticipated that even new companies could be spined off this invention. The green and living wall cells could be developed as modular systems and manufactured by new local companies.</td>
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<tr>
<td>C4.1.3 Adoption guidelines for new technologies</td>
<td>As per C4.1.2</td>
</tr>
<tr>
<td>C4.1.4 Demonstration and testing of new green technologies</td>
<td>As per C4.1.1 (minus waterway managers)</td>
</tr>
<tr>
<td rowspan="3">Usage 3.05
Water utilities are the key end users for Output 3.05 and Water Utilities that are CRC participants are expected to be the 'early adopter' water utilities for the output. While usage is anticipated to begin with up to 4 Melb Utilities, SA Water, Water Corporation WA and one Qld utility, a more conservative initial usage projected has been adopted. It is assumed that just two urban water utilities (WA Water Corporation -Perth, and SE Water -Melbourne: both are highly likely to implement smarter water metering systems) will be the early adopter of the output.</td>
<td rowspan="3">Utilisation 3.5
Output 3.5, sensor placement and operational protocols and software and algorithms for pumping station optimisation, is utilised by various state water utilities</td>
<td colspan="2">Project C5.1 – Intelligent urban water systems</td>
</tr>
<tr>
<td>C5.1.1 Data analytics for smart metering</td>
<td>Users: Water utilities and researchers
Why? For WU: Will provide information on customer water use behaviours for planning; customer engagement; identification of leakage and high water use customers; more accurate future infrastructure planning; for researchers - actual, rather than perceived water use behaviours can be used to complement existing modelling.
When? Continuing. Internal workshop at Water Corp June 2015; Industry tech report Aug 2015</td>
</tr>
<tr>
<td>C5.1.2 Decision support for pumping optimisation with multiple water sources</td>
<td>Users: Local Government, Water Utilities and Regulators
Why? Will inform LGA and WU of strategies for optimal operation of pumping systems to minimise both cost and GHG emissions resulting from use of electricity from fossil fuel generating sources; demo safe operation of multiple water source systems would inform regulators for integrating non-traditional water sources at different scales.
When? Case studies with end-users currently underway</td>
</tr>
</table>

<table>
<tr><th colspan="4">Adoption Pathways Projects</th></tr>
<tr><th>CRCWSC Impact Tool Usage (Economic Valuation)</th><th>Cth Agreement Usage</th><th colspan="2">Usage as defined by researchers per Impact Pathways template and Research 2012-2016 Report (RR)</th></tr>
<tr><td rowspan="6">Usage 4.01: State and Local Govt agencies; water utilities; technology developers; land developers; consultants; and, the community sector will all be users of the outputs (4.01, 4.02, 4.03, 4.04, 4.05) of Program 4.</td><td rowspan="4">Utilisation 4.1
Output 4.1, 4.2 and 4.3 are utilised by state and local govt agencies; water utilities; technology developers; land developers; consultants; and, the community sector.</td><td colspan="2">Project D1.1 Integration and demonstration through urban design</td></tr>
<tr><td>2 - D1.1.3 Demonstration Project Seminars, Reports, Site Visits

2 - D1.1.4 blueprint Chapter: Research Adoption and Implementation (Officer)</td><td>Users: Water-sensitive urban development consultants, Local Governments (Waterway Management, Urban Development), Water Utilities (Stormwater Harvesting, Stormwater Management)
Why? The reports describe the adoption and application of water sensitive research and insights from the CRCWSC in demonstration projects. This provides an adoption pathway for the wider implementation and/or adaptation of these initiatives.
When? Participating organisations (direct users): from start of demonstration projects – Feb 2010 (Officer), Dec 2011 (Marrickville)
Interested organisations (indirect users): as research initiatives are developed and implemented.</td></tr>
<tr><td colspan="2">Project D1.4 Integration and demonstration through urban design – phase 2</td></tr>
<tr><td>3 - D1.4.1 Case Study Applications of Toolkit

3 -D1.4.2 Seminars and Training (Toolkit Application)</td><td>Users: Local govt., water utilities, and their consultants
Why? Case studies and seminars/training focussed on the application of the Toolkit will demonstrate its potential uses and benefits to support collaborative, evidence-based strategic planning of water-sensitive and green-infrastructure initiatives in new and existing urban areas (for LGs) AND distributed water servicing initiatives in new development areas, and for stream health and green-infrastructure initiatives in new and existing areas (for WUs).
When? From Jan 15</td></tr>
<tr><td colspan="2">Project D3.2 Influencing water sensitive cities policy</td></tr>
<tr><td colspan="2">This Project has no Impact Pathways template entry and is not specifically described in ‘Research 2012-2016’</td></tr>
<tr><td rowspan="2">Utilisation 1.5
Adoption of socio-technical model for scenario planning of water sensitive cities</td><td colspan="2">Project D1.1 Integration and demonstration through urban design</td></tr>
<tr><td>1 - D1.1.1 WSC Toolkit (Version 2 beta

1 - D1.1.2 Seminars and Training</td><td>Users: Local governments, water utilities and their consultants
Why?
LG: The Toolkit will support collaborative, evidence-based strategic planning of water-sensitive and green-infrastructure initiatives in new and existing urban areas (e.g. stormwater management, stream health improvement, urban heat management)
WU: The Toolkit will support collaborative, evidence-based strategic planning for distributed water servicing initiatives in new development areas (e.g. stormwater harvesting and use), and for stream health and green-infrastructure initiatives in new and existing areas (e.g. stream health improvement, urban heat management)
When? Throughout the development phase (since Oct 2011)</td></tr>
</table>

	N/A	**Project D4.1 Strengthening educational programs to foster future WSC leaders**	
		D4.1.1 Masters level modules on delivering water sensitive cities	**Users:** Australian and international urban water professionals and organisations **Why?** The Masters module, builds capacity in individual urban water professionals to drive the delivery of water sensitive city outcomes, and to learn from successful examples **When?** Since July 2013 for IWC Masters and from 2016 in UNESCO-IHE Masters
		D4.1.2 Australian and international skills and knowledge needs assessment report	**Users:** 1) CRC University participants and Executive; 2) CRC Industry participants and other industry organisations **Why?** To help inform strategy around investing in structured professional learning **When?** 1) In 14/15 Q3; 2) In 14/15 Q3 and Q4
		D4.1.3 A structured professional learning vision and set of recommendations for delivering water sensitive city outcomes	**Users:** 1) CRC Executive; 2) CRC researchers; 3) Urban water sector organisations **Why?** *CRC Executive*: To review and act upon recommendations about how the CRCWSC should invest funds into the development of structured professional learning programs and courses *CRC research participants*: To help the D4.1 team ensure that the recommended set of investments into structured professional learning products reflect the latest CRCWSC generated knowledge *Urban water sector organisations*: To review and act upon recommendations about how their organisation's professional development funds might be spent and even pooled to better help deliver water sensitive city outcomes **When?** 1) FY 15/16 Q1; 2) FY 15/16 Q2; 3) FY 15/16 Q2
		D4.1.4 A set of structured professional learning programs and courses with paying participants	**Users:** Australian and international urban water professionals and organisations **Why?** Structured professional learning products (education and training products) will build capacity in individual urban water professionals to drive the delivery of water sensitive city outcomes, and to learn from successful examples. **When?** From July 2015

Appendix I-E: Evaluative Criteria

Criteria	Description	Relevance to CRCWSC
Networks – *informal/* – *formal* – *simple/complex* – *intra/inter-organisational*	Networks, both formal and informal, act as platforms for collective action whereby knowledge (i.e. ideas, information, and research findings) is effectively exchanged and actor-learning is facilitated (e.g. Phillipson et al., 2012). Seeding, building and strengthening networks are established processes in relation to generating a change in policy and on-ground practice (e.g. Hemsley-Brown, 2004; Phillipson et al., 2012). Aspects of network density, connection and complexity are all important factors in supporting and reinforcing change. For example, networks are required within organisations where there is limited cross-discipline activity in support of change (i.e. across different organisational departments/divisions), and between/among organisations (i.e. across a sector(s)) to help support/reinforce a change in practice.	As outlined in the CaWSC evaluation (Bos & Farrelly, 2015), seeding, building and strengthening networks plays an important role in facilitating policy and practice change at varying scales. Determining the number of new networks forming as a result of CRCWSC activities provides an important precursor to change. Furthermore, identifying how the CRCWSC has contributed to strengthening existing networks that may advocate for change is also crucial. Network development and strengthening is not only regarded as a critical process factor in supporting change, but also as a significant societal impact arising from collective action.
Relational capacity – *trust* – *relationships* – *collaboration* – *participation* – *communication*	A significant body of research evaluation and adoption literature highlights the critical importance of developing and sustaining strong, high-quality relationships when embarking upon research-industry collaborations. Elements contributing towards successful relationships, sometimes referred to as social capital (emerging through new and existing social networks), involves: mutual respect; iterative dialogue; trust in reputation/credibility of the program, as well as individuals and relationships (Plewa et al., 2013); reciprocity (mutual benefits); quality of participation and, length of the relationship (see e.g. Meagher et al., 2008; Cherney et al., 2012).	Influence is a stated mission objective of the CRCWSC. To achieve the level of influence anticipated by the CRCWSC (e.g. on the land development industry), the CRCWSC program must build a high level of relational capacity among researchers, industry participants (next-users) and broader sector end-users. This works at a number of different levels: within the CRCWSC operation/program itself; between researchers and industry; and in undertaking the individual research projects (see 'quality' below). The benefit of establishing long-held, high quality relationships was evidenced in the outcomes of the CaWSC evaluation (see Bos & Farrelly, 2015).
Partner engagement – *Inter-personal interaction* – *Frequency and timing of interactions* – *Variety of forums* – *Type of interaction* – *Communication*	Multiple and varied, direct and indirect interactions between researchers, industry participants and broader end-users are important for generating research utilisation and impact. Evaluation and research adoption scholarship suggests that productive interactions are important for helping to achieve co-building of knowledge, which can lead to improved utilisation. As such, mapping productive interactions supporting knowledge exchange can help researchers reflect on their engagement with users and society (by focusing on interactions and processes), and can reveal impacts they may not have previously identified/considered (see e.g. Mitton et al., 2007; de Jong et al., 2014). Of note, the complexity, quality and frequency of direct/indirect interactions plays a role in building trust among stakeholders and helps provide a foundation for collective action. Key aspects of interaction that are considered important include: – Strong inter-personal (two-way) connections, as they can enhance research utilisation (i.e. face-to-face communication/interaction is important) – this involves both formal and informal engagement; – Communication, as it facilitates the development of understanding, which in turn drives the evaluation and success of relationships (e.g. Plewa et al.,	The CRCWSC anticipates that multiple stakeholders and beneficiaries will come together, coordinate their organisational behaviours, cultures and policies to implement on-ground and sustained change. Understanding how these interactions are facilitating collective action is an important part of ensuring that next- (industry participants) and end-users (broader sectoral actors) are engaged, knowledgeable and ready to undertake/promote research utilisation. The CRCWSC program design has embedded a suite of dedicated industry partner engagement activities to build good relationships, establish open lines of communication, and provide multiple spaces of researcher/industry interactions. Some of these activities have already undergone individual activity-based evaluations; this remains important, but so does a collective evaluation of the different activities. These activities should be designed in such a way as to enhance engagement and exchange of understandings and ideas (see also 'social learning'). Furthermore, tracking interactions regarding how industry participants and

	2013). While communication is ongoing, the form, formality and topics change over the course of the research-industry collaboration. – Frequency and timing (this varies over time according to where process is at and who is interacting). For example, as Hessel et al. (2014) point out, being involved early in program design appears to provide an indication of the way in which end-users can support and shape the content of research programs. – Having a variety of forums for interaction, both centralised and decentralised. – Type of interactions (i.e. (i) direct via advisory committees, testing/validating research, or work shadowing, or (ii) indirect via attending seminars, conferences) (see e.g. Phillipson et al., 2012).	broader sectoral users are adopting, adapting and utilising CRCWSC work is likely to reveal expected and unexpected pathways to research utilisation and impact – such data will be essential for informing the economic evaluation tool in arriving at an overall economic return on investment.
Social learning – *Individual (attitudes)* – *Collective (actions)*	Here we are interested in understanding whether collective action has led to a shift in individual and collective understandings (values/behaviours/norms/goals etc.). This would be expressed in shared visions (achieving normative alignment), goals for action, changes in policies and practices. Generating a transformation in how urban water systems are developed and managed requires a significant shift away from traditional approaches towards adopting alternative technologies, practices and management systems. There is broad scholarly consensus that such large-scale transformation requires social learning to support this occurring. Such change would be demonstrated by increased knowledge, awareness and understanding; change in attitude; intention of behaviour change (i.e. Fazey et al., 2014); and ongoing cooperative and collaborative approaches.	Learning is a social process and is deeply connected to the collective action forged through the CRCWSC. The design of the CRCWSC program provides for a variety of interactions and pathways for disseminating new research insights and outputs, while also focusing on dedicated interventions to actively build the skills and knowledge of industry participants. By focusing on these activities/interventions, the CRCWSC is likely to influence the pathway towards a transformation in the way cities manage and use their water. Based on the mutually reinforcing activities and interventions undertaken by the CRCWSC, the program would expect to see a shift in individual and organisational understanding/knowledge/skills and capacities for delivering water sensitive cities and towns. Furthermore, the act of undertaking an evaluative review provides a reflective tool for researchers and industry to identify how to improve and/or strengthen their levels of engagement, interaction and communication. Achieving a change in awareness and understanding, along with improved skills and knowledge, is – building on the theory of change (Figure 4) – expected to increase the chances of broader adoption of research findings.
Capacity building – *awareness/ understanding* – *skills/knowledge*	Capacity building activities and interventions are required to directly support increased awareness and understanding of research insights, and relevant skills and knowledge for adapting and/or adopting research insights (i.e. tools, techniques and guidance information). Through supporting the acquisition of particular skill sets, the academic scholarship points to an improvement in wider adoption of new practices/technologies and inform shifts in local, state and federal policies.	
Quality – *research* – *outputs* – *interventions/ activities* – *facilitation/ communication*	Quality refers not just to the production of high-quality, scholarly research publications (as assessed by discipline peers), but also to the quality of the translation (communication, interventions etc.) of these insights into industry-relevant publications, guidelines and training for future application and use, as well as the quality of productive interactions. Indeed, when research findings and outputs are accessible, clearly articulated, relevant and delivered through multiple interventions/activities (i.e. education and training, demonstration projects, guidance documents etc.), utilisation and impact is likely to increase (Robinson et al., 2012). With regard to the quality information, it is important to acknowledge that this relates to actual and perceived content clarity, relevance and reliability (Fazey et al., 2014); hence the need to tailor messages to different audiences. Recent scholarly works also point to the need for high-quality interactions and exchanges between researchers and stakeholders, for this	Quality within the CRCWSC refers to a number of different arenas: - Communication – varied, tailored and targeted information and communication is important to reach the broad stakeholder base associated with the CRCWSC. For example, focusing on the value added aspects of incorporating CRCWSC research outputs is important for generating impact. - Research design and outputs –high quality science is guided by research advisory panels who work with Program Leaders to ensure rigorous and robust research. - Collective action, a crucial part of the CRCWSC design – aiming for (and assessing the level of) high quality interactions and interventions increases the evidence for attribution. This requires examining various examples of (formal and informal) interactions and exchange both as

	provides intermediate indications of future social impact (Spaapen & van Drooge, 2011). Accordingly, the quality (and timing) of communication and collaboration between researchers and end users provides an important measure of the productivity of these interactions, and consequently an indication of potential future impact (de Jong et al., 2011; Plewa et al., 2013).	research is being undertaken and after final outputs have been delivered. – Stakeholder perceptions – stakeholder-based opinions on the quality and relevance of the CRCWSC projects, program design, and outputs are an important intermediate outcome.
Principles of Good Governance – *Transparency* – *Legitimacy* – *Efficiency* – *Accountability* – *Representation/ inclusiveness* – *Adaptability* – *Integration*	Applying good governance principles is a crucial element for ensuring that complex research-industry collaborations function appropriately to deliver maximum research impact. Drawing on the principles of good governance as outlined by Lockwood et al. (2010), a key component is focusing on the quality of interaction to ensure high levels of transparency with regard to key decision-making and connection to research projects; and that project leaders and program leaders, executive and the many councils are accountable for delivering/meeting their expected roles.	The CRCWSC has a complex governance structure in place designed to support, guide and inform the many different inter-related components of the overall CRCWSC. Industry participation is critical to the CRCWSC, and involves industry representation at different levels. It is good practice to periodically review the appropriateness of governance structures supporting the CRCWSC to ensure the Program is being governed the best way possible.
Accessibility – *of people within an organisation* – *resources* – *researchers/ industry participants* – *research findings*	One of the major drivers behind industry involvement in research collaborations is to gain access to: new research; tools and techniques for the development of new technologies; networks of experts; facilities; and opportunities for public funding (see e.g. Lee, 2000; Piva & Rossi-Lamastra, 2013). Generating impact through research utilisation and adoption is affected by the ease with which users can access research and expertise, and how accessible the information is to a broad variety of end-users (e.g. Robinson et al., 2012). Interactive, collaborative activities such as networking are likely to increase research use among practitioners (Hemsley-Brown, 2004).	The CRCWSC affords a number of opportunities for stakeholders to interact so that industry partners may have access to researchers, preliminary research findings and access to/experience using the latest research outputs; while researchers may have access to industry understanding of context, relevance and utility of their research. Indeed, key activities such as the industry partner workshops and the synthesis and demonstration projects actively influence the extent of research uptake. The availability of latest CRCWSC research publications on the website is also important.
Leadership/ Champions – *quality* – *location (internal or external to an organisation)*	This refers to internal and external leadership, and individual 'champions' who act as an intermediary for influencing and a driver of change. Leadership is a process of influence that involves, for example, providing direction and inspiration (Taylor et al., 2011). The degree of leadership, quality and location are all important aspects when steering large-scale research-industry collaborations (Fazey et al., 2014). In industry-research collaborations, both research leaders and industry champions have been identified as playing a crucial role in knowledge transfer activities (Taylor et al., 2011; Olmos-Penuela et al., 2014). The nature and extent of such activities are closely associated with the academic status of research leaders and the scientific impact of their research.	To support a shift in practice and build support for the utilisation of CRCWSC research findings, the CRCWSC has dedicated activities towards supporting future research leaders through the PhD Program, and is actively working to enable practitioners to champion the uptake of CRCWSC research within their organisations and more broadly through their professional networks.
Intermediaries – *facilitators* – *coordinators* – *bridging entities*	Intermediaries can also be referred to as knowledge brokers, facilitators, bridging organisations – they fundamentally act as mechanism to support knowledge exchange and dissemination, and their presence has been demonstrated to improve the likelihood of research use and achieving impact (Meagher et al., 2008). Of note, this role can relate to an individual, an organisation and/or the	Whilst building the research evidence base for promoting and delivering a transition to a WSC, the CRCWSC itself can be regarded as an intermediary, working to bring leading researchers and interested practitioners to create a fundamental change in practice. The CRCWSC produces research, engages practitioners in its delivery and works to

	media. Intermediaries should understand the motives and needs of researchers and industry practitioners, endeavour to reconcile any differences between the needs of both sets of actors, and work towards building common platforms which support information flows for mutual, collective action (Contandriopoulos et al., 2010; Ankrah et al., 2013).	translate the findings in a broad, accessible format to engage with partners, whilst simultaneously drawing on the insights and experiences of industry to help shape the research and delivery mechanisms.
Opportunities for influence – *Sufficient agency* – *Positional power* – *Access to decision-makers*	As identified above, ensuring research adoption and impact requires building trust and maintaining relationships with a range of different actors. In turn, the actors engaged through the research-industry collaboration require sufficient agency (i.e. power and influence) to create change. Different actors will have different capacities to influence decision-making (policy and practice change), based on their relative positional power within an organisation; their access to policy makers/leaders/executives; and their connection to other sectors/industries, among others. Of note, opportunities to influence decision-making can and does occur in iterative cycles of planning, acting observing and reflecting, based on exposure to the research and interaction between researchers and other industry stakeholders. The aim here is also to be prepared as best as possible to capitalise on emerging windows of opportunity, or external shifts which create opportunities for policy and practice change.	Many key actors leading the CRCWSC have long-established, trusted relationships with key industry participants and organisations. The CRCWSC is also focused on establishing trusted relationships by undertaking a suite of interventions/activities to open up avenues and opportunities for actively influencing change in a broad range of sectors. How these work will provide important insights for better leveraging of key processes, as well as identifying tailored influencing (i.e. lobbying/advocacy) strategies. Here the credibility and quality of research and researchers is also important.
Contextual/ External factors – *Political* – *Social* – *Cultural* – *Historical* – *Institutional* – *Organisational* – *Economic* – *Technical* – *Environmental*	Being cognisant of important contextual and external factors is important for establishing the validity of arguments suggesting patterns of direct and indirect attribution of research influence and impact, but these are rarely captured in monitoring frameworks (Chapman, 2014). Key factors that can independently and collectively influence the pace, direction and scale of change include, for example, historical, political, geographical, economic, social, institutional and organisational aspects. Indeed, for example, the value perceptions by industry regarding awareness, acceptance and perception of risks associated with innovation/change in practice will influence the level of research adoption, and the satisfaction of stakeholders with the interactions/relationships, project and results is important (Mora-Valentin et al., 2004). Transformative change necessitates a broad range of stakeholder organisations be engaged and participating. Partners must understand each other's' needs, environmental and organisational characteristics so that relevant knowledge can be applied for mutual benefit (Plewa et al., 2013). For example, when working with multiple organisations, varying levels of capacity (willingness and readiness) for embracing changes in policy and practice are likely to exist. For this reason, understanding the absorptive capacity of organisations should be clarified, for this has an influence on the ability of key organisations to deliver research outcomes/impacts (see e.g. Hemsley-Brown, 2004; Mora-Valentin et al., 2004; Mitton et al., 2007; Osterling et al., 2008).	Being aware of the external conditions outside of its control requires monitoring to enhance the responsiveness of the CRCWSC to, for example, political and economic shifts, but also for asserting the validity of attributions made regarding CRCWSC interventions/research outcomes and the scale of influence/direct impact on policy and practice change regarding the delivery of water sensitive cities. The theory of change (see Figure 4) assumes that by interacting with a range of different organisations (SMEs, LG, SG, Consultants etc.), we can collectively create change. Similarly, it is important for the CRCWSC to acknowledge that they are innovating ahead of standard practice; thus, the capacity of many organisations that are required to implement and apply CRCWSC research findings is likely to vary dramatically. Indeed, broad scale change requires not only individuals within organisations to be on board, but rather whole organisations and sectors adopting a shift in 'ways of doing' to reinforce this change. Understanding these differences can support the development of tailored approaches to improve the likelihood of utilisation.
Good Program &	The effective management of research-industry collaborations requires high	CRCWSC program governance is comprehensive and involves industry

Project Management	quality program and project management, particularly with regard to objective setting, progress monitoring, effective communication and the employment of highly skilled project managers to run the collaboration (Barnes et al., 2002). High quality, regular and transparent internal (and external) communication is critical to keeping multiple actors engaged and committed. The following presents key aspects of good program and project management: • Clearly defined, mutually agreed objectives are critical to ensuring that projects do not become subject to unrealistic expectations and result in differing perceptions of its overall success. • Successful project planning and progress monitoring requires the development of mutually agreed project plans with realistic aims to ensure participants acknowledge the limitations of what can be achieved within the time and resources available, such that expectations can be managed accordingly. • Program Managers actively supported by lead researchers are better able to manage researchers and ensure they adhere to their agreed timescales. • The development of a clear communication strategy is essential to the effective management of university-industry interactions. It is also important to recognise the important role of open and regular internal communications. • Cost effective and efficient management.	partner organisations playing a key role in advising the CRCWSC research –industry collaboration from the executive scale through to program and project scales.

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Appendix I-F: List of CRCWSC Participants by State (as of June 2015)

ACT	SA	WA	VIC	NSW	QLD	NATIONAL	INTERNATIONAL
1. eWater Ltd	2. Dept. of Environment, Water & Natural Resources 3. SA Water Corporation 4. South Australian Murray-Darling Basin Natural Resources Management Board 5. The University of Adelaide 6. City of Unley	7. Dept. of Water 8. Dept. of Housing 9. The University of Western Australia 10. ChemCentre 11. Dept. of Regional Development 12. LandCorp 13. Metropolitan Redevelopment Authority 14. Swan River Trust 15. Water Corp WA 16. City of Armadale 17. City of Canning 18. City of Gosnells 19. City of Greater Geraldton 20. City of Joondalup 21. City of Mandurah 22. City of Melville 23. City of Nedlands 24. City of Subiaco 25. City of Vincent 26. City of Wanneroo 27. EMRC 28. South East Regional Centre for Urban Landcare 29. Essential Environmental	30. Dept. of Environment, Land, Water & Planning 31. Melbourne Water Corporation 32. South East Water Limited 33. Monash University 34. Dept. of Health & Human Services 35. City West Water Limited 36. Yarra Valley Water Limited 37. City of Boroondara 38. City of Greater Bendigo 39. City of Greater Dandenong 40. City of Kingston 41. City of Melbourne 42. City of Port Phillip 43. Knox City Council 44. Manningham City Council 45. Moonee Valley City Council 46. Maddocks 47. DesignFlow 48. Urban Water Solutions	49. Dept. of Planning and Infrastructure 50. Greater Sydney Local Land Services 51. Metropolitan Water Directorate 52. Blacktown City Council 53. City of Newcastle 54. City of Sydney 55. Fairfield City Council 56. Gilgandra Shire Council 57. Hornsby Shire Council 58. Ku-Ring-Gai Council 59. Marrickville Council 60. Warringah Council 61. Strathfield Municipal Council 62. Flow Systems	63. The University of Queensland 64. Griffith University 65. International WaterCentre Pty Ltd 66. Brisbane City Council 67. Hydrasyst 68. SPEL Environmental 69. Bligh Tanner Consulting Engineers	70. GHD Pty Ltd 71. Kellogg Brown and Root Pty Ltd 72. Veolia Water Australia Pty Ltd 73. E2DesignLab (2 branches) 74. Jacobs Group	75. City of Rotterdam (The Netherlands) 76. UNESCO-IHE Institute for Water Education (The Netherlands) 77. University of Innsbruck (Austria) 78. Danish Hydraulic Institute (Denmark) 79. Technical University of Denmark (Denmark) 80. Investment and Development Kunshan City Planning Bureau (China) 81. Kunshan City Construction (China) 82. Southeast University (China) 83. National University of Singapore (Singapore) 84. Public Utilities Board of Singapore (Singapore)

Appendix I-G: Examples of CRCWSC Tranche 1 projects involving testing and demonstration activities (as of June 2015)

Project	*Organisation/s involved*	*Status*
Project A1.1: Council staff helped develop and test different survey types regarding willingness to pay for specific environmental services and their benefits.	Manningham, Moonee Valley, Fairfield and Warringah Councils	Complete
Project A1.2: Local Governments will be involved in 'road testing' the guidelines detailing how to undertake a non-market valuation study.	Local Governments	To commence July 2015[1]
Project A1.3: 1. Organisations will be involved in setting up live projects on the crowdfunding platform, and to test predictions about successful project types and funding models. 2. Water utility involved in the design and implementation of surveys regarding price perceptions in water demand.	1. Several CRC partners (Brisbane City Council, Swan River Trust, Melbourne Water) and non-CRC industry organisations (e.g. Eco Centre in Port Phillip) have been approached to be project partners 2. Yarra Valley Water	1. Not yet commenced 2. Underway
Project A2.2*:* Initial 'pilot behaviour change initiatives' (i.e. market, social marketing and regulatory tools for influencing behaviour) will be rolled out in pilot cities.	Water utilities (potentially Yarra Valley Water); policy makers in local and state government	To commence July 2018[2]
Project A2.3*:* Experimental testing of optimal message framing and message delivery modes for community engagement strategies.	A2.3 researchers are in conversation with the Cooks River Alliance to see how their findings can be used to inform their community engagement programs.	To commence July 2016[3]
Project A3.1: 1. Policy-makers will be involved in 'testing and refining' the guidelines currently being developed to support governance reform through policy change. 2. Policy-makers and industry associations will be engaged to test where particular recommendations of governance structures will be relevant.	1. State Government policy-makers, Local Governments and Water Utilities 2. State government policy makers and regulators from relevant departments and agencies; Industry associations	Not yet commenced
Project A3.2: Organisations will be involved in testing the risk assessment and diversification models across state and local levels.	State Governments and Water Utilities	Underway
Project A4.3: Water utilities have been involved in the development and testing of theDAnCE4Water tool, and are also expected to be involved in validating the tool. State and Local Governments are also expected to be involved.	South East Water, Melbourne Water State and Local Governments	Underway
Project B2.1: In relation to the Little Stringybark Creek project, the project team worked with the catchment community and Local Council to install more than 280 stormwater control measures across the catchment.	Yarra Ranges Council	Complete

***B2 projects**:* By mid-2015, demonstration projects are to commence focusing on (1) reducing nuisance insects and toxic algal blooms; and (2) new approaches to vegetation buffer zones and riparian strips. Additional projects focusing on vegetation buffer zones and riparian strips will commence at the end of FY 17/18.		To commence July 2015[4]
***B3 Projects**:* By mid-2016 (end of FY 15/16), demonstration projects into improved public realm landscapes will commence, and continue till end of FY18/19.		To commence July 2015[5]
***Project B4.1**:* Local governments and water utilities are currently involved in testing the framework for the development of adaption strategies (part of the flood risk modelling tool).	Melbourne Water, City of Port Phillip	Underway
Project B4.2: Local governments will be engaged in the testing and refinement of software tools, to ensure its usefulness to this user group.	City of Rotterdam, City of Dordrecht, City of Hamburg, Hoboken New York, City of Gosnells, City of Can Tho, City of Port Philip (i.e. Elwood)	Underway
Project B5.1: Draft recommendations are to be 'tested' by carrying out targeted stakeholder consultation through 2-3 workshops with stakeholder advisory group and interviews (involving all relevant CRC Partners).		Oct 15 – April16
Project C1.1: 1. Local governments, water utilities and urban water practitioners have been involved in field demonstrations of advanced biofiltration systems for stormwater treatment and harvesting. 2. UrbanBEATS is being tested by City West Water for a case study in their region 3. The first prototype of Zero Additional Maintenance (ZAM) biofiltration design was built by Manningham City Council. After the tests are completed the Council will build 4 full scale systems as demonstration of the new technology. The Council also applied for funds to build a large number of ZAM systems in their area.	1. Monash City Council has been constructing stormwater harvesting systems (the 'Living Roof Project') 2. City West Water 3. Manningham City Council, Melbourne Water	Underway
***Project C1.3*:** Following laboratory studies into low-cost and low-energy consuming filtration systems for treatment and reuse of reclaimed water, the project will apply developed novel filter materials at the field-scale by incorporating them into existing systems and establishing new pilot plants.	Water utilities and consultants. As of June 2015, researchers are Interacting with Monash City Council for installation of the demonstration site which will test the Cu-Zeolite media for the first time in the field. The systems are now being installed (the first few layers of media are in place).	To commence July 2016[6]
***Project C2.1**:* Trial application of the novel wastewater technologies. A pilot processing plant is being built as part of the larger innovation centre at Brisbane's Luggage Point Advanced Water Treatment Plant. More pilots are also planned with the support of Victorian utilities.	Queensland Urban Utilities	Underway
***Project C3.1**:* A testing site for the project is being set up at the Luggage Point Wastewater Treatment Plant, where two rising and two gravity sewer lines will be built for the use by the project.	Queensland Urban Utilities	Underway
Project C4.1: Stakeholders will be involved in the demonstration and testing of novel hybrid biofiltration (green and living walls) technologies.	Local Governments (e.g. Monash City Council), Water Utilities, Land Developers and Consultants	To commence July 2016[7]

Project C5.1*:* 1. Ongoing smart meter trials of more than 13,000 residential, commercial and industrial properties in Kalgoorlie-Boulder and 500 customers in Karratha. 2. Stakeholders have been involved in a case study for optimal pumping operation of multi-source (natural catchment, stormwater, and groundwater).	1. Water Corporation WA 2. Geolyse Pty Ltd, Orange NSW (on behalf of Orange City Council).	Underway
Project D1.1: 1. Water utilities, state agencies, consultants and NGOs have been involved in the development and testing of the WSC Toolkit. 2. Local governments, water utilities and consultants have been involved in the demonstration of implementation and/or proof-of concept of water sensitive initiatives in Officer and Marrickville. 3. Demonstration of WSC Toolkit in CRCWSC research synthesis projects (i.e. Tonsley, Aquarevo, Bentley etc.).	1. Melbourne Water; City West Water; Department of Water (WA); GHD; e2DesignLab and eWater. 2. *Officer, VIC* – e.g. Places Victoria, South-East Water; *Marrickville, NSW* – e.g. Marrickville Council, Marrickville West Primary School 3. All Synthesis Workshop participants	Underway
Project D1.4*:* Local Governments, water utilities and consultants have been involved in 'case study applications of the WSC Toolkit'.	City West Water, Melbourne Water, City of Unley	Underway
Project D5.1: Demonstration projects involving design scenarios in different climactic and density conditions in Australia and internationally (i.e. Kunshan). These include real projects as well as hypothetical and/or CRCWSC research synthesis projects (i.e. Tonsley, Aquarevo, Bentley etc.). More recent demonstration projects include the Elwood Project and City of Melbourne's major redevelopment precinct Arden/Macaulay.	– Planning Bureau of the City of Kunshan – All participating organisations in Synthesis Workshops, for example the Aquarevo Project involved South East Water, Villawood Properties, AECOM etc. – City of Melbourne, Melbourne Metro Rail, and the Melbourne Planning Authority are involved in the Arden/Macaulay redevelopment project.	Underway
Project D6.2*:* Local Governments have been engaged in the prototype development and testing of the WSC Index.	Prototype index testing with Knox City Council and City of Port Phillip; pilot with Perth to commence end of Sept/early Oct; Other Project Advisory Group members have been involved in re-conceptualisation of the framework (Melbourne Water; City of Melbourne and City of Marrickville)	Underway
Sources: Impact Pathways, Research 2012-2016, Quarterly Reports, and EIAT. The scale and scope of these projects require further confirmation with project leaders. **Notes**: 1 = According to EIAT Usage 1.01; 2 = According to EIAT Usage 1.03; 3 = According to EIAT Output 4.04; 4 = According to EIAT Output 2.02; 5 = According to EIAT Output 2.03; 6= According to EIAT Usage 3.01; 7 = According to EIAT Output 3.04		

CRC for
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