CRC for
Water Sensitive Cities

Mechanisms for unpacking socio-institutional pathways for change: a research compendium from A4.1

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Mechanisms for unpacking socio-institutional pathways for change: a research compendium from A4.1
Cities as Water Supply Catchments: Society and institutions (Project A4.1)
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Executive Summary

This report outlines the collective insights that emerged from a suite of research projects aimed at exploring how to advance the institutional and practical mainstreaming of sustainable urban stormwater water systems in Australia. Originally part of the **Cities as Water Supply Catchments Program**, these research projects became part of the broader Cooperative Research Centre for Water Sensitive Cities in 2012 (Program A: Society; Project A4.1). There were three independent, but mutually reinforcing, sub-projects within A4.1: institutional capacity (P6.1), community receptivity (P6.2) and co-design innovation (P6.3). This report brings together this rich body of work to demonstrate how these insights and approaches can be used in advancing urban water governance practices, with particular reference to stormwater management. Although distinct from the broader 'Governance and Regulatory Reform' suite of projects (Program A; Project A3), the program of research reported here supports and complements those projects.

One of the key documents produced under A4.1 was the ***Moving Towards Water Sensitive Cities: A Guidance Manual for Strategists and Policy Makers*** (Brown et al., 2016). This guidance manual builds on much of the work undertaken across A4.1, and presents a series of guiding steps to assist policy-makers and strategists with the process of benchmarking a city/town in relation to a WSC.

This report is designed to bring attention to how the different sub-projects can inform and contribute towards generating transition pathways. The report outlines the key insights arising from each of the sub-projects and points to how and where they may be positioned along the transition dynamics framework (Brown et al., 2016). This framework provides a structure to analyse the transition phase of a city or organisation and to establish a transition benchmark from which targets can then be set and strategies developed to attain those targets. It does this by focusing attention on five domains of change including Actors, Bridges, Knowledge, Projects and Tools. Thus, insights relating to adaptive governance of urban water systems (including decentralised systems), water practitioners' receptivity to alternative urban water systems (including sustainable stormwater systems) and community receptivity to raingardens are interpreted in terms of these domains of change, depending on the transition phase. In addition, dominant or contesting narratives driving or impeding a transition can be revealed. This analysis complements the results of the sub-projects, which are available in published papers and reports (see Appendix 1).

Quick guide to projects for operational or strategic use

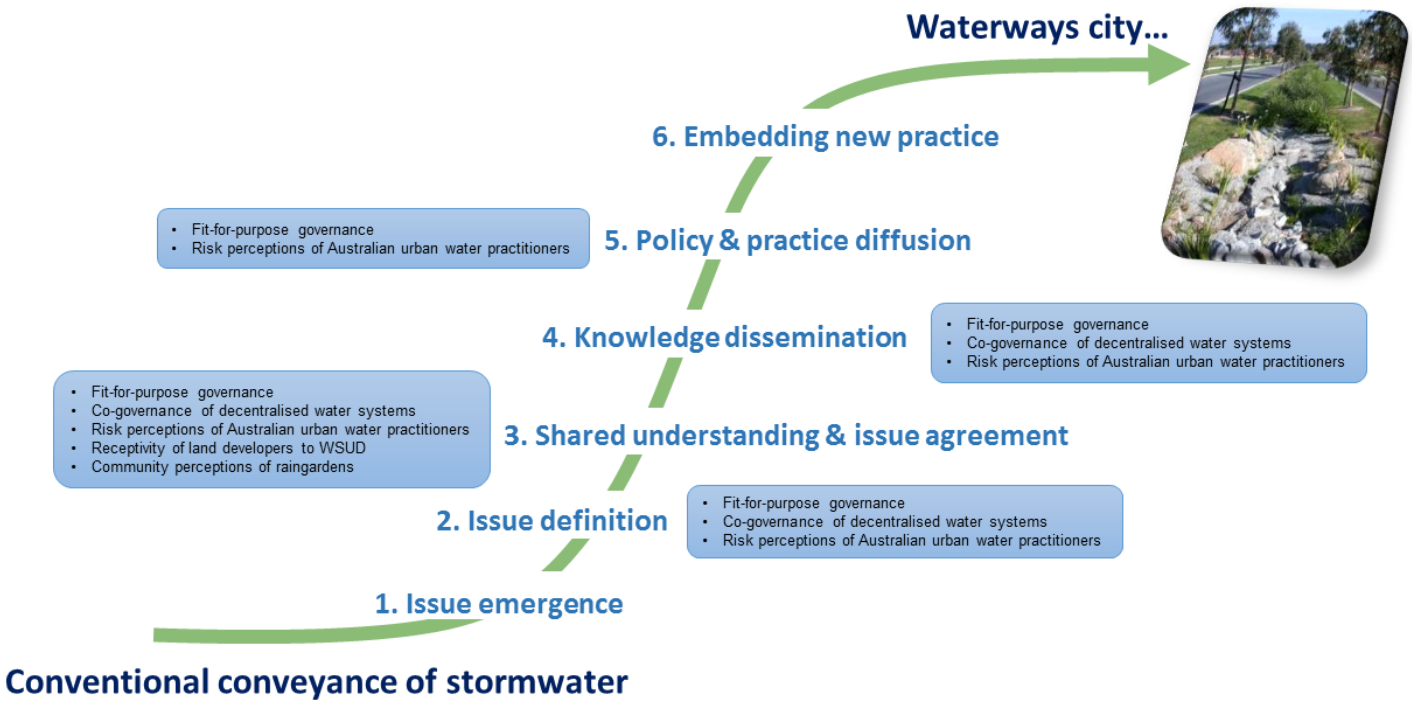
Three key sub-projects comprise Project A4.1. Insights from some or all of them can be used to help benchmark the transition phase of a city or organisation, set targets, or develop strategies to achieve targets. The following list suggests which sub-projects can be used for which of these three purposes. Insights that apply at a sector scale can be useful strategically, whereas insights that apply at an organisational or personal level can be useful strategically or operationally.

1. **Benchmarking transition phase:**
   - Fit-for-purpose governance of urban water systems
   - Co-governance of decentralised urban water systems
   - Receptivity of Australian urban water practitioners to alternative urban water systems, including stormwater harvesting and treatment
   - Receptivity of land developers to WSUD

2. **Target setting:**
   - Fit-for-purpose governance of urban water systems
   - Co-governance of decentralised urban water systems
   - Receptivity of Australian urban water practitioners to alternative urban water systems, including stormwater harvesting and treatment
   - Receptivity of land developers to WSUD
   - Community perceptions of raingardens

3. **Achieving targets:**
   - Fit-for-purpose governance of urban water systems
   - Co-governance of decentralised urban water systems
   - Receptivity of Australian urban water practitioners to alternative urban water systems, including stormwater harvesting and treatment
   - Receptivity of land developers to WSUD
   - Community perceptions of raingardens
   - The hydro-social contract underpins the governance of urban water systems, reflecting the values and agreements between communities, governments and business on how water should be managed.

The following infographic depicts the researchers' interpretation of the most appropriate uses for the different research approaches and insights that have arisen from Project A4.1 in relation to the six critical phases in the transition toward water sensitivity.



Introduction

Transitioning to a water sensitive city (WSC) requires more than just technological change. Achieving a WSC also demands changes in the implicit and explicit agreements among communities, governments and business related to how water should be managed. This 'hydro-social' contract is shaped by the social and cultural context of a city and the historically embedded urban water values. It is expressed through prevailing institutional arrangements and regulatory frameworks, which structure urban water governance, or decision-making at a range of scales, from policy setting to day-to-day management. It is also physically represented by the urban water infrastructure. It is anticipated that hydro-social contracts within a water sensitive city will be adaptive and supported by a flexible institutional regime (Brown et al., 2009). Governance involves multiple actors including: government departments, water utilities, non-government organisations (NGOs), private enterprises and community members. Collectively, these actors will manage a hybrid mix of diverse water sources and systems operating at various scales, including existing large-scale centralised systems, along with innovative alternative systems – some of which will be decentralised. Stormwater harvesting and treatment systems will be an important component of this mix. These changes demand a significant socio-technical overhaul of conventional approaches to urban water governance.

Project A4.1, within Program A: Society of the Co-operative Research Centre (CRC) for Water Sensitive Cities, explored different aspects of institutional change to support these changes in governance. The project commenced in 2010 as Project 6: Society and Institutions within the Cities as Water Supply Catchments Program conducted by the Centre for Water Sensitive Cities at Monash University. In 2012, this Program was incorporated into the CRC for Water Sensitive Cities. The core aim of Project 6 was to identify and demonstrate the social and institutional ingredients to advance the mainstream application of decentralised stormwater harvesting across Australian cities. It sought to develop a template of new governance and policy mechanisms to facilitate the application of stormwater harvesting technologies and to determine industry and community receptivity[1] for sustainable stormwater management. This involved applying an innovative approach to develop an integrated account of socio-institutional contexts for stormwater harvesting. There were three inter-related sub-projects in Project 6: institutional capacity (P6.1), community receptivity (P6.2) and co-design innovation (P6.3). These sub-projects were carried through into Project A4.1 of the CRC. One of the key objectives within Project A4.1 was to understand the risk perceptions and receptivity of urban water practitioners and water leaders to alternative water sources and management techniques. Other core objectives were to explore the management of networks, and the changes in practice afforded by both inter-disciplinarity and the practical engagement of water users and technology recipients in co-governance.

Background to A4.1 projects: the Urban Transitions Framework

Underpinning this program of research is the urban transitions framework (Figure 1: Brown et al., 2009), which describes the parallel shift towards greater sustainability in socio-political drivers for water management and their related water service delivery functions. Within each city state, technological advancement and arrangements for delivering different water services reflect the prevailing socio-political drivers. As attitudes towards water management within a city shift from concerns around water supply, sanitation and drainage to issues of sustainability, resilience and liveability, the associated water delivery services become more sophisticated,

[1] Receptivity refers to an individual or an organisations awareness of an issue, their willingness to implement a solution and their capacity to apply a stated solution.

integrated and adaptive. The aspiration for a water sensitive city incorporates adaptive, multifunctional infrastructure incorporating water sensitive urban design and reinforcing water sensitive behaviours.

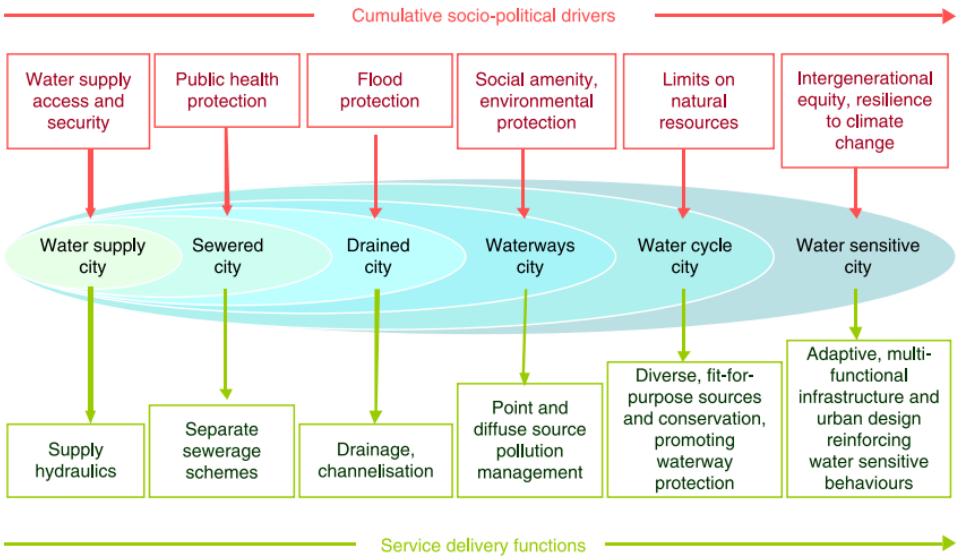


Figure 1. Transitions framework for urban water services. Source: Brown et al. (2009).

Transitioning to a water sensitive city, however, is not easy. Ideally, a transition of a water system innovation will continue through a pattern of take-off and acceleration, whereupon the system stabilises (Figure 2). However, this rarely occurs in practice, with transitions often prevented by system breakdown, backlash or path-dependent lock-ins (see Figure 2). Early related work undertaken within the National Urban Water Governance Program (2005-2012) suggested that the key to a successful transition is the interplay between those people championing a transition and the enabling context for that transition (Brown and Clarke, 2007) (Figure 3). This interplay provides a level of resilience so that a transition does not lose its momentum. The critical variables outlined in Figure 3 contribute to building an enabling context.

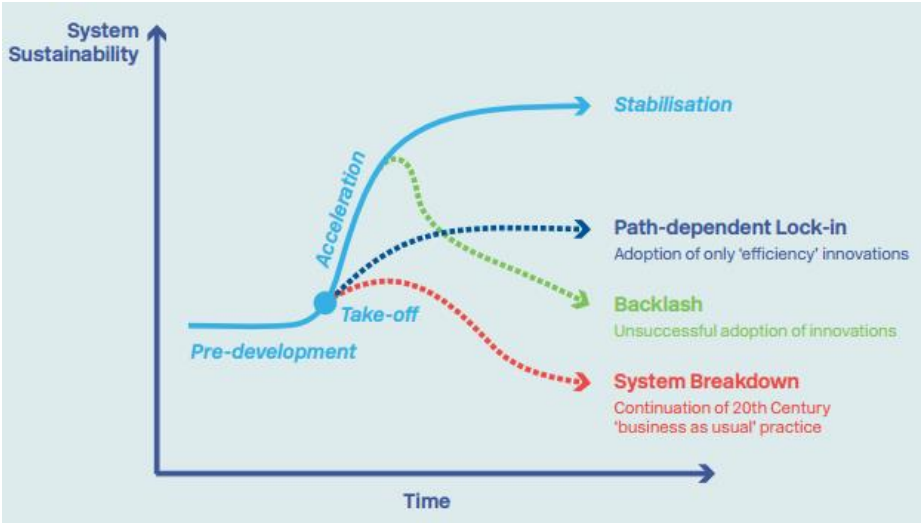


Figure 2. Alternative pathways that a transition can take. Source: Brown et al. (2016), adapted from Van der Brugge and Rotmans (2007).

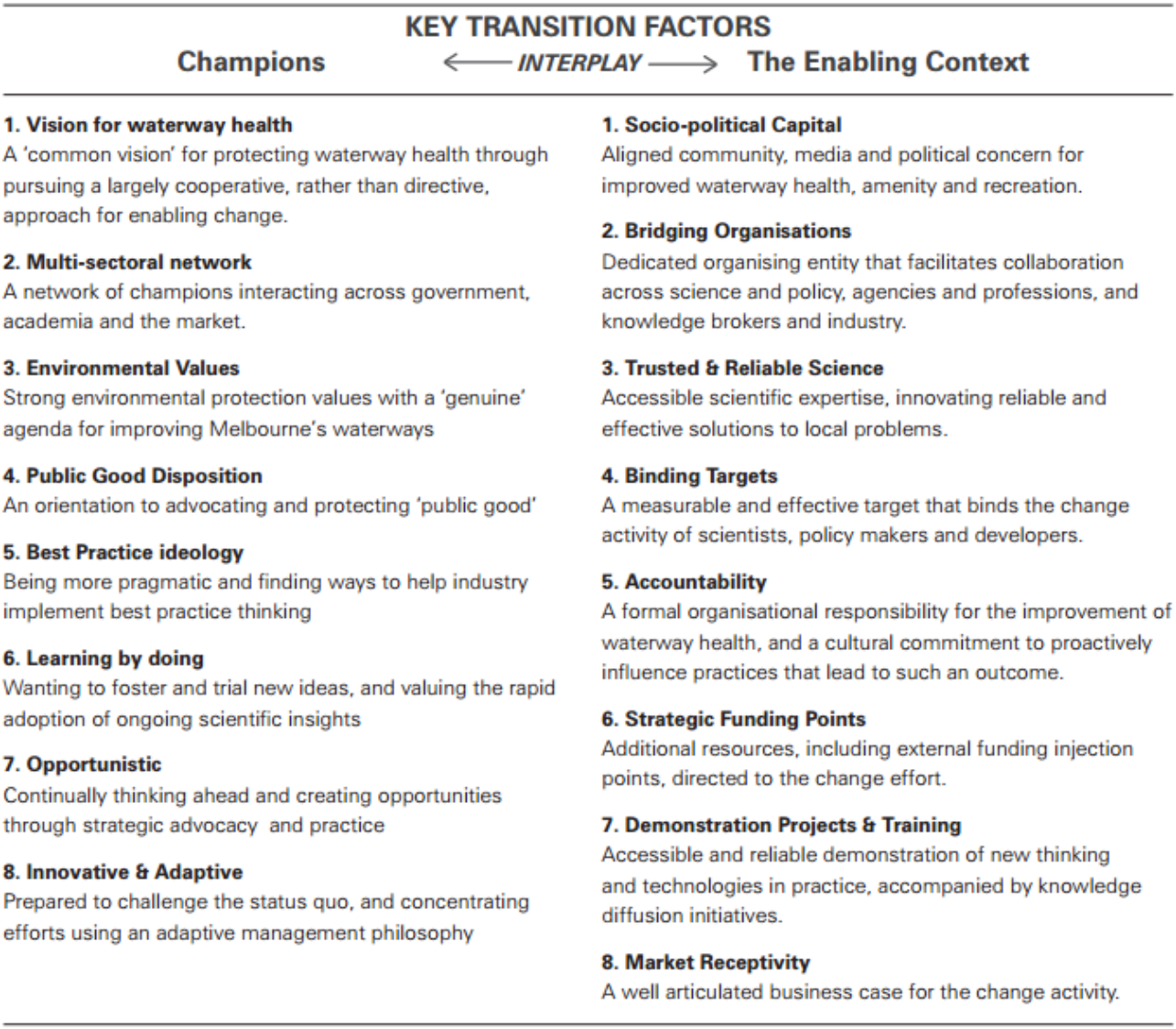


Figure 3: Key Transition Factors in the Melbourne case study. Source: Brown and Clarke (2007, p. v)

This body of work was further developed as a core foundational piece of research within Project A4.1 by (i) Brown, Farrelly and Loorbach (2013) in a scholarly paper, and again by (ii) Brown, Rogers and Werbeloff (2016) in an industry report. The latter identified six critical phases along the transition pathway toward achieving water sensitivity (Figure 4). Identified across both studies were two important factors operating at each phase: (i) dominant narratives and (ii) domains of change (Brown et al., 2016). ***Dominant narratives*** are stories describing the prevailing practices. There can be advocating narratives, which support a new practice and its uptake, or contesting narratives, which challenge or undermine it. The dominant narrative reveals the perception of the transition at that phase, and can be either positive or negative. ***Domains of change*** are the areas that shift during a transition. Domains of change are actors, bridges, knowledge, projects and tools that "influence and organise the formal and informal rules for implementing a practice" (Brown et al., 2016, p. 16). These rules can also be understood as institutions, which underpin governance of urban water systems. Understanding the way in which the five domains of change shift as a transition unfolds can reveal insights into socio-institutional change,

i.e. changes in the inter-relationship of the various institutions involved in urban water governance and the actors within their broader social and economic contexts. These insights can then be used to:

1. identify the current phase of a transition, i.e. benchmark the city's position on the transition curve,
2. guide a transition to achieve desired targets, or
3. evaluate the success of strategies to achieve those targets.

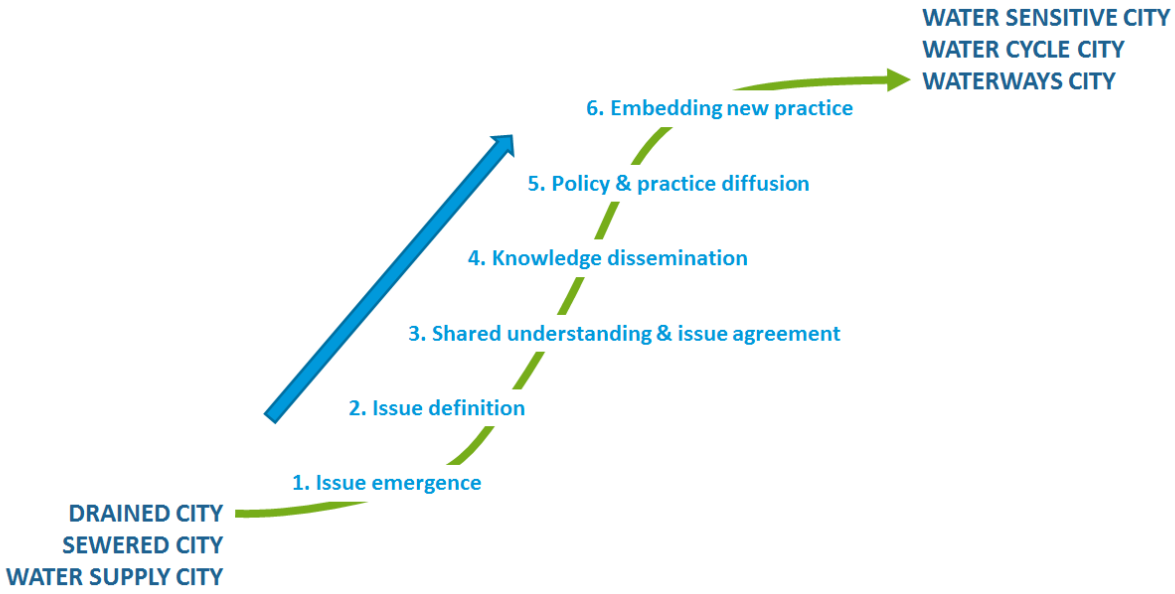


Figure 4. Six phases in the transition toward water sensitivity. Source: Brown et al. (2016).

The design logic behind Project A4.1 was to further explore the various social and institutional aspects of transitioning towards more sustainable stormwater management practices and contribute to the overall transition towards delivering water sensitive cities. Previous research involving an urban water sector-wide survey revealed the variability of professional receptivity to advancing sustainable urban water management across Australia (Brown and Farrelly, 2007). Against this background, the A4.1 sub-projects were designed as independent, but highly-interrelated projects aimed at exploring the prevailing institutions within the 'drained city' - the predominant contemporary state of water management in Western cities - to understand the status quo and to identify strategies for facilitating change. Furthermore, the sub-projects also examined, in finer detail, different aspects of the social dimension of these institutions, in particular, the risk perceptions of urban water practitioners, and the acceptance by communities of alternative infrastructure types (i.e. raingardens).

This report synthesises the results of the three sub-projects and determines, where possible, the relationships between the sub-projects that enrich the outcomes of each individual project. Here we draw on one of the key reports emerging from Project A4.1, the ***Moving Towards Water Sensitive Cities: A Guidance Manual for Strategists and Policy Makers*** (herein referred to as the Guidance Manual) (Brown et al., 2016). The Guidance Manual proposed a transition dynamics framework (Table 1), which elaborates on the dominant narratives and domains of change at each phase of the transition towards water sensitivity (Brown et al., 2016). This framework is useful in helping to describe the transition pathway of a city, to determine the city's position on the pathway, identify targets to facilitate its transition, develop strategies to achieve those targets and evaluate the effectiveness of those strategies. These processes are explained by Brown et al. (2016) and it is not our intention to repeat that information here. Rather, we plan to present the various sub-projects within Project A4.1 in terms of this framework, to provide additional background, context and substance to the framework.

Overall, this synthesis report emphasises the practical tools, recommendations and strategies from the sub-projects that can be used to guide the transition towards water sensitive cities. Where necessary, the reader is referred to published papers and reports for more theoretical and empirical detail (see Appendix 1). The sub-projects were undertaken by research fellows and postgraduate higher-degree-by-research students, under the leadership of Professor Rebekah Brown and Dr Megan Farrelly. The researchers and their projects are listed at the end of this report (see Appendix 2).

Table 1. Transition Dynamics Framework. Source: Brown et al. (2016).

	DOMAINS OF CHANGE				
TRANSITION PHASE	**Actors** Key networks of individuals	**Bridges** (Semi) Formalised organisations, structures, & processes for coordination & alignment	**Knowledge** Research, science, & contextualised knowledge	**Projects** Experiments, demonstrations, & focus projects	**Tools** Legislative, policy, regulative, & practice tools
1. Issue Emergence	Issue activists	N/A	Issue discovery	High profile scientific studies	N/A
2. Issue Definition	Science leaders	Science-industry	Cause–effect	Laboratory-based & scientific solution prototypes	N/A
3. Shared Understanding & Issue Agreement	Technical solution coalition	Science-industry-policy	Basic technological solutions	Minor scientific field demonstrations	Draft best-practice guidelines
4. Knowledge Dissemination	Informal policy coalition	Science-industry-policy-capacity building	Advanced technological solutions	Major scientific field demonstrations	Best-practice guidelines, targets
5. Policy & Practice Diffusion	Policy & decision coalition	Science-industry-policy-capacity building	Modelling solutions, capacity building	Numerous industry-led field experiments	Legislative amendments, market offsets, national best-practice guidelines, regulatory models
6. Embedding New Practice	Multi-agency coalition	Formalised institution	Next research agenda	Standard practice	Political mandate, coordinating authority, comprehensive regulatory models & tools

Table 2 below attempts to align the various A4.1 sub-projects with the key transition dynamics identified in the Guidance Manual. The report will highlight key outcomes from each of the research projects listed and discuss how these could be used to help advance our understanding of contemporary practices so that strategic leverage points for change can be identified.

Table 2. Sub-projects of Project A4.1 and their potential to contribute understandings of narratives and domains of change associated with transition phases identified by Brown et al. (2016).

	NARRATIVE		**DOMAINS OF CHANGE**				
Sub-project	**Dominant**	**Contesting**	**Actors**	**Bridges**	**Knowledge**	**Projects**	**Tools**
Fit-for-purpose governance	✓	✓	✓	✓	✓	✓	✓
Co-governance of decentralised water systems	✓	✓	✓	✓	✓		
Risk perceptions of Australian urban water practitioners	✓	✓	✓		✓		✓
Receptivity of land developers to WSUD	✓	✓	✓		✓		✓
Community perceptions of raingardens	✓	✓	✓		✓	✓	✓

Configuring Adaptive Urban Water Governance

Fit-for-purpose governance

What is governance? Governance refers to the **structures**, **processes** and **mechanisms** which bring together multiple actors (i.e. government, civil society and private sector agents) to guide urban water management. Benchmarking the current position of a city on its transition to a water sensitive city demands an understanding of its current governance structures and processes. Governance in a water sensitive city will be quite different from traditional water governance which emphases certainty, prediction and control (Rijke et al., 2012). In particular, the participation of a range of different stakeholders, including community members in co-governance (Yu et al., 2011), will demand a new approach to urban water governance.

Adaptive governance has been proposed as an alternative to traditional governance (Folke et al., 2005) and is likely to characterise a water sensitive city (Wong and Brown, 2009). This mode of governance has both operational and strategic aspects that are likely to differ from current forms of governance. Project A4.1 has produced insights into these aspects of adaptive governance in order to inform future policies and practice that will facilitate the transition to a water sensitive city.

A framework for diagnosing current governance practices was developed as a starting point (see Figure 5; Rijke et al. 2012, 2013). This framework allows existing governance regimes to be understood in terms of their suitability for addressing sustainable urban water management. Using this framework, decision makers can break down and analyse the contemporary governance setting and then establish programs for change to support a transition.

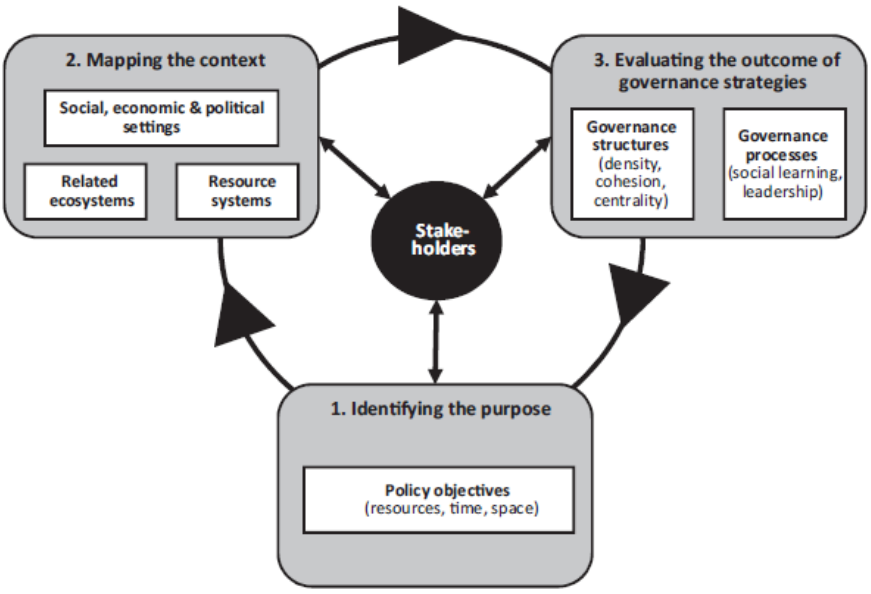


Figure 5. Framework for diagnosing existing governance mechanisms to identify objectives for governance reform. Source: Rijke et al. (2012).

Rijke et al. (2012) outline how to apply such a framework to exploring (i) the specific purpose of governance; (ii) mapping the context including social, economic and political settings; and (iii) evaluating the outcomes of

governance strategies. There are both structural and procedural aspects of fit-for-purpose governance that are important to its operation. **Structural aspects** that define governance are network density, network cohesion and centrality of an actor within a network or variability in the centrality of actors in the network. **Procedural aspects** relate to social learning and leadership.

In applying the framework, attention is drawn to the need to design participation and engagement strategies for a diverse mix of stakeholders to ensure that any assessment of governance is meaningful and reliable. Undertaking this assessment should be done by **collating input from multiple stakeholders, documents and organisations**. Once the framework has been applied to unpack contemporary governance approaches, a thorough description and understanding of current governance arrangements should be readily available to assist with benchmarking a city's progress in its transition towards water sensitivity. By setting targets to improve aspects of urban water governance, regular review of the framework will help determine if targets for governance reform are being achieved.

Co-governance of decentralised water systems

Water Sensitive Cities are expected to have a hybrid of centralised and decentralised water systems, and governance will involve a range of different, non-traditional stakeholders. This sub-project explored (i) public sector governance, co-production and social practices to develop an analytical framework for co-governance of decentralised systems in a water sensitive city; and (ii) examined contemporary examples of co-governance in (the then) Marrickville Council (NSW). There are many ways in which a water system can be configured (Figure 6), with potentially multiple water sources, water providers and water end-users interacting with a diverse set of technologies. The challenge is to manage these complex and diverse decentralised systems, which do not have established boundaries of ownership. There needs to be a 'fit' between the various physical and social infrastructural options and the existing conditions (Yu et al. 2011, 2012).

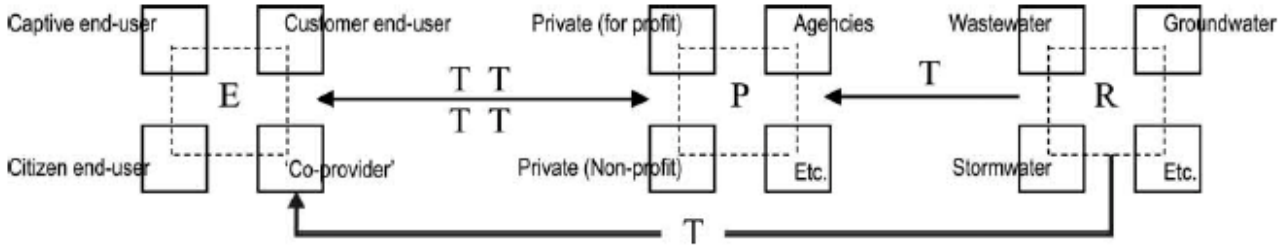


Figure 6. Alternative components in urban water systems for water provision and consumption. Source: Yu et al. (2012). E, end-user; T, technology; P, provider; R, resource.

Yu et al. (2012) have developed an analytical framework to guide decisions around the most appropriate form of governance for decentralised water systems (Figure 7). Critical aspects to be considered are:

1. type of technology implemented;
2. technical factors, e.g. scale, structure and complexity of water technology;
3. end-users' lifestyles, routines, and ability, willingness and/or motivation to plan, manage and maintain decentralised water systems;
4. prevailing policy processes, e.g. regulations and incentives, related to governance; and
5. national or global trends in cultural standards, value systems, regulation and infrastructure related to water.

This analytical framework for co-governing decentralised systems, such as stormwater harvesting and treatment systems, can be used to describe existing governance mechanisms and identify the current transition phase of a city. It can also be used to guide the design of new co-governance arrangements, drawing attention to those aspects that will need supporting policies and strategies for successful implementation. These arrangements can then become targets, against which future assessment can be compared.

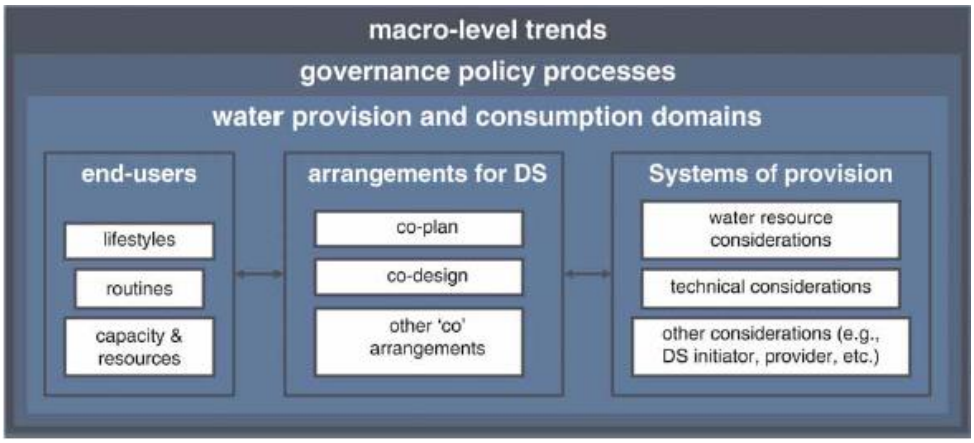


Figure 7. Analytical framework for co-governing decentralised systems (DS). Source: Yu et al. (2011).

This body of research identified that it is anticipated that governance arrangements will shift from one of co-governance, to one of centralised governance as the number of water sources and system scale, complexity and interconnectedness increase (Figure 8; Yu et al., 2011). Trust amongst stakeholders involved in co-governance and familiarity with the particular technology are considered essential for effective co-governance (Dobbie et al., 2016). If co-governance is to be implemented in a water sensitive city, strategies must be implemented to enhance trust between stakeholders and to facilitate the co-production of knowledge for shared decision-making.

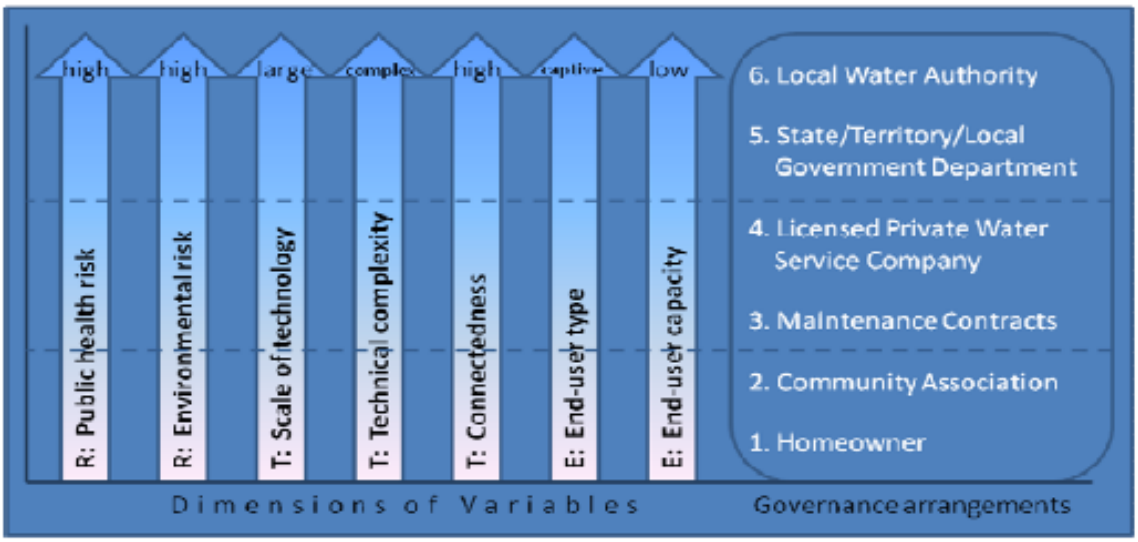


Figure 8. Relationship of water system variables with governance arrangements for urban water systems. Source: Yu et al. (2011).

Research also explored contemporary examples of co-governance in urban stormwater management. This work examined the attempts at co-governance orchestrated by a leading New South Wales Local Government authority (the then, Marrickville Council). This work showcased how the level of public involvement or mode of collaboration should be tailored to the particular parameters of a project and local context (Tawfik, 2016). The design of future co-governance approaches should consider the following lessons:

Build institutional capacity: Internal capacity is critical. The multi-disciplinary group of staff involved in any project need to be appropriately trained and educated on co-governance and community engagement techniques. Additionally, council leadership should actively foster supportive organisational cultures and commitment to collaborative processes.

Analyse and involve all relevant stakeholders: The form and extent of stakeholder involvement requires careful consideration. Prior to any project, potential stakeholders need to be comprehensively analysed to determine appropriate methods and strategies for engagement. Transaction costs can be minimised through early and continuous stakeholder engagement activities that clearly define expectations and responsibilities.

Build trust, local capacity and long-term commitment: Trust and local commitment are necessary for sustaining co-governance in the long-term. Council programs designed to build local capacity can also provide a forum for relationship building and the development of local champions. Regular, face-to-face interactions are needed to maintain momentum and ongoing involvement of non-state participants.

Receptivity to improved urban stormwater management

Understanding the receptivity of urban water practitioners and the community for sustainable stormwater management, and alternative water systems more generally was considered an important step in understanding the current 'state of play'. Receptivity relates directly to the Actor domain of change in the Transition Dynamics Framework, and indirectly to the domains of Knowledge and Tools. The significance of receptivity depends on the specific actors involved, e.g. water practitioners or members of the community, and the particular transition phase. A particular receptivity in Phase 1, Issue Emergence, may have quite different significance and consequences compared with a similar receptivity in Phase 4, Knowledge dissemination. The receptivity of professionals within the water sector and of members of the community to sustainable stormwater management and other alternative water systems can also reveal dominant narratives. This information can help benchmark a city on its transition towards water sensitivity, identify targets and inform the design of strategies to achieve them.

Receptivity to sustainable innovative water technologies and management has been modelled as a four-tiered response, which fundamentally requires learning (Jeffrey and Seaton, 2004). At its most basic level, receptivity involves 'awareness' of a problem and the availability of knowledge, such as an innovation, to address the problem. The next level is 'association', which recognises the benefits of that knowledge by associating it with needs and capabilities within, in this case, the water sector or community. This is followed by 'acquisition' of technologies or behaviours that support implementation of the knowledge, and finally 'application' of the knowledge itself to achieve the benefit.

In Project A4.1, the receptivity of different actors involved in urban water governance was tested. Receptivity of Australian urban water practitioners towards a range of sustainable urban water systems, including stormwater harvesting, treatment and reuse, was explored through a study of their risk perceptions of these systems. In addition, receptivity of land developers to water sensitive urban design (WSUD) was further explored, to unpack constraints and enablers for improving the adoption of WSUD elements.

Risk perceptions of Australian urban water practitioners

Perceived risks relate to three components of the receptivity framework (Table 3). There is an element of subjectivity to this allocation: some perceived risks might relate to more than one component or the allocation might differ depending on context. For example, cost-related risks might be related to acquisition in some contexts and/or application in other contexts (Jeffrey and Seaton, 2004). This report focuses on receptivity towards stormwater harvesting, treatment and reuse. Full details of receptivity for stormwater harvesting and treatment and other systems can be found in Dobbie and Brown (2012, 2013, 2014a&b) and Dobbie et al. (2012a, 2012b, 2014). An understanding of practitioners' receptivity reveals something of the dominant narrative at each phase of the transition pathway. In addition, their receptivity relates directly to the domains of change of Actors at each transition phase, particularly Phases 3, 4 and 5: Shared understanding & issue agreement, Knowledge dissemination, and Policy & Practice Diffusion respectively. Practitioner receptivities could also provide insights into the domain of change of Knowledge and its dissemination, and the development of Tools, including policy development.

Receptivity analysis of Australian urban water practitioners to stormwater harvesting and treatment technologies revealed that perceived management failure, capital cost and maintenance/operations cost risks challenged the

acquisition and application components of their receptivity (Dobbie and Brown, 2012). In addition, for stormwater harvesting systems, the association components of receptivity related to perceived public health risk, and the acquisition and application components related to risk of reputation loss and political risk, varied with the practitioners' work area; the acquisition component related to perceived technological failure risk of stormwater harvesting systems varied with stakeholder group; and the acquisition component related to environmental, flooding and aesthetic risks, varied with primary qualification (Dobbie and Brown, 2014b). Although receptivity components for other urban water systems varied across Australian cities (Dobbie and Brown, 2014b), those for stormwater harvesting did not (Dobbie and Brown, 2014b).

Table 3. Perceived risks of stormwater harvesting systems related to three of the four components of the receptivity framework—association, acquisition and application. It is assumed that all practitioners were aware of stormwater harvesting and treatment and so the awareness component was not explored in Project A4.1. Source: Dobbie and Brown (2012).

Association	Acquisition	Application
Public health	Technological failure	Capital cost
Environmental risk	Management failure	Maintenance/operations cost
Constrained future innovation	Constrained future innovation	Constrained future innovation
Aesthetic		
Flooding	Compliance/legal	Commercial
Loss of end-user commitment		Loss of end-user commitment
Political	Political	Political
Reputation loss	Reputation loss	Reputation loss

The different risk perceptions to stormwater harvesting systems – dependent on practitioner work area, stakeholder group and primary qualification – can be expected to influence and shape the dominant narratives of the transition, depending on the transition phase, as captured by Brown et al. (2013). The relevant phase depends on the practitioner groups, with different narratives and the particular risks related to the various receptivity components. Those practitioner groups receptive to stormwater harvesting are likely to participate in advocating narratives whereas those less receptive are likely to participate in contesting narratives. For example, design professionals might advocate stormwater harvesting, arguing that it has low environmental risks, in contrast to biological scientists, who might contest this. Similarly, practitioners working in stormwater and/or waterways might advocate stormwater harvesting, arguing that its public health risk and political risk are low and do not pose a risk to their reputation, in contrast to those working in sewerage, who might disagree.

The particular perceived risks suggest the transition phase to which the receptivity relates. In Project A4.1, perceived risks appear to relate predominantly to Phases 3-5, depending on the actor network composition and the dominant narratives, reflecting the findings of Brown et al. (2013). In Phase 3, Shared Understanding & Issue Agreement, the key actors form a technical solution coalition. This would include practitioners in stormwater/waterways familiar with the new technologies, possibly trained in engineering, environmental science, business/economics or design. The coalition would advocate the effectiveness of the harvesting technologies, which they associated with low public health risk, and develop minor scientific field demonstrations of the new technologies to show their effectiveness. Practitioners working in water supply and sewerage, or those trained in biological sciences, might offer a contesting narrative of the technologies' ineffectiveness, highlighting their perceptions of high public health, aesthetic, environmental and/or flooding risks. They might be joined by engineers concerned about high aesthetic risk of stormwater harvesting technologies. In Phase 4, Knowledge

Dissemination, the key actors form an informal policy coalition working with science, industry and policy partners. Amongst them might be practitioners working in stormwater/waterways, land development and total water management. Perceiving low risk of reputation loss and low political risk with the technologies, they invest in bridging organisations to translate science into practice to develop capacity building initiatives, such as major demonstration projects. These projects, regardless of scale, provide practitioners with learning experiences that can build capacity, improve communication within and beyond the water sector, and promote familiarity, leading to enhanced adoption of new systems (Dobbie et al., 2014). Practitioners supporting a contesting narrative might work in sewerage and/or water supply, concerned about associated political risks. In Phase 5, Policy and Practice Diffusion, the key actors might again include stormwater/waterway practitioners, land developers and total water cycle managers in a policy and decision coalition. They would advocate that the stormwater harvesting technology is effective in providing a sustainable solution to a problem that the community cares about. These practitioners are comfortable implementing the technology, perceiving low risk of reputation loss and low political risk for themselves. Although some of these practitioners will be employed by state or local governments or water utilities, others from these stakeholder groups are likely to be contesting this narrative, perceiving higher technological failure. Nevertheless, the policy and decision coalition works to advance the implementation of stormwater harvesting systems, using industry-led field experiments and demonstrations in different contexts and at different scales.

Risk perceptions can be complex and difficult to understand. An analytical framework has been produced in Project A4.1 (Figure 9) as a tool to comprehend practitioners' risk perceptions and influences on them (Dobbie and Brown, 2014a). This framework shows the importance of social identity and cultural identity in shaping perceptions of risk associated with an innovative urban water system such as stormwater harvesting or quality treatment technologies. It emphasises that a particular water system, as the risk object, can be associated with multiple perceived risks (e.g. environmental risk, public health risk, political risk) as different and distinct objects at risk. This tool can be used to inform the benchmarking assessment of a city. Interview questions can be framed around the different attributes in the framework (e.g. beliefs, trust, knowledge etc.) in relation to a particular perceived risk of a particular water system, leading to a qualitative measure of the perceived risk and identification of the critical factors underlying it. This understanding can then be used to describe aspects of advocating and contesting narratives of different transition phases, and to identify membership of actor networks. Using this and other qualitative data, the position of the city on the transition pathway can be determined. Once different risk perceptions are understood, strategies can be developed to manage them if they support contesting narratives that are at odds with transition targets.

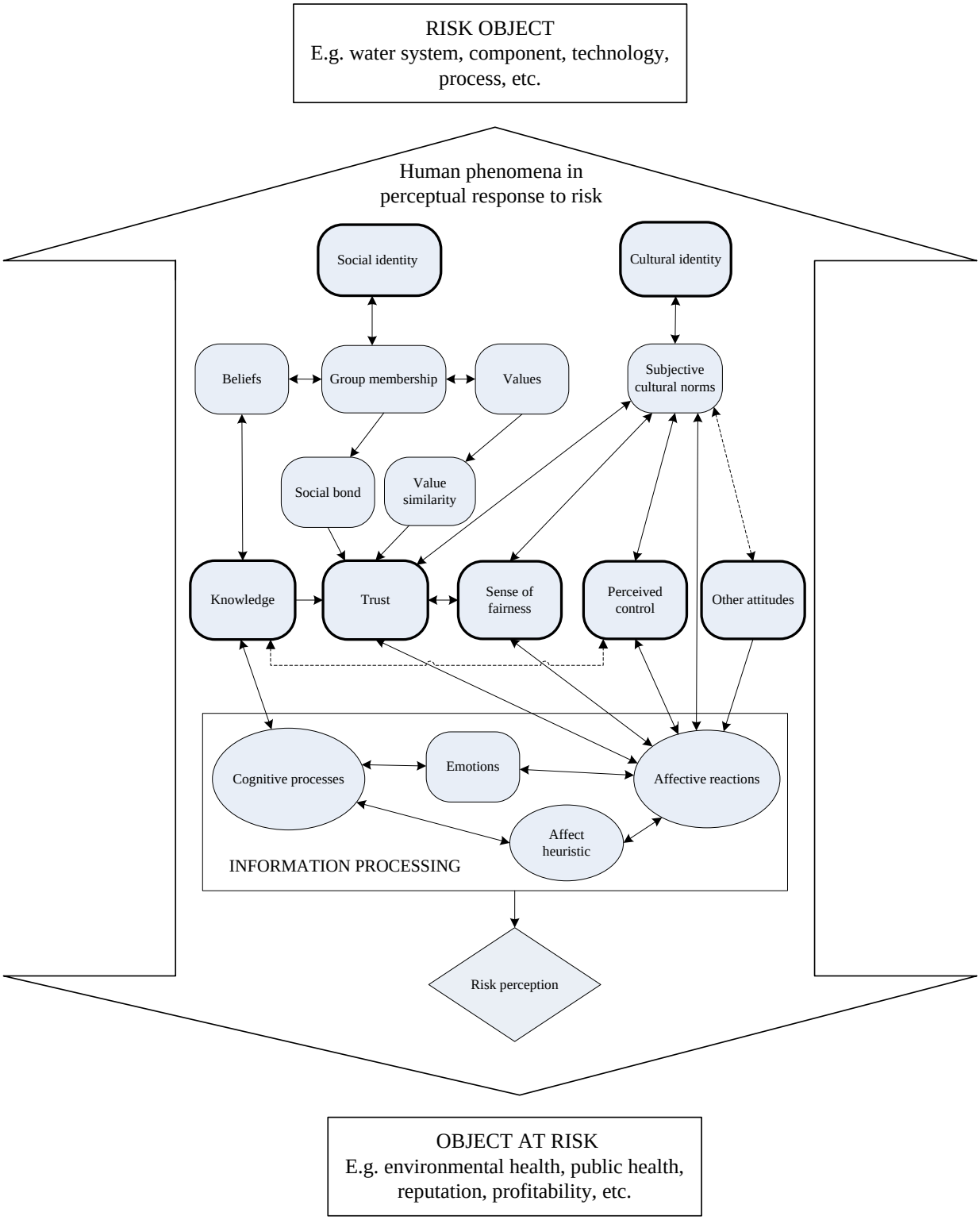


Figure 9. Framework showing influences on risk perceptions. Source: Dobbie and Brown (2014a). ⟷ **Relationship demonstrated empirically in the literature.** ⟷ **Inferred relationship. Refer to original publication for details about sources of relationships shown in framework.**

Receptivity of land developers to WSUD

Land developers are important actors in the transition to water sensitive cities for they can shape how and where WSUD elements are incorporated into urban developments. The receptivity of land developers were examined in detail by Brookes (2011). This study focused on land developers who were regarded as (i) early adopters of WSUD in Melbourne, and (ii) organisations that are responsive to and sometimes push against regulatory requirements relating to water in the development of land. They play a critical role in providing safe drinking water, flood protection and waste discharge. Water can also be used to increase the amenity of a development, enhance market value of a development and/or promote the sustainability credentials and reputation of a development company (Brookes, 2011). Land developers are key stakeholders in mainstreaming WSUD (Brown and Farrelly, 2007).

In this Project A4.1 sub-project, the receptivities of land developers were analysed in terms of the organisational behaviour of each land development company (Figure 10). Potential factors influencing uptake of WSUD were categorised as political, economic, social or technological, at contextual, organisational or individual levels. The organisational behaviour of each land developer was different but common themes were discerned for greenfield developments and infill developments, and it was these that were then related to receptivity (Brookes, 2011). For adoption of WSUD in infill developments, the awareness and acquisition components of receptivity were supportive, whereas the association and application components were both supportive and challenging. In contrast, all four components of receptivity for adoption of WSUD in greenfield developments were a mix of supportive and challenging factors. Receptivity was supported by previous experience, supportive policies and regulation, compatibility of WSUD with organisational values, aspirations and particular business model, access to knowledge and skills, and availability of endorsed standards and financial incentives. It was challenged by unclear policies and incompatible legislation and/or regulation, poor understanding of WSUD within company or wider community, availability of alternative technologies, inappropriateness of WSUD to the scale of a specific project, and insufficient financial incentives.

Each of these various factors is likely to contribute to the advocating or contesting narratives at each phase in a city's transition, and shed light on the Actor domain of change. Melbourne has been benchmarked as a waterways city along the transition pathway (Brown et al., 2016; Rijke et al., 2013). Thus, we can assume that the advocating narratives for WSUD amongst the various stakeholders, including land developers, are stronger than the contesting narratives, as the transition approaches stabilisation.

The approach taken by Brookes (2011) could be implemented when benchmarking cities, so long as the limitations of the method, related to its novelty, are recognised (Brookes et al., 2011). The organisational behavioural wheel (Figure 10) is a new analytical tool, yet to be rigorously verified. Nevertheless, it is useful to frame interview questions in order to understand the political, economic, social and technological influences on the uptake of WSUD or other sustainable water innovations by stakeholders, and to help identify a city's aspirations, policies and actions when benchmarking the transition of a city.

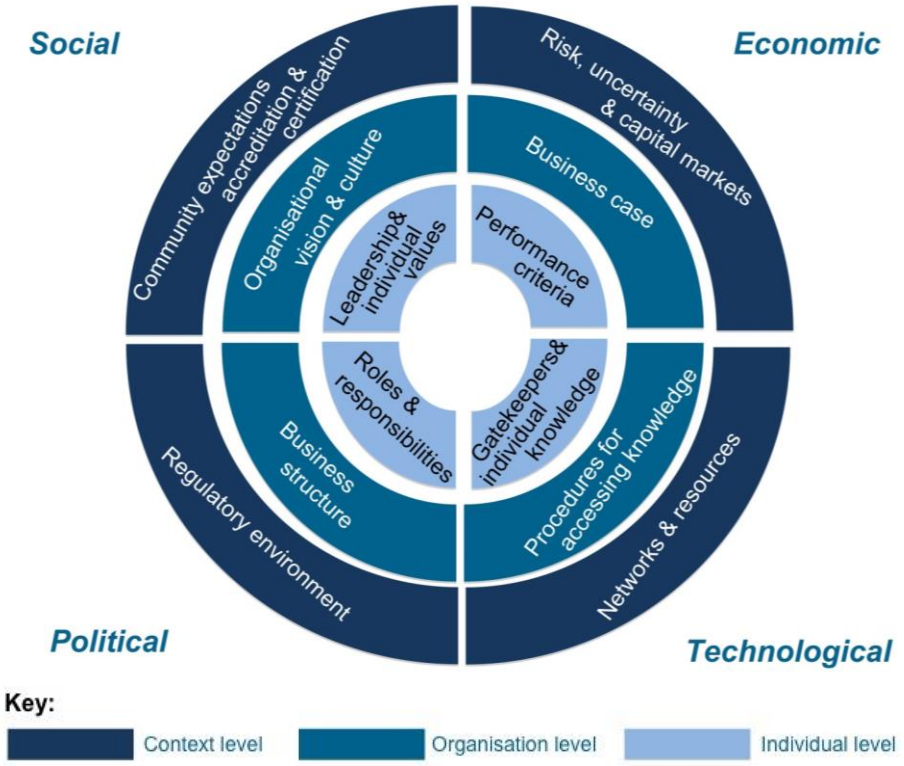


Figure 10. Wheel of organisational behaviour, the framework used to understand factors influencing adoption of WSUD by land developers. Source: Brookes (2011).

Community perceptions of raingardens

Yet another group of actors critical to a successful transition to a water sensitive city is the community of a city and the residents of its urban and suburban landscapes. The community contributes to the dominant and contesting narratives of the different phases of a transition. Their narratives are likely to influence each transition phase, as they interact with professional urban water practitioners and the governance of urban water systems. This interaction could be formal and structured, e.g. as participants in co-governance, or informal and unstructured, e.g. unsolicited feedback from water consumers. Community attitudes towards landscapes with WSUD initiatives can influence the transition status of a city. Understanding these attitudes, often as perceptions, can inform target-setting and development of strategies to promote favourable narratives. To this end, community perceptions of stormwater harvesting and water quality treatment systems were explored. Community perceptions were generally favourable, supporting the implementation of WSUD and the fit-for-purpose use of treated stormwater.

This sub-project also produced recommendations for the design of raingardens to be retrofitted into existing suburban landscapes so that the raingardens are appreciated and valued by the community (Figure 11; Dobbie, 2016). Such raingardens are more likely to be accepted, contributing to their wider adoption and the transition to a water sensitive city. Design recommendations can help develop targets for a proposed transition or can be included in a strategy to facilitate a transition. Importantly, they can contribute to a shift from Phase 3, Shared understanding & issue agreement, by promoting Knowledge dissemination (Phase 4), Policy and practice diffusion (Phase 5) and Embedding new practice (Phase 6). As the transition is achieved, such design guidelines

can be adopted as best practice when constructing bioretention filters more generally (Payne et al. 2015a, 2015b).

The recommendations emphasise the need to carefully consider the overall design and placement of raingardens within a street. Context is critical and should be well understood before the design process starts. Issues to consider are car parking, plant selection, layout, structure, form of the raingarden and its maintenance. Choices related to these issues must reflect the particular context of the specific site and how it might be used – what is appropriate for one site may not be appropriate for another (Figure 11). Wherever possible, trees should be included in the raingarden. Understorey plants should be selected from a broad palette, reflecting the street context. As recent research has demonstrated only 50% of plants must function in water treatment (see Payne et al. 2015a, 2015b), the balance of plants should be selected on the basis of their appearance (aesthetic function), rather than purely for the technical function of water treatment. Maintenance is important to ensure that the raingarden remains neat and tidy, and again appropriate to its context. Many raingardens appear messy, which is generally not appreciated by community members.

Full details about these recommendations and the empirical data behind them, providing greater insight into their development and application, is given by Dobbie (2016). These details can be used to guide and facilitate transitions to a water sensitive city.

Figure 11. Examples of two raingardens, retrofitted into different contexts in Melbourne suburbs. The design of the raingarden in the left-hand photo differs from that of the raingarden in the right-hand photo, reflecting their different contexts. Photos: M. Dobbie

Conclusion

The purpose of this report was to bring together the many discrete but inter-related sub-projects of Program A Project A4.1. This compendium outlines how the insights generated from the key research projects can assist with: benchmarking the transition phase of a city or organisation; set targets; or, develop strategies to achieve targets. This body of work has confirmed the notion that in order to improve urban stormwater management practices requires not just technical changes, but parallel attention to change within the socio-institutional domain.

The following list outlines which sub-projects can be used for the following three purposes: benchmarking, target-setting and achieving targets. Notionally, the insights apply at a sector scale and can be useful strategically to inform future policies and planning, whereas insights that apply at an organisational or personal level can be useful strategically or operationally.

4. **Benchmarking transition phase:**

- Fit-for-purpose governance of urban water systems
- Co-governance of decentralised urban water systems
- Receptivity of Australian urban water practitioners to alternative urban water systems, including stormwater harvesting and treatment
- Receptivity of land developers to WSUD

5. **Target setting:**

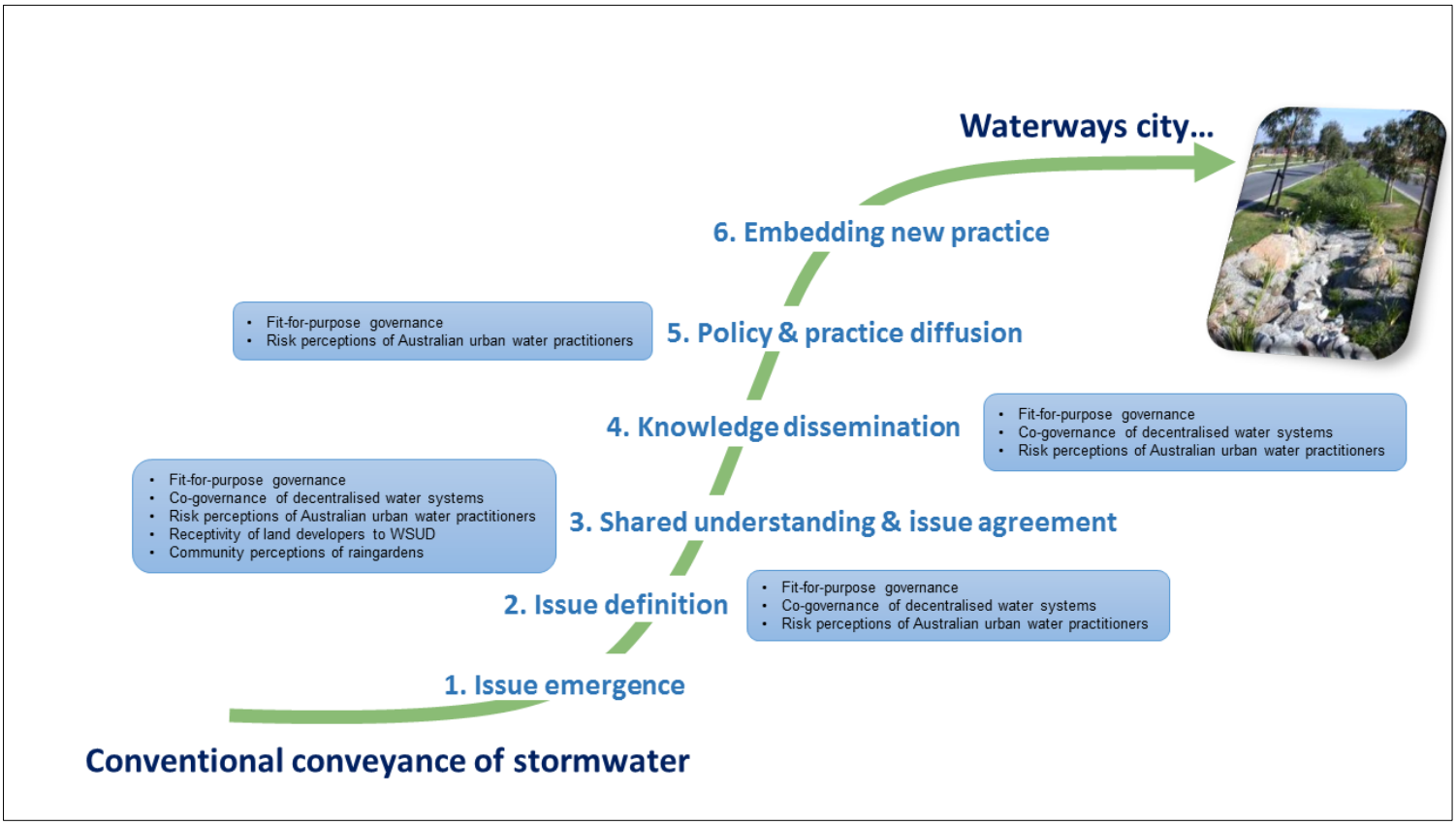
- Fit-for-purpose governance of urban water systems
- Co-governance of decentralised urban water systems
- Receptivity of Australian urban water practitioners to alternative urban water systems, including stormwater harvesting and treatment
- Receptivity of land developers to WSUD
- Community perceptions of raingardens

6. **Achieving targets:**

- Fit-for-purpose governance of urban water systems
- Co-governance of decentralised urban water systems
- Receptivity of Australian urban water practitioners to alternative urban water systems, including stormwater harvesting and treatment
- Receptivity of land developers to WSUD

- Community perceptions of raingardens
- The hydro-social contract underpins the governance of urban water systems, reflecting the values and agreements between communities, governments and business on how water should be managed.

The following infographic depicts the researchers' interpretation of the most appropriate uses for the different research approaches and insights that have arisen from Project A4.1 in relation to the six critical phases in the transition toward water sensitivity.



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Appendix 1: Publications

A full list of all journal and conference papers, CRCWSC Industry/Policy Notes and Technical/Milestone Reports published from this research is given below. Further details about the research presented in this report can be found in these publications.

Peer-reviewed journal papers

Brown, R.R, Farrelly, M.A., and Loorbach, D. (2013) “Actors working the institutions in sustainability transitions: the case of Melbourne’s stormwater management”, *Global Environmental Change*, 23(4), pp. 701-718. DOI: 10.1016/j.gloenvcha.2013.02.013.

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Dobbie, M.F., and Brown, R.R. (2012) “Risk perceptions and receptivity of Australian urban water practitioners to stormwater harvesting and treatment systems”, *Water Science and Technology: Water Supply*, 12(6), pp. 888–894. DOI: 10.2166/ws.2012.069.

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Rogers, B., Werbeloff, L., and Brown, R.R. (2016*). CRCWSC Industry Note (2016): Benchmarking Water Sensitive Cities*. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

CRCWSC Technical/Milestone Reports

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Conference presentations

Peer-reviewed

Brookes, K., Brown, R., and Morison, P. (2011) “A case study analysis of the critical factors influencing a private land developer adopting water sensitive urban design”, paper presented at the *12th International Conference on Urban Drainage*, 10-15 September, Porto Alegre, Brazil. Available at: http://www.waterforliveability.org.au/wp-content/uploads/2011_Brookes-and-Brown_12ICUD.pdf (Accessed: 9 January 2017).

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Appendix 2: Participants in Project A4.1

Program Leaders: Professor Rebekah Brown & Dr Megan Farrelly

Sub-project: Fit-for-purpose governance

Dr Megan Farrelly

Dr Peter Morison

Dr Jeroen Rijke (PhD Student)

Sub-project: Receptivity of Australian urban water practitioners to alternative urban water systems

Dr Meredith Dobbie

Sub-project: Receptivity of land developers for WSUD

Katie Brookes (Master student and research assistant)

Sub-project: Co-governance of decentralised urban water systems

Carlyne Yu (PhD Student)

Sylvia Tawfik (Master student)

Sub-project: Community perceptions of raingardens

Dr Meredith Dobbie

Other Key Researchers

Dr Briony Rogers

Lara Werbeloff (PhD Student and research assistant)

Ana Guzman (PhD Student)

Gemma Dunn (PhD Student)

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