CRC for
Water Sensitive Cities

Moving toward Water Sensitive Cities

A guidance manual for strategists and policy makers

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Moving toward Water Sensitive Cities
A guidance manual for strategists and policy makers
Cities as Water Supply Catchments – Society and Institutions (Project A4.1)
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Glossary

Definitions of key terms as used in this report are provided below. They are presented in order of appearance.

Water Sensitive City is a vision based on holistic management of the integrated water cycle. It seeks to protect and enhance the health of receiving waterways, reduce flood risk, and create public spaces that harvest, clean, and recycle water. It advocates fit-for-purpose water use and delivery of water through both centralised and decentralised infrastructure. Ultimately, the Water Sensitive City vision integrates water and urban planning in order to facilitate better liveability outcomes more broadly, through enhancing biodiversity and providing increased public green space, healthy waterways, and connected communities.

Water sensitivity refers to implementation of aspects of the Water Sensitive City vision.

Transitions are multi-dimensional transformative change processes, whereby a system shifts toward more sustainable modes of production and consumption. Transitions are large-scale transformations that fundamentally change the underpinning culture, structure, and practice of a system. Given the complexity of such fundamental change, transitions typically take place over 25–50 years and are characterised by complementary change 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. Transitions are contrasted with more subtle change that merely tweaks or optimises the operation of the current system. Transitions are about revolutionary – rather than evolutionary – change. Also referred to as: **transformations** or **transformative change**

Urban Water Transitions Framework is a framework developed by Brown et al. (2009). It identifies six distinct developmental "states" that a city can occupy while on its path to increased water sensitivity. The Urban Water Transitions Framework is presented in Figure 1 of this report. Also referred to as: **Urban Water Continuum** or **Continuum**

Transition Dynamics Framework is a framework developed by Brown et al. (2013). It presents six phases of a transition, focusing specifically on the social and institutional changes required. Within each phase, the framework identifies five key domains of change: actors, bridging organisations, knowledge, projects, and tools. The Transition Dynamics Framework is presented in Table 1 of this report.

Executive summary

Our cities are experiencing the pressures of climate change, population growth and rapid urbanisation. As such, the shift toward more integrated approaches to urban water management is being recognised as a challenging but necessary direction to take. While some places are still grappling with the delivery of essential services like water and sewerage, others are struggling to address and overcome some of the vulnerabilities inadvertently created by their existing water management systems. For both developed and developing cities, the concept of water sensitivity offers an exciting means of delivering multiple benefits associated with liveability, sustainability and resilience through a city's water management framework.

This manual is the product of research for Cities as Water Supply Catchments – Society and Institutions (Project A4.1) and provides guidance for cities seeking to transition toward a more water sensitive future. The information presented here is not merely theoretical, but draws on the experience of cities from around the world to provide practical examples of water sensitive transitions in action. The tools presented here have two purposes. First, to facilitate a greater understanding of a city's current water sensitive practices. Second, to provide practical guidance on creating the social and institutional conditions needed for a city to realise its ideal water future.

The manual has three parts:

Part A provides an overview of the benefits – and increasing necessity – for cities to transition toward water sensitivity.

Part B begins by outlining the Water Sensitive City concept and its core principles. It also highlights the value of benchmarking approaches, which can help to inform the development of strategic initiatives that will most effectively support a city's water sensitive transition.

It then introduces a number of benchmarking tools that can be used to conduct a qualitative assessment of a city's current water management regime – as well as the social and institutional changes required to move toward increased water sensitivity. We recognise that cities are at different stages of water management. This is why the Urban Water Transitions Framework is useful, as it enables a city to benchmark its current water management practices, policy, and aspiration. By defining the attributes of water management within more sustainable cities, it helps cities to identify their short and long term goals for water sensitivity.

From this point, the Transition Dynamics Framework provides insight into how transformative change unfolds on the ground; it identifies six distinct phases of transition which in turn allows cities to benchmark progress toward their aspired water future. Most importantly, this framework can reveal a city's strengths and vulnerabilities as it embarks on this journey.

Part C provides guidance on how to apply these frameworks to benchmark your city and identify its current transition phase in its move toward water sensitivity. It then outlines how these benchmarking results can be used to inform the development of strategic action to enable social and institutional progress toward water sensitive management.

Part A – Introduction

1. The case for Water Sensitive City transitions

Water management in 21st century cities has become increasingly challenging. For the first time ever, urban populations exceed those in rural areas, and the pressure on water availability in cities is growing accordingly. This population growth is also occurring in a context of climate change, resource constraints, and stressed ecosystems. Traditionally, water management was based on principles of predictability and control. However, with the greater frequency and severity of extreme weather events such as storms, floods, and droughts resulting from climate change, water availability is becoming increasingly unpredictable. Further, society is becoming more environmentally aware and has higher expectations for urban liveability. All of this means that static water management approaches are no longer appropriate. In less predictable conditions, water supply must be managed adaptively, and this requires substantial shifts in approach and attitudes among community, government, and business sectors. We now aim for innovative approaches that will ensure liveability and resilience for our cities. Concerns about social and intergenerational equity must also be addressed so that this life-giving resource will continue to be managed for the benefit of all.

The concept of a Water Sensitive City has emerged as a unifying vision of an urban water management approach that not only meets a city's water needs, but also delivers a range of associated benefits to enhance liveability and resilience. A Water Sensitive City is based on holistic management of the integrated water cycle to protect and enhance the health of receiving waterways, reduce flood risk, and create public spaces that harvest, clean, and recycle water. It 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, including: biodiversity, public green space, healthy waterways, connected communities, and cultural significance. Ultimately, a water sensitive approach is underpinned by a recognition that water can contribute to the creation of connected, vibrant, and liveable communities.

The path toward greater water sensitivity has traditionally unfolded in a sequential manner, with each "state" building on the developments of the previous state. As described in the Urban Water Transitions Framework (Figure 1), these states are: improved provision of water supply, sewerage, drainage, and environmental protection services. However, such linear evolution is not necessary. The concept of "leap-frogging" provides an exciting alternative route, with particular relevance for cities with poorly developed water management systems. These cities now have the invaluable opportunity to avoid the environmental, social and economic vulnerabilities that come from managing the water cycle in a segmented way. By leap-frogging from one state to another, cities can skip parts of the transition pathway and proceed directly to more sustainable infrastructure. This idea relies on experimenting with innovative technology and tailoring existing ideas to a local context.

Importantly, however, the Water Sensitive City vision is context specific. While there are some common principles to water sensitivity, how this vision manifests will depend on the individual city. Across the globe, water management standards vary greatly with respect to supply, sanitation, and drainage. What "water sensitive" means in a particular city context and how easy it will be to move toward more sustainable urban water management are determined by various factors: the biophysical environment, ecology, climate, history, geography, and demography, as well as the existing technologies and institutional (governmental and organisational) structures that influence water management. The latter reflects the city's "hydro-social contract" (Lundqvist et al., 2001; cited in Brown et al., 2009), which reflects the prevailing values and implicit agreements between community and government about how water should be managed. While we provide some guidance on the underlying principles that characterise various stages of water sensitivity, it will be useful to consider how these principles manifest in your city.

The benchmarking tools presented in this guide have all been derived from research in a developed country context. Research in developing country contexts is our next major focus with a number of projects currently underway. However, in outlining some common principles of water sensitivity and process tools for progressing toward an aspired future state, the benchmarking frameworks presented here are relevant for both developed and developing cities. Although cities in developed and developing countries may have different contexts and challenges, the starting point for planning the transition process is the same. Before identifying strategies to improve current practice, it is first necessary to understand the current state of play. A critical question that initiates the pursuit of greater sustainability is: "What state is my city in now?" To this end, it is also useful to identify some specific aspects of your city's current water management framework that you would like to focus on (i.e. wastewater services, stormwater management, increasing fit-for-purpose supply). This will provide a helpful reference point to assist in the benchmarking process.

Ultimately, this document offers guidance for policy makers and strategists seeking to move their cities to more sustainable urban water management and the water sensitive vision. It first presents an innovative framework for assessing a city's current state of water management and defines what a Water Sensitive City will look like. It then provides the first-ever framework of how to move toward this ideal by sharing novel insights into the transition dynamics that help or hinder greater sustainability. Finally, it provides guidance on how to apply these frameworks in practice to inform the development of strategic actions to enable social and institutional progress toward water sensitive management.

Part B – Introducing the benchmarking tools

2. Urban water management transformations

This section introduces two key benchmarking tools: the Urban Water Management Transitions Framework and the Transition Dynamics Framework. We begin by looking at the Urban Water Management Transitions Framework. This provides some typological principles for defining a Water Sensitive City, and explains how we can assess and benchmark the current water management regime of a city against others. We then look at the Transition Dynamics Framework, which identifies the distinct phases and domains of change that characterise a transition, helping you to see how transformative change unfolds in practice.

2.1 The Urban Water Transitions Framework

In its journey to greater sustainability, it is important that a city both understands its present status with regard to water management and defines its short and long-term sustainability goals. Australian researchers have developed an analytical tool specifically for this purpose: The Urban Water Transitions Framework (Brown et al., 2009). The framework identifies six distinct developmental states that cities move through on their path toward increased water sensitivity. It can, therefore, help urban water strategists define the attributes of more sustainable cities and identify the capacity needs and institutional changes required for more sustainable water management. Figure 1 presents the Urban Water Transitions Framework, while Figure 2 describes each state in more detail.

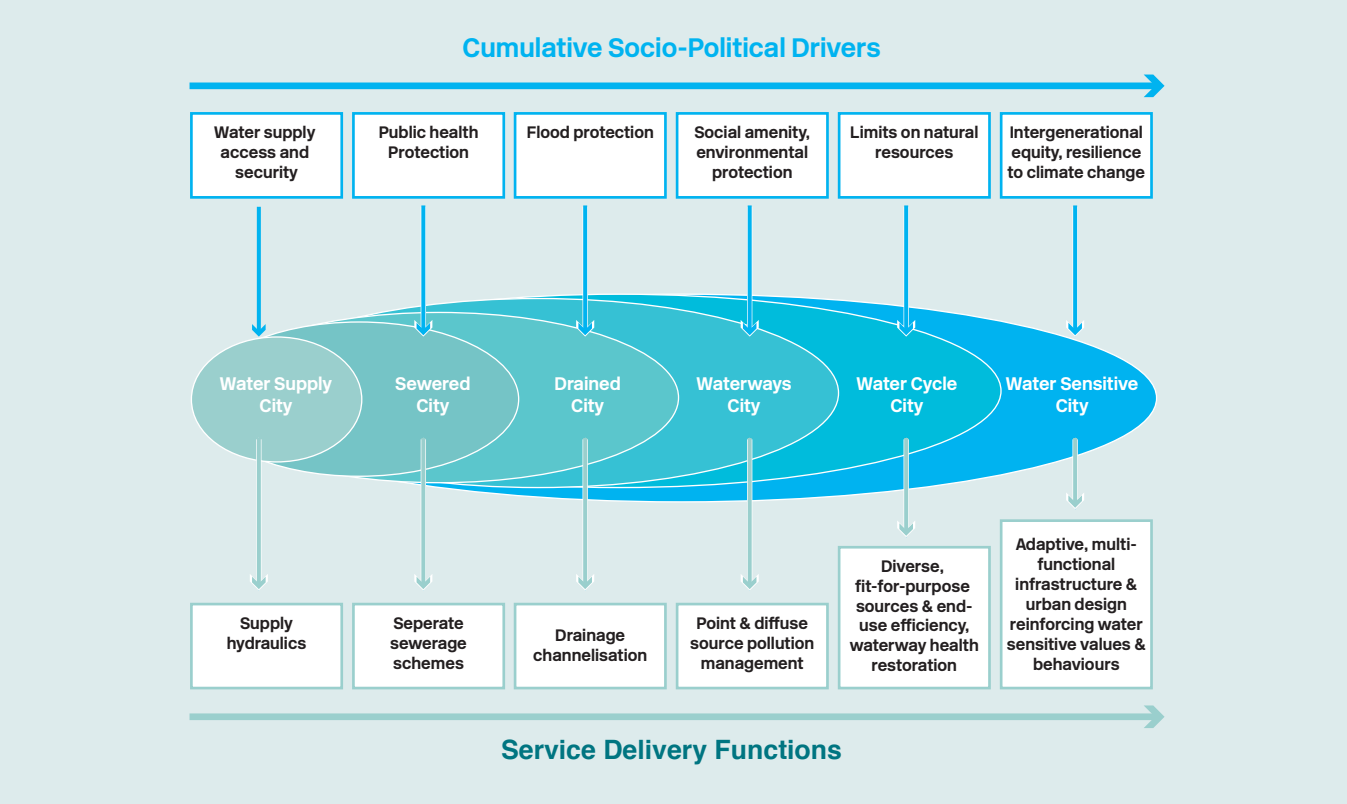


Figure 1. Urban Water Transitions Framework [1]

[1] Brown et al., 2009.

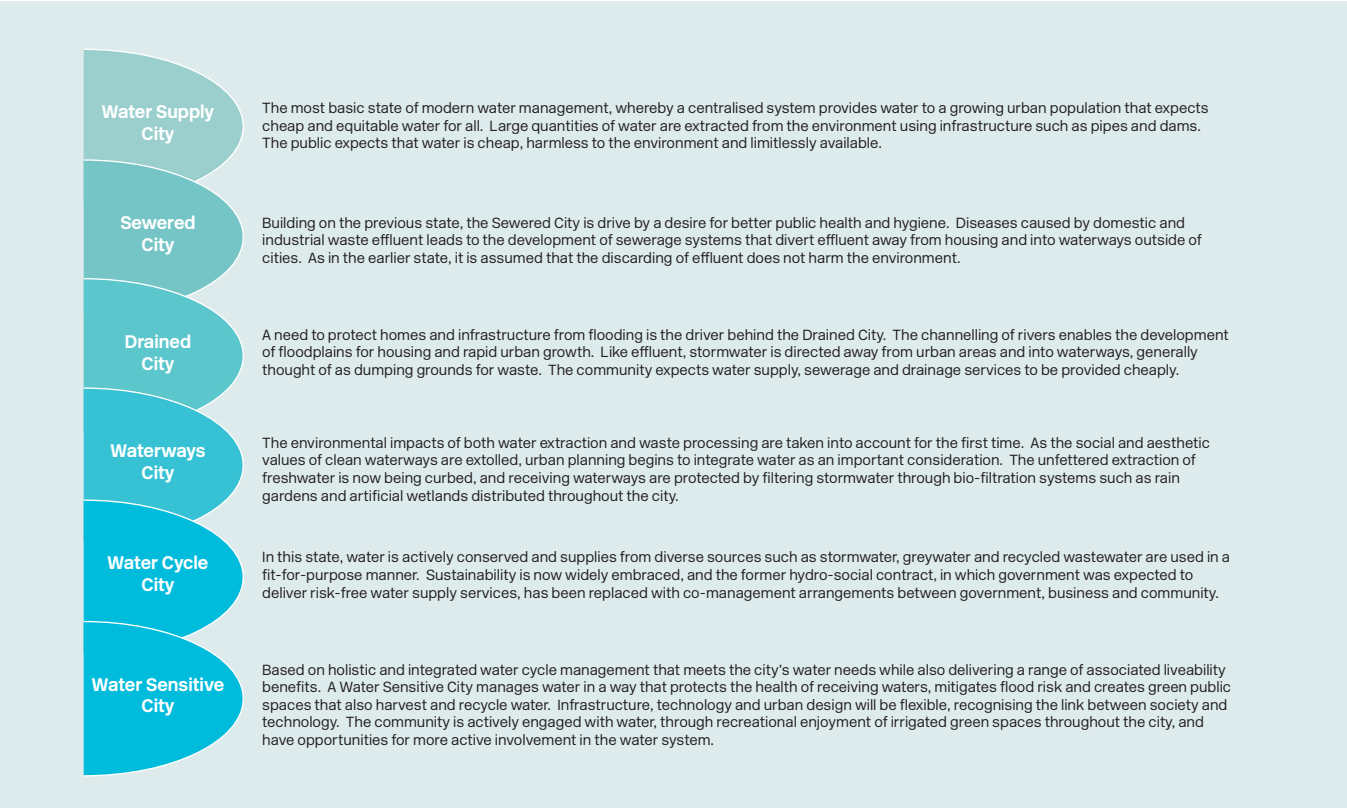


Figure 2. Descriptions of the water management city-states

As you can see, the six states form a continuum that can be mapped along two dimensions:

i. **Cumulative Socio-Political Drivers:** the socio-political drivers (demands and expectations) that emerge from society's growing environmental awareness, amenity expectations and evolving attitudes toward water management

ii. **Service Delivery Functions:** the increasingly diverse services required to address those drivers as cities transition to greater sustainability

The first three states of water management meet largely utilitarian expectations of supplying water, protecting public health, and mitigating the impacts of floods. However, the following three states mark a significant shift beyond survival needs, toward a more sophisticated goal of greater water self-sufficiency and reduced environmental impact. Rivers, streams and lakes are now seen as places for social interaction and aesthetic appreciation; communities are becoming increasingly proud of their sustainable water management practices. In short, water management contributes to a city's identity (Johnstone et al., 2013). Innovative design solutions tailored to local contexts become dominant features in cities in the later transition states. Importantly, the framework reflects an embedded continuum, whereby later city-states build on infrastructure and approaches achieved in earlier city-states.

Overall, as the Urban Water Transitions Framework shows, the water management state of a city can be assessed by its supply, sanitation, and drainage infrastructure, as well as the prevailing institutional and community attitudes that together reveal a city's current conditions and opportunities for moving forward. Tools to explore and assess the outcomes of each city-state, in terms of infrastructure and practices on the ground, are currently under development. The contribution of this framework is in identifying common principles underlying each city-state, which may manifest differently in different cities.

2.2 The Water Sensitive City: Defining the goal

So what would a Water Sensitive City look like? The Urban Water Transitions Framework allows us to envisage this state. The nested continuum of the transition states is built on three principles (or "pillars") of practice that must be integrated into the structural and social fabric of a Water Sensitive City (Wong & Brown, 2009). The pillars provide essential underpinnings in terms of social capital, urban design, and infrastructure; these seek to optimise the use of water resources within a city, buffer the impacts of climate change, and protect ecosystem services in the urban ecological landscape. The three pillars are:

i. Cities as water supply catchments

ii. Cities providing ecosystem services

iii. Cities comprising water sensitive communities.

The first pillar represents the concept of cities not relying exclusively on their natural water sources – be that rainfall run-off accumulated in catchments or groundwater. Instead, they should develop a broader portfolio of water sources, including urban stormwater, roof run-off, recycled wastewater, desalinated water, and groundwater. In a Water Sensitive City, these sources would be utilised as required through a variety of infrastructures associated with water harvesting, storage, treatment, and delivery. Cheaper sources or those with lower environmental impact would be given preference over more expensive and environmentally risky options. A separate supply pipeline for non-potable water would become standard, replacing the use of potable freshwater for purposes such as toilet flushing, laundry uses, garden watering, and irrigation.

The second pillar envisions an urban landscape that actively supports the environment, rather than degrading it and draining it of resources. This can be achieved through innovative use of public spaces and green spaces. In addition to providing public amenities, these spaces could incorporate sustainable water management alongside other ecological services such as carbon sinks, opportunities for food production, and an improved micro-climate through providing shade. For example, stormwater treatment in Australia is increasingly achieved through constructed wetlands and other bioretention systems (or "raingardens") employed at a range of spatial scales, from individual buildings to regional public open spaces. The rehabilitation of degraded waterways is another important dimension of this pillar that can also be addressed via a mix of catchment-wide and site-based works, providing a foundation for all additional waterway health improvement initiatives.

The third pillar of practice points to the importance of institutional capacity and social support for achieving sustainable urban water management. To successfully implement this pillar, the local institutions invested in and responsible for delivering water management must fully embrace technological solutions. It also requires a community to be informed and engaged about water sensitivity, and actively involved in the co-management of water services. At the present time, this pillar remains one of the most onerous reform agendas. Realising it will require collaboration between key champions for sustainable water management across academia, government, and industry.

3. An introduction to transition dynamics

3.1 The transition challenge

Though the benefits clearly outweigh the challenges, transitioning toward water sensitivity comes with its hurdles. Indeed, such transformative change processes are never easy. Contemporary research clearly shows that a focus on technical innovation is not enough; understanding the social and institutional dynamics that underlie any city's attempt at transition is key when trying to move entrenched water management systems into novel directions.

Let us return to the Urban Water Transitions Framework:

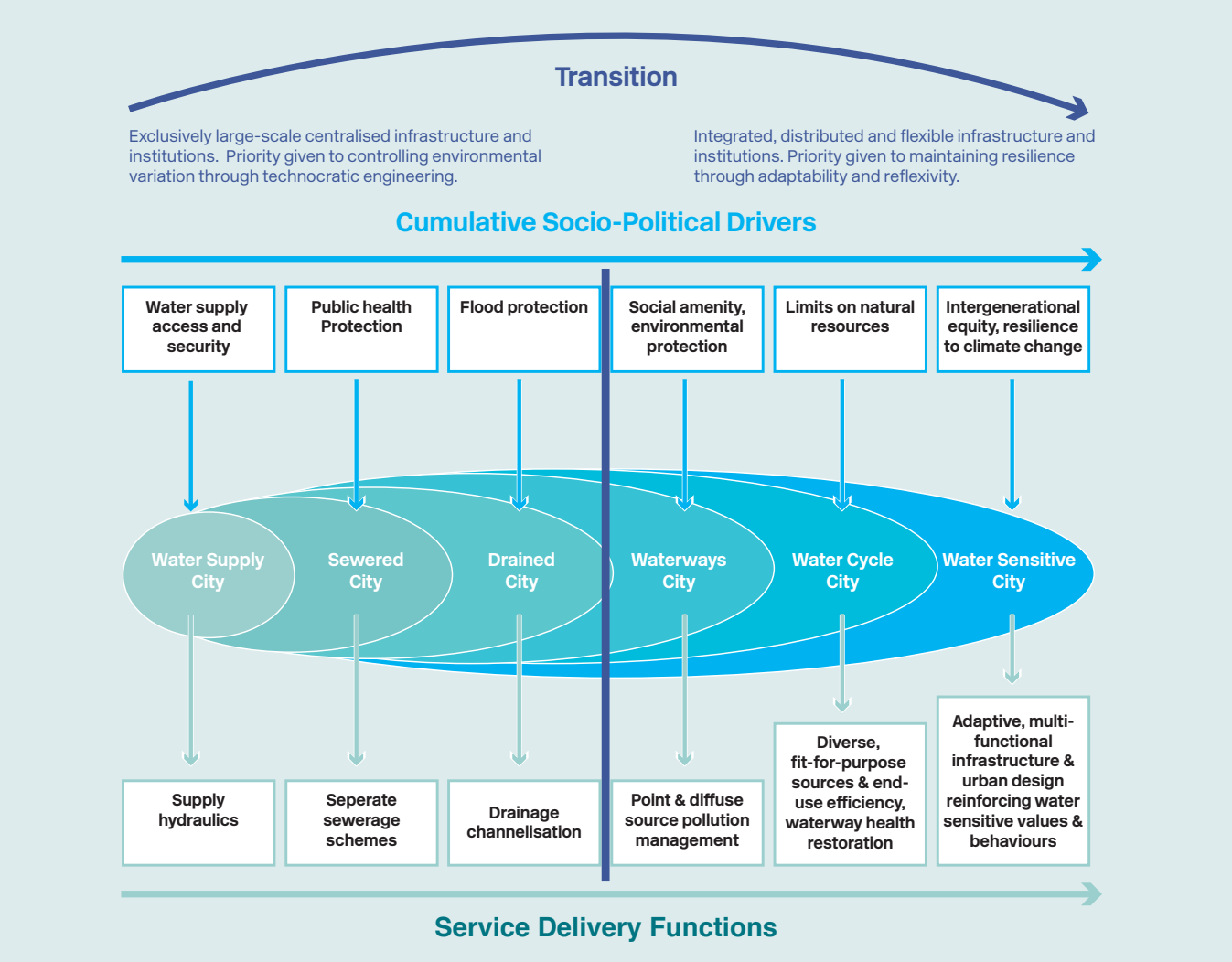


Figure 3. Challenges for urban water transitions [2]

[2] de Haan et al., 2015.

The transition from the left side to the right side is particularly challenging, as it requires cities to fundamentally reorient existing infrastructures, institutions, and approaches to water management. It is this complex web of existing technologies and institutions that typically creates a path dependency that is hard to overcome. Although path dependency inadvertently arises as a result of the increasing returns that follow from a step in a particular direction, it often operates to reduce the range of options perceived to be available, with the consequence of maintaining course on one particular path even in circumstances where alternative options may be preferable.

In addition to path dependency, there are a variety of significant and related barriers to sector-wide transformation: technological lock-in, institutional inertia and fragmentation, and the challenge of reorienting professional and organisational capacity toward a new approach. As Figure 3 demonstrates, the water servicing needs of the first three city-states have traditionally been met through large scale, centralised infrastructure, typically provided by city engineers. However, the more complex and inter-related needs of the last three city states requires a shift to an interdisciplinary approach to provide more flexible and integrated infrastructures and institutions at both centralised and decentralised scales. Current research is showing us two important realities. First, realising an alternative approach on the ground requires mutually reinforcing change across infrastructures, institutions, and practices. Second, social and institutional conditions, as well as organisational capacities, are critical in enabling and facilitating transformation.

Given this complex and multi-faceted change process, transitions research reveals that there are a number of potential transition pathways that can unfold (Figure 4):

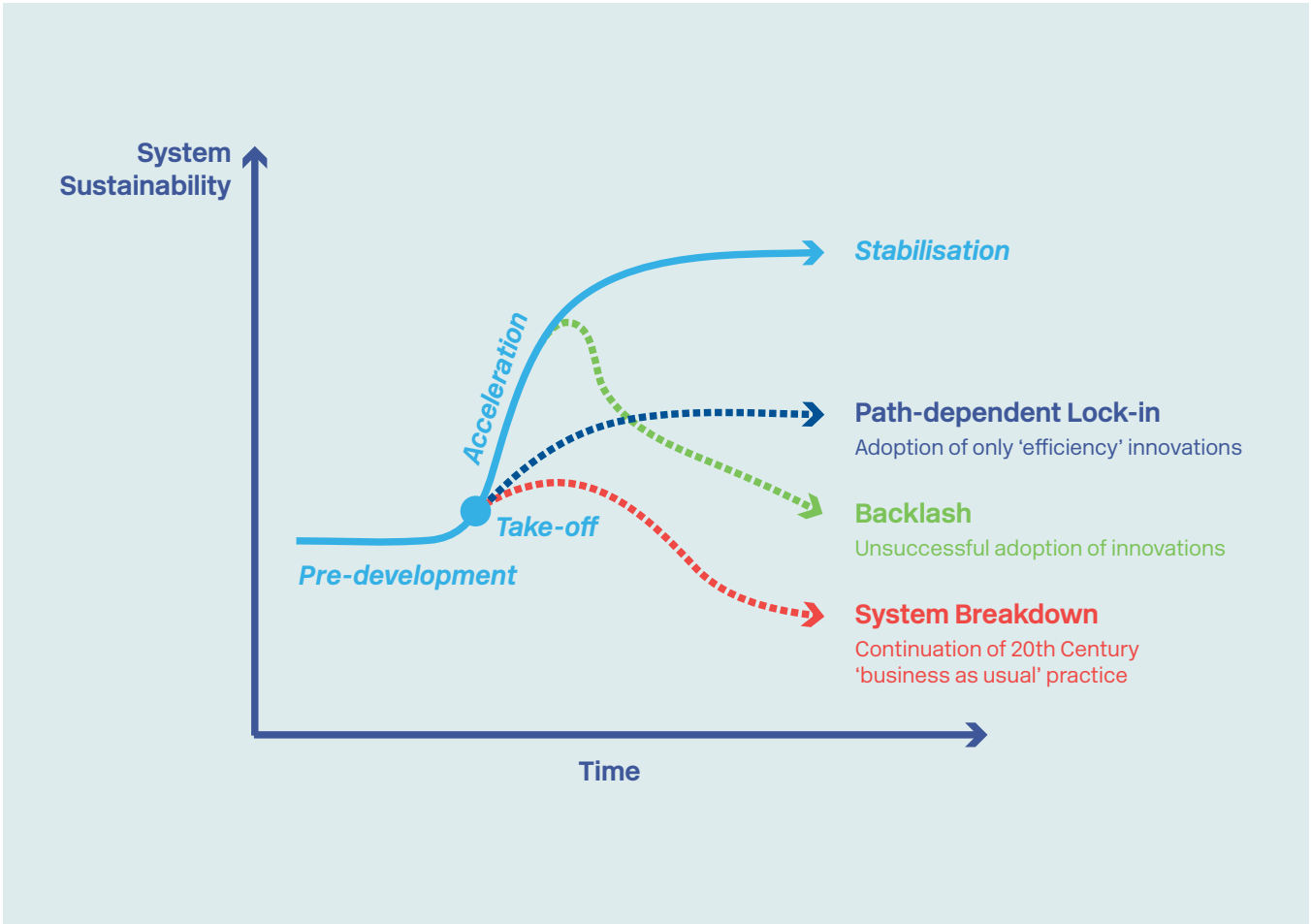


Figure 4. Different transition pathways [4]

[3] Van der Brugge & Rotmans, 2007.

Studies of successful transitions in the past show that the ideal transition trajectory tends to follow the S-curve pattern (reflected by the S-curve in Figure 4) as a new practice goes through a period of pre-development, acceleration, and eventual stabilisation as part of a new socio-technical regime. However, a successful transition pathway is not guaranteed and there are a number of alternative, less desirable pathways that can unfold, such as lock-in, backlash, and system breakdown. As such, ensuring a successful transition process requires ongoing commitment, monitoring and investment to steer change in desirable directions and avoid the other unsuccessful pathways. But where should we focus our efforts if we wish to ensure a successful transition? The Transition Dynamics Framework can help us gain a more detailed understanding of how transformational change unfolds in practice.

3.2 Transition Dynamics Framework in action

So, having considered the potential challenges, how can a city transition toward water sensitivity? A longitudinal case study by Brown, Farrelly, and Loorbach (2013) of Melbourne's transition to improved stormwater water management is a useful starting point. It is the first evidence-based investigation of how a city can transition toward more water sensitive practices. Understanding the social and institutional dynamics that enabled Melbourne's transition from the left hand side to the right hand side of the Urban Water Transitions Framework (Figure 3) can provide valuable insights into how other cities may be able to move entrenched water management systems in more sustainable directions.

The City of Melbourne, Australia has achieved significant milestones in its transition toward sustainable urban water management. Over the past fifty years, the city changed its stormwater management from a traditional drainage system (releasing untreated stormwater into rivers and the ocean) to a more sustainable regime that has substantially reduced its environmental impact. During this time, Melbourne has established a city-wide market-offsets scheme, and a state-government regulatory mandate for sustainable stormwater management that is applied to all new developments across Melbourne. This decades-long shift has placed Melbourne ahead of other Australian cities. The city now boasts a large number of stormwater treatment projects across metropolitan Melbourne, and is actively engaging municipalities and 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 out-dated perspectives on water governance with new approaches that meet the changing needs of the 21st century. A more detailed exploration of Melbourne's transition journey is presented in Section 3.3.

Based on extensive qualitative and quantitative data spanning over five decades, evidence from Melbourne's transition from a Drained City to a Waterways City reveals a typology of six distinct "phases" through which a city's transition toward more sustainable water management would typically progress. This is the Transition Dynamics Framework, and is shown in Figure 5. Each phase identifies unique challenges and opportunities for strategic intervention to improve water management policy and practice.

Taken together, these six phases chart the initial emergence of a sustainability issue through to the eventual embedding of new sustainable water management systems into everyday practice. In the **Issue Emergence** phase, a particular problem is identified (e.g. poor waterway health), followed by the **Issue Definition** phase, in which 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, **Embedding New Practice**, involves making the new practice mainstream.

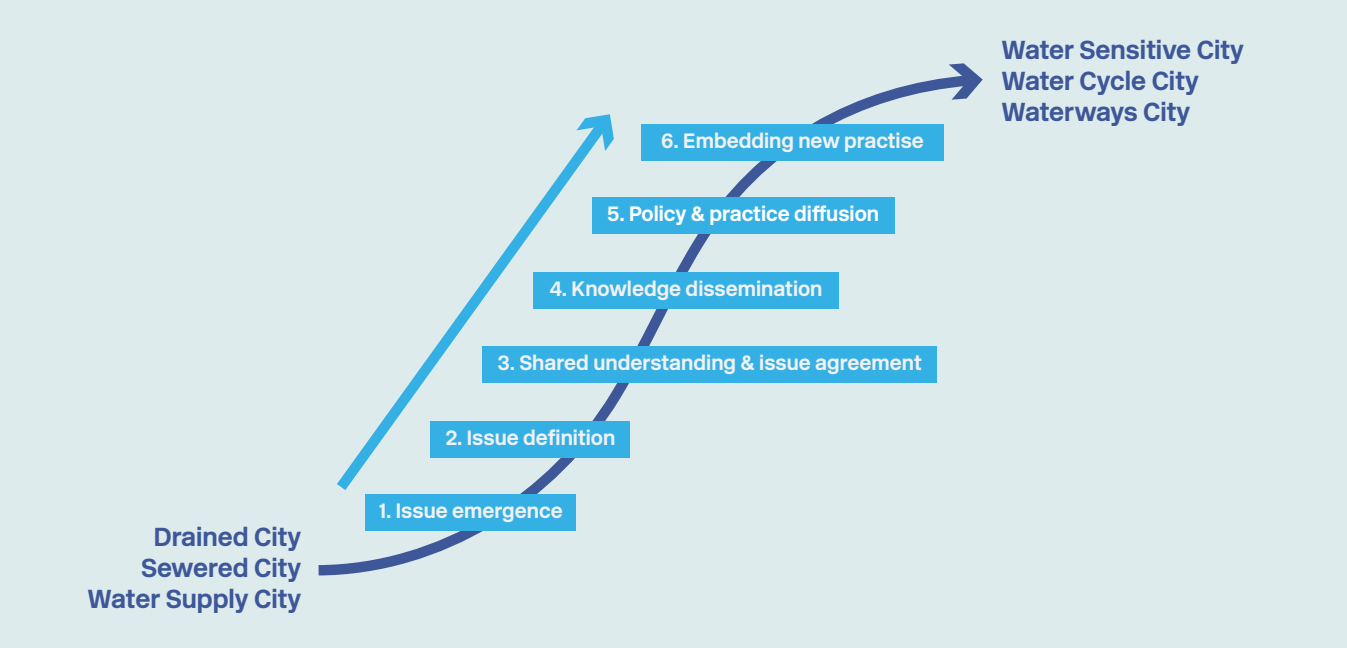


Figure 5. Six phases in the transition toward water sensitivity [4]

It is important not to judge the success of a transition process solely on the manifestation of a new practice. In many cases, widespread change on the ground emerges relatively late in the transition process, typically in the **Policy and Practice Diffusion** or **Embedding New Practice** phases. As such, it is not possible to measure transition progress simply by the identification of a new on-ground practice. Rather, changes in earlier phases are facilitating the eventual emergence and mainstreaming of a new practice, which build to a tipping point resulting in widespread on-ground change in the later transition phases. The earlier transition phases thus play a critical role in the overall success of a transition journey, even though on-ground practice may remain niche or ad-hoc during this time. Benchmarking the phase of transition provides a way of measuring progress for these behind-the-scenes changes as enabling conditions are established to support a new practice becoming a new norm.

The six phase typology invites consideration of questions such as:

- "Who is typically involved in advancing a sustainable water transition?"
- "How do they promote water sensitive practices during each phase?"
- "How does the water management discourse change over time?"
- "What responses may be expected from existing or newly forming institutions?"
- "What processes and tools enable the sustainability transition to proceed?"

We can approach these questions by looking at two important factors within each transition phase: **dominant narratives** and the **domains of change**. Looking first at **dominant narratives**, a narrative is the way a particular practice is described or talked about. Over the course of a transition, the dominant narrative will typically evolve as pressures on a system mount and society's expectations change. It is generally possible to observe two narrative types over the course of a transition:

- **Advocating narratives** that support the new practice and promote its uptake
- **Contesting narratives** that challenge the new practice or undermine it as either unnecessary or inappropriate.

[4] Adapted from: Brown et al., 2013.

Narratives are a useful indicator of the dominant perception of current practices, and the change in narratives over time can usefully reveal a city's current phase of transition. For example, in the early phases of a transition, the dominant advocating narrative may reflect a realisation that stormwater pollution is causing poor waterway health, while the dominant contesting narrative rejects this assertion. By the end of a transition, the advocating narrative may be that improved stormwater management helps deliver enhanced liveability outcomes, while the contesting narrative may challenge the value of improved stormwater management by diminishing its ability to address society's goals.

Moving on to the **domains of change**, research has shown that, during periods of transformative change, shifts occur across five key domains: **actors**, **bridging organisations**, **knowledge**, **projects** and **tools**. Examining developments within these five domains can be another way of revealing what transition phase a city is in. Together, the five domains influence and organise the formal and informal rules for implementing a practice. Indicators of each domain evolve over the course of a transition, with new dimensions added as a practice moves from being novel to mainstream. Here is a more detailed outline of the five domains:

- **Actors:** Individual networks of people that are involved in or engaged with water management. In an ideal or typical transition pathway, the actor network grows over time, as a greater cross-section of stakeholders becomes engaged with refining the new practice and its implementation processes.

- **Bridges:** Formalised or semi-formalised organisations, structures, and processes that facilitate collaborations across science, policy, and industry spheres. In the early phases of a transition, bridging mechanisms can help to deepen understandings of the problem, and at later phases can assist with translating the new practice into action. As the primary function of the bridging organisation changes over the course of a transition, a number of different bridging mechanisms may be used during various transition phases.

- **Knowledge:** Scientific understanding of the problem and the potential solutions, along with contextualised knowledge informed by local research activities. In the early transition phases, knowledge is developed through fundamental science and pilot-scale investigations, with the later phases involving more applied research and capacity building initiatives.

- **Projects:** Experiments, demonstrations, and focus projects to test the viability of new technologies or approaches. Projects typically start with the development of scientific prototypes, then progress to demonstration projects that serve as proof of concept of a new approach, and finally to large-scale field applications to 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 the new practice. Early tools would typically enable and support innovative approaches, while the later tools would focus more on compliance and enforcement.

Table 1 brings together the six phases in the Transition Dynamics Framework and the five **domains of change**. It summarises indicators across the five **domains of change** for each transition phase in the Transition Dynamics Framework. As you can see, key indicators are established as the enabling conditions are strengthened through each transition phase:

Table 1. Transition Dynamics Framework

Transition phase	Domains of change				
	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

Importantly, each transition phase is equally important in the overall transition journey. Together, they create a solid foundation for enabling transformative change. As such, it is not possible to skip a transition phase. It may be possible to leap-frog over particular city-states and proceed with the implementation of more advanced sustainable water practices. However, in transitioning from your city's current to aspired state, it is necessary to move sequentially through each of the six transition phases and build supportive structures across each of the five domains. Without this foundation, the transition process will be vulnerable, and – after some initial success – will run the risk of diverting to one of the less desirable transition trajectories.

Finally, while the Transition Dynamics Framework is focused on change processes at the industry level, community engagement is a critical part of the change process, playing a key role in creating a political mandate for action and providing momentum for transformative change more generally. Successful transitions will rely on bringing the community along the change journey, and tailoring strategies to maximise community buy-in. There are numerous best-practice guidelines on designing community engagement strategies and programs (see Dean et al, 2015 for a comprehensive overview in the context of urban water management).

3.3 Melbourne, Australia: An exemplary transition story

This section presents the story of Melbourne's evolution toward more water sensitive stormwater management in more detail. This narrative shows how these transition dynamics played out in one city, following the six transition phases described in the previous section. Beginning in the 1960s, Melbourne's transition from a Drained to a Waterways City is now significantly advanced. Figure 6 shows how Melbourne progressed through each phase. While further embedding is still needed, the change process has largely stabilised, and efforts to further embed and mainstream the practice are ongoing.

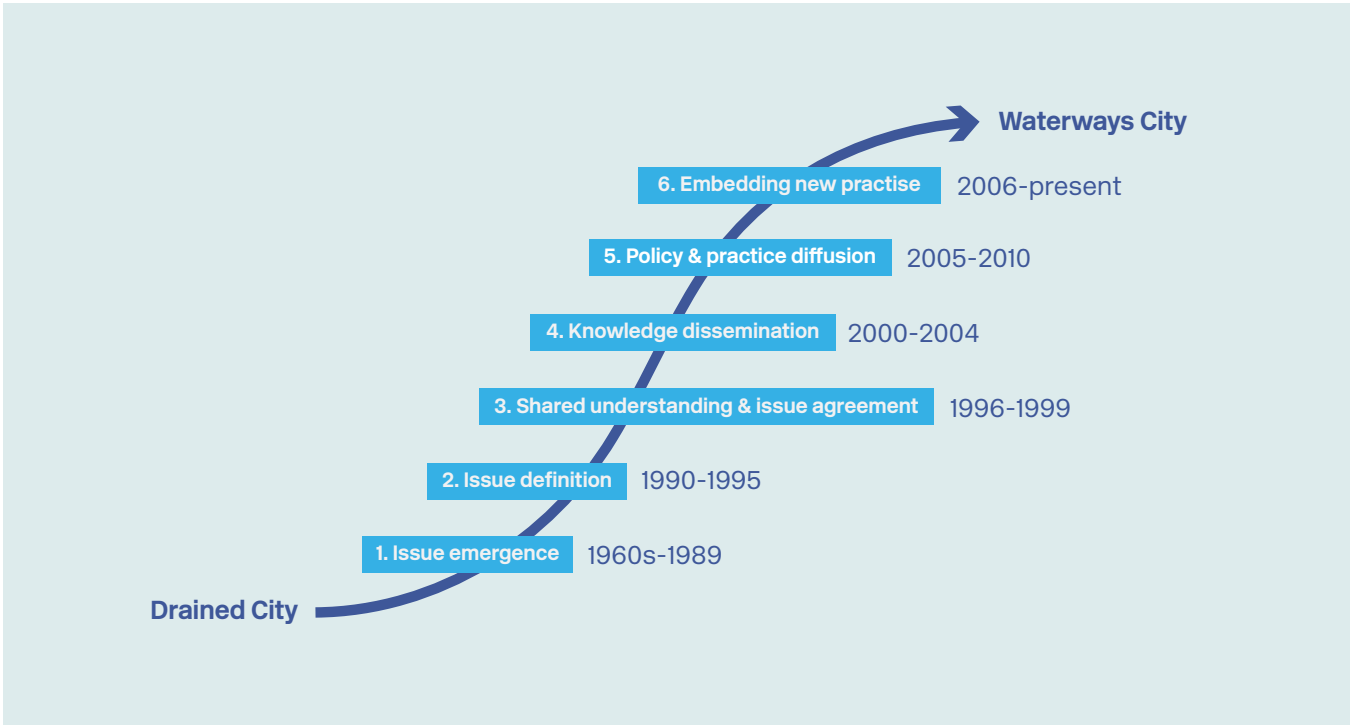


Figure 6. Melbourne's progress to a waterways city through the six transition phases

Emerging concern about waterway health (1960s–1989)

From the mid-1960s, the public – and the media – increasingly began to question the current approaches to waterway management in the context of environmental protection. The emerging social demand for healthy waterways began to exert pressure on the government to reduce waterway pollution. The movement gained even more momentum when a suite of scientific freshwater studies were released, confirming that stormwater pollution was having a negative impact on the health of freshwater bodies. Once environmental protection became formally enshrined in law, this provided the foundation for individual actors to create a niche for improved environmental protection within the traditional water management regime.

Defining the causes of poor waterway health (1990–1995)

It took five years for sustainable urban water management to fully emerge. A common vision of better-managed waterways saw individual actors connect with each other, leading to the creation of an informal network of people from backgrounds such as private sector engineering, academia, and state and local government. This group of champions soon found itself supported by the formation of two national Cooperative Research Centres (CRC) with complementary foci on freshwater ecology and catchment hydrology. These CRCs fulfilled important roles as bridging organisations, and both had a strong presence in Melbourne, helping to increase the profile of better water management in the 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 city's key water utility) and local universities – these ties continue to this day.

Understanding and agreeing on stormwater problems and solutions (1996–1999)

With the issue of stormwater pollution firmly established, the network of science and industry collaborators expanded to include planners, land developers, and a broader range of 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 – Melbourne's iconic receiving environment. This led to the establishment of a formal policy committee for stormwater run-off, which developed best-practice guidelines along with policy-linked stormwater quality run-off targets.

During this formative period, alternative water treatment technologies were being put to the test. Local champions secured national funding to build a number of demonstration water treatment wetlands, proving the concept to industry and reassuring them of the value of this alternative approach. The technology was also tested at the larger scale of a new residential estate on the outskirts of Melbourne, Lynbrook Estate. The project was sponsored by Melbourne Water, who also underwrote the risk of the trial. Collectively, these highly visible projects helped to crystallise and disseminate the idea of stormwater quality treatment through water sensitive design, promoted a philosophy of collaboration among the urban water-related industries, and demonstrated the practical feasibility of pursuing this path into the future.

Disseminating knowledge on improving waterway health (2000–2004)

One of the key events in this phase was the first International Conference on Water Sensitive Urban Design. For the first time, this conference brought together international stakeholders involved with implementing sustainable water management to exchange insights from their experiences. Meanwhile, national and state-based best-practice guidelines were being developed. The CRC for Catchment Hydrology created a computer-based decision support tool called MUSIC (Model for Urban Stormwater Improvement Conceptualisation) to simplify the adoption of urban stormwater quality management measures. MUSIC was used by developers and industry practitioners to assess stormwater management options at a site level, and demonstrate compliance with the best-practice guidelines, which further supported knowledge dissemination.

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 design principles and technologies to the Docklands – an iconic redevelopment in the centre of Melbourne. Advocates from local municipalities around Melbourne 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 an upcoming state election to push the state opposition party to take a leadership role on stormwater. When the opposition was voted into government in 2000, this move resulted in the establishment of a $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 the establishment of a state Stormwater Advisory Council. This new body championed policy at a senior decision-making level, rather than at a technical/operational level as previous policy groups had done.

Diffusing new stormwater management policies and practices (2005–2010)

In this phase, advocates focused on creating formal policy documents and regulatory change. Partnerships between some institutional actors were now formalised through signed agreements that set out the responsibility of each stakeholder 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 stormwater quality treatment approaches. Another key development in this phase was the introduction of a stormwater offset scheme in 2005. The scheme was the first of its kind in Australia, and required developers to meet stormwater quality objectives either by implementing best-practice measures onsite or by making an offset payment for works undertaken elsewhere in the catchment.

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 could be regulated. The network also encouraged broader innovative reforms through the offsets scheme at a time when municipal councils began to experiment more confidently with different approaches to improving stormwater management. Despite the substantial progress made with water management, a set-back occurred when a persistent and severe drought resulted in a political shift back to a 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 preferred supply source, thereby 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 4th International Conference on Water Sensitive Urban Design being held in Melbourne. The ensuing media attention led to a further $22 million funding allocation for capacity building of municipal council staff for stormwater treatment, as well as new on-ground water management projects in four high-profile municipalities.

Embedding new stormwater management practices as mainstream (2011–present)

By 2011, many of the early champions who had supported sustainable water management over long periods had reached senior roles in their organisations and now worked to influence the political opposition party for improved total water cycle management. These advocates became sought after advisors when the opposition came to power and convened an independent Ministerial Advisory Council to the new government to advise on implementing sustainable water management objectives.

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

Many municipal councils now have policies and expertise in relation to water sensitive urban design, and projects are being implemented across the city. Leading councils are also amending their local laws to introduce more comprehensive requirements in relation to stormwater management. In order to become totally mainstream, all 38 municipalities across Melbourne need to fully commit by directing appropriate levels of resourcing to water sustainability. However, the strong conceptual, technical, and operational links between stormwater quality and stormwater harvesting provide a solid foundation for this process. These links ensure that the established niche will contribute actively to making sustainable urban stormwater management the norm.

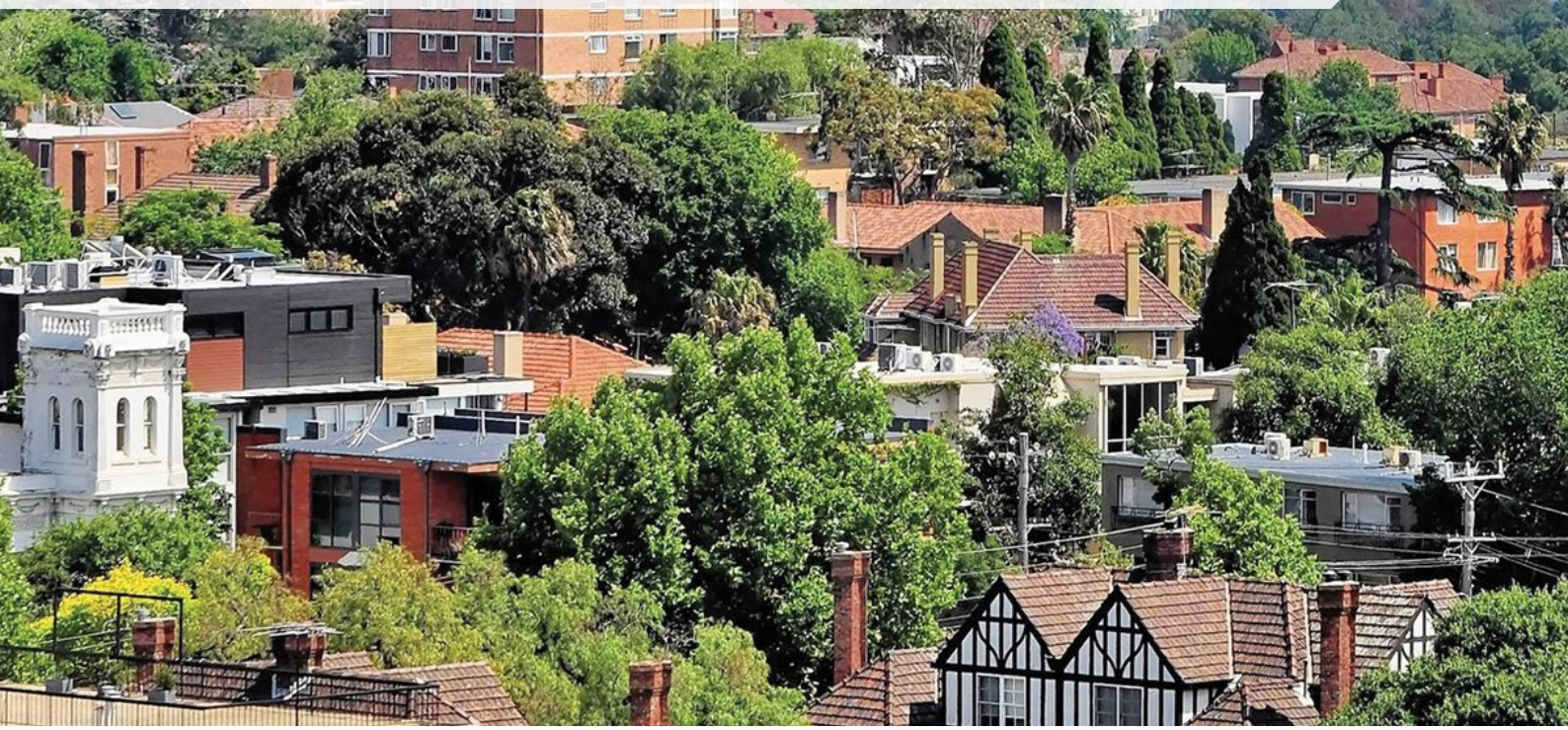
4. Navigating the transition to a Water Sensitive City

To facilitate a city's ongoing transition to water sensitivity, benchmarking progress provides important insight for guiding the development of strategies to most effectively enable change. To use the Transition Dynamics Framework to benchmark in this way, we need to be able to recognise the dominant narratives and indicators across each domain of change in different city contexts. In the next section, we illuminate each of the six phases further. For each phase we offer a brief general description, followed by descriptions of the dominant narratives and domains of change, and finally we provide examples from cities around the world to illustrate how that particular phase has played out in a real-life scenario.

To assist in the benchmarking process, it will be useful to have identified particular areas of focus for your city. This will provide a valuable point of reference for the analysis, and a way of distinguishing between different elements of a sustainable water management framework. For example:

- Does your city struggle with stormwater pollution?
- Are there challenges in relation to wastewater infrastructures and practices?
- Is there a need to increase water security through fit-for-purpose supply?

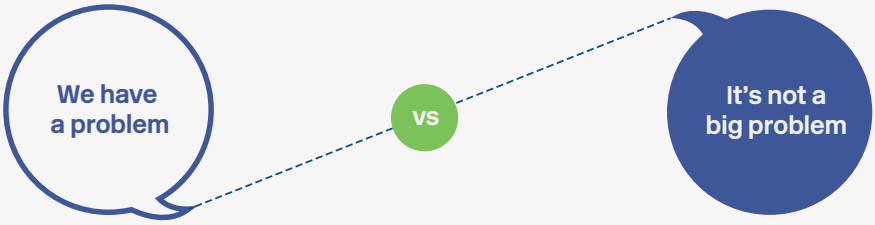
Having a specific area of focus to guide the benchmarking will help identify more specific and tangible insights that can, in turn, be used to enable further progress with the transition journey.



4.1 Phase 1: Issue Emergence

In this phase, a problem is identified (i.e. waterway health, flooding risk, etc.). While there is not yet understanding of the scope or implications of the problem, there is a growing awareness among community, science, and industry activists that there is an issue needing attention.

Dominant Narratives for Issue Emergence



Advocating Narrative

The Actor Network focuses on verbalising the existence of a "problem". During this phase the biophysical manifestation of an issue is noted and socially acknowledged.

Contesting Narrative

A counter-discourse, driven by the institutional and political "establishment", contests the narrative of the Actor-Network, downplaying the existence of the purported problem.

Domains of Change for Issue Emergence

Domain of change	*Indicators*	*Description*
Actor Network	Issue activities	During this phase passionate community and industry actors drives a new "problem narrative". At this stage, the community and industry activists are not necessarily connected to each other, and will likely be using different strategies and channels to raise the profile of the issue. These actors aim to increase the political currently of the issue in question by engaging with the media, politicians and other activist groups. Responsibility for the problem is not yet assigned, and solutions are not yet known – but the issue activists claim that we should care about finding them.
Bridging Organisations	N/A	There are no bridging organisations in this phase of the transition.
Research & Scientific Progress	Issue discovery	During the Issue Emergence phase, scientists are focused on identifying the issue and its biophysical phenomena and establishing its scientific credibility.
Experiments/Focus Projects:	Scientific studies	A high-profile scientific study serves to identify and define the actual problem via gathering of empirical data. This provides a solid scientific basis for understanding and defining the scope of the problem as a first step to determining an appropriate response.
Administrative tools	N/A	There are no administrative tools in this transition phase.

Case study of Issue Emergence: Dili, Timor Leste

Dili, the capital of Timor Leste, is currently undergoing significant transformation. In terms of water systems challenges, Dili has almost no sewerage infrastructure, and as a consequence there are frequent sewer overflows into stormwater drains. The city also has major flooding a few times a year and a limited drainage network, further exacerbating these challenges. Sanitation and drainage have therefore been identified as priority areas in order to improve health, education, environmental and poverty reduction outcomes while also delivering improved flood protection and creating a cleaner city.

Given the immediate need to provide basic sanitation and flood protection services for communities across the city, the priority has been the implementation of basic, decentralised infrastructure solutions, as a first step towards more comprehensive and integrated systems. Relevant national government departments are acting as both the issue activist and main facilitator of works. As is typical of this transition phase, there are no bridging organisations to facilitate science-policy translation.

With the assistance of international experts, a Sanitation Masterplan and a Drainage Masterplan have been developed, outlining a staged program of works to unfold between 2013 – 2025. The Masterplans each provide fit for purpose solutions to address the city's immediate needs, while also keeping an eye to the broader transition goals of the water sector and city more generally. In order to inform the detailed design and implementation of the Masterplans, comprehensive topographical data has been collected. This baseline data will provide a robust basis for directing resources to areas of greatest need and maximising the effectiveness of new infrastructure.

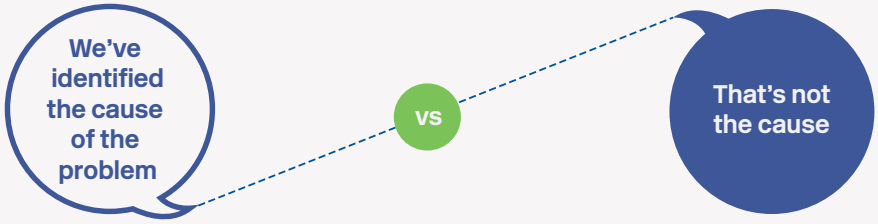
An international contractor has now been engaged to deliver the implementation of both Masterplans and works are currently in the early stages.

Source: WaterAid

4.2 Phase 2: Issue Definition

In this phase, the problem becomes more clearly defined as its scope and consequences are explored and become better understood. The issue becomes part of the public agenda and there is a growing community expectation that the issue will be addressed.

Dominant Narratives for Issue Definition



Advocating Narrative

Discourse is now centred on the cause of the problem, which has been identified by science. Research findings are broadly communicated to decision-makes and the community, and serve to inform a political discussion.

Contesting Narrative

The contesting narrative still downplays the existence of the problem in the first place, but also challenges the early scientific findings that identify the cause of the problem.

Domains of Change for Issue Definition

Domain of change	*Indicators*	*Description*
Actor Network	Science leaders	Multi-sectoral science leaders ("champions") caucus together, forming scientific advocacy groups that champion the issue to the broader industry.
Bridging Organisations	Science-industry	Collaborations between science and industry are formed. Driven by the actor network, science, industry and the public sector collaborate through temporary but formally structured organisations that aim to deepen the understanding of the problem, and to fine-tune the political narrative.
Research & Scientific Knowledge	Cause-effect	No longer centred on issue discovery, resources are dedicated to understanding the causes and effects of the problem and honing in on the physical manifestations and repercussions of the identified problem.
Experiments/Focus Projects:	Laboratory & prototypes	Scientific prototypes are developed in the laboratory, allowing for a test-run of possible solutions before they are implemented.
Administrative tools	N/A	There are no administrative tools in this transition phase.

Case study of Issue Definition: Port Vila, Vanuatu

Port Vila is the capital of Vanuatu, an island nation located in the South Pacific Ocean. Considering its current water management framework, Port Vila is best described as a Water Supply City. A reliable and good quality water supply is delivered through a centralised infrastructure network that is owned and operated by a private sector company. Despite challenges in relation to leaks and the loss of non-revenue water, the network is well established and becoming increasingly financially viable. Port Vila does not currently have an established wastewater system, instead it relies on pit latrines or septic tanks that are emptied at lined dump sites.

With only around 15% of the city serviced with stormwater drainage infrastructure, Port Vila is subject to regular inundation and nuisance flooding. Without a systematic approach to drainage, there is currently limited institutional support for the establishment, operation, and maintenance of drainage services. With a strong reliance on tourism, the need to both minimise flooding and protect receiving coastal waters has become increasingly clear. As a result, improved stormwater drainage has been identified as a need, and Port Vila is currently at an Issue Definition phase in its transition to improved stormwater management.

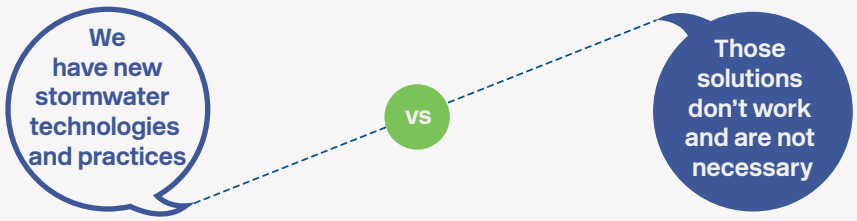
Through financial and technical assistance from the Asian Development Bank (ADB), Port Vila is attempting to address its current drainage challenges through a more water sensitive approach. In this way, Port Vila may be able to leap-frog over the Drained City state and implement infrastructure and practices that reflect the Water Cycle City approach. Key actors facilitating this transition are the Department of Environment and Department of Public Works (responsible for roads and drainage, among others), who together with the ADB form a science-industry collaboration for implementing improved stormwater management systems. In terms of scientific demonstrations and projects, guidance on implementing decentralised stormwater infrastructure has recently seen the piloting of some small-scale projects in Port Vila. As is typical of this stage of the transition, there are currently no regulatory or practice tools in place.

Source: AAP

4.3 Phase 3: Shared Understanding and Issue Agreement

This phase is characterised by a shared understanding of – and agreement on – the problem, its causes, and its repercussions. Solutions are not yet agreed upon, but the need for action is now widely acknowledged.

Dominant Narratives for Shared Understanding and Issue Agreement



Advocating Narrative

The discourse revolves around a call for action and emphasises the need for a solution. A preliminary solution is proposed.

Contesting Narrative

The focus now shifts to challenging and undermining the proposed solutions, downplaying their ability to help remedy the problem.

Domains of Change for Shared Understanding and Issue Agreement

Domain of change	*Indicators*	*Description*
Actor Network	Technical solution coalition	Brought together by the champions (science leaders), an informal "shadow network" of interested people forms a technical solution advocacy coalition. This group of technical experts from the public and private sectors have a vested interest in changing their job roles in light of the problem. Bridging organisations help stimulate this network and contribute to the sharing of knowledge and ideas.
Bridging Organisations	Science-industry-policy	These draw on science, industry, and government. A group of policy officials across the relevant government organisations coalesce to form a working group or committee. As an policy-focused coalition, they link themselves to the science-industry bridging organisations developed during the **Issue Definition** phase of the transition.
Research & Scientific Knowledge	Basic technological solutions	Basic technological solutions gain their "proof of concept". Laboratory solutions are taken to field.
Experiments/Focus Projects:	Minor scientific field demonstrations	A major scientific field demonstration project in a low-profile area serves as an empirical test case for implementing the proposed solution in a low-risk, real-life setting.
Administrative tools	Draft best-practice guidelines	In conjunction with the "shadow network" of practitioners, the multi-agency policy coalition drafts a set of informal best-practice guidelines.

Case study of Shared Understanding and Issue Agreement: China

Poor environmental quality is increasingly seen as a limit to the growth and prosperity of cities across China. Rapid industrialisation has severely compromised environmental health, particularly in terms of air and water quality, with undesirable consequences for community wellbeing and the liveability of cities more broadly. As a result, the Chinese government has recently announced an era of 'ecological civilisation' to guide the future development of the country.

This new paradigm sets an overall direction for cities across China, requiring city based strategies and plans to provide for environmental repair and protection as a priority. Whilst there is a shared understanding of the need to improve environmental health, there is not yet a clear idea of how to proceed. As a result, cities are now actively seeking input from international experts to provide guidance on how to best address their environmental challenges, and provide tangible solutions in a city-specific context.

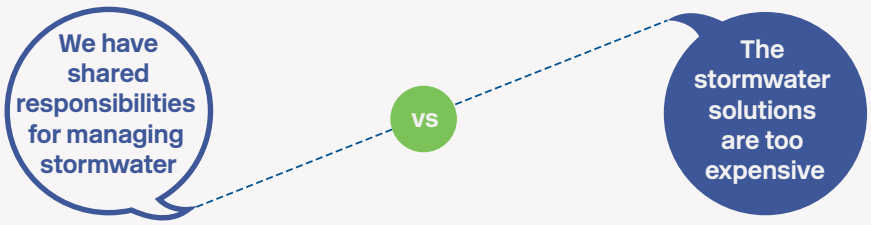
To date, responses to this new paradigm have been highly varied, with each city government determining an appropriate response for their city. Some cities are investing in research programs to better understand their specific challenges with a focus on building up local knowledge, while others are engaging external service providers to provide tailored solutions. Local pilot projects are taking place in a number of cities to help refine appropriate context-specific responses. In each city, the city council acts as a bridging organisation, bringing together planning, development and infrastructure expertise with science and research.

Ultimately, in this shared understanding phase, Chinese cities are using urban development processes as an opportunity to catalyse environmental repair and are actively looking for appropriate solutions to this end.

4.4 Phase 4: Knowledge Dissemination

In this phase, there is general consensus on the preferred solution. The focus is on communication and building familiarisation with the solution and associated practices across a broad cross-section of stakeholders.

Dominant Narratives for Knowledge Dissemination



Advocating Narrative

The discourse emphasises the shared nature of responsibility for addressing the problem, highlighting the need for an integrated, multi-stakeholder response.

Contesting Narrative

The contesting narrative is focused on undermining the proposed solution, typically framing the solution as not financially viable.

Domains of Change for Knowledge Dissemination

Domain of change	*Indicators*	*Description*
Actor Network	Informal policy coalition	The informal policy coalition of Phase 3 becomes more formalised, now including a broader cross-section of policy stakeholders across local and state government.
Bridging Organisations	Science-industry-policy-capacity building	Building on the science, industry, policy partnerships developed in the previous phase, capacity building initiatives are now introduced. Money and resources are invested in new bridging organisations that "translate" science and practice to industry practitioners. The focus is on up-skilling, building industry capacity and confidence in the new practices, as well as creating networks and facilitating peer-to-peer learning.
Research & Scientific Knowledge	Advanced technological solutions	Advanced technological solutions derive from major technological and scientific breakthroughs. Solutions are increasingly attractive to industry, since they are now multi-functional and scalable.
Experiments/Focus Projects:	Major scientific field demonstrations	A major scientific field demonstration project in a high-profile area demonstrates the viability of the proposed solution. A focusing event (e.g. a national conference) is dedicated to profiling the project and its findings.
Administrative tools	Best-practice guidelines & targets	Best-practice targets and technical guidelines are established. Science leaders may criticise process-based targets are too prescriptive, calling instead for outcome-based implementation targets to enable market offset schemes.

Case study of Knowledge Dissemination: Lodz, Poland

The city of Lodz, Poland, is prone to typical urban landscape problems: prolonged drought during summer months often coupled with heavy rain incidents, causing stormwater flooding. There is also a need to mitigate the urban heat island effect and treat excess nutrients in the waterways. To address these related challenges, stormwater retention via landscaped, decentralised systems is now seen as important for the future of the city. Over the last two decades, an awareness of the benefits of decentralised stormwater treatment has evolved, and there is growing consensus across government and industry that widespread implementation is both necessary and desirable.

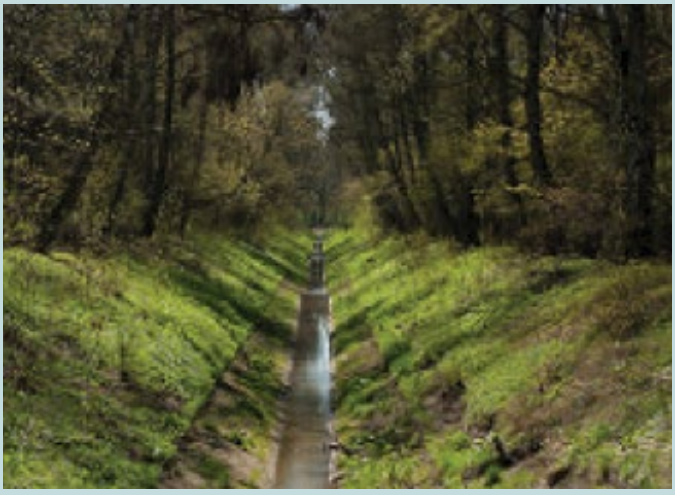
Providing further commitment to this approach are the recent directives from the European Union, such as the Water Framework Directive and the Communication of the European Commission on Green Infrastructure – Enhancing Europe's Natural Capital, making clear that green growth and nature is an important direction for the future.

Poland is now in a process of harmonising its national legislation to be consistent with these EU directives. In addition, Lodz developed its own city strategy for Integrated Development for the City of Lodz 2020+, released in 2013.

One of the three pillars of this strategy is the creation of blue-green networks throughout the city, thus creating a clear enabling policy framework at both the city and national scale.

In terms of implementation, a number of successful pilot and implementation projects have been conducted across the city, with technological refinements helping build confidence in this approach. These cases have been important to familiarise decision makers and industry practitioners with water sensitive urban design. As is typical in the knowledge dissemination phase, the focus for Lodz (and other cities in Poland) is now disseminating technical know-how across the industry and widespread capacity building on the design, installation and maintenance of this type of infrastructure.

To facilitate this upskilling of industry, the city of Lodz is in the early stages of developing technical guidelines and management tools to assist decision-making processes and the operationalisation of the blue-green infrastructure approach on a larger scale.

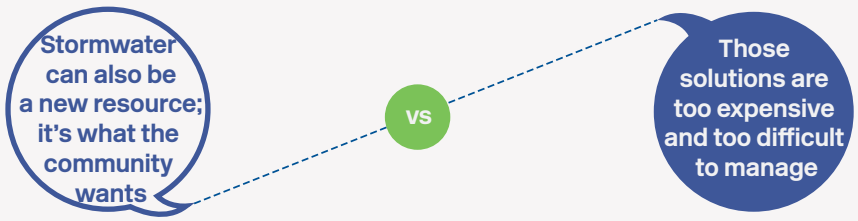


Source: Sebastian Szklarek

4.5 Phase 5: Policy and Practice Diffusion

This phase is focused on supporting widespread implementation through creating an enabling policy environment and up-skilling industry practitioners through capacity building programs. As practitioners become increasingly familiar with the new practice, there are a growing number of on-ground implementations and demonstrations.

Dominant Narratives for Policy and Practise Diffusion



Advocating Narrative

During the phase, commentary centres on the assertion that the solutions are working and helping to address a problem the community cares about.

Contesting Narrative

In this phase, the contesting narrative frames the solution as being impractical both in financial term and the onerous impact they have on stakeholders and organisations responsible for implementation.

Domains of Change for Policy and Practise Diffusion

Domain of change	*Indicators*	*Description*
Actor Network	Policy & decision coalition	A multi-disciplinary science-practice network establishes a policy and decision coalition for advancing implementation of the solutions.
Bridging Organisations	Science-industry-policy-capacity building	The bridging organisations connect with another science–industry partnership on an associated problem or issue in order to position the problem and solution in a broader context.
Research & Scientific Knowledge	Modelling solutions Capacity building	In this phase, research and science are focused on computer modelling tools to support implementation, and research moves into the social sciences, with an applied focus on enabling and/or diffusing research outcomes.
Experiments/Focus Projects:	Numerous field experiments	There are now numerous industry field experiments and demonstrations in various contexts and at different scales.
Administrative tools	Legislation & regulation Market offsets Regulatory models	The use of regulatory tool helps to embed change in the legal system (through legislative amendments); in the economic system (through a market offset scheme); and in the industry domain (through national best practice guidelines).

Case study of Policy and Practice Diffusion: The Netherlands

River flooding is a significant threat for a low-lying country such as the Netherlands, much of which sits below sea level. As a result of this geography, urban planning in the Netherlands has traditionally relied on separating, and maintaining the separation between, the land and the sea through an engineering dominated "command and control" approach. This has resulted in construction of an extensive and ever-higher network of dykes and other engineered water works to protect cities and communities from floodwaters.

However, a concern about the ecological consequences of this approach emerged in the 1970s, and this environmental ethic grew over the next two decades. Significant and potentially devastating floods in the Rhine and Meuse rivers in 1993 and 1995 then prompted a realisation that safety was no longer only improved by more and heavier infrastructure, and that a new approach to flood protection would be needed to ensure safety as well as liveability and resilience, particularly in the face of uncertain and variable climate change impacts.

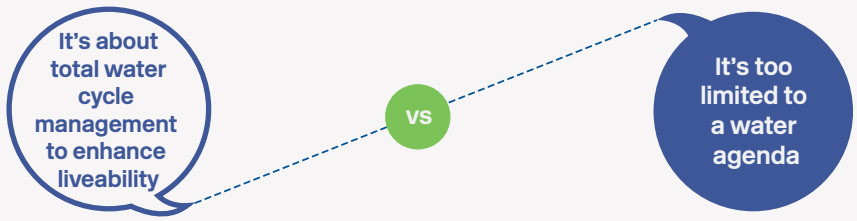
This new approach is encapsulated by the idea of "making room for the river", which preferences spatial, rather than infrastructural, flood protection measures. The "Room for the Rivers" policy was first introduced in 1996 and noted that strengthening dykes would no longer be the default option, and that spatial flood protection measures would be implemented as far as possible. Through the explicit integration of water and spatial planning, this new philosophy encouraged a widening of the floodplains in order to increase the discharge capacity of the rivers. As a result, more solution options opened up, and the Netherlands has shifted from total reliance on large-scale engineered solutions toward both large and small scale spatial and ecological solutions.

The government's commitment to this new approach was confirmed through a long-range planning document released in 2000: "Dealing differently with water: Water policy in the 21st century". A number of more detailed planning policies and strategic guidelines have since been released, providing more detail on the roll-out of this new approach. The implementation of the "Room for the River" program began in 2007, and by the end of 2016 is expected to have completed 39 individual projects across the country.

4.6 Phase 6: Embedding New Practice

In this final phase, the practice is now widely used and has institutional support, providing a strong foundation for its ongoing mainstreaming. The practice is increasingly linked to a broader sustainability agenda.

Dominant Narratives for Embedding New Practice



Advocating Narrative

Discourse in this phase centres around a big-picture view of the "human condition" that is focused on delivering prosperity and liveability for all. The new practice is framed as a means of delivering on broader liveability goals.

Contesting Narrative

The contesting narrative in this phase is dismissive of the new practice, downplaying its ability to assist with the broader societal goals in any meaningful way.

Domains of Change for Embedding New Practice

Domain of change	*Indicators*	*Description*
Actor Network	Multi-agency coalition	A multi-agency coalition has been formed and is central to the implementation and governance of the new practice.
Bridging Organisations	Formalised institution	These have become formalised institutions, supporting the new practice, enacting formal institutional practice. Bridging organisations in this phase may take on a strategic coordination and integration role.
Research & Scientific Knowledge	Next research agenda	There is no major new research agenda during this phase. Existing knowledge is reframed to establish links with broader liveability outcomes.
Experiments/Focus Projects:	Standard practice	There are no experiments or focus projects during this phase, as the new solutions are now embedded and have become standard practice.
Administrative tools	Political mandate Coordinating authority Comprehensive regulation	More comprehensive regulatory tools are linked to a political mandate and to a new coordinating authority charged with the strategic oversight of the new practice.

Case study of Embedding New Practice: Singapore

Singapore has made significant progress with implementing a water sensitive strategy, and is now approaching the Embedding New Practice phase of its transition toward being a Water Sensitive City.

With a dense population and limited water and land availability, Singapore began its transition by diversifying its water supply. In addition to surface water capture, Singapore built a desalination plant and invested strongly in recycled water (called NEWater). Five NEWater plants were constructed, which provide treated wastewater predominantly for industrial purposes. A small amount of NEWater is blended with raw water in reservoirs before undergoing further treatment – it is then distributed for domestic use. There is now strong political support for recycled water, and after an extensive community engagement campaign, there is also wide community support for NEWater.

Singapore then turned to focus on stormwater. It commenced its "Marina Barrage" project, which converted the Singapore marina into a freshwater reservoir in the heart of the city. Building on this foundation, Singapore launched its "Active, Beautiful and Clean (ABC) Waters" program in 2006. The program aims to transform the city's 8,000 km network of waterways into integrated blue corridors that improve water quality, while also creating vibrant and picturesque landscapes for the community to enjoy.

To realise the ABC program, Singapore began with an assessment of its institutional capacity to implement this water sensitive approach. This assessment led to the development of an implementation framework with three areas of focus: the regulatory and administrative framework, technological development and implementation, and building industry capacity. The implementation program was put in place to build on each key area and guide investment to address identified weaknesses.

In response, Singapore embarked on a journey to build capacity in relation to water sensitive urban design (WSUD), engaging external consultants to provide technical guidance in relation to the design and maintenance of WSUD systems. Following a number of successful WSUD demonstration projects, the government mandated an ABC approach for all new developments. In addition, a WSUD training course was established under the joint auspices of the peak bodies for architects, engineers, and landscape architects. Completion of the course provides practitioners with accreditation as an "ABC Water Practitioner", which is legally required to give the necessary sign-off for WSUD projects. A modelling tool was created in order to demonstrate compliance with the policies, and was used to help further develop WSUD targets. A WSUD training program was developed through the National University of Singapore, helping to build industry capacity.

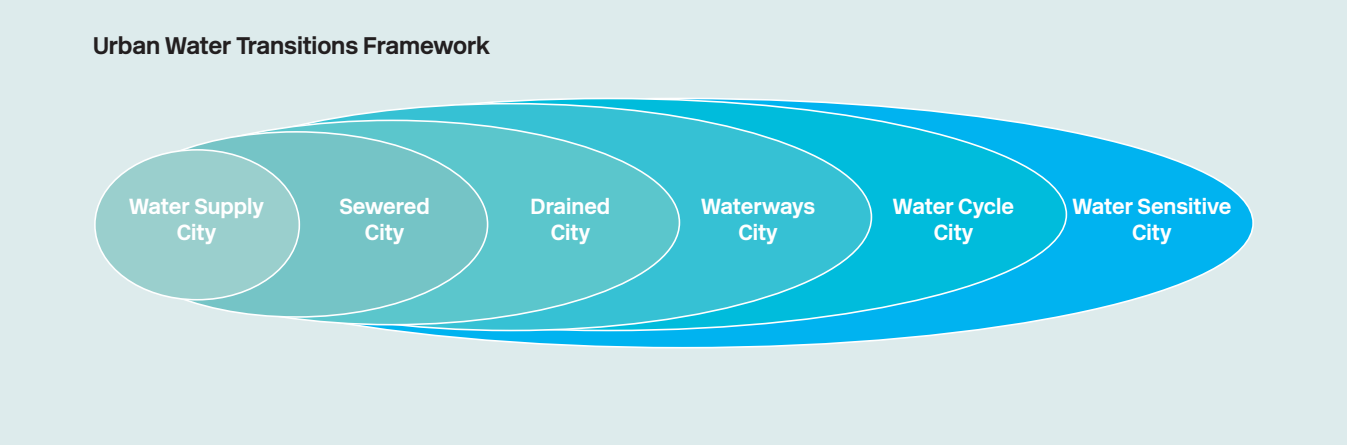
Now, WSUD is standard practice in Singapore. Designs are certified by an ABC accredited professional and projects demonstrate compliance through the rating tool, giving further confidence to government. There are ongoing capacity building programs and a strong regulatory framework. Singapore's water utility, the Public Utilities Board, played a key role as a bridging organisation through this transition, promoting a whole of government response to the improvement of water quality. Bringing together departments for transport, public housing, urban planning, and national parks, PUB helped ensure coordination and alignment in the delivery of the ABC approach. To support the PUB effort, a formalised institution in the Centre for Liveable Cities has recently been created under the auspices of the Prime Minister's Office, providing a strong political mandate and facilitating a multi-agency coalition for the delivery of a water sensitive city approach.

Part C – Applying the benchmarking tools to your city

5. Benchmarking procedure

This section outlines procedures for benchmarking your city, and identifying your city's current transition phase in its move toward more sustainable water management. Section 5.1 focuses on identifying the city-state that best characterises your city in terms of both its current practice and its aspired future. After you have identified where you are and where you want to be, Section 5.2 provides guidance on identifying what transition phase your city is currently in. That is, how far along your city is in realising the aspired future state. Once you have identified the city-state and transition phase that best characterises your city, how do you take action in order to move further along the Urban Water Transitions Framework? What processes can you use that will help you implement change toward the ideal of a Water Sensitive City? The final section of this report spells out one such process – also developed and trialled in Melbourne – to illustrate how the theoretical frameworks presented in Parts A and B of this report may be translated into practice.

5.1 How can I assess my city's current water management state?



Individual assessments

Given that water sensitivity is dependent on context, it is unlikely that there will be a standard set of performance indicators that are equally relevant to all cities across the globe. Nevertheless, by exploring the underpinning drivers and attributes of each of the city-states, the Urban Water Transitions Framework is a useful benchmarking tool for measuring the sustainability of a city's water management approach. As such, the framework is both well accepted in scientific literature and widely used in practice as a conceptual benchmarking and comparison tool.

When the Urban Water Transitions Framework is applied, the resulting benchmarking assessment is qualitative in nature, which helps you to have an integrated and detailed understanding of your city's water management practices within its real-world context. Qualitative analysis ensures that all relevant variables – especially those that may not be immediately apparent – are considered in the analysis. Further, it enables the integration and synthesis of multiple sources of evidence. For a comprehensive assessment of your city, both primary and secondary data should be used. An overview of the benchmarking process is provided in Figure 7, with further detail provided below.

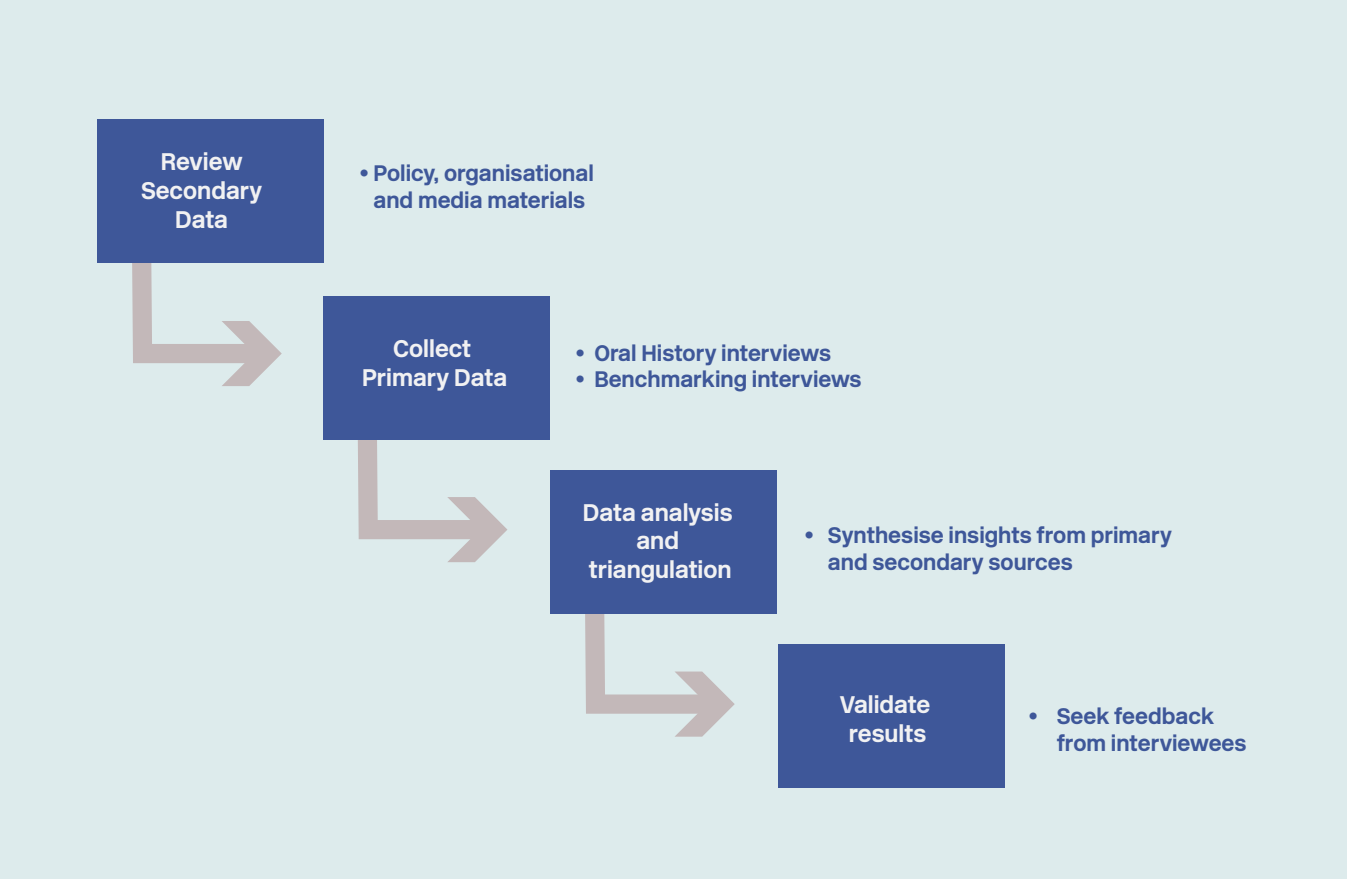


Figure 7. Benchmarking procedure

Secondary data

To begin the assessment, it is useful to conduct a desktop review of publically available documents, including policy materials, industry reports, and organisational literature from relevant industry bodies and professional associations. This can provide a useful framework for understanding and mapping the evolution of water management in the city to date. The focus of the desktop review should be on understanding the urban water successes and challenges to date (including efforts to address these challenges), as well as identifying the roles and responsibilities of all relevant stakeholders. It may be useful to construct a chronology of key events over the relevant time period. Engaging with the literature in this way can also reveal gaps in the timeline, which can be useful for focusing some of the discussions during interviews with relevant stakeholders.

Primary data

Following a review of the secondary data, interviews should be conducted with a broad range of stakeholder representatives within the city. Interviews should be conducted on the condition of anonymity and confidentiality so that people feel able to speak freely about their opinions on the current state of water management in their city. Any quotes that are used as evidence to illustrate key perspectives should be sampled from across the full spectrum of interviewees and be carefully selected to ensure the identity of interviewees remains protected. Alongside the interview data, interviewer reflections and observations should also be included in the subsequent analysis.

A number of different interview formats can be adopted to assist in the benchmarking process. Oral histories are a useful starting point, in which key stakeholder representatives that have been deeply involved in water management provide their "stories" of how the city's water management has unfolded both historically and more recently. These narratives are a valuable way of understanding how system changes have evolved and can assist with the identification of key turning points in the transition process.

Participants should be asked follow up questions in relation to why and with what evidence they have made that assessment. Questions in relation to drivers, challenges, and opportunities for change can provide valuable information about the broader system context and future trends. For a comprehensive assessment, it is useful to conduct both oral history and benchmarking interviews, in order to ensure all relevant information is captured in the subsequent analysis.

Data triangulation

Data from the interviews needs to be triangulated, which means that multiple perspectives from different people should be considered when drawing insights and conclusions about the data. While there is no set number of interviews that are required, interviews should be conducted with a diverse and representative range of stakeholders, from different organisations as well as different hierarchical levels (e.g. executive, management, and officer levels).

Alternatively, or in addition to oral history interviews, more focused benchmarking interviews can be undertaken. To facilitate this discussion, it can be useful to use the Urban Water Management Transitions Framework as a benchmarking tool. Ask participants where they would place their city on the continuum in relation to the city's aspiration, policy, and on-ground action, noting that each may sit within different city-states (see the section on data analysis below for further information).

Perspectives that are often important to consider include stakeholders that provide the following services:

- engineering and technical
- environment and natural resources
- parks, gardens, and landscapes
- roads and transport
- strategy and policy
- environmental, health, and financial regulation
- political representation
- consultancy
- land development
- science and research.

Triangulation with data from available policy, organisational, management, and other documentary evidence about water management in the city context is also important. At this stage, it may be necessary to update the secondary data analysis to account for any documents not included in the preliminary review.

Data analysis

When analysing the documentary and interview data, use the Urban Water Management Transitions Framework to identify the core characteristics of your city's water management **aspiration**, **policy**, and **action**. **Aspiration** refers to the dominant goal for water management across the sector as articulated by key stakeholders, **policy** refers to the vision for water management as contained in policy documents, and **action** refers to the mainstream, everyday, and business-as-usual practice on the ground. **Aspiration** will typically be ahead of on-ground practice.

It may be useful to plot each of a city's **aspiration**, **policy** and **action** along the continuum, as reflected in Figure 8. The objective here is to capture the dominant trends in each city. There may be outliers, as represented by the individual boxes labelled "individual stakeholder representatives" and "individual projects". This enables the analysis to capture the champions and projects that are pushing the envelope, while noting that such people or projects do not yet reflect the mainstream approach.

Data validation

Validating the data is critical for ensuring the robustness of qualitative research, through testing the accuracy of the synthesised insights gained from interpretation of multiple sources of evidence. A number of different validation methods can be used, and a combination may sometimes be appropriate. This includes validating benchmarking results through workshops with stakeholder representatives where preliminary insights are presented back to the interviewees, with an opportunity for discussion about the early insights and any perceived gaps in the analysis. Other validation methods include follow-up interviews with a representative selection of interviewees, and providing interview participants with an opportunity to comment on a draft benchmarking statement.

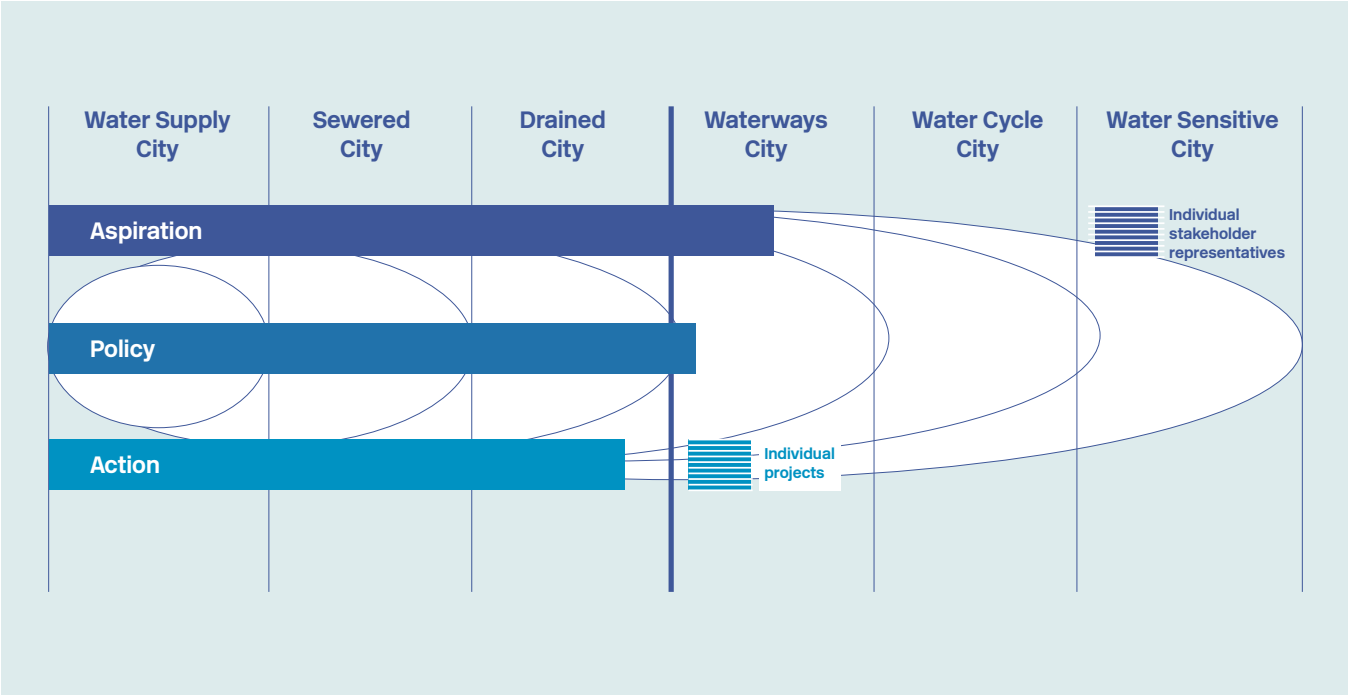


Figure 8. Example map of a city's aspiration, policy and action for its stormwater management practice

Comparative assessments

The Urban Water Transitions Framework can also be used to conduct a comparative city assessment, benchmarking a city against others based on current water practices. By assessing a city's water supply, sanitation, and drainage systems, as well as the provision of the service delivery functions, it is possible to place cities on the Urban Water Transitions Framework in order to make a comparative assessment of the sustainability of the existing water management regimes. To conduct a comparative assessment, you can follow the benchmarking process outlined above, and cities can be grouped according to the results.

Figure 9 demonstrates the outcome of one such comparative benchmarking exercise. It illustrates the results of a UNESCO SWITCH City Water Summit project that adopted the Urban Water Transitions Framework as a benchmarking and visioning tool to show stakeholders the state of their city at the outset of the transitioning process, and to help them envision the possible outcomes (Jefferies and Duffy, 2011).

Using the framework, cities were benchmarked on the basis of their existing water supply, sanitation, and drainage services. The assessment process produced two clear clusters of cities along the transition continuum. Cities in developing countries were aggregated between the Water Supply City and Sewered City end of the scale; those in developed countries clustered between the Drained City and Waterways City states. This finding illustrated the three hypotheses on which the model was built:

i. Developing cities are less advanced than developed cities in the sustainability of their current water management regimes.

ii. Developing cities are less "locked into" existing infrastructure and entrenched governance systems.

iii. Developing cities are therefore well placed to attain an advanced transition state more quickly through "leap-frogging", a pathway that nevertheless remains available to developed cities.

However, the question remains: "How may such leaps be taken in practice and where do we begin the transition?" The following section provides an overview of potential intervention points within a water management system. The information is based on empirical research into the social and institutional dynamics that characterise the transition toward a Water Sensitive City.

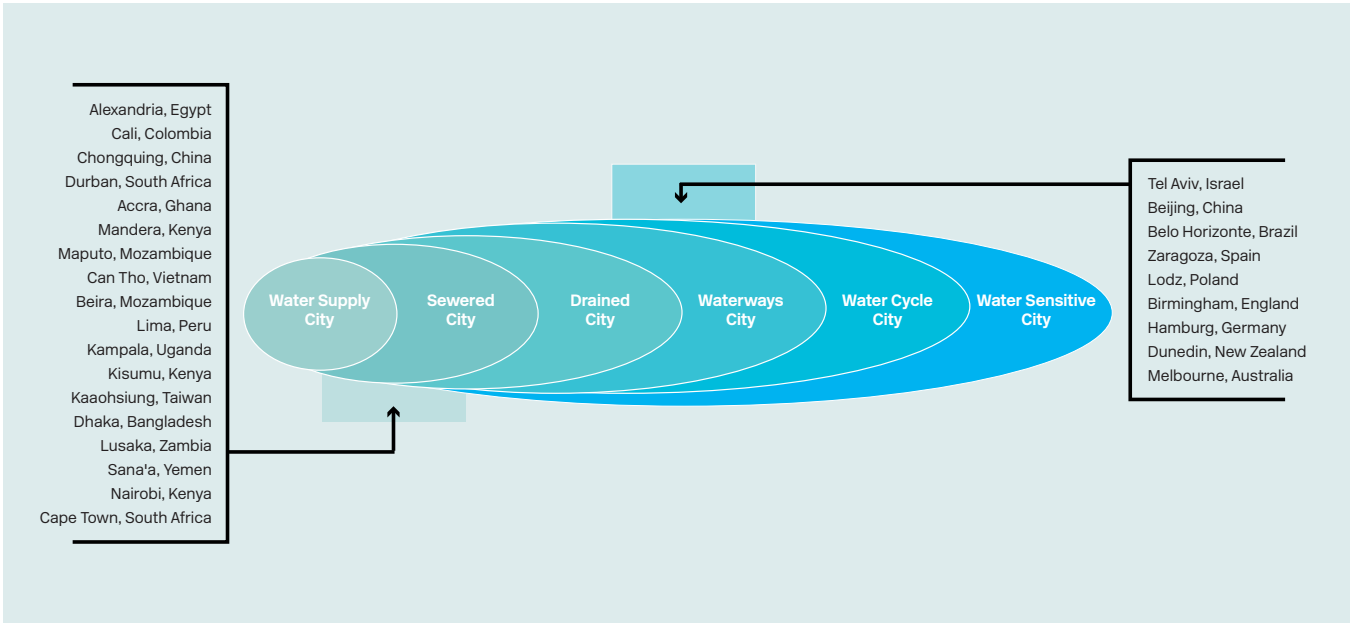


Figure 9. UNESCO SWITCH project to benchmark developed and developing cities [5]

[5] Adapted from: Jefferies & Duffy, 2011.

5.2 How can I assess my city's transition progress?

Having identified the city-state(s) that best represents your city's **aspiration**, **policy** and **action**, the next step is to understand what transition phase your city is currently in. For example, let us say that the benchmarking exercise reveals that the **action** is in the Drained City state, but the **policy** and **aspiration** are in the *Water Cycle City*. This part of the assessment can then be used to see where your city is placed along the transition journey. In other words, how close is it to being a *Water Cycle City*?

Underlying this part of the assessment is a recognition that transformational change takes time. So while **action** may be in the Drained City, some progress in moving toward the aspired future state may already be underway. This process helps identify the specific transition phase a city is currently in, which can be useful for revealing where future efforts should be focused in order to progress further along the transition curve.

Simplified assessment

Using the Transition Dynamics Framework (see Table 1 and Section 4 for further detail), it is possible to identify the transition phase that your city is currently in. A simplified assessment of the transition phase can be conducted by considering the dominant **advocating** and **contesting narratives** around new water sensitive practices. Narratives are a useful way of revealing the dominant conversations that are happening in relation to water sensitivity, and considering "which voices speak the loudest" can provide insight into the current phase of change.

As Figure 10 indicates, each phase of change is characterised by a different **advocating** and **contesting narrative**. The narrative clouds sitting along the S-curve reflect the generic narratives that we would expect to see at various transition phases. How these generic narratives are articulated will depend on what water management states a city is transitioning between. The italicised quotes in Figure 10 indicate how these narratives play out in terms of a transition toward more sustainable stormwater management practices.

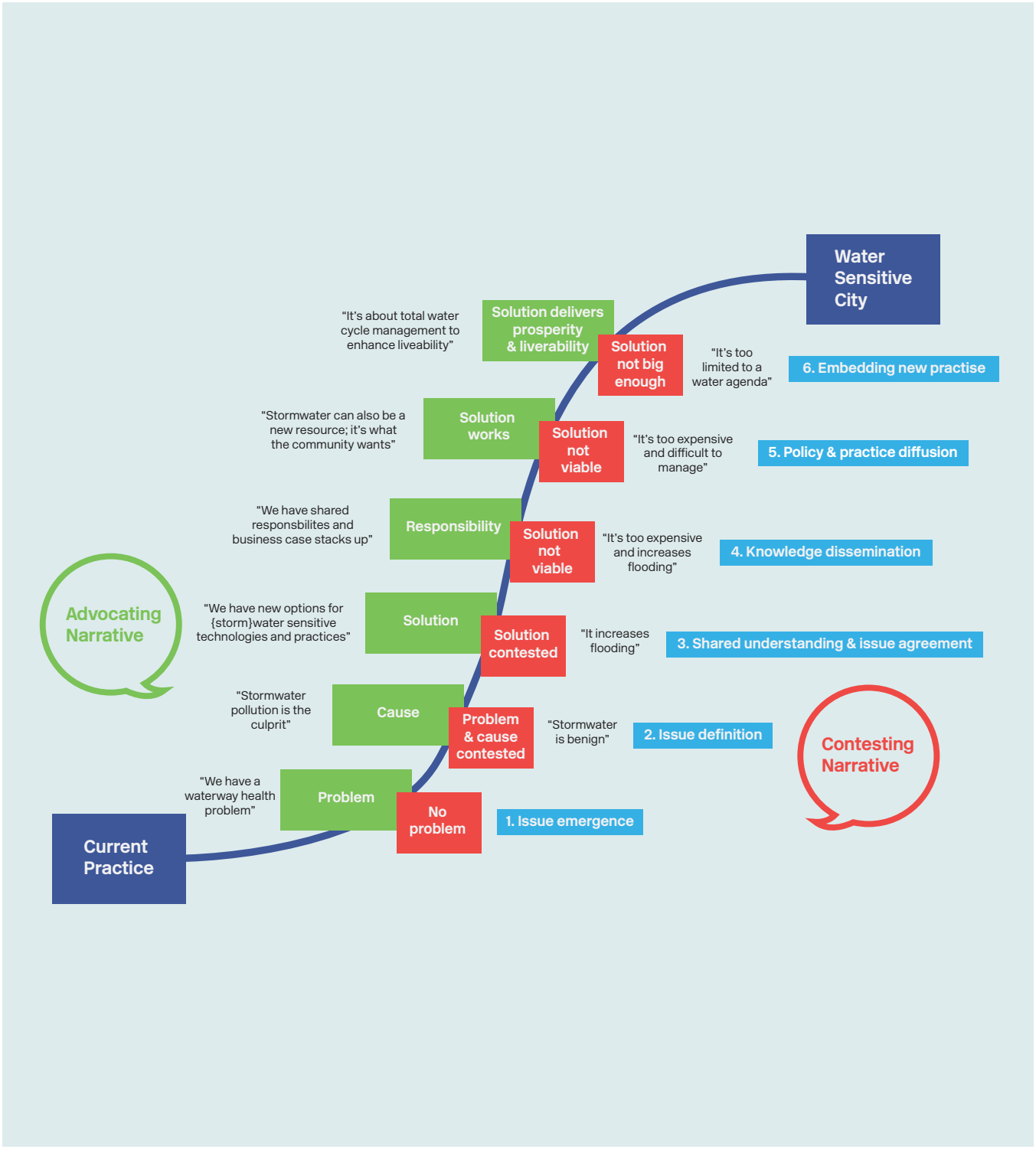


Figure 10. Advocating and Contesting Narratives

The simplified assessment uses diagnostic interviews, in which participants are provided with a diagram of the different phases of the transition with the key advocating and contesting narratives, and are asked to identify the current narrative and how the narratives have evolved over recent years. Follow up questions around the legitimacy of each of the discourses and who is giving voice to both the advocating and contesting narratives is recommended. A simplified assessment is particularly useful where cities do not have resources available to fund a comprehensive benchmarking assessment of their current transition phase. In the absence of sufficient resources for interviewing a wide range of stakeholders, a broad-brush assessment can be made by identifying the core narratives that are being told by people about water management. For cities seeking to undertake a more detailed assessment, benchmarking interviews around the dominant narratives should be followed by a more diagnostic assessment of the city's transition phase in relation to the five domains of change (described below).

Detailed assessment

A city's changing water management practice can be benchmarked using the Transition Dynamics Framework. For a more comprehensive assessment, it is useful to follow up interviews about the dominant water management narratives with more detailed questioning using the indicators within each of the six transition phases described in Section B. Both interview and documentary evidence are valuable for this diagnostic assessment.

As with the city-state benchmarking process (Section 5.1), oral history interviews with stakeholder representatives deeply involved in the city's water management can be undertaken, with the resulting narratives synthesised to map the phases of change to date. To facilitate the benchmarking process, diagnostic-focused interviews should then be undertaken, with the overall aim of identifying the current phase of change. To assist the assessment, it may be useful to use a number of the benchmarking tools within the interview (for example those in Figures 4 and 9, and Table 1), and ask participants where they would position their city on the respective frameworks and the reasons for that assessment. The benchmarking tools are provided in a format for printing in Appendix 1.

Once a particular transition phase has been identified, follow up questions should be asked around indicators within each domain of change (**actors**, **bridges**, **knowledge**, **projects** and **tools**). This can confirm that the appropriate transition phase has been identified and help unpack challenges and opportunities in the city's current context. The framework presented in Table 1 can be used as a checklist in order to identify the institutional features that are and are not present in the city's current context (a hypothetical example is presented in Table 2). Use of the framework in this way can be valuable for revealing strengths and vulnerabilities in the current transition phase, and identifying where future efforts should be focused in order to consolidate the current position and lay the foundation for further progress.

Group interviews with multiple stakeholders who have similar sectoral roles may also be useful for exploring possible strategic leverage points for future action in more detail. Again, validating the data is important, and can be achieved through stakeholder representative workshops, follow-up interviews or written feedback on a preliminary analysis.

Typically, a city will oscillate between two transition phases, as it tries to progress further up the transition curve. This is to be expected, as transformational change is difficult to achieve, and may sometimes reflect a "two steps forward, one step back" approach. To chart the city's transition journey to date, it may be useful to plot the evolution of change on a transition curve, such as the hypothetical example outlined in Figure 11.

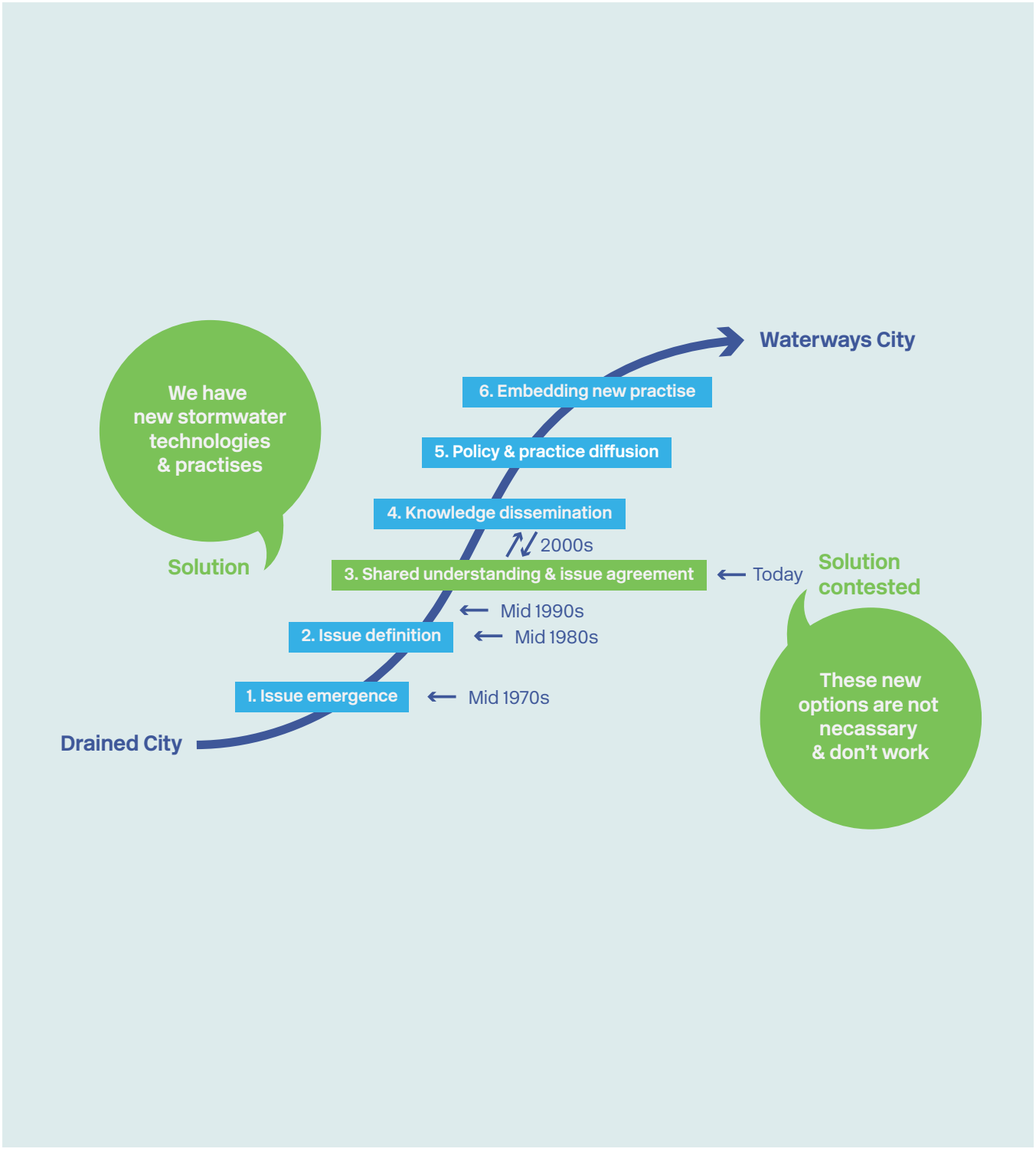


Figure 11. Transition evolution (hypothetical city)

6. Developing a transformation agenda

6.1 How do I identify priority areas for strategic action?

Using the Transition Dynamics Framework as a checklist lays the foundation for identifying priority areas for action. Identifying the transition phase that best characterises your city by considering which indicators are present provides valuable insight about your city's strengths and vulnerabilities to date. Commonly, the indicators across each domain of change in the relevant phase will not be of equivalent strength. That is, some domains of change (**actors**, **bridges**, etc.) may have a stronger foundation than others. Indicators within the **knowledge** domain are typically more advanced than the particular transition phase that has been identified. Scientific and technical innovations often lead transformational progress. A common area of vulnerability is in terms of bridging organisations, which play a critical role in providing coordination and alignment across science, industry, and policy sectors, and creating translation pathways for the scientific knowledge. Structures and processes for translating context specific research findings into policy and practice takes time, and will commonly benefit from more focused and deliberate efforts to establish and maintain them.

The benchmarking assessment for your city should help you identify strategic leverage points for future action. The priority should be to consolidate progress in relation to each of the indicators that are already present. Transformational change is not a linear or static process. As such, any vulnerabilities in relation to previous achievements should be identified, and strategies put in place to avoid them or minimise their effects.

From that point, strategies should be put into place to address any gaps in the benchmarking assessment. For example, while a city might have reached the **Knowledge Dissemination** phase, the indicators in relation to a science-industry-policy-capacity building bridging organisation and best-practice guidelines and tools might be relatively weak. In order to shore up the position at the **Knowledge Dissemination** phase, these two areas should be the focus of further action. Table 2 shows how the Transition Dynamics Framework is used as a checklist in a hypothetical city to identify gaps.

Table 2. Transition dynamics checklist (hypothetical city)

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	Scientific studies	N/A
2. Issue Definition	Science leaders	Science/industry	Cause–effect	Laboratory & 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 field experiments	Legislation & regulation Market offsets Regulatory models
6. Embedding New Practice	Multi-agency coalition	Formalised institution	Next research agenda	Standard practice	Political mandate Coordinating authority Comprehensive regulation

Some presence | Complete presence | Gap in current transition phase

This hypothetical city is currently sitting in the Shared Understanding and Issue Agreement phase. Indicators present in the city are highlighted in blue, with the darkness of shading showing the relative strength of each indicator. Gaps in the current transition phase are noted in orange. Applying the Transition Dynamics Framework reveals that most of the indicators of the Shared Understanding transition phase are present. However, the city is currently missing a bridging organisation to link the science, industry, and policy spheres. While the city is continuing to build knowledge characteristic of later transition phases (i.e. advanced technical and modelling solutions), efforts in the immediate term should focus on establishing a bridging mechanism; this will help to consolidate transition efforts to date and strengthen the foundation of the Shared Understanding phase. Continuing to pursue the indicators of subsequent transition phases without this foundation creates vulnerabilities that may lead to setbacks or failures in the transition process.

In identifying areas for future action, it is useful to again reflect on the aspiration for your city, the current practice and particular transition elements requiring priority action. It may be useful to put together tailored "packages" of initiatives that work in a mutually reinforcing way to build a solid foundation for moving toward increased water sensitivity. These packages could be implemented either consecutively or simultaneously. The specifics of each program would be determined based on the results of the earlier benchmarking activities. From this point, it may be useful to identify a number of short- to medium-term goals for your city and implement a number of initiatives that collectively build toward realisation of those goals.

By way of example, one goal could be to build a multi-stakeholder network that is aligned to a common vision. This package could include initiatives such as:

- A visioning process to develop a unifying and context-specific vision for the city's water future that has meaning to all the relevant stakeholders
- Workshops or planning days designed to bring together stakeholders that may be missing from current discussions around water futures
- Strategic planning workshops for all stakeholders to consider their role in delivery of the common water sensitive vision, and opportunities for collaboration.

A second and related goal could focus on building capacity across the broader water sector in relation to more water sensitive practices. This package could include initiatives such as:

- Establishing a dedicated capacity-building organisation to be a central repository of the latest knowledge, tools, and skills
- Holding regular "industry learning" events, including technical tours of demonstration projects
- Actively trying to grow the stakeholder network.

A third suite of initiatives could focus on encouraging mainstreaming of the new practice through enabling structures and administrative tools. This package could include initiatives such as:

- Lobbying for or facilitating regulatory change
- Establishing a market offset scheme
- Establishing a coordinating authority to ensure ongoing strategic and integrated planning.

Ultimately, the benchmarking results should aid in identifying the strategic leverage points for future action, and be considered alongside your city's priorities for a water sensitive future.

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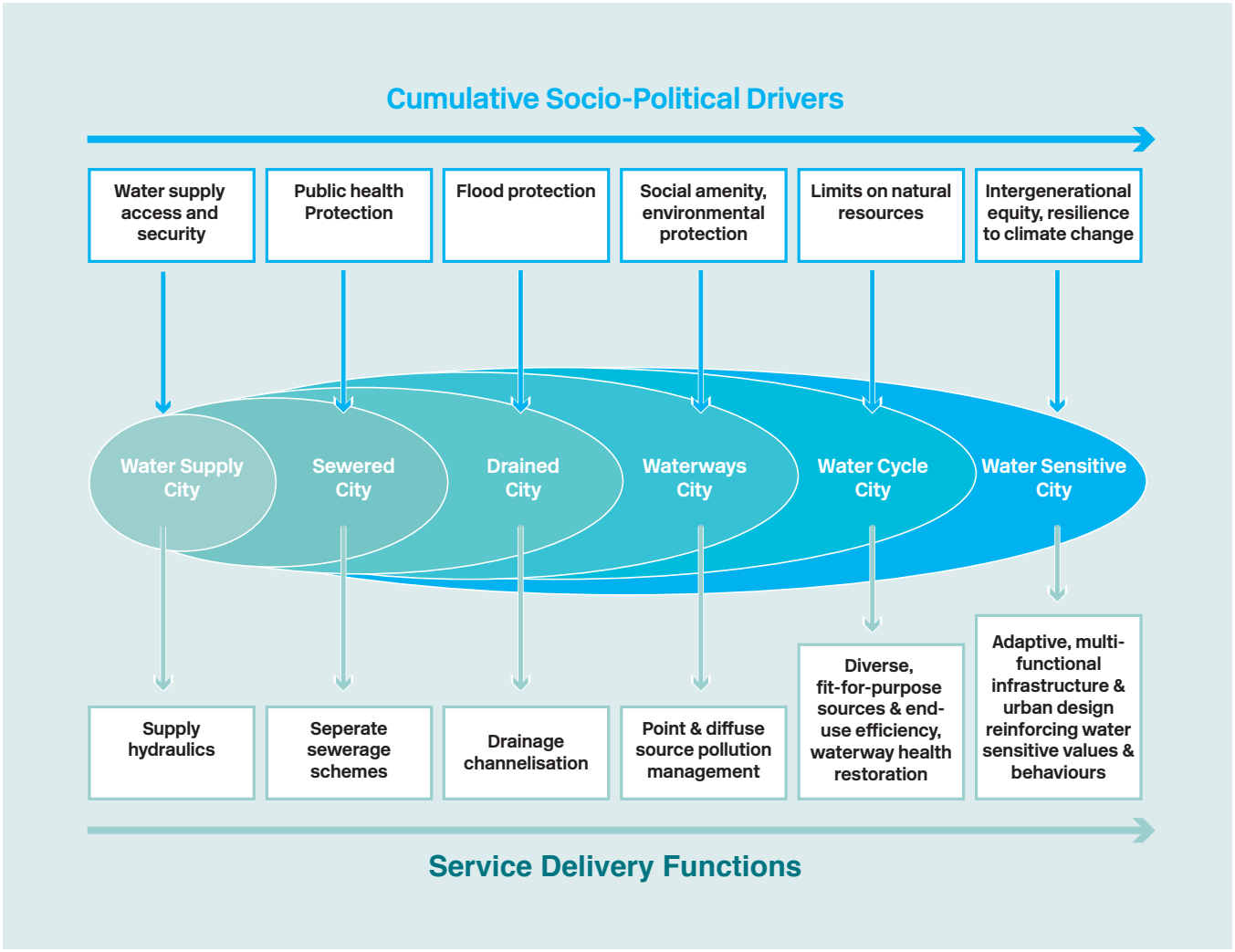
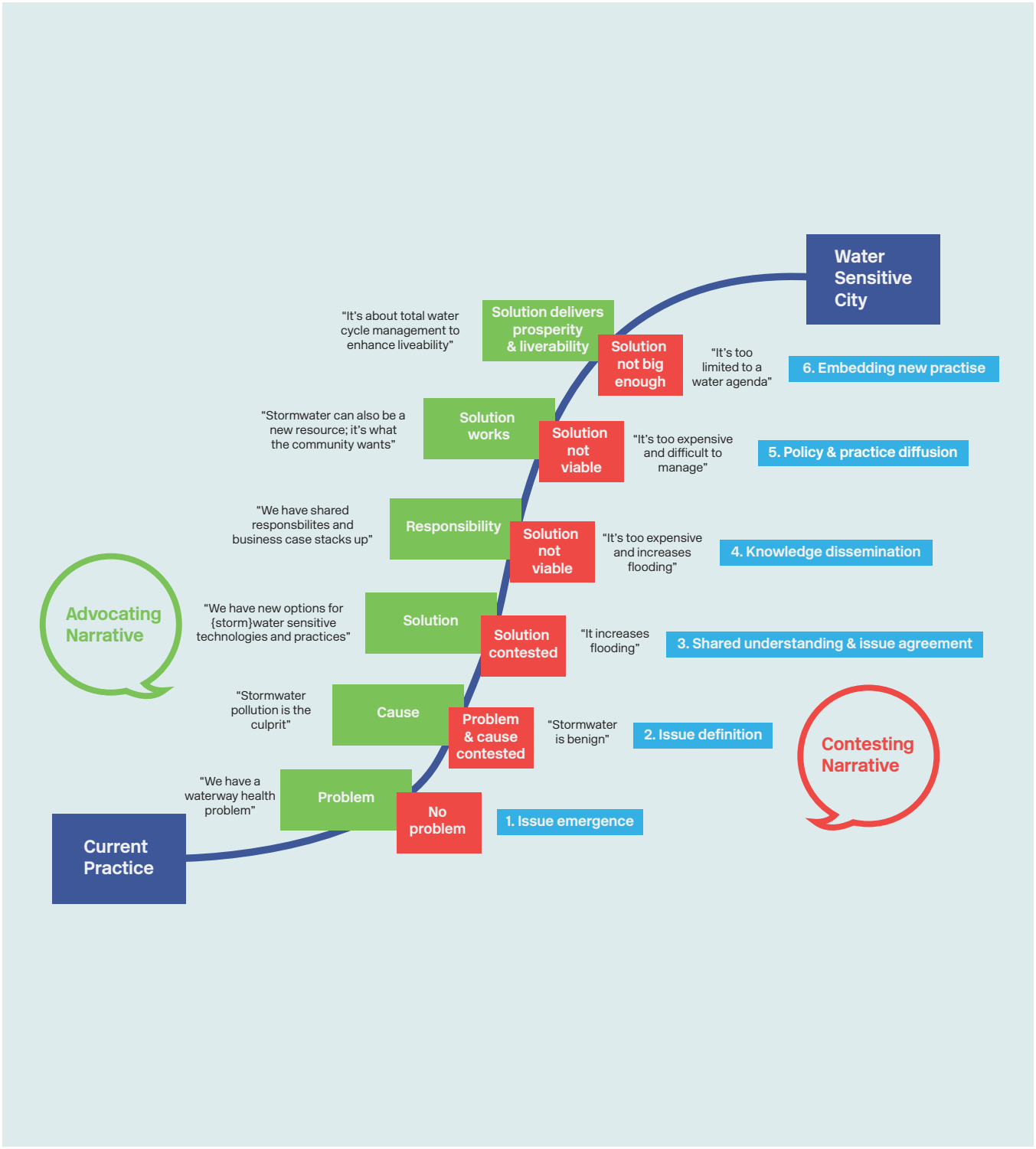
Appendix 1. Benchmarking Tools

Identifying Water Development State



Identifying Transition Phase (simplified)



Identifying Transition Phase (detailed)

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	Scientific studies	N/A
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6. Embedding New Practice	Multi-agency coalition	Formalised institution	Next research agenda	Standard practice	Political mandate Coordinating authority Comprehensive regulation

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