



CRC for
Water Sensitive Cities

Vision and Transition Strategy *for a Water Sensitive Greater Perth*

CRCWSC Integrated Research Project 1:
Water Sensitive City Visions and Transition Strategies



Australian Government
Department of Industry,
Innovation and Science

Business
Cooperative Research
Centres Programme

Vision and Transition Strategy for a Water Sensitive Greater Perth

IRP1 WSC Visions and Transition Strategies

IRP1-4-2018

Authors

Katie Hammer^{1,2}, Briony Rogers^{1,2}, Chris Chesterfield²

¹ School of Social Sciences, Monash University

² CRC for Water Sensitive Cities

© 2018 Cooperative Research Centre for Water Sensitive Cities Ltd.

This work is copyright. Apart from any use permitted under the Copyright Act 1968, no part of it may be reproduced by any process without written permission from the publisher. Requests and inquiries concerning reproduction rights should be directed to the publisher.

Publisher

Cooperative Research Centre for Water Sensitive Cities
Level 1, 8 Scenic Blvd, Clayton Campus
Monash University
Clayton, VIC 3800

p. +61 3 9902 4985

e. admin@crcwsc.org.au

w. www.watersensitivecities.org.au

Date of publication: August 2018

An appropriate citation for this document is:

Hammer, K., Rogers, B.C., Chesterfield, C. (2018) Vision and Transition Strategy for a Water Sensitive Greater Perth. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

This report builds directly on “Shaping Perth as a Water Sensitive City: Outcomes and perspectives from a participatory process to develop a vision and strategic transition framework”, which was the output of a precursor CRCWSC project, *A4.2 Mapping water sensitive city scenarios*.

Acknowledgements

The authors would like to thank the Water Sensitive Transition Network for their ongoing enthusiasm and commitment to the water sensitive city agenda in Perth. In particular, we would like to thank the working group for their willingness to work with the IRP1 team in developing and testing the methods and tools that are being applied in other cases across Australia. The authors would also like to thank Philippa Munckton for creating the vision images and for bringing Perth’s water sensitive vision to life.

Disclaimer

The CRC for Water Sensitive Cities has endeavoured to ensure that all information in this publication is correct. It makes no warranty with regard to the accuracy of the information provided and will not be liable if the information is inaccurate, incomplete or out of date nor be liable for any direct or indirect damages arising from its use. The contents of this publication should not be used as a substitute for seeking independent professional advice.

Table of contents

1. Introduction	5
1.1 About this report	5
1.2 What are water sensitive transitions?	6
2. Perth's water history	8
2.1 A short water history	12
2.2 Why aspire to a water sensitive Perth?	15
3. Vision for a water sensitive Perth	16
3.1 Aspired water sensitive outcomes	16
3.2 Guiding principles for water sensitive practice	26
4. Assessing Perth's current water sensitive performance	28
4.1 Perth's WSC indicator scores	28
4.2 Perth's benchmarked city-state	30
5. Advancing Perth's water sensitive city transition	33
5.1 Assessing Perth's WSC transition progress	33
5.2 Strategies for advancing Perth's overall vision	36
5.3 Strategies for advancing individual vision elements	38
5.4 Vision Theme 1: Fostering stewardship of the system	39
5.5 Vision Theme 2: Protecting and enhancing the wellbeing of the people and the environment	42
5.6 Vision Theme 3: Integrating and engaging with the built and natural environment	45
5.7 Vision Theme 4: Sustaining the long-term use of Perth's resources	48
5.8 Towards strategy implementation	51
6. Conclusion	52
Appendix A - Research methodologies	54
Appendix B - Transition analysis	56

Glossary

CRCWSC	Cooperative Research Centre for Water Sensitive Cities
Collaboration platform	A forum, network, group, program, project, or other mechanism for connecting a diverse group of stakeholders to share knowledge and information, develop ideas and establish a collective voice
DWER	Department of Water and Environmental Regulation
IRP1	CRCWSC Integrated Research Project 1 <i>Water Sensitive City Visions and Transition Strategies</i>
Narrative	A well-articulated rationale and/or compelling case for a particular practice or action, including a description of its ecological, economic, and social benefits
Traditional Owners	Traditional custodians of Greater Perth's catchments, together with other Aboriginal people who have made it their home
Transition	A fundamental shift in cultures, structures and practices as society changes from one pattern of socio-technological development to another, usually more sustainable, pattern
Transition Dynamics Framework	A framework that conceptualises how system-wide changes in practice (e.g. the transition to water sensitive practices) unfold over time, based on the establishment of key enabling factors: individual and organisational champions, platforms for connecting, science and knowledge, projects and applications, and tools and instruments
Urban form	The physical characteristics that make up the built environment, including urban density and size, parcels and buildings, public spaces, ecological assets and key services such as transport and drainage
Urban Water Transitions Framework	A framework that conceptualises different forms of urban water servicing as a city responds to evolving drivers: Water Supply City, Sewered City, Drained City, Waterways City, Water Cycle City, and Water Sensitive City
WSC	Water Sensitive City; a WSC provides water system services in a way that reflects an integrated approach to infrastructure, the built form, the environment, governance and community, in order to deliver outcomes that support the enduring sustainability, liveability, resilience and productivity for a place's community and ecosystems
WSUD	Water Sensitive Urban Design; an approach to the planning, design and maintenance of urban landscapes that will deliver WSCs through protecting and enhancing natural water systems and integrating the management of the total water cycle
WSC Index	A tool to benchmark and diagnose the water sensitive performance of a place (from the municipal to metropolitan scale), based on 34 indicators organised by seven goals: good water sensitive governance, community capital, equity of essential services, productivity and resource efficiency, ecosystem health, quality urban space, and adaptive infrastructure.
WSTN	Water Sensitive Transition Network: an informal community of practice in Perth, originating from the A4.2 visioning workshops in 2015, that aims to advocate and provide support for Greater Perth's transition to a water sensitive city.

1. Introduction

1.1 About this report

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) has undertaken significant research and investigations in Perth and other regions of Australia in order to develop new knowledge to support the transition of Australian cities and towns to more water sensitive practices.

One of the key lessons from this research is the critical need for collective and collaborative efforts across government, industry and the community to deliver a shared vision for a water sensitive city. Although often perceived as a major impediment to change, technological advances in the water sector are significant and solutions are often readily available. This report, therefore aims to provide guidance on how to enable and drive Perth's transition towards an aspired water sensitive future by focussing on coherent actions across diverse stakeholders to drive change.

This guidance is based on outcomes of the CRCWSC research program that has considered Perth's water system from a number of perspectives, including the ways in which water has shaped the development of Perth and how water system services are delivered today. The report presents a vision for how water services might be delivered in the future and a pathway for transitioning from the present to the aspired future city. Together, these elements set out a broad scope of action for coordinating and steering the transition and for guiding Perth's urban water, planning, environment and development sectors.

This document and the actions it describes have no organisational commitment or status in government policy. It is not intended to be a substitute for a state-led water strategy. However, it is intended to provide guidance for future policy and planning, to be used by many different stakeholders as a sector-wide strategic framework to inform the development of intra- and cross-organisational policies, strategies and programs.

The content in this document reflects the findings from multiple projects across each of the CRCWSC's research areas including society, water sensitive urbanism, future technologies, and adoption pathways. Two related projects have particularly informed the development of this report: *A4.2 Mapping Water Sensitive Scenarios*, completed in 2015, and this current project *IRP1 WSC Visions and Transition Strategies*¹. Both projects have involved a review of qualitative and quantitative evidence in literature, participant interviews and workshop discussions. The individual methodologies underpinning these research projects are outlined in the appendices.

The following sections are presented in this document:

Section 2	An analysis of the local historical, social cultural, ecological and geographical context for water in Perth, as well as current and future drivers that articulate clear rationale for change
Section 3	A vision for Perth as a water sensitive city in 2065 including a set of vision outcomes and associated principles for practice
Section 4	Assessment of Greater Perth's current water sensitive performance using the WSC Index benchmarking tool
Section 5	A strategic transition framework for delivering the vision, including identification of strategies that are considered critical to pursue

This document will be supported by an Implementation Plan currently being developed by the Perth Water Sensitive Transition Network (WSTN) with assistance from the CRCWSC. The Implementation Plan will detail actions and ideas to implement the strategies in this document to achieve Perth's water sensitive vision. It will also provide a framework for delivery, supported by monitoring and review of transition progress.

¹ This IRP1 report builds on and supersedes the A4.2 report: Rogers, B.C., Hammer, K., Werbeloff, L., Chesterfield, C. (2015). *Shaping Perth as a Water Sensitive city: Outcomes of a participatory process to develop a vision and strategic transition framework*. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

1.2 What are water sensitive transitions?

As cities and towns globally are grappling with the challenges of climate change and rapid urbanisation, practitioners, decision-makers and academics are recognising the importance of water in supporting urban liveability, sustainability and resilience for a city's long-term prosperity.

In Australia, the vision of the WSC is now widely used to represent an aspirational concept in which water has a central role in shaping a city. In a WSC, people are not disrupted by flooding, and can enjoy reliable water supplies, effective sanitation, healthy ecosystems, cool green landscapes, efficient use of resources, and beautiful urban spaces that feature water and bring the community together.

A WSC incorporates innovative infrastructure, design and governance solutions. For example, water recycling at different scales through wastewater recovery and stormwater harvesting provides a diversity of water sources and improves the health of downstream rivers and creeks by reducing pollution and flow impacts. Water sensitive urban designs integrate nature-based infrastructure into the landscape to provide hydraulic and water treatment functions, as well as amenity benefits such as an aesthetic environment and mitigation of urban heat island effects. Integrated and collaborative land use and water planning results in catchment-scale approaches to enhancing flood resilience and connecting areas of green and blue to create ecosystem and recreation corridors throughout the city footprint. Citizens are active in caring for water and the environment, and there is cohesion amongst the community as their sense of place and collective identity is nurtured through their connection with water.

Many places are starting to articulate aspirations represented by the WSC concept. Becoming a WSC requires a significant departure from the conventional mode of water servicing, which typically manages water as separate streams for water supply, wastewater and stormwater through large-scale, centralised infrastructure. These traditional water systems have given us critical benefits such as clean water, safe sanitation and effective drainage, and this mode of servicing is still an important part of a WSC. However, we now recognise that adaptations are needed to address key social and environmental vulnerabilities that result from conventional approaches, such as degraded waterways, uncertain and extreme rainfall patterns and growing community expectations for improved liveability.

The Urban Water Transitions Framework presented in Figure 1 depicts the evolution in water system servicing as these drivers unfold. Most cities in the world would appear somewhere on this continuum, however, a city's journey from a water supply city through to the aspirational WSC is not linear. Australian cities are typically somewhere between a drained city and a water cycle city, with observable features across all six of the city-states.

Becoming a WSC requires significant changes in policy and practice as the water servicing system moves through different city-states. A successful transition will therefore rely on commitment and alignment amongst many different people and organisations.

Developing a shared perspective of water today, a compelling vision for the future and a framework to guide coherent strategic action is critical for establishing the understanding, motivation and capacity amongst stakeholders to drive their WSC transition.

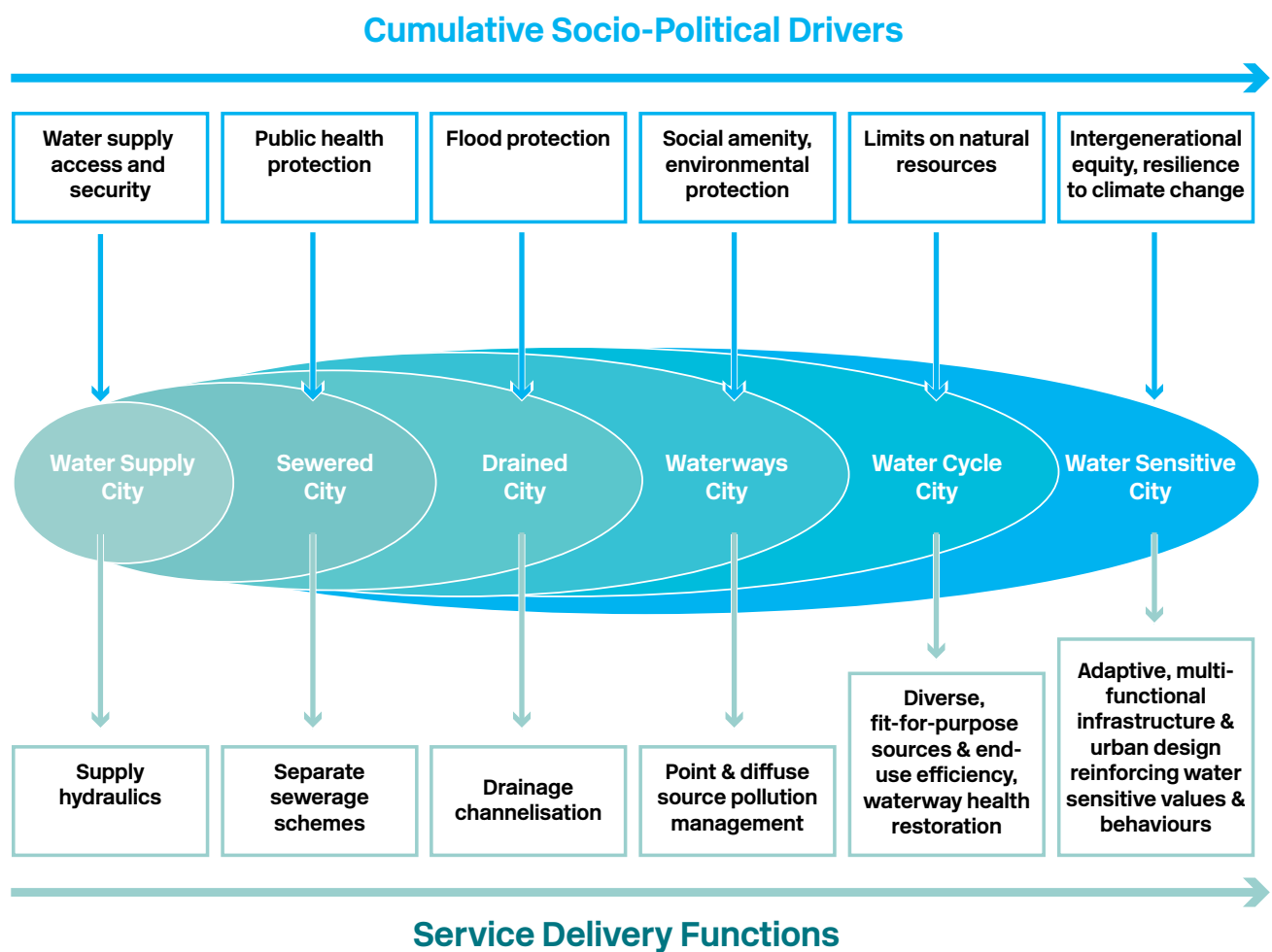


Figure 1. Urban Water Transitions Framework (Brown, Keath & Wong, 2009) ²

² Brown, R., Keath, N., & Wong, T. (2009). Urban water management in cities: historical, current and future regimes. *Water Science and Technology*, 59(5), 847–855.

2. Perth's water story

2.1 A short water history

The climate of Perth is changing, becoming drier and hotter. Annual rainfall has fallen significantly since the 1970s and Perth's water supply is regarded to have been one of the most affected by a changing climate that any other major city in the world. This creates the formidable challenge of providing reliable water for an increasing population while maintaining Perth's status as one of the world's most liveable cities.

The people of this remote part of south-west Australia have always had to adapt to the unique environment of the region. Long before Europeans arrived in Australia, the Swan Coastal Plain was inhabited and cherished by Noongar peoples who relied on the springs, rivers, wetlands and estuaries for water, food and other resources. They maintained a strong spiritual connection to both the land and water. According to Noongar culture, the rivers, valleys, wetlands, and landforms were carved out by the *Waugal*, a serpent-like dreamtime spirit.

European settlers brought with them different values and perspectives regarding the natural landscape. From its beginnings in 1829, the Swan River Colony struggled to become established. The British settlers were faced with isolation, an unfamiliar environment, unreliable climatic conditions and disputes with Noongar peoples.

The Mediterranean climate yielded wet winters and hot, dry summers and the settlers soon realised that without storage, the amount of rainfall during the winter months was insufficient to supply the city with water throughout the summer.

Settlers turned from relying on surface water to collecting and storing water from local natural springs, which was the major water source until the end of the 19th century. As Perth continued to grow, especially with the discovery of gold in 1885, the city was forced to increase its water supply infrastructure to cope with the increasing population. Construction of dams began at the turn of the century to capture and store surface water supply.

The Goldfields Water Supply Scheme was completed in 1903, a visionary engineering scheme by C. Y. O'Connor involving construction of Mundaring Weir in the Darling Range and a pipeline to carry water 560km to Kalgoorlie. Demand for water in Perth continued to grow, with further water crises in the early 1920s leading to water restrictions and public pressure on the government to improve supplies. In 1923, the government committed to build the Hills Water Supply Scheme and entered an era of large dam construction. The opening of Canning Dam in 1940 was considered a milestone in provided a reliable and abundant supply of water to the people of Perth. Today, the Integrated Water Supply Scheme (IWSS), managed by the Water Corporation, delivers 289 billion litres of water each year to over 2 million people in Perth, the Goldfields and agricultural region and some parts of the South West, but only a small percentage of that is now provided by inflow to dams.

In response to a typhoid epidemic and the high death rate in Perth due to poor sanitation in the late 1800s, a reticulated network of deep sewerage pipes and pumping stations were built with household connections commencing in 1911. By 1933, 50% of dwellings in the metropolitan area were sewered, but by 1976, still just over half of all dwellings were unsewered and septic tanks were widely relied upon for sewerage disposal. The infill sewerage program commenced in 1994 to provide properties in established urban areas with access to the reticulated sewerage network.

After World War II, the city began to rely more heavily on the extraction of groundwater, initially from the shallow superficial aquifers of the Gnangara and Jandakot mounds and later to the deeper confined aquifers. The availability of accessible, affordable and good quality groundwater has shaped Perth's urban form. This source was (and still is) accessed directly for urban horticulture, public open space, sporting grounds and for many domestic gardens. There was a boom in backyard bore installation during the late 1970s and early 1980s with subsidies for domestic garden bore installation as recently as the early 2000s.

Accessing from the Gnangara and Jandakot mounds proved to be relatively easy, low cost and reliable for many decades; however, groundwater systems are complex and the consequences of cumulative impacts of extraction and changes to recharge, particularly with a drying climate were not well understood until the 1990s.

There were many freshwater wetlands and lakes on the Swan Coastal Plain that were rich with flora and fauna prior to European settlement. Most of these naturally occurring wetlands are an expression of the high groundwater table. Some of these wetlands are seasonal, drying out when the groundwater levels drop in summer. Most of the wetlands in the Perth metropolitan area have been filled, drained, mined for peat or clay, or cleared of vegetation. Open channels were dug across the Swan Coastal Plain to drain wetlands and waterlogged land to enable agriculture and urbanisation.

The removal of these natural water filters in the landscape and the construction of drainage channels and piped systems to convey stormwater and shallow groundwater have contributed significantly to the water quality and health problems of the Swan and Canning river systems and estuary.

Perth's groundwater system has supported the maintenance of green open spaces during many long hot summers, but recent impacts on the sustainability of the system have been under recognised by much of the community. The level of science, regulation and water planning has increased significantly but groundwater levels have been dropping since the 1970s and the system will not sustain the projected demand.

Total water use (scheme and self-supply or centralised and decentralised supply) in the Perth and Peel region in 2016 was 580 gigalitres. This is made up of 71% groundwater, 22% desalination, 6% surface water and 1% recycled water. 46% of the total 580 gigalitres of water used in the Perth and Peel region is supplied through the public drinking water supply scheme (IWSS). The remaining 54% is self-supplied through licensed private bores, municipal bores and unregulated back yard garden bores.

Strategies to decrease demand through water use efficiency and water sensitive landscaping and practices, as well as development of alternative water sources both for scheme and self-supplied water are required to address this projected gap. This is critical if Perth is to bring abstraction to within sustainable limits and rebalance the groundwater system.



Today, there are numerous strategic initiatives occurring in Perth that can support efforts to achieve the vision of a water sensitive city. One of these strategies includes the Perth Peel Water Supply Strategy for a population of 3.5 million people by 2050, which aims to address the significant challenge of how to provide water for a city growing by nearly 70% under an ongoing drying climate.

Perth's unique environment has shaped how urban water is managed and the institutions that are present within Perth's urban water sector today. The following timeline outlines more recent major events in Perth's urban water sector that lead up to present day.

1975 - 2000	Reduced inflow to surface water dams. Various demand management measures (e.g. water restrictions) implemented and groundwater extraction is increased to meet supply demands.	2004	Kwinana recycling plant opens to supply fit-for purpose recycled wastewater for industrial use. The Water Corporation adopts a 'Security through Diversity' approach to water management which includes plans for desalination, development of groundwater sources, and further demand management campaigns.
1988	Formation of the Swan River Trust.		
1994	Guidelines for implementing Water Sensitive Urban Design (WSUD) are released in Western Australia.	2005 - 2014	Mining resource boom drives high economic and population growth, thus increasing land development.
1996	Following the Council of Australian Government reforms, the WA water sector is restructured into a services utility (Water Corporation), water resources development and conservation agency (Water and Rivers Commission) and regulatory body (Office of Water Regulation).	2006	Dedicated water management agency, the Department of Water, is created.
2001 - 2010	Surface water storage inflows continue to decline, reaching a record-breaking low (12GL) in 2010. Groundwater levels decline.	2006	Australia's first desalination plant, the Perth Seawater Desalination Plant at Kwinana, is brought online to supply 45 GL (approximately 17%) of Perth's annual potable water supply.
2001	Two day a week sprinkler rosters introduced.	2007	State Water Plan released. Provides strategic framework for water resources planning and management.
2003	Then Premier Hon Geoff Gallop MLA hosted a three day Water Symposium drawing together community leaders and government representatives to develop a response to the decline in rainfall; as a result, the State Water Strategy was developed and released, setting a broad agenda for sustainable water management.		Stormwater Management Manual for Western Australia released.
			Swan and Canning Rivers Management Act 2006 came into effect.
		2008	Better Urban Water Management released. Provides guidance on incorporating WSUD into land development through State Planning policies.

2008	Healthy Rivers Action plan released to protect the environmental health and community benefit of the Swan and Canning rivers by improving water quality.	2013-2015	The State government announces plans to amalgamate Perth's 30 local governments to 16 but ongoing opposition from many local councils led to this being removed from the State's agenda in 2015.
2009	Water Corporation's water supply management plan, Water Forever, released. Includes plans for reducing water demand, increasing water recycling, and developing new water sources. Gnangara groundwater areas allocation plan released which caps water use from Perth's largest groundwater resource; initiates a step down in groundwater abstraction for public scheme supply; and a focus on water wise programs for self supply water users. Three-year trial of a groundwater replenishment scheme (water treatment and recycling for aquifer storage and later recovery) by the Water Corporation begins.	2014	State Government approves construction of a 14 GL Groundwater Replenishment Scheme, the first indirect potable recycling scheme using groundwater storage in Australia, after a successful three-year trial. Perth Regional Confined Aquifer study commenced.
	Swan Canning Water Quality Improvement Plan was released providing load reduction targets for the Swan Canning catchments to protect the river system.	2015	Swan Canning River Protection Strategy released to coordinate the multiple stakeholder management framework to protect and enhance the ecological and community benefits of the Swan Canning river system.
		2016	State Government announces plans to expand the Groundwater Replenishment Scheme, doubling its capacity to 28 GL of water recycled each year.
2010	Further water restrictions imposed through winter sprinkler ban.	2016	Launch of joint Department of Water and Water Corporation Drainage for Liveability program
2011	The Southern Seawater Desalination Plant at Binningup brought online, initially able to supply 50 GL of potable water annually, expanded to supply 100GL. The WA Local Government Association (WALGA) develops an investment plan for the Swan-Canning Catchment, raising issues and options for drainage governance.	2018	Release of Perth & Peel @ 3.5 million

2.2 Why aspire to a water sensitive Perth?

Greater Perth is now at an important juncture in its development as a major Australian city. Planning is underway to accommodate a projected 3.5 million people for Perth and Peel by 2050, requiring significant consumption of resources and urban expansion and densification. The impacts of climate change on Perth's rainfall patterns, temperatures and sea level are already being felt and will be exacerbated into the future. Perth faces challenges of both not enough and too much water (depending on the location and the season), of protecting water quality for water supply and ecosystems, and of maintaining or recreating waterways, wetlands and greenery to add to amenity and mitigate heat effects of the urban environment.

Against this backdrop, the community's growing aspiration for Perth to be one of the world's most liveable cities sets a clear agenda for the city's future. It is therefore critical that today's planning, design and infrastructure decisions are made with reference to the long-term liveability, sustainability and resilience of Greater Perth.

The management of water is fundamentally linked to Perth's broad goals. The Department of Water and Environmental Regulation (DWER) is responsible for managing and regulating the state's environment and water resources. Potable water is supplied by the Water Corporation through a centralised, large-scale system. However, decentralised supply of non-potable water (through self-supply groundwater bores) is a key feature of Perth's water management, supplying 54% of all water used in the Perth Peel region. Over 90% of properties in Perth are connected to the centralised reticulated sewerage network, operated by the Water Corporation. Wastewater is largely collected, treated and discharged to the environment, however recycling and reuse of wastewater in Perth is increasing. Management of the drainage system is fragmented. The Water Corporation operates 40% of Perth's urban drainage networks (the main arterial drainage networks) to protect properties from flooding. Local governments plan, construct, operate and maintain local drainage networks, while DWER provides the overall strategic planning and regulatory functions. This system has a strong legacy in meeting the city's basic needs for water supply, safe sanitation and flood protection but it has also led to deteriorating waterway and wetland health and has been vulnerable to the drying climate of Western Australia. Persisting with the traditional water management approach will mean these challenges become more pressing with each passing year.

Poor waterway health has long been identified as a challenge for Perth, with the majority of wetlands along the Swan Coastal Plan having been filled, drained or cleared and many inland waterways showing indications of poor ecosystem health. Sixty iconic wetlands across the Gnangara and Jandakot mounds are managed to limit the impacts of groundwater abstraction and while affected by drying climate, many retain significant ecological, social and cultural values. As Greater Perth continues to grow and become more urbanised, traditional approaches to development and drainage will result in hydrological changes that will impact on the health of wetlands and waterways. Without a water sensitive approach to development, pollution from human activities will increase, causing even higher pollutant loads to enter surface, ground and coastal waters. This poorer water quality will result in more frequent algal blooms, intensified by the warmer air and water temperatures and drier climate predicted for the region. The resultant ecological impacts will be significant, reducing the biodiversity of Perth's iconic coastal and inland water systems. Algal blooms also disrupt people's access to waterways for swimming and other recreational pursuits.

Climate change will affect the water quality of Greater Perth's aquatic environments in other ways too. The Swan Canning river system is expected to experience increased saltwater stratification due to sea level rise and decreased streamflow, depleting the amount of oxygen available to aquatic species in the lower layers of water. Coastline aquifers are also vulnerable to saltwater intrusion from sea level rise and intensified storm surges; this intrusion changes the ecosystem functioning and can lead to salinisation of important freshwater resources. People and property are also at risk from increased storm surge and sea level rise, causing more frequent and severe coastal and inland flooding, impacts that are already being experienced in some areas (e.g. Fremantle).



Perth is the capital of the Southwest Australia Ecoregion, one of only thirty-five internationally recognised Biodiversity Hotspots (i.e. both biologically rich and deeply threatened). The extreme weather events predicted as the climate changes also include longer and more intense heatwaves, which will have severe health impacts for both Perth's people and its flora and wildlife. Combined with patterns of urban development that do not incorporate sufficient amounts of green space, trees or water bodies, the urban heat island effect is expected to significantly increase the incidence of heat-related illnesses and deaths during extreme heat events. People's physical and mental wellbeing is also affected by urbanisation approaches that do not prioritise public open space, green landscapes and recreational opportunities.

Land clearing for urban development has led to the widespread depletion of endemic vegetation and natural wetlands. A large number of species in the Wheatbelt and Swan Coastal Plain have become extinct and significant changes have occurred to the ecosystems and habitats of native flora and fauna, threatening Perth's rich biodiversity. Reduced availability of fresh, locally grown food is also likely, as land development encroaches on traditional agricultural areas and rainfall decreases with climate change.

Reduced rainfall also impacts on the availability of water resources for Greater Perth. Since 2010, the average annual streamflow into Perth's dams has dropped to one eighth of the long-term average to 1974. Water levels in aquifers such as the Gnangara Mound have dropped significantly, exacerbated by land use changes and over-abstraction relative to more recent recharge from rainfall, and with major consequences for nearby ecosystems as well as water supplies.

Perth has responded to these water resource challenges and maintained scheme water supplies by constructing two seawater desalination plants and, more recently, a scheme to replenish groundwater with wastewater treated to drinking water quality. While these solutions have markedly improved Perth's water security, they are costly and energy intensive. Water for local green space, horticulture and some gardens makes up more than half of Perth's water demand and is sourced from groundwater. Over the last decade groundwater allocations have been capped and are now being gradually reduced, so all groundwater users are seeking more effective ways of using the water they have, and increasingly looking for alternative supplies.

As climate change impacts worsen and urban development expands and intensifies in areas with limited or fully allocated groundwater resources, Perth's reliance on highly treated seawater and wastewater risks the affordability of water supplies being compromised, particularly for non-drinking purposes such as the irrigation of private gardens and public open space. DWER is working with stakeholders to develop the Perth Peel Water Supply Strategy and the Gnangara Groundwater Areas Allocation Plan (for Perth's largest, most accessible, lowest cost source of fresh water) to find ways to transition to alternative water supplies, manage demand and bring the groundwater system back into balance with recharge from rainfall.

The Water Corporation, DWER, and local government work closely with industry and the community on the highly successful Waterwise programs, which aim to conserve water and increase efficiency and recycling. Perth's per capita scheme water consumption has reduced by over 30 per cent over the last 15 years, but Perth still remains one of the highest water using cities in Australia (and, indeed, the world).



The Perth and Peel regions are projected to grow to 3.5 million people by 2050 – an increase of almost 70 per cent on current population. Supporting this growth and delivering an efficient and liveable city while protecting the unique natural environment under an ongoing drying climate is a significant challenge. The Western Australian Planning Commission has released the Perth and Peel at 3.5 million land use planning and infrastructure frameworks to meet this challenge. The frameworks define the urban form for the next 30 years, limit unsustainable urban sprawl and encourage greater housing diversity to meet changing community needs. They provide guidance and certainty to State Government agencies, local government and the development sector.

The plans – for the Central, North-West, North-East and South Metropolitan Peel sub-regions – determine where new homes and jobs will be located; make best use of existing and proposed infrastructure; and protect important environmental assets. They set the groundwork for the development of vibrant new communities, particularly around key transport links, including METRONET station precincts and activity centres, within a compact and connected city. They underline the need to explore and plan for new urban growth opportunities and to redress the balance between infill and greenfield development – currently at 47 and 53 per cent respectively. The plans

encourage significantly greater infill development with almost half of the required 800,000 new homes – 380,000 at a minimum – to be built through infill development. The majority of these – around 214,000 – will be built in existing suburbs within the Central sub-region and particularly through alignment with Stage 1 of the METRONET initiative.

Greater Perth is not alone in grappling with water management complexities and uncertainties such as those described above. There is now recognition globally that significant shifts in urban water management are required for a city's long-term aspirations to be realised. In response, the concept of the water sensitive city has emerged in scientific, policy and practice domains, representing an alternative vision for urban water servicing based on principles of flexibility, diversity and integration.

For Perth this means re-establishing a sense of place and adjusting to, rather than compensating for, the weather patterns of long hot summers and lower winter rainfall driven by its unique (in Australia) geographic location.

For further information on the rationale for a water sensitive Perth, see Appendix A in *Shaping Perth as a Water Sensitive City: Outcomes and perspectives from a participatory process to develop a vision and strategic transition framework*.³



³ Rogers, B.C., Hammer, K., Werbeloff, L., Chesterfield, C. (2015). *Shaping Perth as a Water Sensitive City: Outcomes of a participatory process to develop a vision and strategic transition framework*. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

3. Vision for a water sensitive Perth

3.1 Aspired water sensitive outcomes

A 2065 vision of Greater Perth as a water sensitive city was developed by project participants⁴ to orient and align the actions of stakeholders over the long-term. Their aspirations are expressed as a suite of outcome statements with accompanying rich descriptions, organised into four interconnected themes (Figure 2). The timeframe enables people to stretch their ambitions beyond today's systems and constraints to reflect on the transformative change that is possible over such a period.

A WATER SENSITIVE PERTH IN 2065

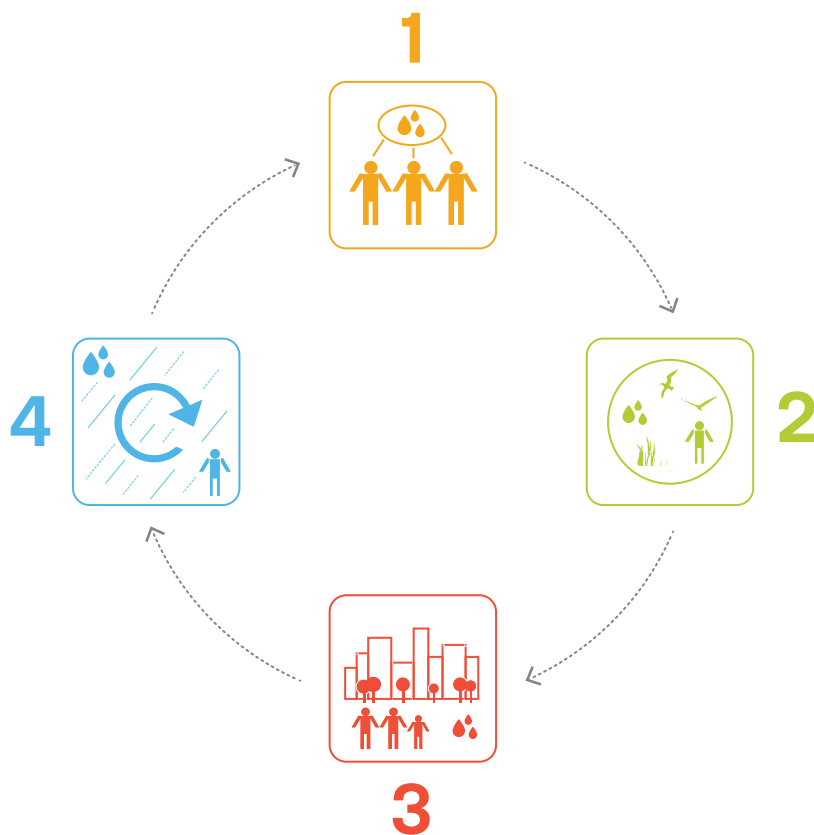


Figure 2: Themes of Perth's water sensitive city vision

⁴ Project A4.2 Mapping Water Sensitive City Scenarios

1. Fostering stewardship of the system

- a. People understand the entire water cycle and recognise the need to adapt to uncertain and changing conditions
- b. People feel a sense of belonging in Perth, identify with its evolving water story and connect with Nyoongar water knowledge and values
- c. People are appropriately engaged in open and inclusive decision-making processes that are informed by comprehensive information and transparency in people's priorities
- d. There is continuous investment in developing necessary knowledge, skills and capacity across water-related professions, sectors and the community

2. Protecting and enhancing the wellbeing of people and the environment

- a. Water is valued and managed with respect for the interdependent and dynamic relationship between people and the environment
- b. Perth's coastal and inland water ecosystems are protected and thriving with biodiversity
- c. Flood and inundation risks are managed in harmony with local conditions to minimise impacts on and embrace opportunities for the city

3. Integrating and engaging with the built and natural landscape

- a. Perth's urban character reflects its unique landscape and water environments
- b. The urban environment is comfortable, safe, and promotes health and wellbeing
- c. The city is filled with a network of beautiful, well-designed and high quality places that are diverse, accessible, loved and enhanced by effective water management
- d. Infrastructure planning and development is coordinated and integrated to deliver multiple benefits

4. Sustaining the long-term use of Perth's resources

- a. Water is available to equitably meet the needs of people and the environment both now and in the future
- b. Fit-for-purpose water is supplied through adaptable systems that work across multiple scales
- c. Efficient use and recovery of resources is ensured through innovative water cycle management

Theme 1: Fostering stewardship of the system

People understand the entire water cycle and recognise the need to adapt to uncertain and changing conditions. They feel connected to water and are committed to looking after it over the long-term. This refers to everything from the rivers and wetlands, to the groundwater sources, to how water is supplied and managed, to wastewater treatment and resource recovery. Climate change is acknowledged and people recognise the need to proactively adapt in response.

People feel a sense of belonging in Perth, identify with its evolving water story and connect with Nyoongar water knowledge and values. They understand the cultural dimensions of Perth's water, which involve the historical movement of water in the environment, along with Aboriginal connections to water. Perth's diverse cultural communities feel a sense of belonging and connection to this story. The built form supports this connection by reflecting the historic and natural landscape and waterscape.

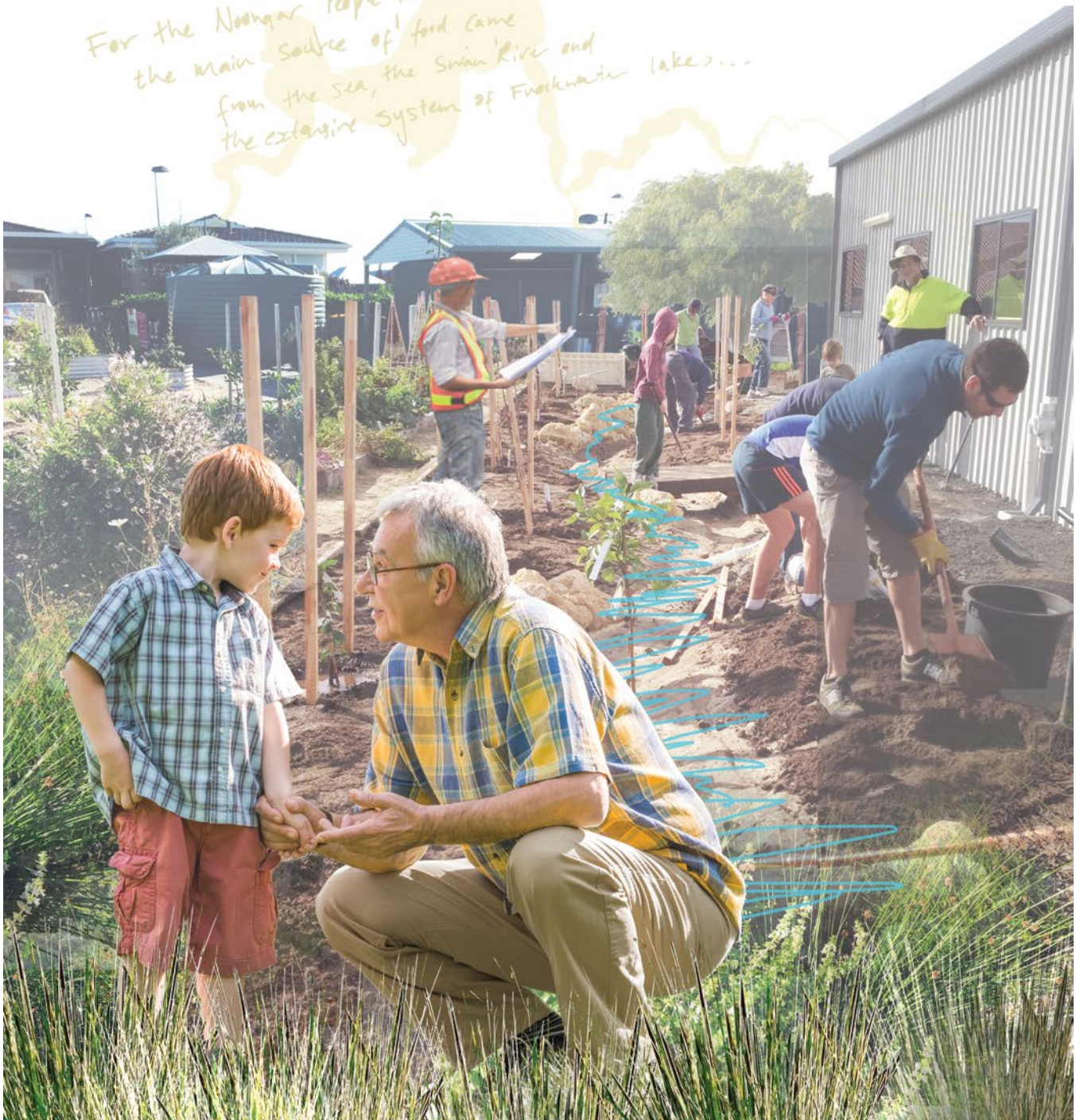
People are appropriately engaged in open and inclusive decision-making processes that are informed by comprehensive information and transparency in people's priorities. The costs, benefits and risks of different options are transparently considered and communicated to stakeholders, including the community, to inform strategic decision-making. Economic benefits are displayed through demonstrated efficiencies and local Perth projects. Aboriginal knowledge, values, stories and ways of thinking inform water planning and decision-making.

There is continuous investment in developing necessary knowledge, skills and capacity across water-related professions, sectors and the community. The community is educated about demonstration projects and water-related decisions through capacity-building and education programs at various levels. Innovations are encouraged in an enabling environment and driven by both collaboration and competition throughout the sector. Business and commercial opportunities are created and pursued through a holistic and innovative approach to water and resource management.



1. FOSTERING STEWARDSHIP OF THE SYSTEM

*For the Noongar People in Perth
the main source of food came
from the sea, the Swan River and
the extensive system of Freshwater lakes...*



Theme 2: Protecting and enhancing the wellbeing of people and the environment

Water is valued and managed with respect for the interdependent and dynamic relationship between people and the environment. The public is protected from potential health risks through effective water and environmental management. Waste management handles pathogens and other hazards in a safe and reliable way.

Perth's coastal and inland water ecosystems are protected and thriving with biodiversity. The rivers, wetlands, estuaries, and coastline are alive and healthy. The air and water quality levels are exceptional and attract birds and other wildlife to the area. The Swan and Canning rivers are viewed as iconic symbols of Perth that are valued both locally and internationally. Perth is also recognised for its unique extensive network of groundwater aquifers. People are conscious that these iconic natural features need to be protected – therefore water is sustainably allocated and land uses are managed for their protection.

Flood and inundation risks are managed in harmony with local conditions to minimise impacts on and embrace opportunities for the city. People understand these risks and also see them as opportunities for the city. There is widespread community acceptance that some inundation naturally occurs and is an important part of the natural water system, and thus the built form is responsive to seasonal flooding and shallow groundwater with scientifically-supported design features that minimise the impacts when flooding and inundation occurs.



2. PROTECTING AND ENHANCING THE WELLBEING OF PEOPLE AND THE ENVIRONMENT



Theme 3: Integrating and engaging with the built and natural landscape

Perth's urban character reflects its unique landscape and water environments. The presence of water is integrated within the public realm in a way that is creative, innovative and sustainable. This creates a beautiful city through considered urban structure, built form and multifunctional spaces that reflect Perth's unique environmental qualities. Features such as the Swan River, the coastline and wetlands are celebrated and showcased through good planning and design of the built form that encourages greater awareness of water. This gives people the opportunity to connect with all aspects of the water cycle during wet and dry periods and emphasises that water exists as an ephemeral and vital element within our community, supporting Perth's comfort, amenity and resilience.

The urban environment is comfortable, safe, and promotes health and wellbeing. The city feels cool and convenient for people to walk through. Landscape elements are well-integrated within the built environment, including green roofs, green walls, and shaded streets. Innovations in materiality and the built form have reduced the urban heat island effect to minimise heat-related deaths and stress incidents. A network of high quality spaces is prevalent throughout the city and connected to pedestrian infrastructure to promote healthy living, not only because of the physical health benefits provided by the urban environment, but also the mental wellbeing and social amenity they offer. It is commonly recognised that these spaces contribute to public health, so they are valued, well cared for and maintained and the importance of effective water management to support this is recognised.

The city is filled with a network of beautiful, well-designed and high quality places that are diverse, accessible, loved and enhanced by effective water management. These places provide a sense of place and social cohesion, allowing community members to connect with their environment and one another. The city offers natural ecosystems, playground areas, sport spaces, walking paths, and other features that suit the needs for all people at different ages and stages of life. In addition to being diverse, the spaces are responsive to trends in sport and recreation and to the changing needs of the community. Existing natural features, such as the coastline, wetlands and rivers, are made accessible so people can enjoy them for their health benefits.

Infrastructure planning and development is coordinated and integrated to deliver multiple benefits. Value, performance, and community and environmental impacts are considered holistically. Functional service delivery systems, such as urban drainage systems, are also designed to be beautiful and aesthetic. Movement networks integrate both grey and green infrastructure systems, for example, some roads are narrowed to allow space for green corridors. Service delivery systems are seen as opportunities to integrate multi-functional green networks. Water is also an active and considered transport mode for Perth, and Swan River ferries are accessible and used.



3. INTEGRATING AND ENGAGING WITH THE BUILT AND NATURAL LANDSCAPE



Theme 4: Sustaining the long-term use of Perth's resources

Water is available to equitably meet the needs of people and the environment both now and in the future. Water is not wasted and demand is well managed in order to sustain the water sources of the region. Water is available for food production in all urban and peri-urban communities so people have access to locally grown fresh produce. Larger agricultural areas are strategically located next to water sources to minimise transport and irrigation costs.

Fit-for-purpose water is supplied through adaptable systems that work across multiple scales. Users understand the concept of fit-for-purpose and there are clear water quality targets for different types of usage. Fit-for-purpose schemes integrate with the broader water system to provide reliable and adaptable configurations to suit different contexts and conditions.

Efficient use and recovery of resources is ensured through innovative water cycle management. Wastewater is recycled and utilised as a valuable source of water and other resources, such as nutrients, biosolids and energy. These resources, amongst others, are efficiently recovered through innovative water cycle management. Water supply systems are efficient in delivering services for all water purposes. Renewable energy is used for energy-intensive water systems.



4. SUSTAINING THE LONG-TERM USE OF PERTH'S RESOURCES



3.2 Guiding principles for water sensitive practice

Accompanying the vision is a set of principles to guide water sensitive practice in Greater Perth⁵. These principles were developed by exploring the types of practice that would be needed to achieve the desired water sensitive outcomes expressed in the vision. The guiding principles are designed as a coherent, collective set; individual statements should not be read in isolation.

Table 1: Guiding principles for water sensitive practice

Type of practice	Guiding principles for water sensitive practice in Greater Perth
<p>Urban and water systems planning</p> <p>Strategic and statutory planning of the greater metropolitan region, including its land use zones, development policies, water resources and water infrastructure systems.</p>	<ol style="list-style-type: none"> 1. Water systems planning and urban planning are integrated and consider both local and regional objectives and priorities 2. Urban and water systems planning is conducted with a long-term view that accounts for current and future water-related needs of people and the environment, resource availability and ecological limits 3. Urban and water systems planning is conducted within an overarching policy framework that reflects a locally defined vision for a water sensitive Perth 4. Urban and water systems planning is guided by outcome-focused standards that match the scale of the target area 5. Urban and water systems planning ensures public open space and the public realm is of sufficient quantity and quality to support human wellbeing in existing and new urban areas
<p>Decision-making and investment</p> <p>System-wide governance approaches, involving formal and informal structures and processes, that inform water-related planning and investment decisions</p>	<ol style="list-style-type: none"> 6. Decision-makers across water-related sectors are fundamentally aligned and make decisions in the context of a shared vision and evolving narrative for a water sensitive Perth 7. Governance arrangements clearly define roles and responsibilities for all aspects of the water cycle 8. Governance arrangements encourage innovation while ensuring social, ecological and economic sustainability in all decisions and investments 9. Decisions about water are made pursuant to reliable evidence, transparent planning and highest community value

⁵ Project A4.2: Mapping water sensitive city scenarios

<p>Stakeholder engagement</p> <p>Engagement with community, business, industry and government stakeholders to influence water sensitive outcomes</p>	<p>10. All stakeholders are actively engaged and supported with targeted information and educational support to encourage shared knowledge of Perth's water narrative and to promote individual and collective responsibility and capacity as water stewards</p> <p>11. The inputs of different stakeholders into water-related initiatives are facilitated with appropriate timing and with respect for their influence, capacity and needs</p> <p>12. Clear and consistent messages are communicated to the community and other stakeholders</p> <p>13. The community is involved in and has the opportunity to influence decision-making about water through transparent and disclosed processes</p>
<p>Water systems and urban design</p> <p>Design of buildings, public and private spaces, urban landscapes, and water, transport and other urban infrastructure systems</p>	<p>14. Water sensitive principles, local characteristics and informed community values guide holistic site-specific designs that make water sensitivity physically and conceptually legible in the built environment and ensure multiple benefits are delivered over the long-term</p> <p>15. Water system and urban design connects all elements of the water cycle and considers whole-of-life costs and benefits, including broad social and environmental impacts</p> <p>16. Water sensitivity is encouraged through design practice that continually innovates, adapts and improves as conditions and objectives evolve</p>
<p>Management and operation of water systems</p> <p>Management and operation of the integrated water system and its individual infrastructures, including traditional technologies, green technologies and natural environmental features</p>	<p>17. Overarching governance arrangements for water management ensure coordination and consistency with mutually reinforcing approaches across stakeholder organisations</p> <p>18. Water management approaches are flexible and inclusive to provide opportunity and mechanisms for involvement by all interested and relevant stakeholders</p> <p>19. Water systems are managed as part of the whole water cycle within their catchment and the broader urban system</p> <p>20. Water infrastructure is managed according to reliable and well-resourced asset management regimes that protect the integrated system's long-term integrity</p>

4. Assessing Perth's current water sensitive performance

Planning Perth's transition to its WSC vision requires a detailed understanding of its current performance in relation to its aspirations. The CRCWSC's Water Sensitive Cities (WSC) Index is a benchmarking tool designed for this purpose. It articulates seven WSC goals, which organise 34 indicators representing the major attributes of a WSC. These indicators are also mapped to the idealised city-states represented in the Urban Water Transitions Framework (Figure 1) to provide a benchmarked city-state.

While a city's local WSC vision may not emphasise all indicators of the WSC Index to the same degree, the tool enables diagnosis of key areas of strength and aspects for improvement. These insights can then inform the prioritisation of actions and provide a framework for ongoing monitoring and evaluation of a city's water sensitive performance.

4.1 Perth's WSC indicator scores

The WSC Index was applied to Greater Perth to benchmark current water sensitive performance. Figure 3 below shows the WSC Index goal results for Perth (shown by the shaded teal area). Table 2 below provides the individual indicator scores for each goal.

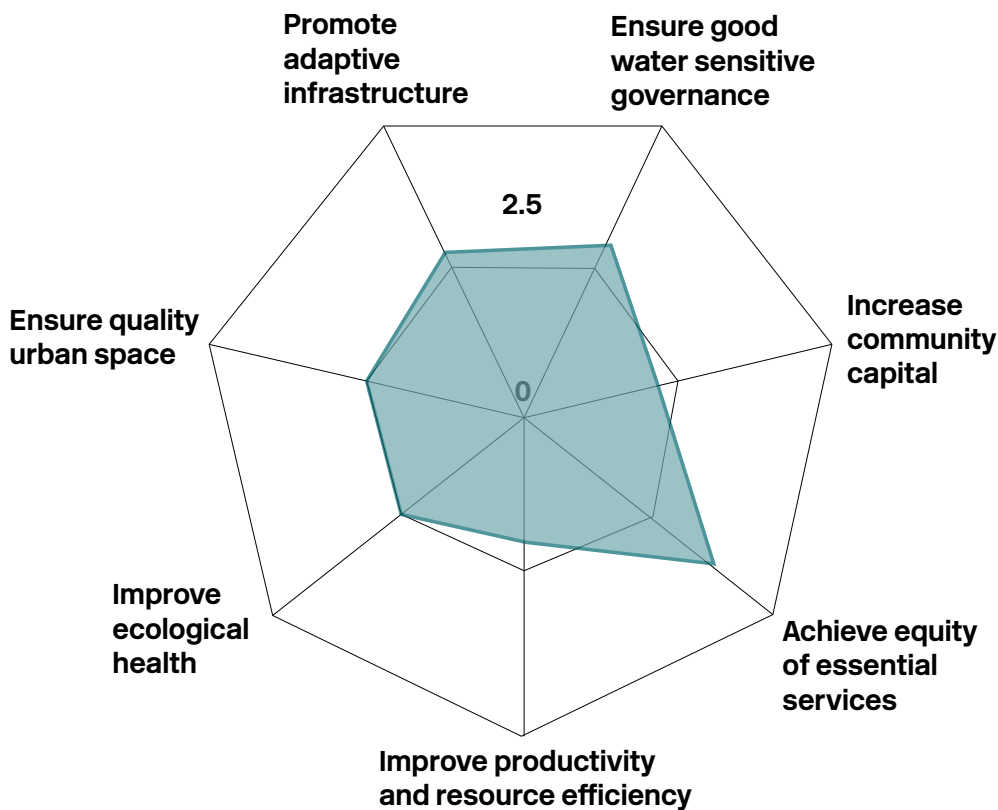


Figure 3: Perth's performance (shaded teal area) compared to the water sensitive goals

Table 2. Recommended strategies to advance healthy land and water environments and community stewardship

WSC Index Goal and Indicators	Score /5	WSC Index Goal and Indicators	Score /5
1. Ensure good water sensitive governance	2.9	4. Improve productivity and resource efficiency	2.0
1.1 Knowledge, skills and organisational capacity	3.0	4.1 Benefits across other sectors because of water-related services	3.0
1.2 Water is key element in city planning and design	3.0	4.2 Low GHG emission in water sector	1.0
1.3 Cross-sector institutional arrangements and processes	3.0	4.3 Low end-user potable water demand	2.0
1.4 Public engagement, participation and transparency	2.5	4.4 Water-related commercial and economic opportunities	2.0
1.5 Leadership, long-term vision and commitment	4.0	4.5 Maximised resource recovery	2.0
1.6 Water resourcing and funding to deliver broad societal value	3.0	5. Improve ecological health	2.5
1.7 Equitable representation of perspectives	2.0	5.1 Healthy and biodiverse habitat	2.0
2. Increase community capital	2.1	5.2 Surface water quality and flows	3.0
2.1 Water literacy	2.0	5.3 Groundwater quality and replenishment	2.0
2.2 Connection with water	2.0	5.4 Protect existing areas of high ecological value	3.0
2.3 Shared ownership, management and responsibility for water assets	2.0	6. Ensure quality urban space	2.5
2.4 Community preparedness and response to extreme events	2.0	6.1 Activating connected urban green and blue space	3.0
2.5 Indigenous involvement in water planning	2.5	6.2 Urban elements functioning as part of the urban water system	2.0
3. Achieve equity of essential services	3.8	6.3 Vegetation coverage	2.5
3.1 Equitable access to safe and secure water supply	5.0	7. Promote adaptive infrastructure	2.8
3.2 Equitable access to safe and reliable sanitation	4.0	7.1 Diverse fit-for-purpose water supply system	3.0
3.3 Equitable access to flood protection	4.0	7.2 Multi-functional water system infrastructure	3.0
3.4 Equitable and affordable access to amenity values of water-related assets	2.0	7.3 Integration and intelligent control	3.0
		7.4 Robust infrastructure	3.0
		7.5 Infrastructure and ownership at multiple scales	2.5
		7.6 Adequate maintenance	2.5

4.2 Perth's benchmarked city-state

Figure 4 summarises the city-state benchmarking results for Metropolitan Perth. Percentage attainment for each city-state ranged from 100% as a Water Supply City and Sewered City through to 5% as a Water Sensitive City. This section summarises the key elements that contribute to the overall percentage attainment of each city state.

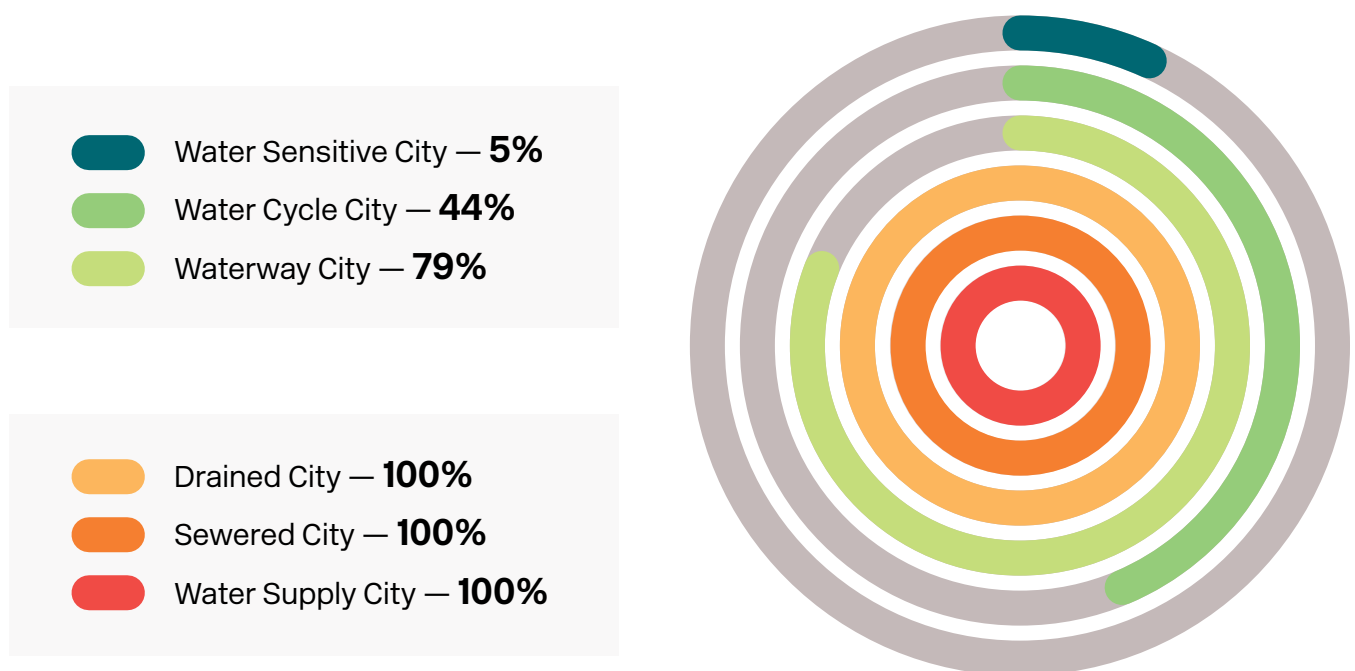


Figure 4: Summary of Perth's performance against the ideal measures for each city-state

100% Water Supply, Sewered and Drained City

The Water Corporation and Local Governments in Perth have been successful in providing a secure supply of drinking water and water for irrigation of public open spaces, as well as sewerage and drainage services to residents of Greater Perth in the face of a drying climate. Record-breaking low dam levels in 2001 led to the construction of two desalination plants and a step towards a climate-resilient water supply. The Water Corporation's Groundwater Replenishment Scheme is currently recharging up to 14 billion litres of recycled water into groundwater supplies each year, with plans to double the capacity by 2019. These alternative water sources ensure safe and reliable scheme water supply for Perth residents. Groundwater was initially seen as a more resilient alternative to dams in the face of a drying climate.

Perth's distributed approach to non-potable water needs has been possible through an extensive aquifer system with accessible, good quality groundwater. A water sharing approach is enabled through DWER's water licensing and allocation strategies, with self-supply water users accessing the shallow aquifer, and the deeper aquifers used primarily for scheme supply. This high reliance on groundwater and lower recharge from rainfall means the effects of climate change on groundwater are now significant, and groundwater for both scheme supply and self-supply is gradually being reduced in order to rebalance the system.

The Water Corporation also operates three major wastewater treatment plants in Greater Perth which treat about 80% of Western Australia's wastewater. Reuse on green space is limited in the city compared to regional locations. Wastewater is treated to a high standard for aquifer storage and recovery at one site – with a 14 gigalitre scheme just commencing, expanding to 28 gigalitres over the next two years. The remaining wastewater is treated prior to use for non-potable uses or for discharge to the ocean.

DWER has done extensive flood planning and mapping with floodplain management plans for higher risk areas across the state. Because of Western Australia's drying climate, there has been relatively little major flooding, though occasional intense rainfall after tropical cyclones can extend to the south west and cause flooding. There are ongoing issues with inundation in some parts of Perth that have poor recharge to aquifers and thus high groundwater tables in winter.

79% Waterway City

Greater Perth scored 79% as a Waterway City due to the growing attention on health of receiving waterways and surrounding environments. Point source pollution is well regulated and controlled, while urban runoff and diffuse-source pollution (especially from agriculture) continue to contribute to high nutrient loads in the Swan and Canning Rivers and Peel-Hervey Estuary. There have been historic challenges in relation to responsibility for water quality in drainage assets, however the recent Drainage for Liveability program, which is a collaboration between the Water Corporation and DWER, is designed to enhance the value to the community of stormwater main drains and basins.

The Swan Canning river system is a significant asset in Perth and people value it for the recreational, amenity and ecological values it provides. Algal blooms, fish and dolphin deaths have in the past brought the health of the rivers to public attention.

Long term monitoring of the groundwater dependent wetlands of the Gnangara and Jandakot systems shows that water quality is the primary indicator of ecosystem health.

44% Water Cycle City

Greater Perth has made significant advancements in alternative water supply sources such as desalination and groundwater replenishment. Non potable-water, primarily for horticulture and green space, is accessed under licences authorised by DWER. Many residents in Perth utilise private garden bores which up until a decade ago were encouraged as an alternative to scheme supplies. Now, the scale of garden bore use is significant in the context of climate change and competition for limited resources. New approaches to reduce the volume of water drawn from garden bores are being considered – and a new community awareness about groundwater and climate will be needed.

Apart from licenced water users, the Perth community is largely disconnected from the water issues facing the region. Despite the extreme decline in traditional surface water resources resulting from climate change, the cost of water has remained relatively low. Two-day a week water restrictions have been adopted permanently, but the long hot and dry summers drive a relatively high level of outdoor water use compared to cities with a different climate. Many households continue to value green European-style gardens, with one in four maintaining their gardens through the use of bores.

5% Water Sensitive City

To achieve a Water Sensitive City, Greater Perth will need to fulfil the multiple objectives of ecosystem protection and restoration, security of supply, flood control, public health, amenity, liveability and economic sustainability, among others. While Perth has begun to make strides towards a Water Sensitive City, significant efforts will be needed to transition to water sensitive technologies and practices.

Perth's citizens feel some connection to their waterways and regard the Swan River as an icon. They value the river for its recreation and amenity benefits, and recognise that water quality and ecological health play a role in this. Several toxic algal blooms and the death of dolphins in the river in 2009 sparked awareness and led to the creation of community volunteer groups such as the River Guardians and Dolphin Watch. These programs aim to engage the public and increase custodianship of the Swan and Canning Rivers and have had local success in increasing community participation in waterway protection. There is some broader public recognition that Perth's ground and surface water sources need to be protected but, overall, engagement with issues of water quality and supply constraints is limited.

In addition, there is still limited understanding and awareness of the impact of people's everyday behaviours on the water cycle. A national survey of Australians' water knowledge and literacy⁶ conducted in 2015 demonstrated Western Australian's water literacy compared to other Australian states. They have a high knowledge of factors that can negatively or positively impact on waterway health, reflected by the value they place on the Swan River, but little awareness of where their household water comes from or which catchment their household is in.

There is also limited engagement with Aboriginal communities on water-related issues. Policies are in place, but engagement generally happens at the consultation level rather than with the aim of long-term partnering and incorporating Aboriginal knowledge and values into water planning and decision-making.

⁶ Fielding, K., Karnadewi, F., Newton, F., Mitchell, E. (2015). *A National Survey of Australians' Water Literacy and Water-related Attitudes*. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

5. Advancing Perth's water sensitive city transition

Perth's transition towards its water sensitive city vision will require significant changes across the structures, cultures and practices of urban and water system planning, design, management, engagement and decision-making.

These changes are likely to happen over a long time frame, in the order of decades, as new water sensitive practices are established and replace old practices. CRCWSC research has identified water sensitive transitions unfold over six phases: an (1) issue with old practice emerges and (2) becomes more defined; people develop (3) shared understanding and agreement about the issue; (4) knowledge about solutions is disseminated; and new solutions are (5) diffused through policy and practice, and eventually (6) embedded as new mainstream practice.

The CRCWSC's Transition Dynamics Framework (see Appendix B for more detail) sets out five types of enabling factors that help to drive progress through these phases of change: **champions, platforms for connecting, science**

and knowledge, projects and applications, and practical and administrative tools. Together, these five factors create an enabling environment for accelerating a water sensitive transition.

Building the momentum for transition will require a diverse range of strategies and actions that progressively establish these enabling conditions. Strategies and actions with the most impact during the early phases of transition will be different from those during the later phases. It is critical to identify a city's current transition progress to ensure that actions are prioritised according to the effectiveness they will have in accelerating the WSC transition.

This section presents recommended strategies for advancing Perth's water sensitive transition based on analysis of the city's current transition progress. Strategies are identified to advance the overall water sensitive Perth vision, as well as its individual thematic elements.



5.1 Assessing Perth's WSC transition progress

The CRCWSC's Transition Dynamics Framework was used as a diagnostic tool to assess the presence or absence of enabling factors as an indicator of progress towards Perth's aspired change in practice as it advances towards its water sensitive city vision (Table 3). It provides a checklist of the factors that should be deliberately and sequentially built up to inform the prioritisation of strategies and actions.

The overall transition progress assessment for Perth suggests that significant advancements have been made towards its water sensitive vision. However, it is at risk of stagnation if critical enabling conditions are not established to shore up Phase 3 (shared understanding and issue agreement) and Phase 4 (knowledge dissemination) and continue pushing into Phase 5 (policy and practice diffusion). A brief explanation and justification of the transition assessment follows.

Table 3: Overall assessment of Perth's transition progress

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Notes: Green boxes indicate the enabling factor is fully present and regression into the previous phase is unlikely. Yellow boxes indicate some presence, however they are vulnerable to regressing to the previous phase. Red boxes indicate a complete absence of the enabling factor, and that progression is unlikely.

The overall assessment for Perth suggests significant advancements in building up a network of champions, particularly in recent years. This has been supported by initiatives such as CRCWSC-led processes⁷ that invited in-depth dialogue about Perth's current and future water system across diverse stakeholders. The establishment of the WSTN as a community of practice following the CRCWSC A4.2 project has provided local WSC champions with a platform for discussing ideas and sharing knowledge to advance Perth's WSC transition. Key agencies such as the Department of Water and Environmental Regulation, the Water Corporation and the Department of Planning, Lands and Heritage are now championing the WSC agenda and incorporating it into organisational policies, strategies and programs.

There have also been significant advancements in knowledge and projects, with several water sensitive city solutions being demonstrated at a large scale.

The Groundwater Replenishment Scheme is an example of a technical solution to water supply that is now being implemented at a large scale and supported by community. The Water Corporation and DWER's Drainage for Liveability program is an example of a governance solution to improve drainage and water management while increasing urban liveability. The Water Corporation and DWER's Waterwise Councils Program is also an example of a large-scale governance solution designed to support Councils in their collaborative efforts to improve local water sensitivity.

Perth also has made strides in the tools and instruments space, with policies and guidelines such as Liveable Neighbourhoods and Better Urban Water Management articulating water sensitive outcomes. Embedding the full range of water sensitive city solutions in projects, administrative tools and practice tools will be an important focus going forward.



⁷ Project A4.2 Mapping Water Sensitive City Scenarios, Project D6.2 Developing a WSC Index, and Tranche 2 Needs and Opportunities stakeholder workshop

5.2 Strategies for advancing Perth's overall vision

Based on this analysis, the following four high-level strategies are recommended for progressing Perth's water sensitive city transition:

- I. Develop a broad community mandate for pursuing the vision for a water sensitive Perth
- II. Embed Perth's water sensitive vision in organisational policies, plans and strategies
- III. Increase knowledge about potential solutions for aspects of Perth's water sensitive city vision that are less progressed
- IV. Implement large-scale demonstrations and develop practical guidance for a broad range of water sensitive solutions

I. Develop a broad community mandate for pursuing the vision for a water sensitive Perth

Water sensitive city outcomes such as liveability cannot be delivered by just one organisation or sector, requiring a diversity of stakeholders to align actions towards a common goal. It is therefore critical that the benefits of a water sensitive city, and the solutions needed for their delivery, are understood and embraced by the broad community to enable collaboration towards Perth's vision.

Perth has recently solidified its network of water sensitive champions, which has good representation across many sectors and levels of seniority. However, there are groups and perspectives that need to be more strongly engaged in discussions about a water sensitive Perth in order to build broad support and leadership for the agenda. Particular focus should be given to including more voices from urban development, transport and politics in an expanded community of practice. Articulating a compelling narrative that communicates the benefits of a water sensitive Perth to different audiences will help with this.

Particular attention is also needed on engaging the general public in dialogue about water sensitive outcomes and solutions. This is important to ensure there is enduring support for Perth's water sensitive city vision, even in the face of potentially disruptive

influences such as political changes, economic downturns and competing priorities. Interest from the community to deliver multiple benefits and liveability outcomes from water system services will support a broad government and industry-wide long-term strategic response.

II. Embed Perth's water sensitive city vision in organisational policies, plans and strategies.

Perth's water sensitive city vision has support from the committed group of champions that comprise the WSTN and many of their organisations. To formalise this support, legitimise and promote the agenda, and mobilise resources for implementation action, the vision needs to become embedded within organisational policies, plans and strategies. Embedding the vision across diverse organisations will enable and encourage an integrated and holistic approach to water management that works towards the shared future water sensitive vision for Perth, and will provide a framework for supporting intra- and inter-organisational alignment and implementation of solutions.

Linking the narrative of the benefits of the envisioned water sensitive city with the aspirations for Perth more broadly, including the city's future prosperity, the health and wellbeing of its people, and the preservation and enhancement of its natural environments, will also help strengthen formal commitment to the water sensitive city vision.

III. Increase knowledge about potential solutions for particular aspects of Perth's water sensitive city vision that are less progressed

Knowledge will underpin many elements of a successful transition to a more water sensitive Perth. Where an issue is unfamiliar or novel, new knowledge may be needed to understand the various responses or solutions available and the associated costs and benefits. Where the development and implementation of solutions is challenging and carries significant risks, small-scale pilots can help to refine the solutions, identify the benefits, develop implementation guidance and build industry capability in their delivery. For example, as well as leading to improved technical designs, pilots and experiments can give insight into how technical, financial or reputational risks can be managed.

Ultimately, a more comprehensive knowledge base for solutions that are underdeveloped for Perth's context is needed to support decision-making and guide solution implementation to advance the vision for a more water sensitive Perth. Some of these solutions that need to be developed include ways of empowering communities to be active water stewards, effectively and meaningfully incorporating Aboriginal knowledge and values in

water planning and decision-making, and collaborative governance arrangements for delivering a broad range of water sensitive outcomes. Focus should be given to more systematic investment in knowledge development that is aligned with strategic priorities. This should be complemented by investment in knowledge sharing platforms that span sectors, disciplines, stakeholders and levels of government.

IV. Implement large-scale demonstrations and develop practical guidance for a broad range of water sensitive solutions

Becoming a water sensitive city will require a range of innovative solutions across social, technical and design domains to be developed and mainstreamed. To date, there has been a range of innovative water solutions trialled in Perth with some, such as the Groundwater Replenishment Scheme and Drainage for Liveability, being implemented at a large scale. Large-scale demonstrations for the range of solutions needed for becoming a water sensitive city are needed, such as processes for empowering communities to be active partners in water planning and decision-making. Lessons from both small and large-scale demonstrations then need to be incorporated into practical guidance for practitioners to be able to implement the solutions more broadly.



5.3 Strategies for advancing individual vision elements

A more detailed assessment of Perth’s transition progress was also conducted, using the CRCWSC’s Transition Dynamics Framework (Appendix B) to consider each of the individual thematic elements of the city’s water sensitive vision.

Figure 5 below summarises the current transition progress for each individual vision theme and highlights the variety across specific elements. Vision themes early in their

transition will require different types of strategies to progress further change than those later in their transition.

This analysis informed the development of specific recommendations for strategies to advance each part of Perth’s water sensitive city vision. The following sections present a brief explanation and justification of the transition progress assessment and associated recommended strategies.

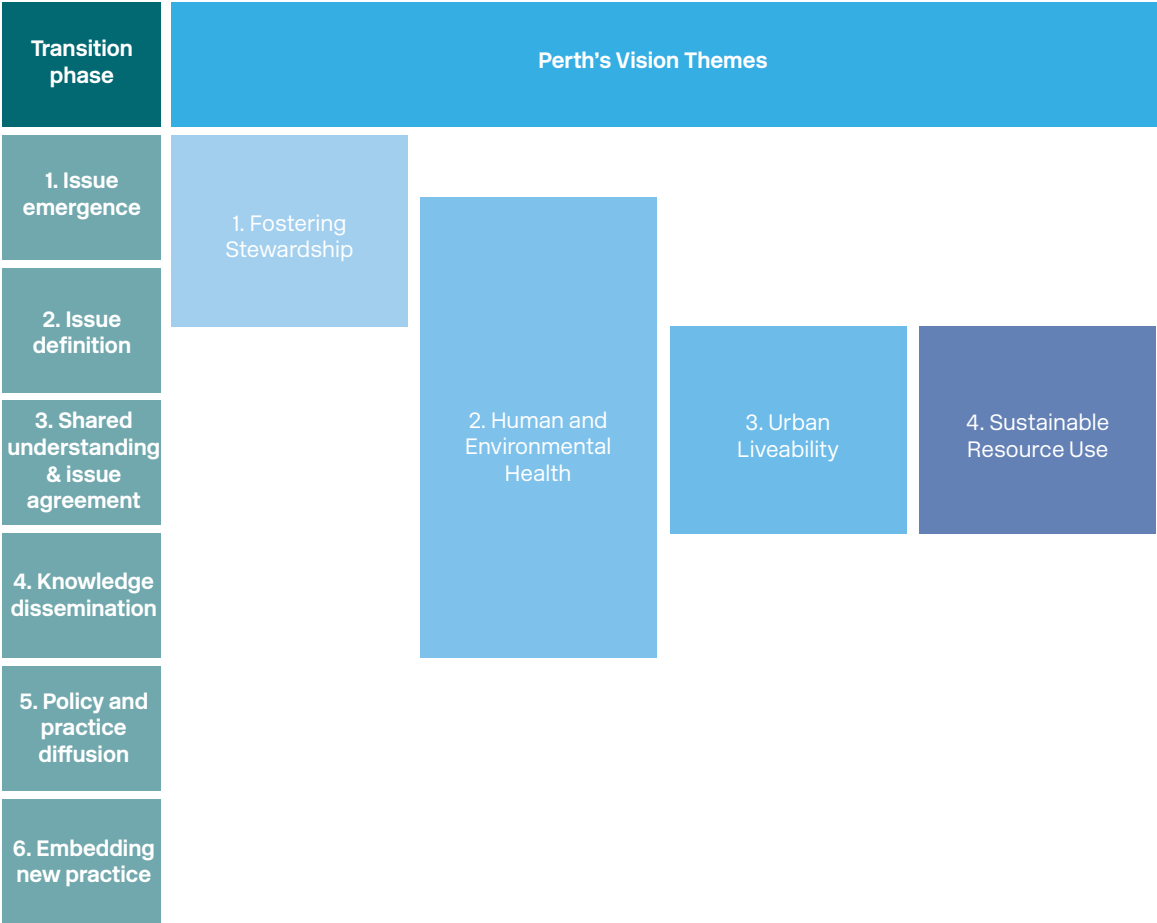


Figure 5: Transition phases for Perth's four vision themes

5.4 Vision Theme 1: Fostering stewardship of the system

Required changes in practice

Perth's vision for stewardship of its water system will need to be built on a foundation of people having a good knowledge of, strong connection with, and deep sense of responsibility for water. This means expanding beyond a perception of communities as only customers who pay for water system services such as water supply, sanitation and drainage. While this relatively simple transaction between provider and end-user has been effective for services delivered through large-scale centralised infrastructure, it will be inadequate

to achieve Perth's water sensitive city vision. Growing the required foundation will require community engagement practices to be meaningful and transparent, focused on empowering people to have the interest, capability and opportunity to be active stewards in achieving Perth's water sensitive city vision. This approach to engagement will need to be embedded within governance systems and processes that enable and drive integrated, long-term, cross-sector, and inclusive planning and design decisions that influence water's role in Perth.

Assessment of Perth's enabling conditions

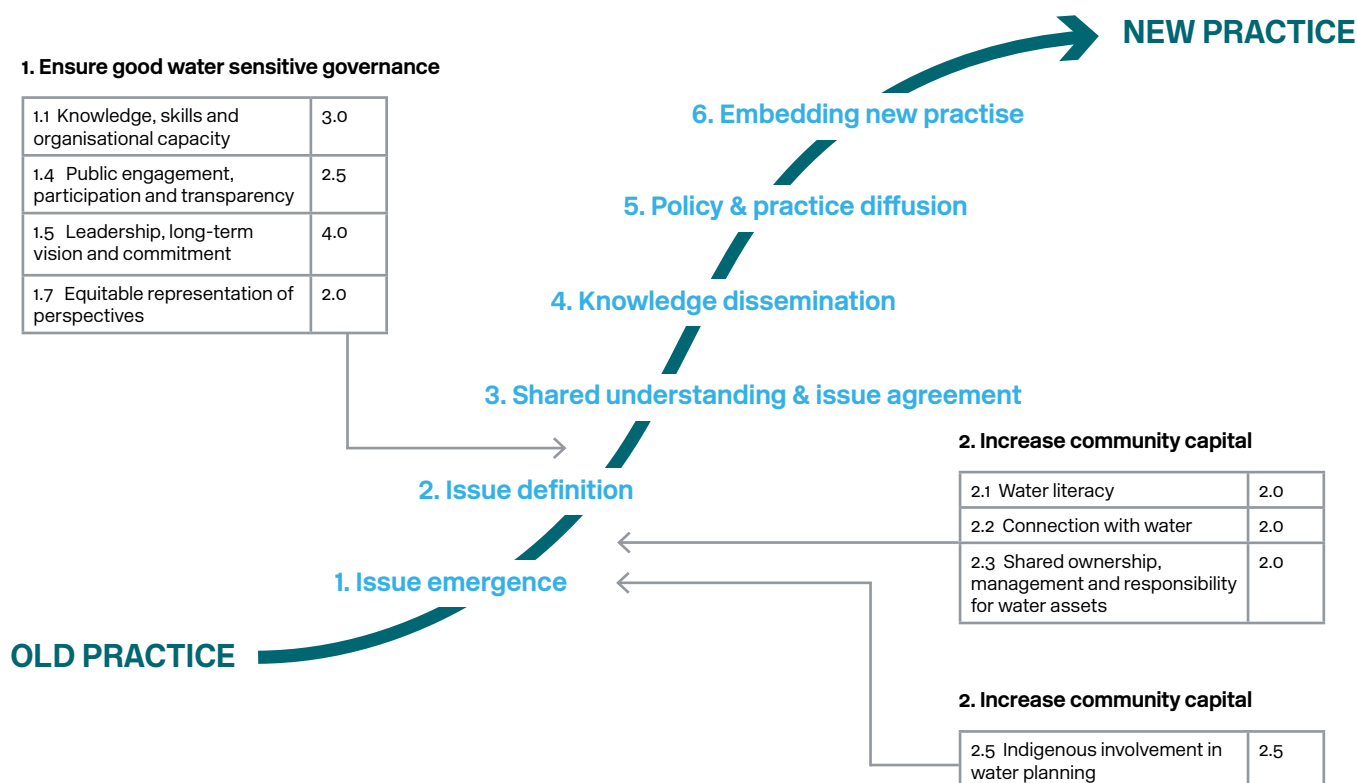


Figure 6: Transition phase for Vision Theme 1 represented through relevant WSC Index indicators

The Perth community generally has low understanding of or connection to water and how their behaviours impact on the surrounding environments. A national survey of Australians' water knowledge and literacy⁸ conducted in 2015 demonstrated how Western Australian's water literacy compared to that of other Australian states. They have a high knowledge of factors that can negatively or positively impact on waterway health, reflected by the value they place on the Swan River, but little awareness of where their household water comes from or which catchment their household is in. These insights indicate that Perth is relatively early in its transition towards a community that has the levels of awareness, knowledge, connection and responsibility aspired to in the city's water sensitive vision. Initiatives to increase these dimensions should be informed by knowledge on *why* there is currently low community capital so that the solutions that are explored and developed can be most effectively targeted. It is therefore important to **invest in social science to clarify why Perth has low community capital** (Strategy 1.1).

There are a few individual champions within the water sector who are advocating the importance of this issue. This advocacy message is getting stronger as these individuals increasingly connect and work together. However, there is a vulnerability of their voices not being heard, so champions from both inside and outside the water sector should be further nurtured to ensure the issue remains firmly in the sector's awareness. In addition, there is emerging knowledge about solutions for building community capital in fields outside of urban water but there has been limited application of this knowledge to the context of urban water in Perth. This means there is little available evidence or guidance for Perth professionals to inform and support the uptake of the associated practices. A stronger collective voice is therefore needed to advocate for local solutions that will improve community capital. This can be driven by initiatives to **advance platforms for champions to get clarity around the issue of low community capital and explore potential solutions** (Strategy 1.2).

Water system stewardship for Perth will mean engaging with Traditional Owners as active and meaningful partners in water planning and decision-making. There are currently policies that require consultation on projects involving Aboriginal heritage sites, but this tends to be done as isolated engagements rather than long-term partnering. Generally in Perth, the importance of involving

Traditional Owners and Indigenous knowledge and values in water planning and decision-making is not yet widely practiced within the sector.

Like most places in Australia, Perth's engagement with Traditional Owners as part of water stewardship is in its infancy and requires greater focus and attention. To better recognise and value the role of Traditional Owners in water planning and decision-making, as well as the role of community more broadly, initiatives are needed to **support champions to advocate for greater community and Traditional Owner involvement in water governance processes** (Strategy 1.3).

While the current water governance arrangements for Perth have enabled a stable institutional environment for reliable provision of traditional water services, innovation in governance will be needed to establish inclusive and integrated structures and processes for achieving Perth's water sensitive city vision. While there are champions advocating for a more integrated and cross-sectoral governance approach, proposed solutions have tended to focus on current pressing issues (e.g. drainage management) and as such, do not yet address the full range of water sensitive aspirations expressed in the Perth vision. Therefore, champion networks and platforms for collaboration should give focus to **developing a suite of potential governance and engagement solutions** (Strategy 1.4) that would support Perth to become a water sensitive city, bringing in diverse people and perspectives to reflect the many different outcomes expressed in the vision.

The recently established Drainage for Liveability program, a collaboration between the Water Corporation and DWER is a promising example of an innovative governance solution aimed at a more integrated, long-term and cross-sectoral approach to drainage infrastructure management. Further **trials and demonstrations of governance and engagement solutions for achieving Perth's vision of water stewardship** (Strategy 1.5) are needed. Trials and demonstrations with a governance or engagement focus would help to build an evidence base of the costs, benefits and risks of potential new solutions, as well as provide insight into the capabilities needed for their effective implementation.

⁸ Project A2.3 Engaging communities with water sensitive cities

Table 4: Strategies for advancing stewardship of the water system

Transition Phase	Strategies	Purpose
Increase community capital		
Issue definition (2)	1.1 Invest in social science to clarify why Perth has low community capital	To inform the development of solution options for increasing the community's awareness, knowledge, connection and sense of responsibility in relation to water
Issue definition (2)	1.1 Advance platforms for champions to gain clarity around the issue of low community capital and explore potential solutions	To build a collective voice that can advocate and explore solutions to improve community capital
Ensure good water sensitive governance		
Issue emergence (1)	1.3 Support champions inside and outside the water sector to advocate for greater community and Traditional Owner involvement in water planning and decision-making	To ensure the role of community and Traditional Owners in water stewardship is recognised and valued
Shared understanding and issue agreement (3)	1.4 Expand existing champion networks to integrate a greater diversity of perspectives and extend the focus of platforms for collaboration to consider governance and engagement solutions	To develop a full suite of potential governance and engagement solutions for delivering the many different dimensions of Perth's water sensitive city vision
Shared understanding and issue agreement (3)	1.5 Implement trials and demonstrations of governance solutions for achieving Perth's vision of water stewardship	To explore and demonstrate how potential governance and engagement solutions can be delivered; evidence of costs, benefits and risks; learning about the capabilities needed for their effective implementation

5.5 Vision Theme 2: Protecting and enhancing the wellbeing of people and the environment

Required changes in practice

Perth's aspiration for protecting and enhancing the wellbeing of people and the environment will require shifts in water management practice. The characteristics, functions, conditions and values of ecosystems and urban environments need to be understood and respected, and controls need to be in place to manage the impacts of urbanisation, resource extraction and pollution. Achieving these outcomes will require natural assets to be integrated into the water management system so their management can be adequately planned and resourced.

Assessment of Perth's enabling conditions

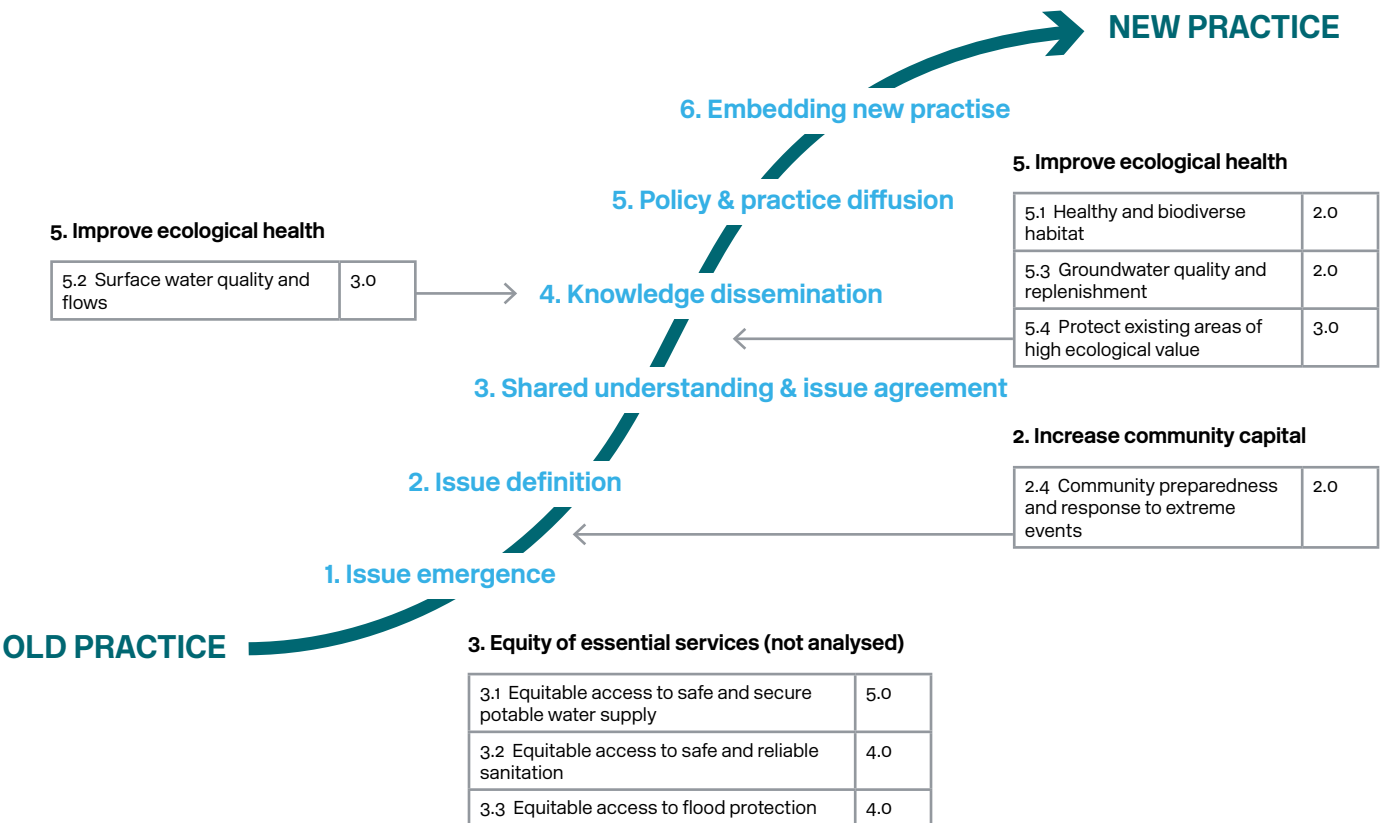


Figure 7: Transition phase for Vision Theme 2 represented through relevant WSC indicators

While there is general agreement throughout the sector that environmental health is an issue, there is not yet broad support for implementing system-wide solutions. Individual and organisational champions have influence within their sectors, however they are generally operating under their own organisational agendas. It is therefore important to build a collective voice amongst these champions so that it can become influential and effective amongst broad audiences in promoting the importance of water system services in delivering community and environmental wellbeing. Initiatives are therefore needed to advance collaboration platforms to **strengthen the alignment and coordination of voices across sectors that highlight environmental and human wellbeing as a valuable outcome of water system services** (Strategy 2.1).

There are not yet organisational champions influencing the broader regulatory space and fostering organisational alignment. Support amongst the authorising environment therefore needs to be built through the **development and communication of a narrative for the importance of water system services in delivering environmental health outcomes** (Strategy 2.2).

The Department of Biodiversity, Conservation and Attractions' (DBCA) and DWER's extensive ecological monitoring program (wetland vegetation, water quality, macroinvertebrate, etc.) has informed a good understanding of environmental issues affecting Perth across the sector. The Swan Canning and local Water Quality Improvement Plans also help identify water quality issues and outline

strategies for their improvement. Individual solutions to improve water quality and ecological health are being implemented and trialled, including wetland restoration projects, the Drainage and Nutrient Intervention Program project sites, oxygenation of the Swan and Canning rivers, and the groundwater replenishment scheme. While there are numerous localised solutions, they are not yet embedded within a system-wide approach. In order to demonstrate how innovative solutions can be delivered and to build an evidence base of their costs, benefits and risks, there needs to be **implementation and resourcing of significant trials and demonstrations of both technical and governance solutions that aim to improve environmental health** (Strategy 2.3).

Policies for protecting the natural environment (e.g. state and local government policies to improve urban stormwater quality through water sensitive urban design) are in place but not always effective. Defined goals and service standards beyond traditional water, sewerage and drainage services would result in improved outcomes for the receiving environments. Similarly, the threats to community wellbeing resulting from Perth's rising temperatures and drying climate are not addressed by current policy or guidance on service levels. In order to progress Perth's transition to its vision for human and environmental wellbeing, effort is needed to **translate policy goals into system-wide standards and programs of implementation** (Strategy 2.4) that clarify organisational roles and responsibilities and improve their effectiveness. This is particularly necessary for water quality policy.



Table 5: Strategies for advancing protection and enhancement of human and environmental wellbeing

Transition Phase	Strategies	Purpose
Improve ecological health		
Shared understanding and issue agreement (3) and Knowledge dissemination (4)	2.1 Strengthen the alignment and coordination of voices across sectors that highlight environmental and community health as an outcome of water system services	To build a collective voice that is influential and effective amongst broad audiences in promoting the importance of water system services in delivering environmental outcomes
Shared understanding and issue agreement (3) and Knowledge dissemination (4)	2.2 Develop and communicate a narrative for the importance of water system services in delivering environmental and community wellbeing outcomes	To harness authorising environment support for water system initiatives that aim to improve the health of the environment and the community
Knowledge dissemination (4)	2.3 Implement significant trials and demonstrations of both technical and governance solutions that aim to improve environmental health, including an explicit learning agenda	To demonstrate how innovative solutions can be delivered; evidence of their costs, benefits and risks; learning about the capabilities needed for their effective implementation
Policy and practice diffusion (5)	2.4 Translate policy goals for environmental health (in particular water quality) into system-wide standards and programs of implementation	To improve the implementation of policies and clarify organisational roles and responsibilities for managing, protecting and enhancing environmental outcomes

5.6 Theme 3: Integrating and engaging with the built and natural environment

Required changes in practice

Achieving Perth's vision for an urban environment that is well-designed and delivers multiple benefits, including public and private spaces that are green, cool, aesthetic and utilised, will require the practices of water system planning and urban planning to be more integrated and collaborative to achieve standards and service outcomes that link to a broader vision of urban liveability, human wellbeing and environmental health.

Assessment of Perth's enabling conditions

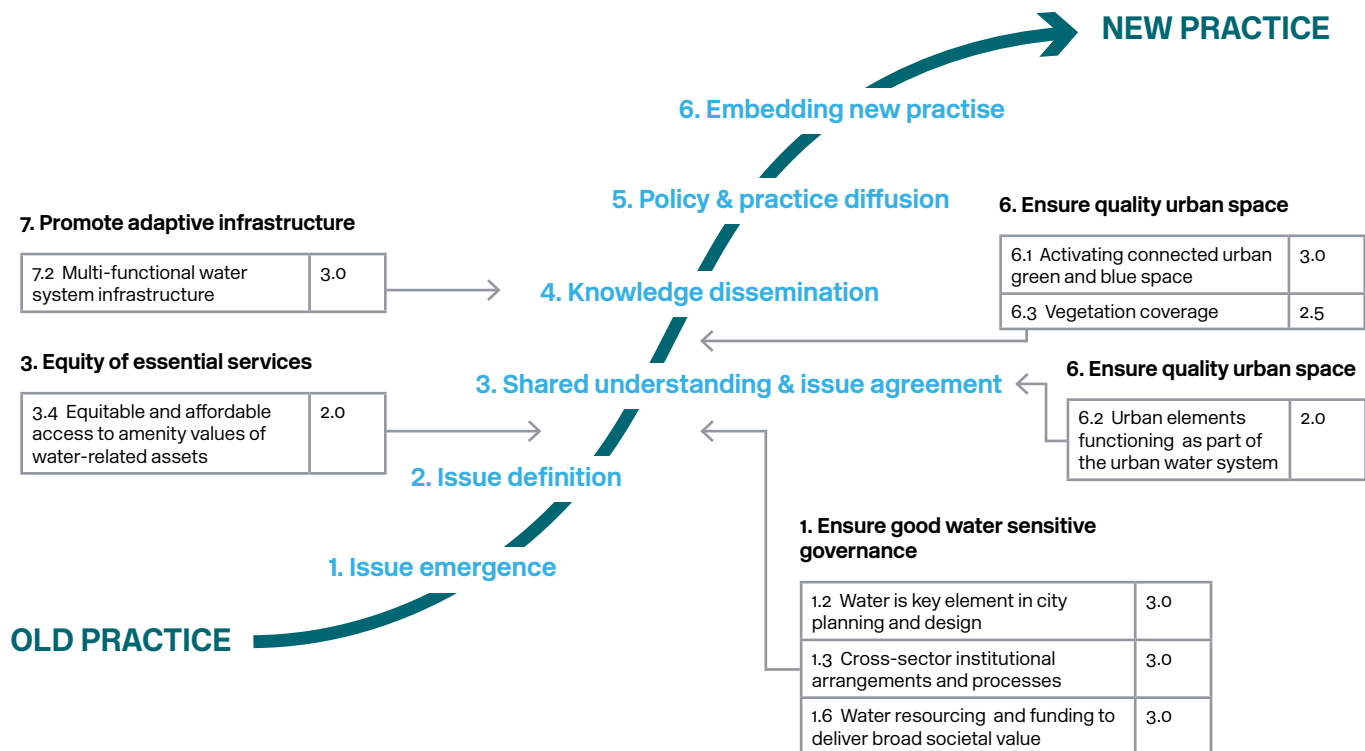


Figure 8: Transition phase for Vision Theme 3 represented through relevant WSC Index indicators

Many champions in Perth are advocating for a more collaborative and integrated approach to city planning and design (for example, the Green Space Alliance, New Water Ways, the Australian Institute of Landscape Architects and the WSTN). The influence of these networks with decision-makers and the community would increase with a **narrative for the importance of integrated solutions that shape both a desired urban form and function as part of the water system** (Strategy 3.1). This would help to create an authorising environment that supports integrated water and land-use planning for multiple benefits.

Broad support for water-related outcomes through city shaping interventions also needs to be built within the urban planning, design and development sectors, as some urban professionals are not yet aware of the benefits of an integrated and collaborative approach to urban and water planning and design. Initiatives are therefore needed to **build understanding amongst urban planning, design and development professionals about their role in delivering water outcomes** (Strategy 3.2).

There has been some participation of these broader (non-water) urban professionals through New Water Ways, CRCWSC-led processes, and in the ongoing WSTN. This network can be strengthened and expanded to grow the community of practice focused on improving the quality of urban space through water sensitive approaches, and thereby increase its influence and ability to work together to deliver innovative water sensitive solutions. This would be well supported by initiatives that aim to **build capacity of planning, design, development and water professionals to deliver solutions for multi-functional urban spaces** (Strategy 3.3).

Awareness raising and capacity building is helped by on-ground demonstrations that showcase the types of solutions needed. There are currently significant demonstrations of integrated, multi-functional urban spaces and infrastructure, including the White Gum Valley development, projects that are part of the Water Corporation and DWER's Drainage for Liveability program, and the Water Corporation's Groundwater Replenishment Trial and Subiaco Wastewater Treatment Plant buffer zone project. There are also many small-scale demonstrations across local

councils, including those highlighted in the *Public Parkland Planning and Design Guide (WA)* (Government of Western Australia 2014), which provides guidance for delivering multi-functional urban spaces. While this significant activity in the innovation and demonstration space will help support Perth's transition towards its vision for the built and natural environment, there will need to be more processes to **capture the lessons from these individual projects and use them to inform guidelines, policies and standards to encourage broad application of these solutions across different sectors** (Strategy 3.4).

State agencies such as the Department of Planning, Lands and Heritage, DWER, and DBCA are championing the desired practices by embedding a more integrated approach to city planning and design into state policies and guidelines (e.g. Liveable Neighbourhoods, Better Urban Water Management, State Planning Policies 2.9 Water Resources and 2.10 Swan Canning River System, Public Parkland Planning and Design Guide (WA)). Further progress is needed to improve the effectiveness of these existing government policies and guidelines and remove implementation barriers. Attention is therefore needed to **consolidate and align policy and regulatory tools for water and urban planning and design** (Strategy 3.5). This can initially be supported through some easy wins, such as releasing the new version of Liveable Neighbourhoods as part of State Planning Policy 7: Design WA and updating the water sensitive principles in State Planning Policy 2.9: Water Resources.

Implicit in Perth's water sensitive city vision is that amenity values of the city and its water-related assets are accessible to everyone, regardless of their socio-economic position. However there is not yet a shared understanding of this aspiration and its potential benefits. It would therefore be important to **undertake a system-wide assessment to understand the full range of amenity values of water-related assets** (Strategy 3.6) that can contribute to improving access for all of Perth's communities. This could inform the **development of a narrative for the importance of equitable and affordable access to water-supported amenity** (Strategy 3.7) that would help to articulate a collective voice around the issue and attract support for the implementation of solutions from the authorising environment.

Table 6: Strategies for advancing integration and engagement with the built and natural environment

Transition Phase	Strategies	Purpose
Ensure quality urban space		
Shared understanding and agreement (3)	3.1 Develop a narrative for the importance of integrated solutions that shape both a desired urban form and function as part of the water system	To ensure the authorising environment (State and local governments, community members, urban development industry) supports integrated water and land-use planning for multiple benefits
Shared understanding and agreement (3)	3.2 Build understanding amongst urban planning, design and development professionals about their role in delivering water outcomes	To ensure broad support for water-related outcomes across urban planning, design and development sectors
Knowledge dissemination (4)	3.3 Build capacity of urban and water professionals to create pathways for implementing solutions for multi functional urban spaces	To ensure professionals across planning, design and development have the ability to work together to deliver innovative water sensitive solutions that create high quality, socially inclusive urban spaces
Knowledge dissemination (4)	3.4 Learn from and showcase new and existing projects that demonstrate solutions for multi-functional, quality urban spaces	To inform the development of comprehensive guidelines, policies and standards
Policy and practice diffusion (5)	3.5 Consolidate, strengthen and align policy and regulatory tools for water and urban planning and design	To improve the effectiveness of existing policies and remove implementation barriers for strengthening the role of water in delivering quality and multi-functional urban spaces
Amenity of water related assets		
Issue definition (2)	3.6 Undertake system-wide assessment to understand the full range of amenity values of water-related assets and to appreciate the complex picture	To understand the extent and potential benefits of improving access to amenity values of water-related assets to inform advocacy and potential solutions
Shared understanding and agreement (3)	3.7 Develop a narrative for the importance of equitable and affordable access to water-supported amenity	To articulate a collective voice advocating for equitable access to amenity values of water-related assets and attract support for the implementation of solutions from the authorising environment

5.7 Theme 4: Sustaining the long-term use of Perth's resources

Required changes in practice

Traditional water system services are generally designed to meet singular objectives (e.g. water supply, sanitation, drainage) and have tended to prioritise cost efficiency over resource efficiency and to externalise environmental costs. As the impacts of human activity on planetary health are recognised, the community has become more aware of the natural limits in the availability of water, energy and other resources and the need for more sustainable water systems.

For Perth to realise its vision of sustaining the long-term use of its resources and the broader benefits this would achieve, alternative modes of service provision will need to be explored, some of which have been largely incidental to traditional approaches to water system services. This includes taking greater advantage of the synergies and connections between water, energy, food and land resources.

It will require a gradual transition to a more adaptive water servicing approach, involving greater integration of multi-functional systems across scales, supplying more diverse fit-for-purpose water resources and possibly providing greater customer choice of services and service levels. This may mean individuals and businesses are able to provide infrastructure and services at property and precinct scales, which can be integrated with centralised systems through flexible regulation and intelligent control. The planning, design, management and maintenance practices to deliver such an approach will need to be highly collaborative, with systems and processes in place to enable the sharing of risks, costs, benefits, data and lessons between infrastructure providers and operators, including individual property owners.

Assessment of Perth's enabling conditions

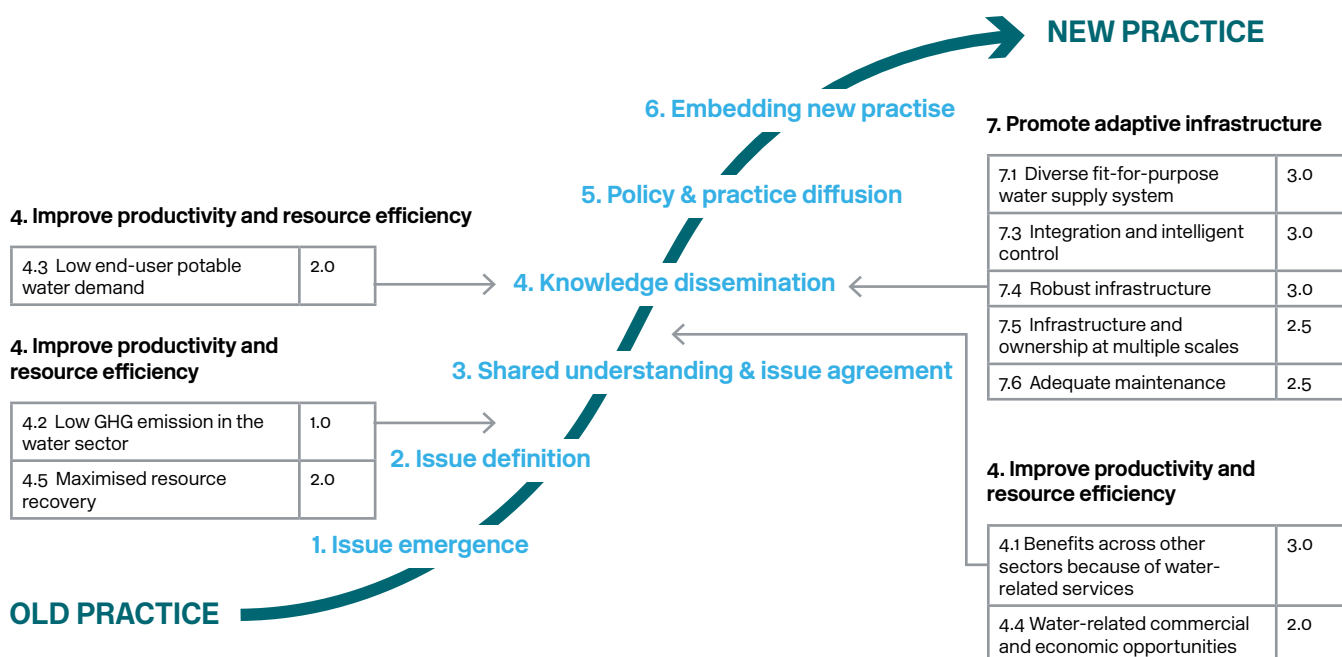


Figure 9: Transition phase for Vision Theme 4 represented through relevant WSC Index indicators

The need for smart, multi-functional and robust infrastructure is well understood amongst Perth's water sector champion networks, however the **narrative explaining why such an approach is important and valuable needs better articulation** (Strategy 4.1) in order to build broader support and to develop pathways for their implementation.

The commitment for emissions reduction and resource recovery (beyond recycled water) is largely driven by international and national agendas, which have not yet been translated to provide significance for the local Perth context. National targets exist for greenhouse gas emissions but local commitment to meet these targets is limited. In contrast, local support for low end-user potable water demand is high, with wide acknowledgement of the issue across the sector and demand measures in place. Awareness of the need to reduce use of self-supply groundwater needs to be raised and alternative supplies and replenishment schemes developed. Champions are experimenting with technical solutions to develop alternative non-potable supplies, and they are beginning to implement them at scale. Wastewater recycling in particular has some early large-scale demonstrations (e.g. the Water Corporation's Managed Aquifer Recharge project). However, there is a need to **increase knowledge about adaptive, multi-functional and integrated solutions beyond wastewater recycling** (Strategy 4.2) so that technical opportunities and governance arrangements needed for their implementation can be developed. This is particularly the case for solutions that aim to recover resources beyond wastewater (stormwater, nutrients, biosolids, heat and energy).

The Water Corporation is beginning to harness and recover these resources from wastewater treatment plants for large-scale re-use for purposes such as fertilizers for agriculture and horticulture. Practical experience of such approaches is needed by Perth practitioners more broadly, which can be built through **implementing trials and demonstrations of innovative adaptive, multi-functional and resource efficiency solutions** (Strategy 4.3). Such projects should involve an explicit learning agenda to examine what makes them successful or unsuccessful and to understand how solutions can be applied in the field, forming the basis of new and refined practical guidelines. They would also help to build an evidence base of costs, benefits and risks that can inform the development of a value proposition and business case.

These insights, as well as system data, should be readily

shared through strengthened collaboration platforms focused on delivering adaptive infrastructure and resource efficiency solutions across organisations and sectors (Strategy 4.4). This knowledge sharing would help lessons be applied to other projects of different scale, resource type, end-use and governance model to further advance solutions and develop application guidance. It would also help build cross-sectoral commitment and encourage people and organisations to adopt the necessary collaborative, innovative and risk management behaviours needed to achieve sustainable resource outcomes.

Lessons from scientific developments and on-ground trials and demonstrations should then be translated to **strengthen policy to support the further implementation of adaptive infrastructure and resource efficiency solutions** (Strategy 4.5).

While not an explicit part of Perth's vision for long-term sustainable resource use, there is potential for commercial opportunities as the city pursues this agenda through adaptive, integrated and multi-functional water systems. This is in terms of the direct supply of resources and greater environmental health, as well as the potential business that can be generated as Perth becomes established as an innovative water city. Some people in the water sector recognise the potential for multiple benefits across different sectors, however it is not yet broadly acknowledged and there is not yet a system-wide approach for pursuing water-related economic and commercial opportunities. To support an investment planning and decision-making approach that accounts for the broader benefits of innovation in delivering water system services, effort should go into **developing a business case and strategy for pursuing water-related economic and commercial business opportunities** (Strategy 4.6).

Table 7: Strategies for advancing sustainable long-term use of Perth's resources

Transition Phase	Strategies	Purpose
Promote adaptive infrastructure		
Shared understanding and issue agreement (3)	4.1 Develop a narrative for the importance and value of an adaptive, integrated, multi-functional infrastructure approach	To build broad support amongst policy-makers and across sectors so that pathways for solution implementation can be pursued
Shared understanding and issue agreement (3)	4.2 Increase knowledge about adaptive, multi-functional and integrated solutions beyond wastewater recycling (e.g. stormwater, nutrients, biosolids, heat and energy)	To develop technical opportunities and governance arrangements needed for their implementation
Shared understanding and issue agreement (3) Knowledge dissemination (4)	4.3 Implement trials and demonstrations of innovative adaptive, multi-functional and resource recovery solutions, including an explicit learning agenda	To understand how solutions can be applied in practice to inform the development of practical guidelines; to build an evidence base of costs, benefits and risks that can inform the development of a value proposition and business case
Knowledge dissemination (4)	4.4 Share knowledge and data through strengthened collaboration platforms focused on delivering adaptive infrastructure and resource efficiency solutions across organisations and sectors	To share lessons and apply insights to other projects, to build cross-sectoral commitment and encourage people and organisations to adopt the necessary collaborative, innovative and risk management behaviours
Policy and practice diffusion (5)	4.5 Strengthen policy to encourage and enable adaptive infrastructure and resource recovery solutions to be adopted	To remove barriers and improve implementation of adaptive infrastructure and resource recovery solutions
Improve productivity and resource efficiency		
Issue definition (2)	4.6 Develop a business case and strategy for pursuing water-related economic and commercial business opportunities	To support an investment planning and decision-making approach that accounts for the broader economic and commercial benefits of innovation in delivering water system services

5.8 Towards strategy implementation

Greater Perth's water sensitive city vision is ambitious and long-term. Transitioning towards such an aspirational water future will involve multiple institutions and individuals acting with common purpose. The scale of the transition may be considerable, but the commitment expressed by stakeholders involved in Perth's transition activities to date and their pursuit of a meaningful action agenda indicates the city is already making significant advancements.

For Perth stakeholders to progress implementation of the transition strategies and actions, further work will be required. In the last 18 months, they have explored a range of implementation dimensions through the CRCWSC's IRP1 project and other initiatives. A key discussion point has been action development, prioritisation and planning. A companion report that sets out the implementation plan for Perth's transition strategy is currently under development by the WSTN in collaboration with the CRCWSC IRP1 team.

The implementation plan presents the many transition actions identified by WSTN members, along with ideas for their implementation, including local opportunities that may be leveraged in the short- to medium-term. These are intended to help guide further action development by

local working groups and do not necessarily reflect any organisational commitment. Further planning by the WSTN is needed to develop actions into an operational plan that defines roles, responsibilities, targets and timeframes.

The implementation plan will also set out the framework for ongoing monitoring and evaluation of action implementation and Greater Perth's transition progress, as well as the governance structures and processes that have been, or are in the process of being, established to maintain collective momentum across stakeholders committed to implementing the strategy.

Ultimately, it is intended for this Vision and Transition Strategy, and the companion report, to provide a resource for Greater Perth stakeholders as they continue to collaborate through these next strategy implementation stages.

The CRCWSC has been working with other cities to support their implementation planning and can offer guidance to Perth through the provision of tools, strategic advice, facilitation of further processes and sharing of lessons from other places.



6. Conclusion

Greater Perth's drying climate, along with population growth and urban development pressures, have presented significant challenges for the city's water system and its communities' broader liveability aspirations. There is now broad recognition amongst water industry stakeholders that better collaboration and integration across diverse sectors and organisations is needed to ensure Perth's long-term liveability, productivity, resilience and sustainability.

To explore opportunities for a more collaborative and integrated approach to water management, leaders and strategic thinkers from across Perth's water, planning, environment and development sectors came together for multiple CRCWSC-led projects to examine how this can be achieved. Perth's historic, current and future water story was explored and informed the development of this transition strategy, which structures and highlights the change processes that will be required to achieve their water sensitive city vision. The results provide a framework for prioritising and designing strategic action across the many stakeholder organisations that will need to work collaboratively and coherently to facilitate Perth's water sensitive city transition.

Participants in these recent CRCWSC projects agreed on shared aspirations for Greater Perth, with the vision themes of water system stewardship, human and environmental wellbeing, integrated built and natural landscapes, and sustainable resource use receiving unanimous support. Workshop discussions that created this vision highlighted the pride the Perth community has in its unique context and the potential the city has to offer its residents, businesses and visitors over the long-term, even in the midst of challenging climatic, growth and economic conditions.

The insights presented in this transition strategy show that Greater Perth has valuable foundations and many opportunities to leverage in accelerating the city's transition towards its envisioned water future. Its strong vision and collective leadership provides an important base for pursuing shared aspirations and exploring more integrated solutions. The WSTN was purposefully brought together in July 2015 and since then, has met regularly and demonstrated a commitment to an action agenda for achieving the vision.

Key agencies are also championing the WSC agenda and starting to incorporate it into their strategic frameworks and programs. This builds on a historic focus on tools and instruments to guide water sensitive practice, for example through policies and guidelines, as well as recent significant advancements in knowledge development and on-ground projects.

Collaboration will be critical to deliver integrated solutions that deliver multiple benefits for the city and will need to maintain focus going forward. Priorities for advancing Perth's WSC transition include the need for inclusive water governance arrangements that account for the entire water cycle, underpinned by the water sensitive city vision being deeply embedded in organisational policies, plans and strategies. Attention will be needed to expand the focus of existing platforms for collaboration so that all goals of a water sensitive city are addressed. This includes initiatives to support the development of solutions for aspects of Perth's water vision that are less progressed, through increased knowledge, on-ground demonstrations and practical guidance for implementation.

Perhaps most importantly, the benefits of a water sensitive city need to be understood and appreciated throughout the Perth community so that initiatives to drive change are welcomed and endorsed broadly. This requires a compelling narrative of the value of Perth's water sensitive future to give stakeholders, decision-makers and the general community focus and clarity around their priorities and aspirations for the city.

The dedication of individuals and organisations in Perth, combined with a practical focus, is essential for Perth's transition and creates a strong enabling environment for rapid adoption of water sensitive city principles and practices. Embedding the momentum of the WSTN through strengthened policy and regulation, informed by on-ground innovation and learning, will help accelerate further progress. With ongoing commitment from stakeholders to implementing the strategies identified in this report, Perth will be in a strong position to achieve its vision of being a liveable, sustainable, productive and resilient city.

Appendix A – Research methodologies

This appendix provides a brief overview of the research projects and methodologies that have been drawn upon in developing this vision and transition strategy for Greater Perth.

A2.3 Engaging Communities with Water Sensitive Cities

A national survey was conducted in February-March 2014 and involved 5,194 participants across all states and the ACT. The survey covered a broad range of demographic variables including cultural background, current residential status, current employment status, as well as water-related concepts. The survey included questions covering the following topics:

- Knowledge of catchments and the urban water cycle
- Knowledge of water treatment and management
- Knowledge of impacts of actions on waterway health
- Attitudes to alternative water sources and water management approaches
- Engagement in water-related activities
- Sources of information about water

Focus groups were also conducted to provide further detail and understanding of the survey results. Six focus groups were held in Brisbane, Townsville, Melbourne, Bendigo, Perth and Geraldton. Participants reflected a mix of ages, genders, and incomes. The focus groups included discussions about perceptions of water and stormwater, and knowledge about diverse management practices to mitigate stormwater pollution.

For further information on community knowledge about water, please refer to the following report:

Dean, A., Fielding, K., Newton, F., & Ross, H. (2015) *Community knowledge about water: Who has better water-related knowledge and is this important?* Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

For further information on water literacy in Australia, please refer to the following report:

Fielding, K., Karnadewi, F., Newton, F., & Mitchell, E. (2015) *A National Survey of Australians' Water Literacy and Water-related Attitudes*. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

A3.2 Better Regulatory Frameworks for Water Sensitive Cities

An assessment of the regulatory framework in Western Australia was undertaken to determine the extent to which the framework facilitates or hinders the establishment of a water sensitive city. This assessment was undertaken by Maddocks University and focused on primary and selected secondary State legislation. A template was developed to capture the results of the stocktake and included:

1. Overview of the legislative instrument that may be relevant to the establishment of a water sensitive city
2. Relevant provision(s) of the legislative instrument that may be relevant to the establishment of a water sensitive city
3. Specific topic or issue raised by the provision that is relevant to the establishment of a water sensitive city
4. Assessment of the extent to which the provision can facilitate or hinder establishment of a water sensitive city

For further information, refer to the following report:

De Sousa, D. (2014). Results of a Legislative Stocktake for Western Australia. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities. ISBN 978-1-921912-21-4.

A4.2 Mapping Water Sensitive Scenarios – Greater Perth case study

The project methodology was based on the latest scientific insights on transition planning processes and frameworks for application to cities and towns wanting to shift practice towards water sensitivity. It drew on the basic principles of envisioning, backcasting and scenario planning that underpin the development of “transition scenarios”, the latest generation of scenario approaches that has emerged in response to sustainability challenges. These approaches have integrated scholarship from socio-technical transitions (transition management in particular) and social-ecological system resilience.

In applying these methods, the project tailored them to suit the local context, with adaptations as the series progressed to accommodate workshop timeframes and evolving priorities of the participants. It involved a series of five half-day workshops held over the course of five months (July to November 2015) in Greater Perth, designed as a “pressure cooker” participatory process. These workshops guided participants through a series of analytical and creative steps:

1. Analysing the System
2. Horizon Scanning
3. Envisioning
4. Diagnosing the Challenges
5. Backcasting
6. Operationalising

Each workshop involved a combination of whole group discussions, small group discussions and facilitated activities designed to examine the workshop themes in detail. Between workshops, the research team synthesised and analysed results, which were then presented back to the participants at the following workshop for validation. This enabled an iterative process of reflection and refinement, ensuring that this final report is an accurate reflection of the workshop process and outputs.

For detailed process methodologies in each of the workshops, please see the following report:

Rogers, B.C., Hammer, K., Werbeloff, L., Chesterfield, C. (2015). Shaping Perth as a Water Sensitive city: Outcomes of a participatory process to develop a vision and strategic transition framework. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

This vision and transition strategy has directly built on the above document, as well as insights from other research projects and the application of more recent tools developed by the CRCWSC. It therefore supersedes the content from the A4.2 project report.

D6.2 Developing a water sensitive cities assessment tool

The CRCWSC’s WSC Index is a benchmarking tool designed to provide a detailed understanding of a city’s current performance in relation to its aspirations. It articulates seven WSC goals, which organise 34 indicators representing the major attributes of a WSC. These indicators are also mapped to the idealised city-states represented in the Urban Water Transitions Framework to provide a benchmarked city-state.

While a city’s local WSC vision may not emphasise all indicators of the WSC Index to the same degree, the tool enables diagnosis of key areas of strength and weakness. This insight can then inform the prioritisation of actions and it provides a framework for ongoing monitoring and evaluation of a city’s water sensitive performance.

The purpose of the WSC Index is to guide governments and organisations to transition cities into liveable, resilient, sustainable and productive places through water related actions. It aims to:

- Provide a communication tool for describing key attributes of a WSC.
- Articulate a shared set of goals of a WSC.
- Provide benchmarking for a city's water-sensitive performance.
- Measure the progress and direction towards achieving WSC goals.
- Assist decision-makers prioritise actions, define responsibility and foster accountability for water-related practices.

The WSC Index was co-designed with a diverse range of industry partners and pilot tested for metropolitan Perth and two of its local councils (City of Subiaco and City of Swan). Its application relies on cross-organisational knowledge sharing and collaboration that strengthens broader industry relationships to deliver commitment to action.

The seven goals of the WSC Index are to:

1. Ensure good water sensitive governance
2. Increase community capital
3. Achieve equity of essential services
4. Improve productivity and resource efficiency
5. Improve ecological health
6. Ensure quality urban space
7. Promote adaptive infrastructure

By assessing the current levels of practice and outcomes of each of the 34 indicators, it is possible to identify a city's progress in terms of the Urban Water Transitions Framework.

For further information, please refer to CRCWSC's website (<https://watersensitivecities.org.au/solutions/wsc-index/>) and the following paper:

Chesterfield, C., Rogers, B.C., Beck, L., Brown, R.R., Dunn, G., de Haan, F., Lloyd, S., Urich, C. & Wong, T. (2016). *A Water Sensitive Cities Index to support transitions to more liveable, sustainable, resilient and productive cities*. Singapore International Water Week, Singapore.

Appendix B – Transition analysis

This appendix presents the framework, methodology and results of the analysis Perth's transition progress in Section 5 of the main report.

Transition Dynamics Framework and Methodology

Transitions theory is a body of interdisciplinary research that studies how transitional changes are driven and enabled over time. CRCWSC research has drawn on this knowledge base to develop the Transition Dynamics Framework (Brown,

Rogers and Werbeloff, 2016⁹; Brown, Rogers and Werbeloff, 2017¹⁰). This Framework identifies six distinct phases of change during a city's water sensitive transition (Figure 9).

As a city moves through each phase sequentially, enabling conditions are established to support its trajectory towards its WSC vision and avoid the risk of change pathways that reflect lock-in, backlash or system failure patterns (Figure 10).



Figure 10: Six phases of change during the transition to a new practice

Actions to orient and drive change towards a city's envisioned water sensitive future need to progressively establish these enabling conditions. Actions with the most impact during the early phases of transition will be different from those during the later phases. It is critical to identify a city's current phase of change to ensure that actions are prioritised according to the effectiveness they will have in accelerating the WSC transition.

⁹ Brown, R.R., Rogers, B.C., Werbeloff, L. (2016). Moving toward Water Sensitive Cities: A guidance manual for strategists and policy makers. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

¹⁰ Brown, R.R., Rogers, B.C., Werbeloff, L. (2017). A framework to guide transitions to water sensitive cities. Chapter 9 in Moore, T., de Haan, F.J., Horne, R. & Gleeson, B. (Eds) Urban Sustainability Transitions: Australian Cases – International Perspectives. Springer, Japan.

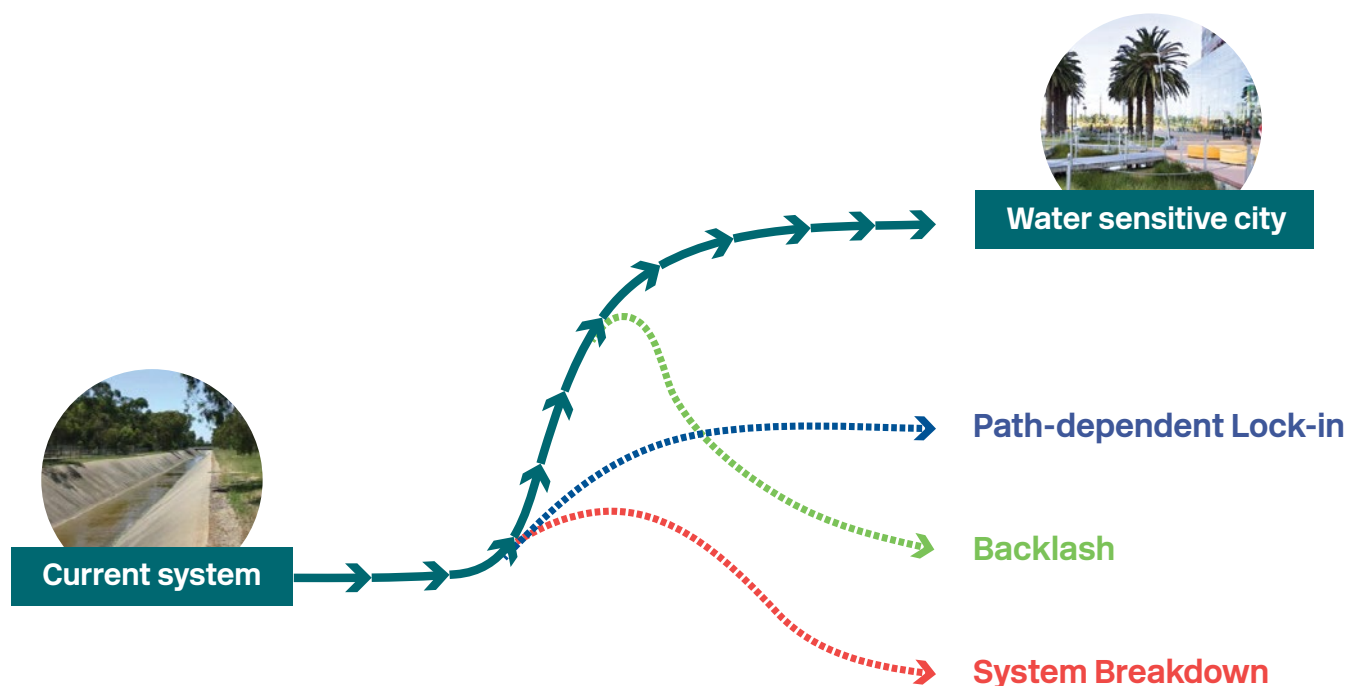


Figure 11: Transition pathways: successful transition, lock-in, backlash and system breakdown

The CRCWSC's Transition Dynamics Framework sets out five types of enabling factors that need to be present throughout a transition: champions, platforms for connecting, science and knowledge, projects and applications, and practical and administrative tools. Together, these five factors create an enabling environment for a WSC transition and, mapped against the six transition phases, they create a matrix (Figure 11) for a deeper understanding of the current transition phase for each vision outcome.

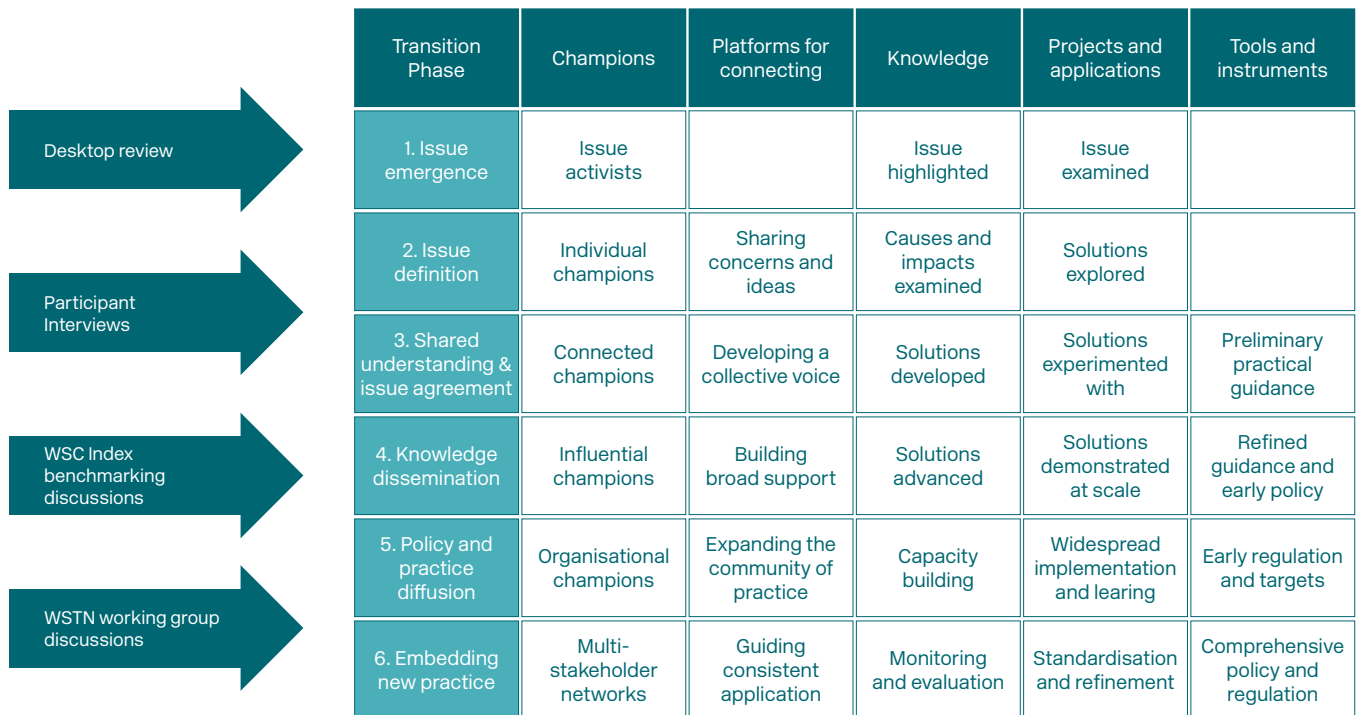


Figure 12: Transition Dynamics Framework (adapted from Brown et al., 2016; Brown et al., 2017)

The Transition Dynamics Framework was used as a diagnostic tool to assess the presence or absence of enabling factors as an indicator of progress towards Greater Perth's aspired change in practice as it advances towards its water sensitive city vision. A range of desktop and engagement activities provided data on Perth's enabling environment and the IRP1 research team worked closely with a WSTN working group to apply the Framework and determine the city's transition progress for each dimension of its water sensitive city vision.

The Framework provides a checklist of the factors that should be deliberately and sequentially built up to inform the prioritisation of strategies and actions.

Transition Analysis Results for Perth

The transition analysis was conducted using the CRCWSC's WSC Index as an organising framework. The Transition Dynamic Framework was applied to each WSC Index goal to consider Greater Perth's associated transition progress. For goals where the constituent indicators were too diverse to be considered on one transition pathway, one or more indicators were grouped together for the transition analysis.

This section presents the assessment results and key evidence informing the analysis. The results were then rearranged in the main body of this report so they align with Perth's water sensitive city vision themes rather than the WSC goals.

1. Ensure good water sensitive governance (Indicators 1.1-1.7)

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Champions	Bridges	Knowledge	Projects	Tools
<ul style="list-style-type: none"> • Key networks of individuals • Drainage for Liveability (DWER, Water Corporation) • Champions for specific aspects and issues, not across the whole issue of governance • Many individual champions across industry • Community can be blockers • CRC • WSTN • NRM groups 	<ul style="list-style-type: none"> • (Semi) Formalised organisations, structures, & processes for coordination and alignment • Drainage for Liveability • Capacity building organisations (New WATER Ways) • WSTN • Green infrastructure forum • WWC • Local government groups (formed to focus on single issues) 	<ul style="list-style-type: none"> • Research, science & contextualised knowledge • Science exists but it is not transferred, not shared, and agencies are not supported to apply it • CRC governance research, policy influence research, IRP1 	<ul style="list-style-type: none"> • Experiments, demonstrations, & focus projects • Drainage for Liveability – no projects across the broad aspect of governance 	<ul style="list-style-type: none"> • Legislative, policy, regulative, & practice tools • Better Urban Water Management • Liveable Neighbourhoods • State Planning Policy 2.9



2. Increase community capital (Indicators 2.1-2.4)

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

2.5 Indigenous involvement in water planning

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Champions	Bridges	Knowledge	Projects	Tools
<ul style="list-style-type: none"> • <i>Key networks of individuals</i> • Champions exist in a narrow sense e.g. water conservation. • LGA have community engagement programs • Education programs around flooding, some water conservation messages • No one defining the issue for indigenous involvement • CRC, Urbaqua, WSTN, Josh Byrne and Associates, CSIRO, Water Corporation, DWER, DBCA, SERCUL • WSTN Community engagement subcommittee • New WAter Ways 	<ul style="list-style-type: none"> • <i>(Semi) Formalised organisations, structures, & processes for coordination and alignment</i> • WSTN • WSTN community engagement subgroup • Waterwise councils program • Metropolitan Regional Council 	<ul style="list-style-type: none"> • <i>Research, science & contextualised knowledge</i> • Solutions are being developed mainly for awareness, literacy and connection – not for shared ownership, preparedness and indigenous involvement • CRC national survey • Water conservation solutions are developed and delivered • No clear understanding of WHY Perth has low community capital • Water Forever • Fertilise Wise • Database of imagery (CRC/ UQ) • River Guardians 	<ul style="list-style-type: none"> • <i>Experiments, demonstrations, & focus projects</i> • Projects around water conservation, mainly single issue focused 	<ul style="list-style-type: none"> • <i>Legislative, policy, regulative, & practice tools</i> • CRC community engagement research • No guidance

3.4 Equitable access to amenity values of water-related assets (Indicators 3.1-3.3 not analysed)

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Champions	Bridges	Knowledge	Projects	Tools
<ul style="list-style-type: none"> • <i>Key networks of individuals</i> • SAPP • Greenspace Alliance • Department of Planning, Lands and Heritage • Water Corporation • CRCWSC researchers • Local government champions • Department of Local Government, Sport, and Cultural Industries • Perth NRM • SERCUL • Champions not engaging well with policy yet • DBCA 	<ul style="list-style-type: none"> • <i>(Semi) Formalised organisations, structures, & processes for coordination and alignment</i> • New Water Ways (green infrastructure symposium) • WALGA • Perth NRM • 2020 Vision (LGAs using Urban Forestry Strategy guidance when preparing their own strategies) • Greenspace alliance 	<ul style="list-style-type: none"> • <i>Research, science & contextualised knowledge</i> • Urban forest guidance (2020 Vision) • Living streams guidance note • Urban heat research • Xeroscaping research • Public open space guidance document 	<ul style="list-style-type: none"> • <i>Experiments, demonstrations, & focus projects</i> • Urban Forest Strategy • Local Government drainage retrofits across Perth • Drainage for Liveability • Adopt-a-verge (City of Vincent) • Water Corporation's Waterwise verges program 	<ul style="list-style-type: none"> • <i>Legislative, policy, regulative, & practice tools</i> • Liveable Neighbourhoods • Design WA • Drainage for Liveability • Strategic community planning processes undertaken by LGAs • Swan and Canning Rivers Management Act (2006) and River Protection Strategy

4.2 Low GHG emissions and 4.5 Maximised resource recovery

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

4.1 Benefits across other sectors and 4.4 Water-related economic and commercial opportunities

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Champions	Bridges	Knowledge	Projects	Tools
<ul style="list-style-type: none"> • <i>Key networks of individuals</i> • Not many local champions, driven by international and national agendas – not yet localised for Perth • E.g. national targets for greenhouse gas emissions – limited local commitment • Champions exist for low end-user potable water demand • Need business case for water-related economic and commercial business opportunities 	<ul style="list-style-type: none"> • <i>(Semi) Formalised organisations, structures, & processes for coordination and alignment</i> • Specific projects (e.g. delivered by Water Corporation) 	<ul style="list-style-type: none"> • <i>Research, science & contextualised knowledge</i> • Non-potable supply solutions exist • Need to raise awareness of the need to reduce use of self-supply groundwater • Little knowledge on solutions beyond wastewater recycling • Need for governance solutions 	<ul style="list-style-type: none"> • <i>Experiments, demonstrations, & focus projects</i> • Managed Aquifer Recharge program (significant demonstration) • White Gum Valley development • Recovery of resources (Water Corporation) for fertilizers 	<ul style="list-style-type: none"> • <i>Legislative, policy, regulative, & practice tools</i> • Little guidance – need evidence and business cases • National/ international targets and policies

5. Ecological health (Indicators 5.1 Healthy and biodiverse habitat, 5.3 Groundwater quality and replenishment, and 5.4 Protecting existing areas of high ecological value)

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

5.2 Surface water quality and flows

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Champions	Bridges	Knowledge	Projects	Tools
<ul style="list-style-type: none"> • <i>Key networks of individuals</i> • Individual (and organisational) champions exist (e.g. DWER, DBCA) not yet collective voice • Not yet influencing regulation 	<ul style="list-style-type: none"> • <i>(Semi) Formalised organisations, structures, & processes for coordination and alignment</i> • Specific projects 	<ul style="list-style-type: none"> • <i>Research, science & contextualised knowledge</i> • Good understanding of ecological issues – DBCA/ DWER ecological monitoring program (wetland vegetation, water quality, macroinvertebrate) 	<ul style="list-style-type: none"> • <i>Experiments, demonstrations, & focus projects</i> • Swan Canning WQIP, local WQIPs • Wetland restoration projects • Drainage and Nutrient Intervention Program • Oxygenation of Swan and Canning rivers • Groundwater replenishment scheme • Mainly local solutions, site specific 	<ul style="list-style-type: none"> • <i>Legislative, policy, regulative, & practice tools</i> • WSUD exists in state and local government policies, not always implemented/ effective • BUWM

6.1 Activating connected pleasant urban green and blue space and 6.3 Vegetation coverage

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

6.2 Urban elements functioning as part of the urban water system

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Champions	Bridges	Knowledge	Projects	Tools
<ul style="list-style-type: none"> • <i>Key networks of individuals</i> • Green space alliance, Josh Byrne and Associates, AILA, WSTN • Water Corporation, DWER, DoP • WSTN has a common position through community engagement subgroup 	<ul style="list-style-type: none"> • <i>(Semi) Formalised organisations, structures, & processes for coordination and alignment</i> • Greenspace alliance, 202020 vision • Drainage for Liveability • New WAtEr Ways • DWER 	<ul style="list-style-type: none"> • <i>Research, science & contextualised knowledge</i> • CRC research • 202020 vision • New WAtEr Ways 	<ul style="list-style-type: none"> • <i>Experiments, demonstrations, & focus projects</i> • Turf irrigation trial, biofilter trials • Urban wetland projects (City of Subiaco, Point Fraser wetland, Bannister Creek) • White Gum Valley • Sump retrofits across Perth councils • Drainage for Liveability 	<ul style="list-style-type: none"> • <i>Legislative, policy, regulative, & practice tools</i> • Liveable Neighbourhoods • Design WA (trees, root zones) • DSR public parklands strategy

7. Promote adaptive infrastructure (Indicators 7.1-7.6)

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue Emergence	Issue activists	N/A	Issue highlighted	Issue examined	N/A
2. Issue Definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	N/A
3. Shared Understanding & Issue Agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge Dissemination	Aligned and influential champions	Building broad support	Solutions advanced	Significant solution demonstrations	Refined guidance and early policy
5. Policy & Practice Diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding New Practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Champions	Bridges	Knowledge	Projects	Tools
<ul style="list-style-type: none"> • <i>Key networks of individuals</i> • DWER (organisational and individual champions) • Water Corporation (organisational and individual champions) • Other individual champions (from LandCorp, local governments) 	<ul style="list-style-type: none"> • <i>(Semi) Formalised organisations, structures, & processes for coordination and alignment</i> • CRCWSC • WSTN • New Water Ways • Infrastructure Coordinating Committee (WAPC) • SAPPR 	<ul style="list-style-type: none"> • <i>Research, science & contextualised knowledge</i> • MAR and wastewater reuse coming out of the Water Corporation's groundwater replenishment scheme • Shire of Kalamunda • Community bore and drainage retrofit research out of White Gum Valley • Biofilter vegetation trials (Shire of Serpentine/ Jarrahdale) • CRC biofilters and living streams guidance documents • Other CRC research 	<ul style="list-style-type: none"> • <i>Experiments, demonstrations, & focus projects</i> • Groundwater Replenishment Scheme (Water Corporation) • White Gum Valley (LandCorp and Josh Byrne and Associates) 	<ul style="list-style-type: none"> • <i>Legislative, policy, regulative, & practice tools</i> • Guidelines for the use of non-drinking water in WA • Drainage for Liveability (and associated guidance notes) • Living streams, living walls and biofilter guidance • Liveable Neighbourhoods • SAPPR process • ICC processes • Water services legislation • ERA licensing • SPP2.9



CRC for
Water Sensitive Cities

Cooperative Research Centre for Water Sensitive Cities



Level 1, 8 Scenic Boulevard
Monash University
Clayton VIC 3800



info@crowsc.org.au



www.watersensitivecities.org.au