Chapter 8
A Framework to Guide Transitions to Water Sensitive Cities

Rebekah R. Brown, Briony C. Rogers, and Lara Werbeloff

Abstract This chapter explores the transition challenges and opportunities facing urban water sectors globally, as pressures from urbanisation, climate change and ecological degradation drive new approaches to urban water management. Framed around the vision of a future Water Sensitive City and drawing on empirical evidence from a case study of storm-water quality management in Melbourne, Australia, this chapter presents a framework for benchmarking a city's progress in its urban water transition. It provides a nuanced understanding of how these complex change processes unfold and identifies the enabling conditions that can be used to help steer change in urban water systems towards the envisioned water sensitive city.

Keywords Benchmarking framework • Institutional change • Stormwater quality management • Urban water transitions • Water sensitive cities

8.1 An Emerging Vision for Urban Water Systems

Water management in the twenty-first century cities has become increasingly challenging. For the first time ever, urban populations exceed those in rural areas, and the pressure on water systems in cities is growing accordingly. Traditional water management approaches, typically based on principles of predictability and control, are increasingly ill-equipped to cope with today's complex and interrelated

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challenges including climate change, urbanisation, population growth, degraded waterways and environments, resource constraints and the liveability aspirations of communities.

With greater frequency and severity of extreme weather events such as storms, floods and droughts resulting from climate change, the flow of water through and around cities is becoming increasingly unpredictable. With this uncertainty and variability in the conditions that water systems need to be able to cope with, they must be managed adaptively. Further, systems need to be planned and designed to deliver multiple benefits including secure water supplies and flood risk management, as well as responding to issues such as the urban heat island effect and deteriorating ecological conditions of urban waterways and other urban ecosystems.

De Haan et al. (2015), in introducing a special issue on urban water transitions in the Environmental Innovation and Societal Transitions journal, provide an overview of new visions and solutions that have entered the discourse on water management globally in response to these challenges. Collectively these new approaches represent an emerging water sector paradigm that is underpinned by principles of integrated water management, hybrid systems of centralised and decentralised technologies, green infrastructures that deliver a range of ecosystem services, urban planning and design approaches that are responsive to changing water conditions, and communities that value water and are actively engaged in its management.

In the Australian context, and increasingly internationally, this new paradigm is represented by the vision of the Water Sensitive City (Wong and Brown 2009; Ferguson et al. 2013a). The vision encompasses holistic management of the integrated water cycle to protect and enhance the health of receiving waterways, mitigate flood risk and create public spaces that harvest, clean and recycle water. It uses water management as a means of facilitating better liveability outcomes more broadly and recognises that a water sensitive approach to urban development and regeneration processes can help deliver on a range of objectives critical to the liveability of a city, such as biodiversity, public green space, healthy waterways, connected communities and cultural significance. Ultimately, a water sensitive approach is underpinned by a recognition that water plays a key role in the creation of connected, vibrant and liveable communities.

Achieving the Water Sensitive City vision will require substantial shifts in the approach and attitudes among community, government and business sectors. Ferguson et al. (2013b) describe the range of cultural-cognitive, normative and regulative dimensions that would need to be addressed to establish an enabling institutional context for supporting these system-wide shifts. For example, creating new understanding of our inability to predict and control the environment, generating knowledge and evidence to support technological innovations, establishing new water policy goals associated with urban liveability outcomes, providing political leadership to support implementation of the new paradigm, encouraging communities to be vocal about their water-related aspirations and expectations, instituting water governance arrangements that support collaboration, and designing markets that are receptive to innovative modes of water service provision.

The Water Sensitive City vision is part of a broader transition towards sustainable cities. Similar transformations are currently unfolding in other domains including energy (See Chaps. 1, 7 and 11), urban development (see Chap. 9) and transport (see Chap. 13). Transformations towards sustainability across these various sectors will ultimately need to integrate and co-evolve with each other in order to deliver urban transitions more broadly.

There is a growing body of evidence on the socio-institutional barriers inhibiting progress towards these types of enabling conditions in the water sector (e.g. Brown and Farrelly 2009). In response, urban water strategists, policymakers and practitioners are now asking how they can actively work towards overcoming these barriers to establish an institutional context that is conducive to facilitating the required system changes on the ground.

This chapter aims to provide guidance on this question, drawing on empirical evidence from a case study of transition in Melbourne's stormwater quality management system to develop a framework for benchmarking and navigating a city's transition to a Water Sensitive City.

8.2 Urban Water Transitions

The Water Sensitive City vision represents a significant change from the current water management approach in Australian cities, meaning that transitions are needed. Ideas and concepts from transitions studies offer useful insights into the dynamics of transition processes within complex systems and provide theoretical guidance on how such change processes may be steered. For the purpose of this chapter, transitions are understood to be a multidimensional transformative change process whereby a system shifts towards more sustainable modes of production and consumption (Markard et al. 2012). They typically take place over 25–50 years and are characterised by complementary changes across and within a number of domains (including technological, economic, institutional, behavioural and cultural), all of which operate synergistically to reinforce and drive the transition (Rotmans et al. 2001).

For large sectoral systems such as urban water, transitions rely on overcoming institutional inertia. The phenomenon of institutional inertia and lock-in is well documented, whereby suboptimal technologies and approaches are maintained because of the sheer enormity of the task to change them (Pahl-Wostl et al. 2009; Walker 2000). Sunk costs associated with prior infrastructures, institutions and entrenched routines and practices also operate as significant barriers to the adoption of better alternatives (Pierson 2004). Even where there is impetus and appetite for change, such change will typically unfold in an incremental, path-dependant way. Deeply embedded rules and behaviours also help to keep the current framework firmly anchored (Pierson 2004). A combination of technological lock-in, institutional inertia and the challenge of reorienting professional and organisational capacity towards a new approach all serve as significant barriers to sector-wide transitions. As such, more radical sustainability approaches that may not be consistent with the

established architecture are immediately less favourable, with cities instead tending to continually optimise inherently unsustainable approaches.

Realisation of such transitional change in urban water sectors is no easy task. Like the systems for provision of all essential services, the current urban water management framework is the result of complex interactions across a range of dimensions, including regulatory, institutional, infrastructure, markets, behaviours, user practices and technical expertise, which have all co-evolved over a long time and operate in a mutually reinforcing way to embed the status quo.

Research into sector-wide transition processes indicates that realisation of change on the ground requires mutually reinforcing change across infrastructures, institutions and practices (De Haan and Rotmans 2011; Smith et al. 2005; Rotmans et al. 2001). Further, a focus on technical innovation is not enough and that the social and institutional dynamics that underpin any city's transition attempt is key when trying to move entrenched water management systems into new directions (Rogers et al. 2015). Effectively managing these various components of the change process therefore relies on concerted effort, requiring ongoing commitment, monitoring and investment to steer change in desirable directions.

To consider transition processes in the context of urban water management more specifically, the Urban Water Transitions Framework (Brown et al. 2009) is a useful guide. The framework identifies the evolving sociopolitical drivers and service delivery functions as six distinct developmental 'states' that cities can be seen to move through, or are expected to move through, in response to society's increasing liveability, sustainability and resilience aspirations for urban water management (Fig. 8.1). These city states form an embedded continuum, culminating in the Water Sensitive City.

A critical step on the path towards a Water Sensitive City is to overcome the barriers in moving beyond a *Drained City*. As reflected in Fig. 8.1, moving to the right side of the continuum is particularly challenging, as it requires a significant reorientation of existing infrastructures, institutions and approaches to water management. The water servicing needs of the three left side city states have traditionally been met through large-scale, centralised infrastructure. However, the more complex and interrelated needs of the three right city states require a shift to an interdisciplinary approach that provides more flexible and integrated infrastructures and institutions at both centralised and decentralised scales.

In the *Waterways City*, the social, environmental and aesthetic values of clean waterways are a key focus, with consequent investment in improved stormwater management. This is particularly challenging, as stormwater pollution cannot be managed successfully through existing centralised technology but requires a holistic approach, including both source control and distributed systems in combination with centralised infrastructure.

In the *Water Cycle City*, water and other resources (such as energy and nutrients) are actively conserved and regenerated; supplies from diverse sources such as storm water, greywater and recycled wastewater are put to their most appropriate uses. Across social, economic and environmental contexts, sustainability is widely embraced, and the former hydro-social contract, in which government was expected

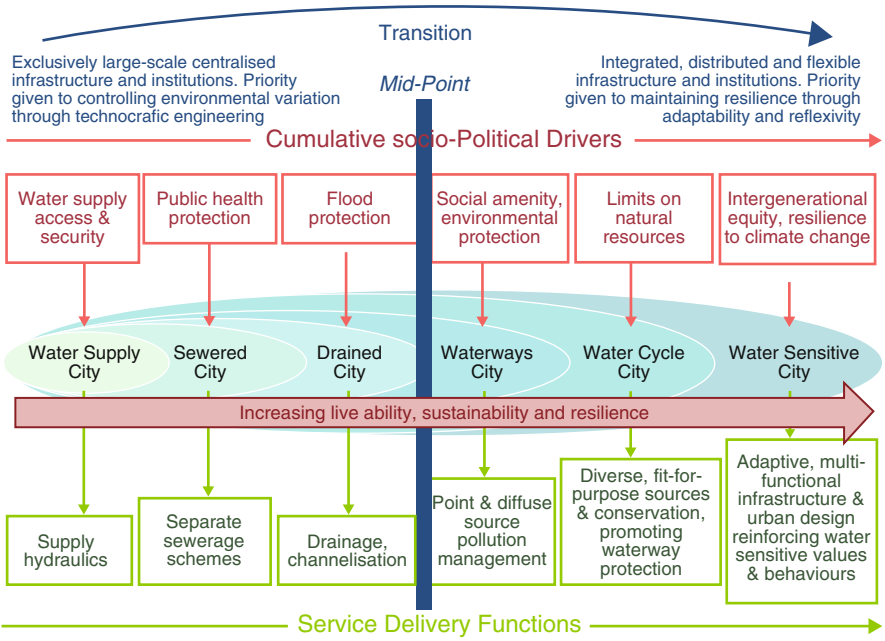


Fig. 8.1 Urban water transitions framework (Adapted from Brown et al. 2009; De Haan et al. 2015)

to deliver risk-free water supply services, is replaced with co-management arrangements between government, business and community. Such progress is hampered where governments remain resistant to change. In Australia, for example, recent extended drought conditions led to the return of rhetoric for greater control and expansion of centralised systems, rather than to the implementation of a flexible, shared approach.

Finally, the futurist state of the *Water Sensitive City* will be very different from conventional urban water management approaches. It is envisaged that communities will be driven by the aim of actively protecting natural resources and ecological integrity and providing resilience to climate change for future generations. Infrastructure, technology and urban design will be flexible, recognising the link between society, technology and the urban form. All parts of the water sector will be committed to the sustainable management of a city's water resources and hydro-social contracts will be adaptive and evolving. This state represents the ultimate vision outlined by the Urban Water Management Transitions Framework, an endpoint to be attained through overcoming current challenges. The Water Sensitive City vision therefore represents a fundamentally different approach to water management in our cities, requiring new infrastructural, institutional and organisational capacities.

8.3 Melbourne's Transition to a Waterways City

As Fig. 8.1 highlights, the realisation of the Water Sensitive City vision relies on transitional change, involving the development of responses to the increasingly complex sociopolitical drivers on the right side of the framework. Shifts from one city state to another, while remaining in the left-hand side of the framework (e.g. from the Sewered to Drained City), represent incremental developments or evolutionary steps. Similarly, shifts between states on the right side are also evolutionary in nature. However, the shift across the midpoint of the Urban Water Transitions Framework is a significant milestone in the broader transition to a Water Sensitive City, indicating that a foundation for radically new institutions, infrastructures and capacities has been established and can be further developed to assist realisation of a Water Sensitive City.

In order to explore the transition dynamics of urban water systems in more detail, we now present the story of this transition for Melbourne, based on a longitudinal case study by Brown et al. (2013). This case study is the first evidence-based investigation of how a city can transition towards more water sensitive practices; understanding the enabling social and institutional dynamics can provide valuable insights into how other cities may be able to move entrenched water management systems in novel directions.

The metropolitan region of Melbourne, Australia, has achieved significant milestones in its transition towards sustainable urban water management. Over the past 50 years, the city changed its stormwater management from a traditional drainage system that releases untreated stormwater into rivers and the ocean to one that retains stormwater at source to support multiple objectives, such as creating local ecological landscapes, improved amenity and flood mitigation. First commencing in the 1960s, this decades-long shift has placed Melbourne ahead of other Australian cities through the provision of a city-wide market-offsets scheme, as well as through a state-government regulatory mandate for sustainable stormwater management that is applied to all new developments across Melbourne. The city now boasts a large number of stormwater treatment development projects across metropolitan Melbourne and is actively engaging municipalities as well as private landholders in the process. The guidance provided by a number of champions from across the community, government, as well as the private and research sectors has been instrumental in replacing outdated perspectives on water governance with new approaches that meet the changing needs of the twenty-first century.

While the transition in urban stormwater management is only one component of a broader WSC transition, it is an important step on the transition journey. The diffuse nature of stormwater pollution, and consequent need for solutions to be integrated into the broader urban landscape, requires a significant shift in the dominant infrastructures, institutions and practices that typically characterise city states on the left-hand side of the continuum. The success of this shift over this

transition milestone and into the Waterways City is indicated by a widespread new practice in Water Sensitive Urban Design, an extensive policy and regulatory framework and a new network of actors involved in both policy and practice spheres. It is therefore a case worthy of examination in order to better understand the dynamics of how such revolutionary shifts unfold in practice.

From its current position in the Waterways City, Melbourne has a strong foundation to transition more swiftly towards the WSC vision. As noted above, the shift from the left to the right-hand side of the continuum is a significant transition milestone, and subsequent shifts to the other city states require only evolutionary or incremental changes that build on the foundation already established. As a result, there is the potential for Melbourne to move rapidly towards the WSC vision, although the pace of change will of course be influenced by a range of factors including political will and industry and government investment.

Evidence from Melbourne's transition from a Drained City to a Waterways City, based on extensive qualitative and quantitative data spanning over five decades, reveals a typology of six distinct phases through which the city's transition towards more sustainable stormwater management was seen to progress (Fig. 8.2). These phases were developed through a chronological analysis of Melbourne's transition, which was derived from an extensive process of data collection, comprising oral history (n = 28), individual (n = 24) and group (n = 91) interviews (Brown et al. 2013). The analysis went through a validation process with over 50 interviewees representing all stakeholders related to urban stormwater quality management in Melbourne to identify gaps in the historical account, refine the transition phases and domains of change identified (Brown et al. 2013).

Taken together, these six phases chart the initial emergence of a sustainability issue through to the eventual embedding of new sustainable water management practices as part of a business-as-usual approach. Each phase was characterised

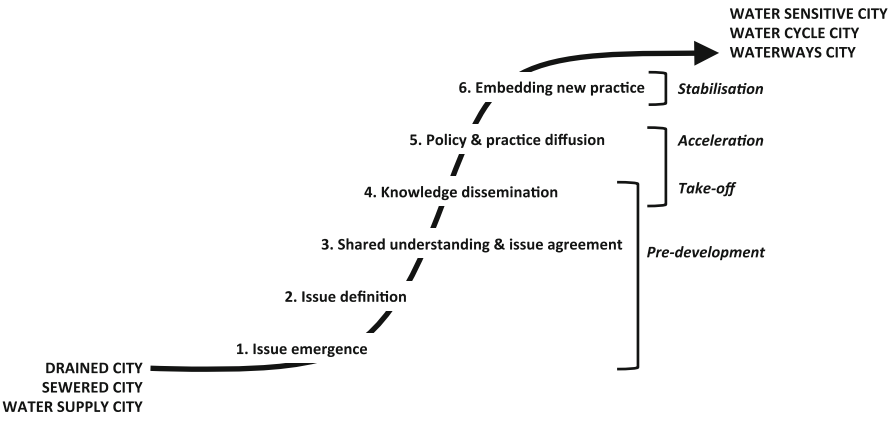


Fig. 8.2 Six phases in the transition towards water sensitivity (Adapted from Brown et al. 2013)

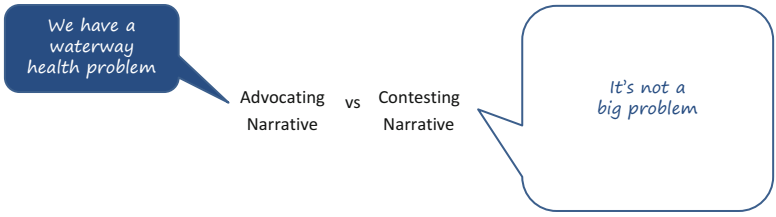
by different social and institutional dynamics and presented unique challenges and opportunities for strategic intervention to improve water management policy and practice.

In the *issue emergence* phase, a particular problem is identified (e.g. poor waterway health), and in the *issue definition* phase, a cause of that problem is identified (e.g. stormwater pollution). The *shared understanding and issue agreement* phase is characterised by a common understanding of, and agreement on, the problem, its causes and its repercussions. Solutions are not yet agreed on, but the need for action is acknowledged. From this point, the *knowledge dissemination* and *policy and practice diffusion* phases are marked by greater agreement on the appropriate solutions among a broad cross section of stakeholders. The final transition phase involves *embedding the new practice* as mainstream.

The transition dynamics within each phase during Melbourne's transition to a Waterways City are now presented, highlighting the key institutional developments that worked to embed new stormwater quality management practices. Each phase is characterised by dominant narratives that represent the way a particular practice was described or talked about within the sector. The dominant narratives are seen to have evolved as the transition unfolded, with an *advocating narrative* (supportive of the new practices and promoting its uptake) increasing its power over a *contesting narrative* (challenging the new practices or suggesting they are unnecessary or inappropriate).

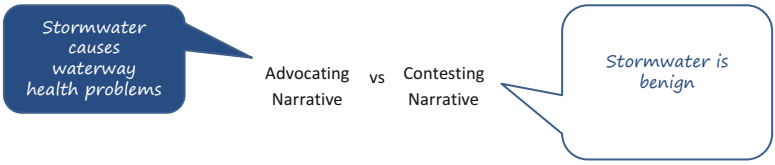
8.3.1 Phase 1: Issue Emergence (Mid-1960s–1989)

Reflecting the emergence and growth of the environmental movement, the public (and the media) increasingly began to question the current approaches to waterway management in the context of environmental protection. The growing social capital around healthy waterways began to exert pressure on the government to reduce waterway pollution and was given added impetus by a suite of scientific studies that confirmed the adverse impact of stormwater pollution. Once principles of environment protection became formally enshrined in law, the sociopolitical capital around waterway health provided the foundation for individual actors to create a niche for better water management within the traditional water management regime.



8.3.2 Phase 2: Issue Definition (1990–1995)

Sustainable urban water management took 5 years to fully emerge as an alternative vision for Melbourne's water sector. A common vision of better-managed waterways initially led to the formation of an informal network of people from backgrounds such as private engineering, academia and state and local government who had an interest in water. This group of champions emerged organically, driven by a common passion for the environment and healthy waterways, and soon found itself supported by the formation of two national Cooperative Research Centres (CRCs) with complementary foci on freshwater ecology and catchment hydrology. These CRCs fulfilled important roles as bridging organisations. Both had a strong presence in Melbourne and helped to increase the profile of better water management in this city. The CRCs produced reliable scientific information on the impact of stormwater pollution on receiving waterways and initiated the development of new technologies to deal with water quality issues. Importantly, they also led to the formation of strong collaborative relationships between Melbourne Water (the water utility responsible for the major drainage system and river health) and local universities that continue today.

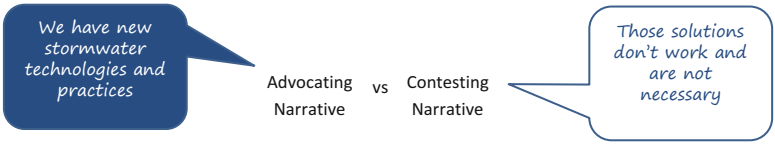


8.3.3 Phase 3: Shared Understanding and Issue Agreement (1996–1999)

With the issue of stormwater pollution firmly established by this phase, the network of science and industry collaborators expanded to include planners, land developers and local government representatives. During this period, the call for better stormwater management was strengthened by the realisation that the nitrogen content of stormwater run-off was polluting Port Phillip Bay. This led to the establishment of a formal stormwater policy committee, which developed best practice guidelines along with policy-linked stormwater quality run-off targets.

Another important development during this formative period was that alternative water treatment technologies were being put to the test. Local champions secured national funding to build a number of demonstration water treatment wetlands, which reassured industry of the value of this alternative technology. The technology was also tested at the larger scale of a new residential estate on the outskirts of

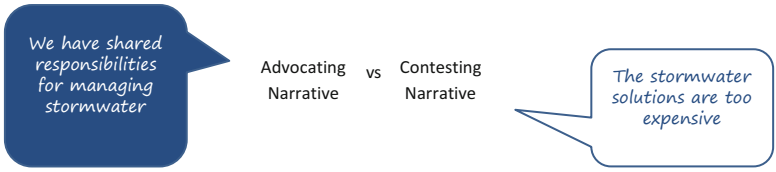
Melbourne (Lynbrook Estate). This project was sponsored by Melbourne Water, which agreed to be the sole risk bearer of this trial. Collectively, these highly visible projects helped to crystallise and disseminate the idea of sustainable stormwater management, promoted a philosophy of collaboration among the urban water-related industries and demonstrated the practical feasibility of pursuing this path into the future.



8.3.4 Phase 4: Knowledge Dissemination (2000–2004)

One of the key events of this phase was the first international Water Sensitive Urban Design Conference. For the first time, this conference brought together international stakeholders involved with implementing sustainable water management to exchange their experiences. Meanwhile, national and state-based best practice guidelines for urban water management were developed, and the CRC for Catchment Hydrology created a computer-based decision support tool called MUSIC to simplify the adoption of urban stormwater quality management measures in Australia (*Model for Urban Stormwater Improvement Conceptualisation*).

One of the most defining activities of this phase was political lobbying. The earlier success of the water sensitive residential development at Lynbrook Estate led water management champions to lobby the state land developer to apply water sensitive urban design principles and technologies to the Docklands, an iconic redevelopment in the centre of Melbourne. In local municipalities around Melbourne, advocates from within councils also lobbied their organisations to set up trials and encouraged other municipalities to do the same. At a more strategic level, a number of local champions took the opportunity of a pending state election to lobby the state opposition party to take a leadership role on stormwater to garner the support of the community and private sector land developers. When the opposition was voted into government in 2000, this move resulted in the establishment of an AU$22 million state fund to develop stormwater management plans and fund capacity building for stormwater professionals. This, in turn, led to the rapid increase of stormwater management actions around Melbourne, as well as to the establishment of a state Stormwater Advisory Council which championed policy innovation at a senior decision-making level rather than at a technical/operational level as previous policy groups had done.

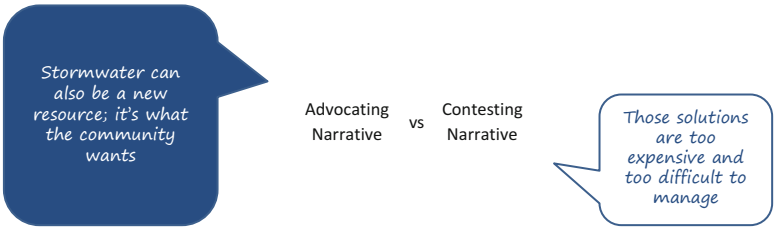


8.3.5 *Phase 5: Policy and Practice Diffusion (2004–2010)*

During this latter part of the acceleration phase, advocates focused on creating formal policy documents and pursuing regulatory change. Multi-stakeholder partnerships were now formalised through signed agreements that set out the responsibility of each organisation for improving waterway health. One of several important documents produced during this period included a planning framework that identified statutory opportunities to influence the implementation of water sensitive urban design. This was adopted by Melbourne Water and integrated into an offset strategy that provided an incentive for land developers to incorporate stormwater treatment into their planning rather than paying a charge for nutrient run-off once a development was completed.

The focus of the informal network of champions at this time was to pursue amendments to the Victorian Planning Provisions so that stormwater quality targets became a regulatory requirement. The network also encouraged broader reforms such as the introduction of an innovative offsets scheme. Over this time local councils were also experimenting more confidently with different approaches to improving stormwater management. Despite the substantial progress made with water management, a setback occurred when a persistent and severe drought resulted in a political shift back to the narrower, more traditional water supply focus. As the state government began to redirect resources to controversial options such as seawater desalination and limited wastewater recycling, the champions adapted their lobbying approach by promoting harvested stormwater as a better source of supply, thereby also implicitly promoting stormwater quality treatment.

An opportunity for strong media engagement on stormwater management arose when a kayaker fell ill after falling into the Yarra River in 2006. This event happened to coincide with the event of the 4th Water Sensitive Urban Design Conference being held in Melbourne and the ensuing media attention led to a further AU$22 million funding allocation to capacity building of municipal council staff for stormwater treatment as well as new on-ground water management projects in four high-profile municipalities.

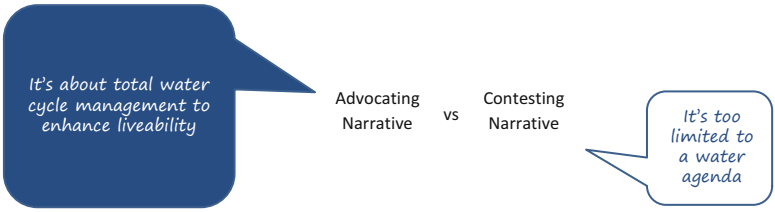


8.3.6 Phase 6: Embedding New Practice (2011–Present)

By 2011, many of the early sustainable water management champions had now reached senior roles in their departments and organisations and worked to influence the political opposition party for better management of the total water cycle. This advocacy role became an advisory one when the opposition came to power and convened an independent Ministerial Advisory Council to the new government, comprising some key champions. The government also formed a new agency, the Office of Living Victoria, to implement sustainable water management objectives and facilitate interactions between the bridging organisations focused on science, policy and capacity building. While this agency had a limited lifespan, its responsibilities and mandate continue as part of the state Government Department of Environment, Land, Water and Planning.

A further important development of this phase was the launch of the CRC for Water Sensitive Cities with an explicit focus partly on stormwater harvesting and treatment. This CRC replaced the two earlier CRCs, which had reached the end of their funding terms in 2005. The new CRC's objective is to help Australian cities and towns to become more water sensitive by improving their urban water systems using tools and technology being developed through the CRC's research.

In order to become fully stabilised as the new standard way of operating, all 38 municipalities across Melbourne need to fully commit to improved storm-water quality management by directing appropriate levels of resourcing to water sustainability and better integrating stormwater quality management with other council processes. However, the strong conceptual, technical and operational links between stormwater quality and stormwater harvesting are ensuring that this emergent niche will contribute actively to making sustainable urban stormwater management the norm.



8.4 Navigating the Transition to a Water Sensitive City

In the early phases of Melbourne's transition to a Waterways City, the dominant advocating narrative reflected a realisation that stormwater pollution is causing poor waterway health, while the dominant contesting narrative rejected this assertion. By the end of the transition, the advocating narrative was that improved stormwater management helps deliver enhanced liveability outcomes, while the contesting narrative continued its challenge by questioning the value of improved stormwater management by diminishing its ability to address society's goals. These shifts highlight the value of narratives as a useful indicator of the dominant perceptions and therefore transition phase, as their evolving structure reflects the power of advocates of a new practice growing while the contesting voices that challenge the necessity or suitability of new practices shrink in relative power. In drawing attention to the dominant conversation unfolding in a sector, narratives can usefully reveal transition progress and also encourage reflexivity among practitioners to better understand their system by considering which voices speak the loudest.

More detailed analysis of the key strategies and processes that occurred within each of these phases during Melbourne's transition to a Waterways City identified five domains of change that can be used as indicators to support a more comprehensive diagnosis of the transition status and opportunities. These domains – actors, bridges, knowledge, projects and tools – influenced and organised the rules for implementing improved stormwater management practice in Melbourne. Their characteristics evolved over the course of the transition, with new dimensions added as the new practices moved from being novel to mainstream.

- *Actors:* Individual people, organisations and networks that are involved in or engaged with water management. Over time, actors involved expand from being a focused group of activists, science leaders who work to expose and define key issues, then a network of technical specialists and then to a broader coalition of policy-makers and decision makers who have the power to institutionalise the new practice. This reflects the emphasis in transitions literature on the importance of strengthening agency through shadow networks and leadership to drive transitional change (e.g. Huitema and Meijerink 2010; Olsson et al. 2006).
- *Bridges:* Organisations, structures and processes that facilitate collaborations across science, policy and industry spheres. The role of bridging organisations and mechanisms in enabling transitions is well explored in the literature (e.g. Berkes 2009; Folke et al. 2005). In the early phases of a transition, bridges help to deepen understandings of the problem and at later phases assist with translating the new practice into action. As such, the number of bridging organisations and mechanisms grows over the course of the transition.
- *Knowledge:* Scientific understanding of the problem and the potential solutions, along with contextualised knowledge informed by local research activi-

ties. Knowledge is initially developed through fundamental science and pilot-scale investigations, with the later phases involving more applied research and capacity-building initiatives. This reinforces the message of transition scholars that different types of knowledge are critical for driving changes towards sustainability (e.g. Beierle 2002; Hedelin 2007).

- *Projects:* Experiments, demonstration and focus projects to test the viability of new technologies or approaches. Experimentation and demonstration projects are well understood in the literature to be important catalysts for transitional change (e.g. Huitema et al. 2009; Vreugdenhil et al. 2010). Projects may include the development of scientific prototypes, demonstration projects that serve as proof of concept of a new approach and large-scale field applications that build trust and sector-wide capacity.
- *Tools:* Administrative and practice tools such as legislative and regulatory instruments, market mechanisms, models and best practice guidelines to help embed and structure the new practice. More recent transitions literature explores how innovations are embedded through tools to support knowledge diffusion and formal regulatory and policy structures (e.g. Kivimaa and Kern 2016; Rogge and Reichartdt 2016; Howlett and Rayner 2007). Early tools enable and support innovative approaches through practice guidance, while the tools in later phases focus more on compliance and enforcement.

Drawing on Melbourne's transition from a Drained City to a Waterways City, the results offer valuable insight into the possible dynamics of city transitions towards the Water Sensitive City more generally and in particular the changes across the five domains of change that are conducive to enabling the required practice change. A key lesson is that mutually reinforcing shifts are needed across all five domains of change for a transition to occur within a particular problem context. For Melbourne to build on the momentum of its stormwater management transition, its broader transition to a Water Sensitive City would likely maintain its actors and bridges (which are now sufficiently diverse to be relevant beyond storm water), while developing new knowledge, projects and tools focused on the whole water cycle and integration with the urban landscape.

Table 8.1 summarises the dominant narratives and indicators across the domains of change for each of the six transition phases. Reading the table from left to right highlights the developments that occurred across each domain of change during the different transition phases, while reading it from top to bottom describes the evolving nature of each domain of change over the course of a transition.

While Table 8.1 needs application and testing in other city contexts, it proposes a framework that could be used to understand and explore a city's current phase in the transition to a Water Sensitive City and potentially for urban sectors beyond water. In identifying generic indicators of change across the five domains, the framework can be used by other Australian cities to assess currently unfolding water sector transitions. Water challenges remain a key issue across Australia, with many local

Table 8.1 Indicators of change in urban water transitions

	Dominant narratives		Domains of change				
Transition phase	Advocating message	Contesting message	Actor's: Key networks of individuals and organisations	Bridges: Organisations, structures and processes for coordination and alignment	Knowledge: Research, science and contextualised knowledge	Projects: Experiments, demonstrations and focus projects	Tools: Legislative, policy, regulative and practice tools
1. Issue emergence	Problem	No problem	Issue activists	N/A	Issue discovery	High-profile scientific studies	N/A
Mid-1960s–1989			Citizens, media		Fundamental science on waterway health	Port Phillip Bay Environmental Study	
2. Issue definition	Cause	Problem and cause contested	Science leaders	Science-industry	Cause-effect	Laboratory-based and scientific solution prototypes	N/A
1990–1995			Scientists, engineers	CRCs, Melbourne Water	Stormwater pollution impacts, new technologies for removing pollution	Laboratory testing of new technologies	
3. Shared understanding and issue agreement	Solution	Solution contested	Technical solution coalition	Science-industry-policy	Basic technological solutions	Minor scientific field demonstrations	Draft best practice guidelines

(continued)

Table 8.1 (continued)

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	Advocating message	Contesting message	Actor's: Key networks of individuals and organisations	Bridges: Organisations, structures and processes for coordination and alignment	Knowledge: Research, science and contextualised knowledge	Projects: Experiments, demonstrations and focus projects	Tools: Legislative, policy, regulative and practice tools
1996–1999			Scientists, engineers, planners, land developers and local government	CRCs, Melbourne Water, Lynbrook Estate, stormwater policy committee	Treatment wetlands	Lynbrook Estate demonstration	Best practice guidelines for stormwater quality management
4. Knowledge dissemination	Responsibility	Solution not viable	Informal policy coalition	Science-industry-policy-capacity building	Advanced technological solutions	Major scientific field demonstrations	Best practice guidelines, targets
2000–2004			Scientists, engineers, planners, land developers, local government, policymakers	Stormwater Advisory Council, international WSUD conference, political lobbying	Biofiltration systems	Docklands demonstration	Pollution reduction targets

5. Policy and practice diffusion	Solution works	Solution not viable	Policy and 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
2004–2010			Scientists, engineers, planners, land developers, local government, policymakers, senior decision-makers	Formalised multi-stakeholder partnerships	MUSIC model development, capacity building programme 'Clearwater'	Local government experimentation	Planning framework, developer offsets for nutrient run off
6. Embedding new practice	Solution delivers prosperity and liveability	Solution is insufficient for meeting a wider set of needs	Multi-agency coalition	Formalised institution	Next research agenda	Standard practice	Political mandate, coordinating authority, comprehensive regulatory models and tools
2011–present			Executive level champions across key organisations	Office of Living Victoria, DELWP	Managing storm water as part of the whole water cycle	Integration into council processes	Ministerial attention, DELWP, MUSIC, practice guidance

and state governments looking to move towards the Water Sensitive City vision. This framework provides a means of assessing progress towards this goal and can also be used to inform investment and the development of a strategic transition plan going forward. The framework can also be used to examine water transitions in countries beyond Australia and may also provide a basis for the development of a similar framework tailored to other sectors.

By identifying the dominant advocating and contesting narratives that are heard by different actors across the sector, and diagnosing which of the domains of change are already present, key gaps may be revealed. For example, if the framework indicates that the city in question is currently in Phase 4 (Knowledge Dissemination) and all indicators except the *Informal policy coalition* are present, further progress would be best accelerated by focusing on the enabling conditions that help to build that missing coalition to further advance water sensitive management practices towards Policy and Practice Diffusion. Considering the enabling conditions most relevant to particular phases of change provides step-by-step guidance on how to build up a foundation to support a broader transition. This type of guidance can provide strategists, policymakers and practitioners with clear direction on how to most efficiently and productively invest resources as they navigate their city's water sensitive transition.

8.5 Conclusion

In exploring Melbourne's stormwater quality management transition, this chapter reveals the complexity of urban transition processes and the challenge on realising change on the ground. To simplify understanding of this process, and provide guidance for policymakers and change advocates seeking to realise change in their own cities, we have presented a framework that can help identify the types of strategic actions that are needed and their implementation priorities.

The framework in Table 8.1 can be used to qualitatively benchmark the current state of a city's transition towards water sensitive practices, facilitating an integrated and detailed understanding of a city's water management practices within its real-world context. Key issues to consider are what strategic positioning requirements are needed to strengthen the advocating narratives and challenge the contesting narratives, as well as what types of strategic actions will help develop the actors, bridges, knowledge, projects and tools that are required for advancing the transition progress. Ultimately, transition processes are complex, and the case of Melbourne makes clear that ongoing commitment, monitoring and investment are needed in order to guide change in desirable directions and successfully realise change on the ground.

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