Urban WaterGuide

A guide for building sustainable and resilient cities

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THE AUSTRALIAN WATER PARTNERSHIP

About the Authors
The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) operated a national interdisciplinary research program between 2012 and 2021. Its purpose was to change the way we design, build and manage our cities and towns by valuing the contribution water makes to economic development and growth, our quality of life and the ecosystems of which cities are a part. The CRCWSC was supported by the Australian Government.

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Glossary

Blue infrastructure refers to the different places water occurs in urban areas, such as in rivers, canals, ponds, lakes, swamps, wetlands and floodplains (Browder et al., 2019).

GEDSI stands for gender equality, disability and social inclusion (AusAID & AWP, nd).

Green infrastructure means living things within urban areas, specifically the soils, plants and trees, as well as the places where these are found including natural areas like forests, along waterways and in reserves, and managed areas such as parks, gardens, sports fields and agricultural land (Browder et al., 2019).

Grey infrastructure describes the built structures related to water management in cities such as reservoirs, embankments, levees, pipes, pumps, wells, bores and water treatment plants, as well as buildings, roads and structures such as bridges that influence the urban water cycle (Browder et al., 2019).

Indigenous Peoples have a special relationship with the land on which they have lived for generations and act as custodians of this land for the next generation. There are more than 370 million Indigenous people spread across 70 countries worldwide. There is no single definition of 'Indigenous'. Instead, there is an understanding that the term means:

- they self-identify as Indigenous people
- there is a historical link with those who inhabited the land at the time when people of different cultures or ethnic origins arrived
- they have a strong link to territories and surrounding natural resources
- they have distinct social, economic or political systems
- they have distinct languages, culture and beliefs
- they are marginalised and discriminated against by the state
- they maintain and develop their ancestral environments and systems as distinct peoples (Amnesty International, nd).

Integrated water management is a collaborative approach to planning and managing the water cycle. It includes managing and protecting the health of waterways and bays, wastewater management, water supply, stormwater management and water treatment as a single, integrated system, rather than as separate services to be optimised individually (DELWP, 2022).

Multi-functional refers to the ability to allow different functional uses and activities for an asset (etc.) to maximise the benefits to people, businesses and nature.

Nature-based solutions are actions that intentionally protect, sustainably manage, or restore nature with the additional goal of maintaining ecosystem services that benefit human development (DAWE, 2021).

Structural solutions are physical things to manage water services, such as infrastructure. Non-structural solutions are things like customer behaviour change actions, markets and regulations.

Water, sanitation and hygiene (WASH) means affordable and safely managed drinking water, sanitation and hygiene, which are all crucial to human health and wellbeing (WHO, 2022).

Water sensitive urban design (WSUD) refers to the design of buildings, roads and infrastructure to minimise the environmental impact on waterways and oceans. WSUD involves treating and reducing stormwater runoff, as well as water efficiency and creating opportunities for water reuse (Melbourne Water, 2017).

Triple bottom line is a sustainability framework for business and government that examines the social, environment and economic impact in addition to financial performance (Miller, 2020).

Urban water (cycle, management etc.) includes drainage, flood management, groundwater management, sanitation, wastewater management, waterway management and water supply in cities and towns.

Executive summary

Introducing the Urban WaterGuide

Water is critical to the effective functioning of towns and cities, their economies and all members of their communities. When there is not enough water, too much water, or it is too polluted, these communities suffer. Inequality of access to water services also has major implications for everyone, especially poor and marginalised groups.

Urban water managers globally are now rethinking how to tackle these issues, especially in light of climate change impacts on water systems and communities. Increasingly, water managers are using approaches that manage the many different types of water and the different infrastructure systems as a single, integrated and connected system that delivers multiple objectives:

- An integrated and inclusive approach delivers resilient, green cities. These cities adapt to a changing climate by using green development, extracting water, energy and nutrient resources from the water cycle and harnessing low-energy and nature-based solutions.

- Inclusive and integrated approaches in these cities enable equitable access to clean drinking water, reliable sanitation and protection from flooding, especially for marginalised members of the community.

- An integrated and inclusive approach helps deliver the United Nations (UN) Sustainable Development Goals (SDGs). Effective water management enables progress in all SDGs.

These more integrated and inclusive approaches are already being applied in practice, and have been observed in use in Australia, Singapore, North America and the United Kingdom, with examples also appearing in South America, Asia, Africa and Europe. In each situation, the approach is adapted to local context and community needs. One observable difference lies in the objectives (Mishra et al., 2020). In developing cities, integrated approaches are a way to address survivability and resilience concerns, whereas for developed cities, they are a way to tackle environmental and liveability concerns. This adaptation process is illustrated by the following flood management examples.

Elizabeth Street catchment, Melbourne (Australia)

Elizabeth Street is a 308 ha flood-prone catchment in Melbourne's central business district. The City of Melbourne has adopted a catchment approach to mitigate these flood risks, using a series of stormwater harvesting systems to hold water in the top of the catchment and thereby reduce flooding at the bottom of the catchment. In addition to reducing the social and economic impacts of flooding, these projects will reduce the urban heat island effect that previously cost local businesses A$37 million in lost revenue during a 2013 heat wave.

The Royal Exhibition Building and Melbourne Museum stormwater harvesting project is an example of a completed project (Figure 1). Rainwater is harvested from the extensive roofs and surrounding paved areas of these 2 adjacent buildings, and stored in a 1.35 million litre underground tank. The system supplies 6.4 million litres of water for reuse in toilets, fountains, lakes and garden irrigation.

(Source: CRCWSC, 2018)

Figure 1. Melbourne's Royal Exhibition Buildings. (Source: EQRoy / Shutterstock.com)

Sponge cities, Wuhan (China)

China's 'Sponge City Program' was initiated in 2014 to address flooding in 600 cities. Waterlogging was a key issue, and green infrastructure solutions mimicking the natural water cycle were adopted as an alternative to conventional engineering solutions. Wuhan was once known as the 'City of 100 Lakes', with 127 lakes located in the central area alone in the 1980s.

But over time, these natural drainage features have been lost. Wuhan is now retrofitting public spaces, schools and residential areas with green infrastructure features, and by 2019, 38.5 km^2 had been modified at a cost of ¥11 billion (Figure 2).

In 2020, Wuhan experienced record-breaking rainfall. Compared with similar storms in 2016, waterlogging reduced significantly, and there were fewer impacts on traffic and the public. A cost analysis showed the Sponge City measures saved ¥4 billion compared with a conventional approach to upgrade the drainage system.

(Source: Peng & Reilly, 2021)

Figure 2. The city of Wuhan, China (Source: Hao Wan / Shutterstock.com)

Millennium Information Technolgies, Malabe (Sri Lanka)

Millennium City is a software company on a 6.5 ha sloping site near Colombo. The complex has an onsite wastewater recycling and rainwater harvesting system that supplies 75% of the company's daily water needs (Figure 3). The city's water supply network provides the remaining 25%. The rainwater harvesting system connects the site's main roof areas, along with runoff from the sloping site, to 3 large reuse ponds located at the lowest point of the site. These ponds are integrated with the site landscaping to provide amenity and improve micro-climatic conditions. The rainwater harvesting system helps to manage the storm runoff, protects natural waterways by reducing stormwater runoff to virtually zero, and conserves the city's central water supplies.

(Source: Centre for Science and Environment)

Figure 3. Millennium Information Technologies Malabe, Sri Lanka (Source: Foursquare.com)

The Urban WaterGuide comprises five parts

Any city can face barriers in implementing integrated and inclusive approaches (Mishra, 2020). These barriers include resistance to change, poverty and marginalisation, fragmented responsibilities, lack of legislative mandate, lack of experience in engaging the whole community and lack of funding.

The Urban WaterGuide outlines how these barriers are being addressed in Australia, and by Australians working on international projects.

The Guide comprises five parts:

- A **vision** that frames urban water challenges in terms of city-wide and inclusive community-level outcomes: water is an enabler of a wide variety of outcomes in a city and it is important for the water sector and diverse stakeholders to have a say and a clear line of sight to this broader purpose.

- A **strategy** that describes how the city can move to more integrated management of the urban water cycle: harnessing the whole of the water cycle to deliver the vision and to open up new pathways to deliver services for the whole community.

- On-ground **solutions** that take the concept of creating value to a project level, detailing how projects can be multi- rather than mono-functional.

- Practical ways to fund and de-risk the **implementation** of the new agenda so that actions can be delivered on the ground and citizens can enjoy the benefits.

- **Gaining permission** for change to occur by building political and community support for new initiatives.

Inclusive collaboration is also fundamental to the success of integrated solutions and is included as a cross-cutting theme. In the Urban WaterGuide, inclusion is considered through a lens of gender equality, disability and social inclusion (GEDSI). The Guide helps practitioners identify GEDSI stakeholders, their different needs in accessing and using water resources, their role in decision making and the barriers they may experience and how to address them.

How would cities be different if the Urban WaterGuide was widely adopted?

Using the Urban WaterGuide can help cities and practitioners achieve the following objectives.

1. **Cities are planned with water in mind from the outset**. Visions and outcomes for the city and all its citizens are developed inclusively, and the potential to co-design integrated water management outcomes is considered from the outset.

2. **Water security is achieved by harnessing all sources of water** that exist within cities, and considering broader sustainability and health benefits of water management options.

3. **Sanitation is improved** by inclusively, safely and appropriately managing treated sewage at different scales, linked to opportunities to recover water, energy and nutrients.

4. **Stormwater drainage is linked to urban planning** to create opportunities to manage stormwater where it falls using nature-based solutions. This approach creates water reuse and biodiversity opportunities while still providing safe passage and detention of flood waters.

5. **Social capital for sustainability and resilience is built up** by empowering citizens to participate in water management planning and by having water sector professionals who harness Indigenous knowledge systems and 'know-how' to adapt new technologies to local contexts, and governments that encourage cross-departmental involvement in water management.

6. **The financial logic of investment decisions recognises and attributes the inclusion, sustainability and resilience benefits** of urban water management to private and community beneficiaries, prioritising the voices and needs of the most marginalised.

1 About the Urban WaterGuide

The Australian Government, Australian Water Partnership and the Cooperative Research Centre for Water Sensitive Cities partnered to develop a framework to improve water outcomes in international cities and towns, based on Australia's urban water experience. The result is the Urban WaterGuide, which covers water supply, sanitation, drainage, flooding, waterways and urban liveability, with a cross-cutting focus on gender equality and inclusion.
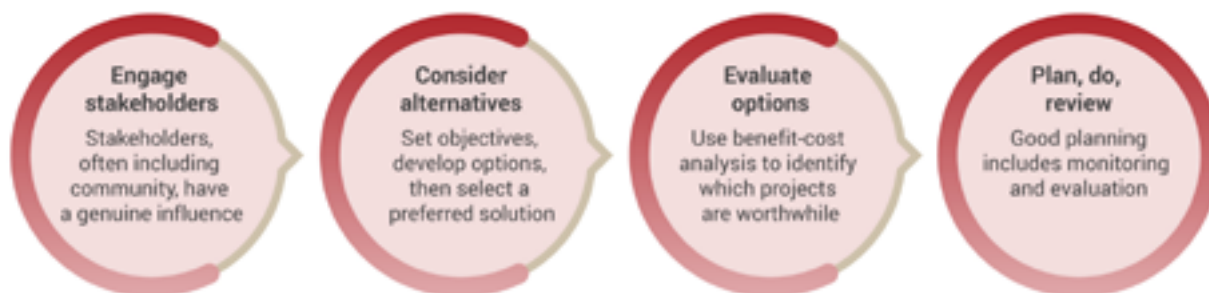
Figure 4. Activities that are commonly included in urban water planning.

The Urban WaterGuide has been written with an assumption that the foundations of good planning (Figure 4) are already in place. The Guide builds on these activities by demonstrating how to:

- frame water management as a way to contribute to the UN SDGs and leave no-one behind

- articulate the importance of water and resilient urban environments in delivering green cities

- harness all resources in the urban water cycle to respond to urbanisation and climate challenges facing cities and towns

- be inclusive, with contributions from different technical professions and diverse community members, especially the most marginalised

- successfully move from planning to actions, to realise benefits for all stakeholders.

1.1   Who is the audience for the Urban WaterGuide?

This Urban WaterGuide helps decision makers who are responsible for water supply, sanitation, drainage, flood management and managing natural water bodies in cities and towns. These leaders frequently work at different scales to manage the basics of public health and water security, as well as the growing role of cities in leading global adaptation to climate change.

1.2   Objectives

The Urban WaterGuide has three objectives.

1. Help water managers **identify ways to address critical urban water challenges** using approaches that also build resilience and engage all citizens.

2. Help water practitioners **engage in policy dialogues with other sectors** that are looking to collaborate on city-scale issues of sustainability, public health and wellbeing, and inclusion.

3. Demonstrate how to **convert principles into practical actions**.

1.3   Further reading

Readers wanting to further explore and understand the underlying concepts of the Urban WaterGuide may be interested in the following AWP Knowledge Projects:

- Human Settlements—A Framing Paper for the High-Level Panel on Water (Wong, 2016a)

- Gender Equality and Goal 6: The Critical Connection (Grant, Willetts & Huggett, 2019).

2 Introduction

Water is critical to the effective functioning of cities, their economies and all their citizens. When there is not enough water, too much, or it is too polluted, these systems suffer. Similarly, inequality in access to water services and resources has major implications for the sustainable growth and health of cities. Urban water managers globally are now rethinking how they address these issues.

The water systems in most cities have evolved over time into large, centrally managed systems that source water from catchments, use it once and then dispose of the treated wastewater to downstream environments. While these approaches can be highly efficient in what they do, they rely on a linear 'take–make–dispose' economic model, missing opportunities and potentially wasting resources such as energy, water or nutrients. The triple threats of climate change, biodiversity loss and continuing urbanisation, combined with the growing gap between the actual and required rates of infrastructure investment,[1] are challenging the continued effectiveness of this conventional model (UNEP, 2021). Yet too often, the response to droughts, floods and pollution is still to replicate and expand existing systems rather than to look at alternatives.

A different approach is needed, and there is growing interest in 'green' cities that are more inclusive, sustainable and resilient to a changing climate. These green cities employ strategies at a range of scales for community-led co-design and governance, low-impact development and recycling of commodities as well as low-energy technologies and infrastructure. Each of these actions can be a powerful climate change mitigation and adaptation response, particularly when magnified by the size of the urban settlements globally. Each action is also directly relevant to urban water management.

Urban water managers leading the adoption of green city agendas share a mindset of seeing the potential for water systems to create broader productivity and welfare gains for cities and towns, beyond providing core essential services. Here, language is important: emphasising *water systems and the way that people interact with them*, rather than a focus on specific infrastructure. A systems approach shifts the focus towards integrated approaches to urban water management that manage the different types of water and the different infrastructure systems as one connected system to deliver multiple objectives and to cope with increased climatic variability.

This change to a systems approach is one of the major insights from Australia's experience over the past 20 years, during a period that included extended droughts, catastrophic floods, wildfires in water supply catchments and rapid growth in urban populations via increased urban renewal and higher-density developments (Appendix 1). Other countries have similarly adopted an integrated systems approach, and this Urban WaterGuide complements Australian experiences with examples from these other cities.

Using these experiences and case studies, the Guide helps city planners, water managers and community groups change the way we design, build and manage our cities and towns by valuing water's contribution to economic development and growth, the quality of life of all people, and the ecosystems that cities rely on.

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1   For example, the Global Infrastructure Outlook (2020) forecasts a A$158 billion gap in Australia alone.

2.1 Urban water management: what is covered in the Urban WaterGuide

The urban water cycle includes natural water in waterways and wetlands, drinking water supplies, sewage, stormwater, floods and recycled water. By extension, urban water management includes:

- harvesting, treating and supplying safe, clean water to households and businesses
- collecting, treating, disposing or recycling wastes (sewage, hard rubbish and trade waste)
- protecting and rehabilitating blue and green urban environments such as waterways, wetlands and green spaces
- providing effective drainage and safe passage for rainfall runoff and flood waters.

These functions are not solely the responsibility of water authorities. They may also be influenced by the decisions of planning and environmental departments, municipal authorities, the private sector and communities. Figure 5 explains how this paradigm of urban water management operates at different scales.

Urban water management at different scales

River Basin — Balance water quality and quantity needs of all users in the catchment, including the environment

City/town — Align metropolitan water needs, infrastructure, systems and agencies towards a common vision

Precinct — Fit solutions to local context and culture of individual suburbs/ precincts/ districts/ villages

Lot — Demonstrate how urban design and water servicing options interact to influence water cycle outcomes

Minimise the urban water footprint, ensure water is safely returned to the environment

Integrated water management that is inclusive, connected to broader planning processes, and contributes to a city or town's future vision

Community based planning of multi-functional urban water solutions. This planning uses universal design principles to incorporate everyone's needs.

Urban water managers' focus

Figure 5. Examples of scales of action in urban water management.

2.2 The grand challenge and the need for a new approach

Urban water management is critical to the functioning of cities and the health of everyone living there. Cities are getting bigger. Globally, there is a trend of rural populations increasingly migrating to cities, and of small cities rapidly growing into larger, denser ones (Figure 6).

3.5 billion

People globally live in cities today, representing approximately half of humanity.

9.8 billion

People living in urban areas by 2050. This represents 68% of the world's population. Urban areas will absorb most of the future growth of the world's population.

95%

The share of the world's urban expansion that will take place in developing countries in the coming decades.

<1 million

The current population size of the fastest-growing cities. These cities are mainly in Asia.

43

Number of global megacities (more than 10 million inhabitants) by 2030. Most of these will be in developing regions.

Figure 6. How our urban populations are expanding. (Source: United Nations, 2018)

This growth of cities puts enormous strain on fresh water supplies, sewage disposal, the living environment and public health (ADB, 2017). According to the United Nations (nd) and the Asian Development Bank (2017):

- Cities' demand for water is growing but water is becoming scarcer. While agriculture remains the dominant use of water in many countries, the water footprint of cities is growing as their populations grow.

- Urban growth rates directly affect urban water security because growing populations require more infrastructure, resources and servicing.

- 600 million people living in urban areas already lack adequate water supply and sanitation (ADB, 2020a).

Climate change presents a further challenge affecting all cities and towns:

• Rainfall shocks—where precipitation is well below or above normal levels—are becoming more frequent, and coping with these shocks is a major challenge confronting humanity (Zaveria et al., 2021).

• Six of the 10 nations most affected by extreme weather events are in Asia and the Pacific (ADB, 2017).

• Further climate change will amplify existing patterns of migration. The majority of climate migrants will end up in cities that may or may not be prepared to house and integrate them (Zaveria et al., 2021).

The nature of the challenges and the number of people affected demonstrates urban water management is a critical, global issue. For each day that this challenge remains unresolved, citizens will continue to find ways to meet their immediate needs, whether environmentally sustainable or not. For this reason, many cities urgently need to find sustainable, resilient and safely managed ways to provide essential water services.

A special focus on informal settlements

Urban population growth is not just a water security challenge. In some cities, population growth is also outpacing the development of services such as housing, infrastructure and food systems. Some urban dwellers even find themselves living in informal settlements on the edges of cities without adequate water and sanitation services. The number of people living in informal settlements increased to 24% in 2018, or over 1 billion people (UNSC, 2020). The poverty and inability to access essential services experienced by these citizens is the single biggest determinant of their health (WHO, 2003).

The impacts of climate change and COVID-19 have exacerbated the vulnerability of these people. The 2020–21 COVID-19 pandemic pushed an estimated 114.4 million people into extreme poverty, including 57.8 million women and girls (UN, 2021).

Delivering water, sanitation and hygiene services to informal settlements is challenging for a range of reasons, especially if utilities do not recognise these areas. In the absence of dedicated action, communities in informal settlements can wait long periods for conventional trunk infrastructure to reach them through aid-funded projects. Other approaches to deliver services often use technologies that are designed to work in rural contexts. But unless water and sanitation options in urban settings are designed with the urban context and full life cycle in mind, solutions like pit latrines can pollute the environment and expose communities to significant health and safety impacts (e.g. diarrhoea in young children, unsafe facilities for women and children and inappropriate services that do not meet peoples' needs such as menstrual hygiene and health).

Innovative approaches that consider different aspects of the above challenges and work in partnership can make effective changes in water management. One example of new ways of servicing informal settlements is the work of WaterAid Australia in Papua New Guinea (PNG) (Box 1).

Box 1. Water supply governance models for PNG's informal settlements

Relevant SDGs:

On the surface, PNG's access to basic drinking water appears good at 86% of the population in 2017, up from 83% in 2000 (WHO & UNICEF, 2019). However, these figures mask the situation of those living in informal settlements. PNG's capital, Port Moresby, has over 400,000 people living in 114 informal settlements (ADB, 2020b). For these people, access to piped water has declined since 2000, and previous attempts to rectify this issue have failed.

The challenge has two sides. Local villages face poor water supply reliability and poor pressure. To meet their immediate needs, they buy water from informal water vendors at inflated prices. For the water utility, illegal connections to the supply network, together with leaks in the network, are a major non-revenue water challenge.

To address this situation, WaterAid Australia is working with Water PNG and the Motu Koita Assembly (a special authority representing urban villagers) to pilot a new water supply governance approach in Pari Village (WaterAid Australia, nd). The pilot established the Pari Water Authority (PWA) to service the village. The PWA has paid, professional staff and operates an internal reticulation network to supply water to households. Bulk water is provided by Water PNG at a negotiated wholesale price and supported by 138 kL of water storage to ensure supply reliability. Water PNG is also removing illegal connections in the area.

The PWA then uses a network of local water kiosks to sell water to villagers. Each kiosk is operated as a small business by local Motu entrepreneurs. Women are actively encouraged to participate in these ventures. The kiosk tariff is a fraction of the amount villagers have been paying to the informal water vendors, but it is enough to ensure cost recovery of PWA salaries, capital expenditure and bulk water charges to Water PNG. This approach will reduce activities by informal vendors.

Through this pilot, villages will gain reliable and affordable access to essential water, and non-revenue water use from Pari Village will be reduced, helping Water PNG recover approximately K60,000 in lost revenue each year. WaterAid and the PWA are also engaging with the informal water carters to negotiate their place in the new system.

Source: WaterAid Australia

2.3 The UN SDGs call for the use of more integrated approaches

The United Nations' Sustainable Development Goals (SDGs) were created as part of the 2030 Agenda for Sustainable Development, establishing an agreed set of international priorities to address global environmental, social and economic issues. The 17 goals set out a comprehensive vision for economic, social and environmental development (Figure 7) in the context of 'leaving no-one behind'.

Figure 7. United Nations' Sustainable Development Goals. (Source: United Nations[2])

The importance of water and cities is immediately evident. SDG 6 commits countries to 'ensure access to water and sanitation for all'. SDG 11 provides a further commitment to 'make cities and human settlements inclusive, safe, resilient and sustainable'. However, water management can have a much broader reach in delivering all SDGs (Wong, 2016a).

- Water and society: Water is essential for public health and wellbeing (SDG 3), ending hunger, achieving food security and improving nutrition (SDG 2). For example, water-related diseases are closely linked to poverty (SDG 1).

- Water, gender equality, disability and social inclusion: Ending discrimination against women and girls and people with disabilities (SDG 5) depends on inclusive, affordable and safely managed water, sanitation and hygiene (WASH). WASH is fundamental to health and wellbeing for the whole community, including maternal health, and supports school attendance, particularly among girls and young women (SDGs 4 and 5).

- Water and the environment: Ecosystems such as wetlands, lakes, rivers and aquifers sustain a high level of biodiversity. They provide cities and towns with a range of benefits and services such as drinking water, water for food and energy (SDGs 2 and 7), habitats for wildlife (SDGs 14 and 15), urban cooling and amenity (SDG 11) and climate resilience (SDG 13). They are also essential for disaster risk management, peace and security (SDG 16).

- Water and the economy: Water is a key input in economic activities, making water insecurity a major constraint on global economic growth (SDG 8). For example, 78% of jobs globally are highly water dependent (UNESCO, 2016). Water raises specific concerns for manufacturing. Industrial processes degrade water quality and, if managed inappropriately, cause pollution that harms people and the environment (SDG 12).

- Cities need water: Cities present a critical mass of people, investment and ideas to contribute to positive change (SDGs 9, 11 and 12). Water—which is critical for all life, economies and ecosystems—sits at the centre of these challenges and opportunities. It has been said that the battle for SDGs will be won or lost in cities and, continuing this analogy, the water sector sits on the frontline of this battle (UN, 2015).

Appendix 2 explains further how urban water actions contribute to the SDGs.

These interconnections show how the SDGs can be pursued as an integrated set of priorities, withinterdependent targets, rather than pursuing each SDG separately.

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2   The content of this publication has not been approved by the United Nations and does not reflect the views of the United Nations or its officials or member states.

2.4   Using integrated urban water systems to build our future cities

The UN SDGs suggest that the large and complex challenges facing cities are best resolved using joined-up, integrated thinking. However, this is not how the water systems in most cities are designed. The technologies and practices that have historically served cities are often characterised by large-scale, centrally managed infrastructure. While these approaches have worked well in the past, their long implementation times and focus on meeting single objectives means they are not likely to meet the urgent challenges outlined in the sections above.

As an alternative, integrated approaches to urban water management (Figure 8) nurture synergies:

- across the water cycle (e.g. transforming treated wastewater into a new water supply source)

- at different scales of investment (e.g. adding small scale, nature-based solutions to provide additional capacity or functions to existing centralised infrastructure)

- between structural and non-structural solutions (e.g. demand management as a 'new' water source during drought)

- in governance, management and operation (e.g. inclusive co-design processes, public– private delivery partners and empowering customers to take local action)

- with other sectors in cities (e.g. recovering nutrients and energy from the water cycle to support urban agriculture, renewable energy and other commercial opportunities).

Integrated planning aligns different interests

Water agencies' priorities

Other stakeholders' priorities

Multi-functional solutions address shared interests
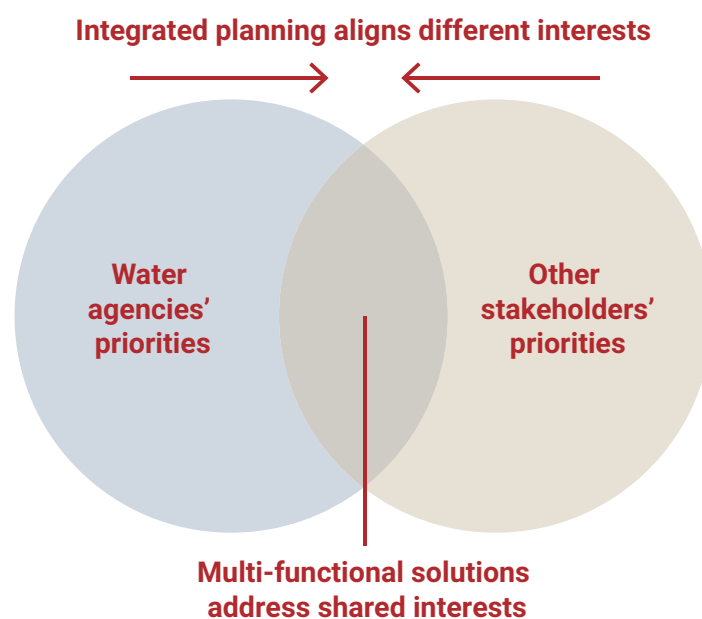
Figure 8. Components of an integrated approach to pursuing shared priorities.

The integrated solutions that emerge use combinations of 'blue', 'green' and 'grey' infrastructure, social and technical approaches, as well as public, private and multi-level government investments. Mixing and matching these elements allows these integrated systems to successfully operate at the nexus between water supply, sanitation, drainage and the built environment to enhance sustainabilityand resilience. This integrated approach is being demonstrated in Melbourne, Australia (Box 2).

Box 2. Water sensitive drainage for Fishermans Bend, Melbourne, Australia

Relevant SDGs:

Fishermans Bend is the largest urban renewal area in Australia, and will be twice the size of Melbourne's existing central business district when completed. The vision for Fishermans Bend is to be Australia's largest urban renewal Green Star community. The development site is low lying and significant areas are vulnerable to tidal inundation.

This flooding risk means the site needs upgraded drainage infrastructure. To ensure the drainage investment is consistent with the vision, a Water Sensitive Drainage and Flood Management Strategy was collaboratively developed by water utilities, councils and the Victorian Government. This strategy uses water sensitive urban design as a way to provide drainage while also enhancing streetscape environments. The strategy also uses rainwater tanks to store and detain roof water runoff from buildings; green infrastructure in the form of distributed storages designed into streetscapes and open spaces; and conventional pipe drainage approaches in locations where surface storage is not technically feasible.

Source: Brotchie et al. (2021)
Image: Development Victoria

2.5 The benefits of integrated water management

A major attraction of integrated approaches is their ability to address the urgent issues facing essential services in a way that creates a pathway towards greater urban sustainability, resilience and liveability for all citizens, including the most marginalised.

The solutions can be mixed and matched at a variety of scales. Decentralised solutions can be combined with existing infrastructure as and when they are needed to:

• repurpose stranded assets

• service specific urban contexts to meet local community aspirations

• allow governments to defer major resource development or trunk infrastructure investments

• adapt infrastructure as new technologies emerge to avoid stranded systems in the future.

The solutions are also inherently multi-functional. Multi-functional solutions create benefits across the water cycle and for other sectors, such as transport and health, and can make cities greener, less polluted and better able to cope with increasing climate variability (Figure 9).

Other circular economy benefits come from using water, energy and nutrients extracted from the urban water cycle (Ellen Macarthur Foundation, nd). As an example, green, connected urban landscapes encourage low carbon forms of mobility (i.e. cycling and walking), promote active lifestyles and support mental health. Access to green open space provides public health benefits such as increased physical activity, which is linked to reduced obesity, chronic disease and mortality (Wolch et al., 2014). Studies have shown those who perceive their neighbourhood as highly green are more likely to have better physical health and mental health (Sugiyama et al., 2008).

These benefits are maximised when there is inclusive planning from the outset with input from a range of stakeholders and community members. This engagement must be supported by GEDSI analysis to understand and include different needs and knowledge.
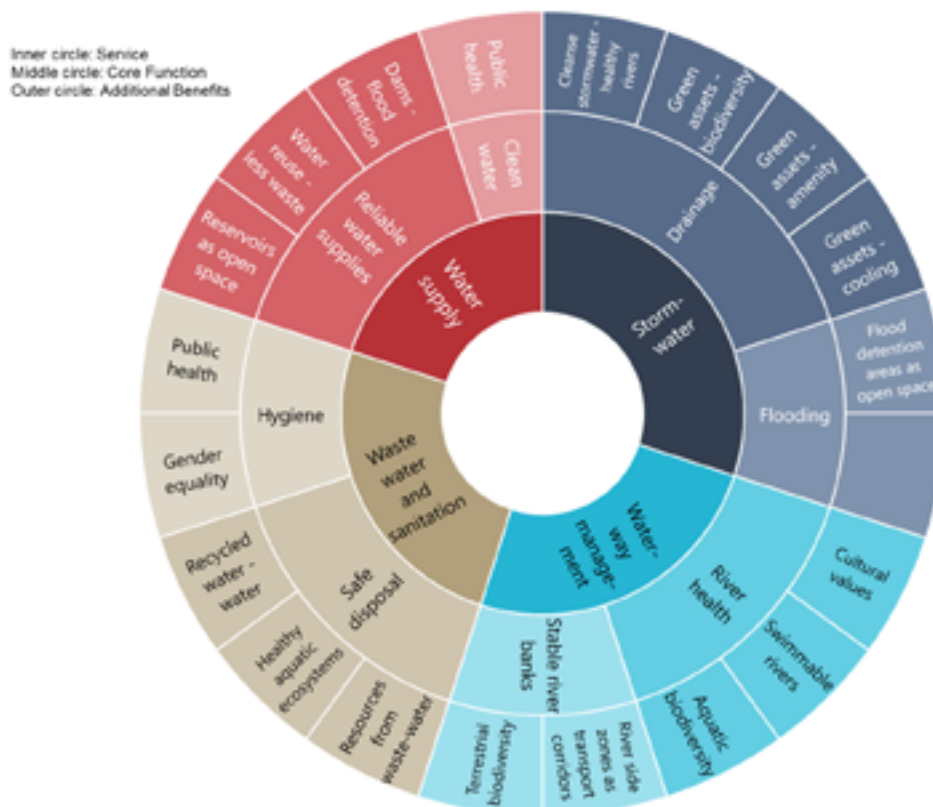
Figure 9. Examples of core functions and additional benefits that can be provided by water services.

3 Introducing the Urban WaterGuide

The Urban WaterGuide helps cities address their urgent urban water challenges in a way that also responds to the strategic threats of climate change and urbanisation, and supports the UN SDGs to leave no-one behind. For instance:

Urgent problems relating to basic services include managing:

- too much water, e.g. detaining, treating and harvesting water that otherwise contributes to flooding
- too little water, e.g. managing scarce resources by providing reliable water supplies and improving water efficiency
- polluted water, e.g. providing safe drinking water or reliable sanitation, or improving water quality in natural water bodies.

Strategic opportunities to enhance resilience and sustainability include:

- reducing reliance on groundwater and rainfall-fed water supplies (i.e. single-source supplies)
- recovering water and resources from wastewater
- reducing the environmental footprint of the water system such as the carbon footprint or the impacts on water-dependent ecosystems
- addressing social inequality as it relates to basic services, using a transformative GEDSI approach
- building human capital to support drought- and flood-resilient communities
- introducing nature-based solutions to improve liveability and health outcomes.

Dealing with these as one problem, not many

The Urban WaterGuide recognises solutions should be inclusively designed to suit the local context, with multiple social, economic and sustainability objectives in mind. What lies behind new solutions to these problems is a process that generates integrated responses; this process is the focus of the Guide. What follows is a series of tangible steps that any city can undertake, along with practical advice to implement each step.

The Urban WaterGuide comprises five parts

The Urban WaterGuide explains how to initiate, plan, develop and deliver integrated water solutions using a five-part process. These parts are presented in a logical order (Figure 10), but water managers can begin to make progress in any one of the parts before returning to other parts to strengthen their approach. The subsequent sections of the Guide are cross-referenced to demonstrate how this approach can work.

1. Set a city vision and articulate water's role in this vision

Considerations:
- What are the macro societal and resilience challenges facing the city and its citizens?
- How can urban water services create a wide variety of positive outcomes for a city, and all its citizens?

2. Develop a total water cycle strategy to solve complex challenges

Considerations:
- Align fragmented administration of individual water services to deliver greater benefit to citizens.
- Create mechanisms to integrate the urban water cycle at different scales.

3. Co-design project-level solutions that perform multiple functions

Considerations:
- Take integration to a project level using solutions that are multi-, rather than mono-functional.
- Working inclusively with a range of stakeholders ensures that all options are considered.

4. Build support to deliver and evolve integrated solutions

Considerations:
- How will agencies work together, what roles will community and the private sector play, and how will multi-functional solutions be paid for?

5. Establish an enabling environment

Considerations:
- Practitioners need to be skilled in influencing decision makers, and working with communities, to gain support for novel approaches.

Figure 10. The parts of the Urban WaterGuide.

3.1 Working collaboratively to implement the Urban WaterGuide

Integrated water management solutions are developed by working together across the different administrative, planning and operation functions with a diverse range of community stakeholders. Thiscollaboration is vitally important in planning and delivering integrated water management, and can be intentionally planned and guided over the life cycle of a project or program, as explained below.

Early stages collaboration: Find a 'champion' to provide leadership and facilitation

Establishing leadership early drives successful collaboration while also challenging conventional planning approaches. This role is often referred to as the 'champion' (Taylor, 2009). Champions can be passionate individuals who are able to foster open conversations and influence practice, or organisations that take on a leadership role in driving, coordinating and delivering activities. Water practitioners can begin by identifying and enrolling champions, and empowering them through information sharing, creating networking opportunities and acknowledging their role.

Mid-stages collaboration: Engage the community early and often

Communities play an important role in driving change by contributing important local knowledge that improves the effectiveness of water management strategies and by providing 'permission' for change to occur. Community involvement also provides insight into how to further support new initiatives and how citizens' diverse water needs are met. Community engagement approaches are effective when they align with existing local knowledge and enable all community members to be active participants, paying special attention to the most marginalised and building their skills to contribute.

Later stages coordination: Establish co-governance arrangements to oversee delivery

The implementation phase can be long, and things will inevitably change over time. The collaborative approach that aided the planning phase should continue throughout the delivery phase. However, the emphasis of stakeholder relationships will shift from collaborative planning to coordinated delivery by individual organisations. Keeping stakeholders connected with each other and maintaining line of sight to their shared vision (and its objectives) ensures that individual actions remain aligned and that necessary decisions along the way cascade through to other parts of an implementation plan (see section 7.2).

Collaborating with community members

It is useful to remember that the reason for urban water management is to service communities, and that communities comprise diverse citizens, families, businesses and social groups. As stakeholders,these people have much to contribute to urban water planning, but they are not water experts and they may find the processes used overwhelming or hard to navigate.

The following principles have been identified as being effective ways to help community stakeholders participate in urban water management processes (Rogers et al., 2020). The principles cover the framing of the engagement (why is the community being asked to participate in discussions?), participation (how can participants be supported to succeed in their role?) and translation (how can information be presented in ways that facilitate understanding?). These principles should be read in conjunction with the Guide sections on considering gender equality, disability and social inclusion (GEDSI).

Framing

- **Establish clear scope:** Communicate who is being asked to participate, what issue is being influenced and how the engagement will inform larger-scale planning.

- **Ground discussions in local values:** Draw out community knowledge and historical context.
This includes Indigenous knowledge and information about the needs of the poor, women, disabled people and other disenfranchised or marginalised groups.

- **Focus on the long term:** Concentrate on community aspirations for the long-term future to establish a truly transformational plan.

Participation

- **Develop community capacity:** Help participants learn about the issues and develop their personal and collective capacity to influence water management decisions.

- **Share information:** Be open with data and information about the city's water cycle.

- **Be inclusive:** Reach out with alternative forms of engagement to diverse sectors of the community that may be under-represented in participatory workshops.

- **Foster openness and trust:** Use process design and facilitation to foster openness and trust among community participants and facilitators.

- **Build ownership of the process:** Build participants' sense of ownership of the outputs through longer engagements that create opportunity for iteration and refinement.

- **Identify meaningful actions:** Arrive at opportunities for tangible and meaningful actions that empower community members.

Translation

- **Do not to assume pre-existing knowledge:** Individuals may be well informed on some water issues but not on others. Build understanding about how the system works.

- **Present content in ways that resonate:** Present and translate key content and technical terms in ways that have meaning to a broad community audience.

- **Maximise visibility for impact:** Strategically promote the process and its outputs to others to maximise its visibility and impact.

Box 3 provides a case study of these principles in an Australian situation.

Box 3. Citizens' jury process, Melbourne, Australia

Relevant SDGs:

The population of Sunbury (Victoria, Australia) is expected to double in the next 20 years, creating an urgent need to meet the growing demand for water, manage increased wastewater and stormwater, and minimise environmental impacts.

To find the best solutions, the two local water utilities sought and received input from the Sunbury community via a community panel, which provided recommendations on the best water management options for the community and the environment. The community consultation panel had 30 panellists who represented the area's diverse demography. The panel met regularly over two months to discuss the problem and formulate recommendations. Two guiding principles were agreed before developing the recommendations:

• Climate change is a fact and will impact rainfall and other climate events in the Sunbury region.

• The costings of recommendations were not to limit panellists' thinking.

Following its deliberations, the panel presented the recommendations to water utility leadership representatives. The agencies then released a formal response to the recommendations that included an understanding of the recommendations, what the current and possible barriers to their implementation might be, and a commitment to actions over the next five years.

Source and image: Melbourne Water (2022)

3.2 Considering gender equality, disability and social inclusion (GEDSI)

Reducing inequalities is at the core of achieving the SDGs. In this Guide, inclusion is considered through a lens of gender equality (including sexual and gender minorities), disability, Indigenous and social inclusion (GEDSI). The Guide helps practitioners identify GEDSI stakeholders and the barriers they might experience, and provides suggestions to make water planning more inclusive.

Who is at risk of exclusion?

Inclusive planning begins by acknowledging people of different genders, abilities and socioeconomic backgrounds share the same human rights as everyone else. They are not just part of a 'vulnerable' group, and their knowledge is vital to solving water management issues. People who might be excluded include:

- Indigenous peoples
- Women and girls
- Elderly people
- People who are displaced, homeless or live in informal settlements
- People who are illiterate
- Discriminated groups, including people who are deemed lower caste
- People with little or no education
- Young parents or child-headed families
- Disabled people and their carers
- People who are economically disadvantaged
- Sexual and gender minorities
- People of certain religious affiliations.

These people may be excluded by discriminatory policies, physical or environmental barriers, barriers related to communication and information, or attitudes and perceptions.

Strategies for inclusion

Inclusion is a process of ensuring everyone is able to participate in decision making related to their infrastructure and service needs, regardless of their gender, wealth, disability status or place in society. It is also an outcome that is achieved when everyone can have their needs and rights met, even if they are met differently. Some high-level inclusion strategies include:

- **Involve marginalised and disadvantaged peoples** and groups in decision-making and planning from the outset, so that all needs are factored into planning processes.

- **Research the needs, behaviours and aspirations of all community groups** to inform evidence-based policies and designs.

- **Support women and people with disabilities to take up senior roles**, leading to greater representation in water-related institutions.

- **Remove physical barriers** by applying universal design principles that facilitate use, understanding and access by the greatest number of people possible (AusAid, 2013).

- **Help people to contribute in ways that are safe and comfortable to them**. This may mean considering childcare, communication needs and use of GEDSI specialists.

- **Provide translation, sign language and Braille interpreters** to aid communication.

An example of this GEDSI approach has been used in the RISE project (Box 4).

Box 4. Gender equitable and inclusive participatory design in informal settings

Relevant SDGs:

The Revitalising Informal Settlements and their Environments (RISE) Program is working with communities, governments and local leaders across Makassar, Indonesia and Suva, Fiji to co-design nature-based infrastructure—such as constructed wetlands, and biofiltration gardens—to improve community health outcomes in 24 informal settlements. This work will help realise SDG 6: Clean water and sanitation for all.

The program uses nature-based approaches that have been proven in other contexts and adapts them for use in informal settlements in Makassar and Suva. These approaches include installing public latrines, communal septic tanks and rain tanks at the lot scale. At the street scale, drainage and stormwater treatment are aided by subsurface wetlands for sewage treatment, biofilters and surface-flow wetlands for stormwater and river water treatment. Community co-design that incorporates local knowledge has been integral to this program to ensure each project suits the local situation.

Community health and wellbeing will be the main benefit from these projects, with fewer infections and better intestinal health among children, as well as increased food production and reduced gender inequality by providing secure domestic sanitation facilities and reliable water supplies.

RISE shows how resource-poor communities can adopt newer, sustainable approaches to leapfrog conventional water management technologies. It also shows how to apply gender equitable and socially inclusive participatory design in informal settlements.

Sources: Asian Development Bank and RISE (2020)
Image: RISE and Kerrie Burge

4 Set a vision for the city and articulate water's role in this vision

Key messages

- Conceptualise the city as an integrated water system, rather than fragmented parts.

- Share information, engage inclusively and build trust.

- Inclusively co-develop a vision for the city's future and define water's role in this vision.

Importance

- The foundation of the integrated approach is laid by bringing stakeholders together and establishing integrated ways of thinking and working.

- How the problem is defined determines what options are later developed.

- Using an interdisciplinary lens deepens the collective understanding of the problem, generates richer solutions and results in earlier identification of barriers to implementation.

Milestones

- Stakeholders have bought into the process and are empowered.

- A shared vision has been established, setting a reference point for other planning activities.

Activities

- Establish a collaborative and inclusive project governance structure.

- Inclusively diagnose the current situation.

- Define the problems to be addressed.

- Develop a shared vision, showing how the problem has been positively resolved.

4.1   Introduction

This part of the Urban WaterGuide begins by understanding the city's current context and then developing a vision for the future of the city. This process frames urban water cycle management in terms of city- and community-wide outcomes and clarifies which problem needs to be addressed.

4.2   Define the boundary of the urban area

Defining the boundaries of the urban area being studied makes the scope of the vision clear. This activity may seem trivial but actually involves important decisions, including:

- What scale is most important given the issues being discussed (river basin, city, town, precinct, lot, informal settlement, village etc.)? (See Figure 5).

- What are the boundary conditions of the chosen geographic or political area? How does the geographic boundary align with the boundary of the catchment and water infrastructure, or the organisations involved (e.g. municipal boundaries or water utility service areas)?

- Are the causes and effects of problems understood? How are these problems (geographic, social or even in the water cycle itself) affecting other areas?

4.3 Gather stakeholders

Delivering integrated urban water management relies on collaboration across a range of sectors, organisations and communities. These stakeholders come from the broader community and key sectors including water utilities, water policy officers, engineers, planners, health professionals, environmental scientists and development sectors. Some participate because they have a direct stake in the problem, while others may be invited because of their ability to influence success (also see section 8.2). Taking the time to identify these stakeholders, their role and their interests in the project will be rewarded in future stages of planning.

The following case study (Box 5) demonstrates an approach used in Victoria to incorporate Traditional Owner knowledge into urban water management.

Engagement with community members should be appropriate for the local context, and underpinned by GEDSI principles. Identify community segments (e.g. gender, culture, age) that are normally overlooked in collaborative processes and support their engagement by considering when and where consultation occurs and by using safe processes (also see section 7.2.2). Other ways to support inclusive engagement include providing different focus group discussions for women, ethnic minorities, people with a disability, illiterate persons and others. Be aware that putting many people with diverse social status together in one meeting may 'tick the boxes' for consultation, but often it is only the senior male representatives who will speak because of social norms, expectations and existing hierarchies. Inviting rights holder groups and GEDSI experts to help design the process can ensure more voices are heard.

Once invited, these stakeholders bring their own values and experiences, as well the mandates of the agencies or constituencies they represent. Facilitating stakeholder discussions to identify individual perspectives, followed by a focus on shared values, is key to a successful process and forms the basis of building a shared vision. Examples of shared values include a 'healthy environment', 'better health for children' or 'swimmable rivers'[3].

4.3.1 How to collaborate?

Stakeholders from different sectors, disciplines and community segments should be engaged differently, based on their levels of technical and cultural understanding of water management issues, social and cultural considerations and the extent to which they will influence the options and decisions. Even matters such as the language used by different technical disciplines can be a barrier to collaboration (CRCWSC, 2016). Gaining the trust of the stakeholders at the outset through respectful, transparent and meaningful consultation helps to build a positive platform for more complex collaboration activities. It is important to be open about how peoples' involvement will be considered (e.g. the IAP2 Spectrum (IAPP, 2018) uses a framework of inform, consult, involve, collaborate, empower), and to what extent participants can influence the outcomes (Bammer, 2018).

Power dynamics (within society at large and within and between institutions) and governance arrangements will influence collaboration activities. In some contexts, stakeholders from different sectors may be collaborating with each other for the first time. Assess the governance context to identify who key individuals or groups are (considering GEDSI across and within the stakeholder groups) and their drivers for participating in developing a vision for the city.

Mechanisms to maintain collaboration through the project can be informal and formal. Informal agreements allow for flexibility to changing conditions and promote communication but lack accountabilities. Formal agreements authorise action but are more rigid.

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3   Swimmable rivers have water quality that supports primary contact recreation. That is, they are clean enough to allow submerged contact in the water.

Box 5. Connecting with Traditional Owners, Victoria, Australia

Relevant SDGs:

For many years, Indigenous people (Traditional Owners) in Australia were not actively included in managing water in urban contexts. This is despite Indigenous people holding thousands of years of knowledge and experience and deep connections to Country. Turning this situation around begins with reconciliation, understanding and building connections.

Learning from and understanding more about Traditional Owners' experience with water, culture and Country is an important step in reconciliation and achieving better social and environmental outcomes. Many water utilities in Australia have put in place Reconciliation Action Plans. An example is Yarra Valley Water's Reconciliation Action Plan, which sets employment and procurement targets and actively involves Traditional Custodians in planning and managing water resources (Yarra Valley Water, 2017).

Several Australian water utilities have also established formal partnerships with Traditional Owner groups and corporations, as well as increasing Traditional Owner participation in their workforces and undertaking projects together with Traditional Owners. Underpinning these actions is a deep acknowledgement of Traditional Owners' connection to land and water, and respect for their knowledge and culture.

Barwon Water, for instance, works in close partnership with the Wadawurrung Traditional Owners. In 2021, Barwon Water signed a partnership agreement with Wadawurrung Traditional Owners Aboriginal Corporation. This has led to Barwon Water and the Wadawurrung Traditional Owners working together at Porronggitj Karrong (Place of the Brolga), a project intended to investigate, rediscover, trial, rehabilitate and introduce traditional land and water management practices (Barwon Water, 2020). A major lesson for the water utility has been to take the time to learn about Country from Traditional Owners, including spending time on Country with Traditional Owners to understand water's connection with the land.

Sources: Australian Water Association, VicWater
Image: Barwon Water

4.4   Understand the current context in an urban area

Understanding the current situation is a prerequisite to solving a problem. At a basic level, a diagnosis builds respect for different stakeholders' needs, and establishes a common language to describe problems. While it is tempting to rush this activity if there is an obvious crisis to address, be aware that it is easy to fall into the trap of narrowly defining symptoms and then working on the wrong solution. For this reason, it is important to explore the problems the city faces before moving into 'solutions mode', and to do this inclusively with stakeholders.

A diagnosis considers the current context from multiple points of view, letting commonly held issues surface through debate. Analysis is deepened when the process adopts a systems approach. A systems approach looks at the different parts of the water cycle and the relationships between them, as well as engaging a range of sectors (e.g. planning, health and tourism) and areas of technical expertise (e.g. engineering, urban design and social science).

4.4.1 How to perform an interdisciplinary diagnosis

A diagnosis that adopts a systems approach is one that looks at all the parts of the water cycle and the relationships between them. A suggested approach is borrowed from design-based disciplines such as architecture and urban planning, as follows (Bertram & Murphy, 2019).

Observation

Observe the city's water systems and how citizens interact with them, highlighting such contexts as:

- **Biophysical context:** e.g. available water resources, wastewater pollution from poor sanitation or extreme weather events. It is also useful to understand the landscape structure of waterways, floodplains and deserts that ultimately limit what infrastructure can achieve.

- **Infrastructure context**: including waterway, drainage, water supply and sanitation infrastructure as well as site latrines and open defecation. Understanding how infrastructure in a city has evolved over time provides a useful analysis of persistent issues.

- **Institutional context**: such as relevant planning, policy and legal organisations and their regulatory frameworks and funding mechanisms.

- **Political context**: entrenched political norms may explain historical decision making. A political context looks at dynamics such as key players, competing interests and incentives.

- **Socioeconomic context**: includes key livelihood activities, community composition, inequalities, education opportunities, industry types and GEDSI analysis.

Analysis

Invite stakeholders who have gathered to share what they have learnt about water by identifying, describing, sorting, categorising and mapping what has been observed and the issues that arise from this activity. This sharing builds a common understanding of structures, systems and patterns.

The analysis can employ modelling tools to analyse historical data sets or to make future predictions. The best tools help by organising, integrating and visualising data in a way that supports interdisciplinary deliberations.

Typically, these tools are used to identify gaps between current levels of service and those required to meet current or future needs. Examples include:

- **infrastructure constraints**, such as pumps, pipes and treatment plants that have reached their capacity and need upgrading

- **resource constraints**, such as competition for limited water resources or emerging energy needs

- **health issues**, including the growing awareness of the wellbeing needs of citizens

- **increasing frequency or intensity** of extreme weather events, such as floods and droughts

- **limits of the natural environment**, such as availability of water for extraction or evidence of ecological impacts such as fish kills

- **constraints and opportunities arising from the political economy**, such as emerging changes to values, consumer needs or rights, regulation or community support.

Developing a **water mass balance**[4] is one analysis technique. Water mass balance approaches suit quantitative data and show how water, energy, nutrients and pollutants flows into, through and out of cities. A water mass balance should describe all of the water flows relevant to urban area, unlike conventional supply–demand balance assessments which only optimise one aspect.

Spatial analysis is sometimes a better way to represent the problem, and **geographic information systems** (GISs) can be useful. GIS shows spatial patterns, particularly when overlaid with social and environmental vulnerability mapping. Mapping service 'outages', threatened ecosystems or marginalised communities who are unserved by water or sanitation services are examples of this.

In other instances, it is necessary to work with **qualitative data**. One tool is to map the conversations among stakeholders (e.g. from interviews or focus groups, which may be conducted separately for diverse groups). For example, mapping the history of a system shows how it has changed over time, and the drivers for these changes (see Box 6).

A fourth way to represent information is with **scenarios**. These can be built around the analysis above by speculating on what alternative versions of each scenario might look like in the future. Scenarios might test different levels of service (e.g. a 'basic' versus a 'gold standard' level of service), performance of a system in different climatic or seasonal conditions (e.g. performance in dry versus monsoon seasons), or in alternative urban development conditions (e.g. high versus low population growth).

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4   Integrated water cycle management promotes consideration of water supply, stormwater and wastewater concurrently as components of the urban water cycle. A water mass balance quantifies the balance between these sources as a way of understanding the various water inputs into, storage within and outflows from, a city (Mitchell et al., 2003). It allows calculation of ratios of different water sources and uses to standardise the comparison of cities in terms of water management and use (Renouf et al., 2017).

Box 6. Developing a water story for Townsville, Australia

Relevant SDGs:
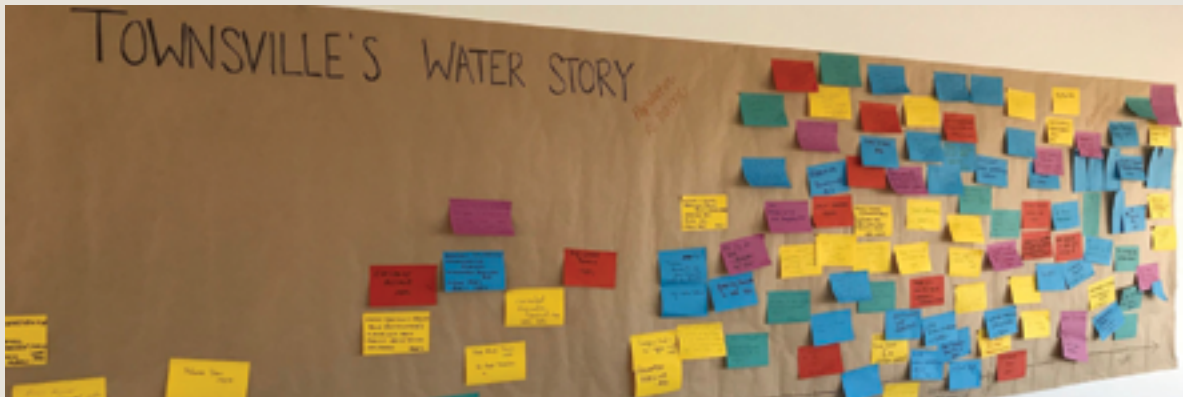
In 2019, the CRC for Water Sensitive Cities worked with Townsville City Council to find new ways to manage the water cycle in this growing regional city in northern Australia. Being located in the dry tropics, and on a major floodplain, water is one of the key natural elements that shapes Townsville. It had recently been inundated by flooding after record-breaking rain destroyed large parts of the city (TCC, 2019). It had also been subject to drought and was concerned about polluted river runoff impacting the adjacent Great Barrier Reef. The city's planners wanted to identify new options to respond to future water security, drought and flood cycles.

Analysis looked at past patterns of droughts and floods as a way to understand the future. To be inclusive and to incorporate qualitative data, the project involved developing a visual timeline of past events, experiences and interventions in the city. Stakeholders wrote down key events that shaped the city's 'water story' and placed these labels onto a timeline on the wall. Events were categorised as: infrastructure and technical systems (e.g. when a major dam was built); governance and policy (e.g. when an institution was formed or restructured); environmental events (e.g. a flood), community trends (e.g. response to waterway pollution); or personal experiences. Next, a facilitated group discussion developed an inclusive historical narrative to explain the significance of these events. This exercise identified the dominant drivers and patterns of change, and these insights were used to shape the types of options that were considered in future water planning

Source and image: CRC for Water Sensitive Cities

4.5   Build a shared vision of the future

After the core problems have been identified and agreed, attention can shift to developing a shared vision for the city that creates alignment on outcomes. By involving stakeholders in its development, the vision fosters commitment and motivation to be involved in planning and delivery.

The vision describes a future that is aspirational and desirable, as well as tangible and relevant to multiple stakeholders. An inclusive approach to developing the vision embeds the needs of diverse groups in the vison-setting process and is informed by local consultation experts, as well as GEDSI organisations and their representatives.

Experience shows how important it is to describe the vision in terms of the place and the community, rather than setting a vision for water infrastructure (e.g. Figure 11). This shows that there can be a second step to translate a place-based vision into the range of functions that a city's water system needs to perform to meet the needs of its citizens.

(Source: Hornsby Shire Council, 2021 and Steve Pym)

Hornsby and its villages are full of beautiful blue and green spaces that connect people to their surrounding environment and local community

Hornsby and its villages are filled with networks of blue and green spaces that keep people cool, comfortable, healthy and connected. People experience and value the connection of ridgelines and valleys unique to Hornsby Shire. Streets and parks are lined with trees that provide shade and urban cooling. Water is seen and used in the landscape through fountains, ponds and vegetation so people can experience and enjoy it. A network of walkways and cycleways promote recreation and connect people to bushland, waterways and parklands for outdoor recreation. Facilities are available for people to actively use the rivers and creeks. Innovative and best practice urban design creates spaces in developed areas that people want to spend time in.

Figure 11. Part of the vision for Hornsby Shire (in NSW, Australia), emphasising biodiversity and amenity outcomes that are supported by water management.

4.6 Ensure active stakeholder participation in visioning using GEDSI

Specific GEDSI actions to take in part one of the Urban WaterGuide include:

• Partner with local consultation experts, GEDSI organisations and their representatives to inform the consultation processes. Consider the diversity of discrimination and disability, and actively develop strategies, informed by disabled people's organisations (OPDs), community organisations and gender-inclusive organisations.

• Understand what barriers might be stopping people from participating or having their visions included. These barriers may be attitudinal, physical, communication or institutional, and will need targeted mitigation.

• Draw on and involve a range of knowledge from different groups, including Traditional Owners' knowledge and connection to Country and associated waters.

• Help stakeholders to increase their water literacy (including the cultural, social and technical aspects of water management) so they can be more involved in the vision-setting process.

• Raise awareness and build capacity among project partners about GEDSI issues.

• Support leadership and decision making roles for women, people with disabilities, Indigenous people and other marginalised groups.

• Gather disaggregated gender and disability data related to water use, needs and other relevant factors, and carry out a gender and disability analysis of the city to inform the context and vision.

• Use vision-setting techniques and tools that do not depend on high levels of literacy (Figure 12).

Figure 12. Community water planning consultation in Timor-Leste with a focus on gender equality and inclusion in WASH. (Source: Melita Grant)

5 Develop a total water cycle strategy to solve complex challenges

Key messages

- The strategy part of the Guide describes how water managers will go about achieving the vision for the city.

- There may be two complementary strategies: a water cycle strategy (including water supply, sanitation, drainage and waterway management as needed) and an urban planning strategy to manage land and water together.

Importance

- To manage the city as one water system, define system-wide objectives. Objectives should be defined inclusively with a range of stakeholders from a variety of disciplines.

- Working at a system level requires multiple technical disciplines finding ways to collaborate and to work outside their organisation's formal remit.

- Building early political and community support reduces the risk that solutions are later ignored, overruled or abandoned because they are not suited to the specific needs of diverse populations.

Milestones

- The vision is translated into measurable objectives and indicators.

- There is an overall strategic approach to achieve the objectives.

- Planning activities are inclusive, empowering and sustainable for community participants.

Activities

- Develop SMART[5] objectives and indictors that articulate how the vision will be operationalised, including GEDSI objectives and indicators.

- Develop water and urban planning scenarios using inclusive and holistic options analysis. Iterate between these individual scenarios to find the best integrated strategies.

5.1 Introduction

In this part of the Guide, the city describes how it will achieve the vision established (see section 4.5). The output is a strategy with two dimensions—managing water, sanitation and drainage (a water cycle strategy) and managing the relationships between water and the urban form (an urban planning strategy).

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5   SMART is an acronym that refers to objectives that are Specific, Measurable, Achievable, Relevant and Time bound.

5.2 How a strategy is typically developed

In its simplest form, a strategy explains where you are now, where you want to be in the future and how you will get there. It can also describe a philosophy that determines what actions will be used (Figure 13).
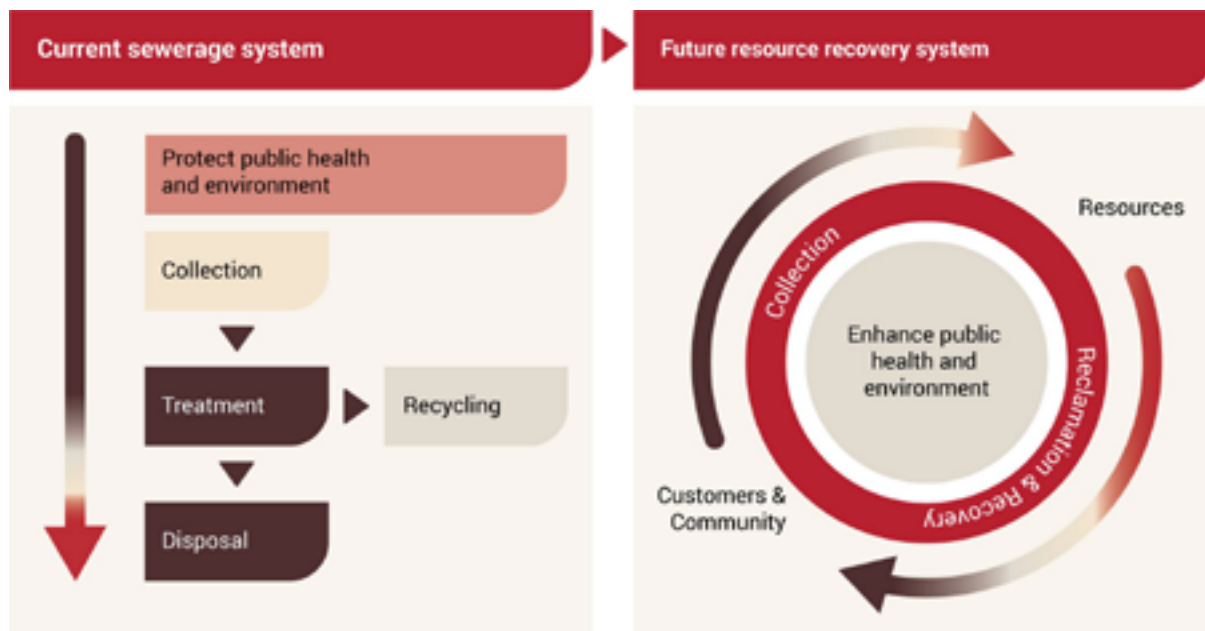
Figure 13. Example of alternative strategies for wastewater management comparing a linear treatment approach versus a circular economy. (Source: Melbourne water corporations, 2018)

A basic process to develop a strategy could include:

1. **Revisit the diagnosis and vision** (see section 4) to confirm the start and end points of the strategy and to understand the drivers for change

2. **Describe the gap** between 'current' and 'future' states to understand what change looks like.

3. **Set objectives**. Objectives and design principles explain the 'how' of the strategy. Figure 14 provides examples.

4. **Establish indicators**. Once objectives have been set, indicators guide progress. Indicators should be easy to communicate and avoid jargon or complex concepts. GEDSI indicators are also important.

5. **Set targets**. Set a date when threshold levels of the indicators should be reached. Using modelling or scenarios, establish interim milestones, such as 10- and 20-year progress points. Table 1 shows how targets can be set at multiple scales.

6. **Identify risks to your strategy**. Strategy implementation is inevitably based on assumptions about the future. Ask what else needs to be done to improve the likelihood of success, and to mitigate climate change-related, political or community risks (see sections 7.2.2 and 8.2.1).

Safe, secure and affordable supplies in an uncertain future

A diverse range of water supplies and sources

Water quality meets regulatory standards and community expectations

Manage water efficiency and demand

Secure water supply for Victorian industry and the economy

Water available to maintain valued green community assets including for climate change

Effective and affordable wastewater systems

Meets public health and environmental standards

Effective sewerage systems

Optimised onsite domestic wastewater

Maximise waste - to - resource opportunities

Effective stormwater management protects our urban environment

Waterway health is maintained and improved

Community and property resilient to local flood risk

Appropriate levels of flood protection in new development

Healthy and valued urban landscapes

Water is prominent in the urban landscape

Urban landscapes retain moisture for cooler, greener cities and towns

Waterways accessible as valuable open space

Aboriginal cultural values associated with waterways are protected

Community values reflected in place based planning

Diverse urban landscapes that reflect local conditions and community values

Empowered engaged community

Local water related risks and issues understood and managed

Figure 14. Objectives and descriptors from Water for Victoria. (Source: Victorian Government, 2016)

Table 1. The Waterwise Perth Action Plan sets targets at multiple scales (WSTN, 2019)

Scale	2030 Target
Household target	- Average annual water supplied is reduced to 110 kL per person
Suburb targets	- 10% less groundwater is used across the region - Recycled water makes up 50% of the gap between future water demand and supply.
City targest	- Best practice waterwise policies are integrated into all state urban water policies, guidelines and technical advice notes - 100% of government-led urban development is waterwise.

5.3   How to incorporate GEDSI into strategy development

This part of the Guide provides an opportunity to apply universal design principles (which improve access for the greatest number of people) in the water and urban planning strategies (AusAID, 2013).
Apply these principles as follows:

- Identify, consult and engage local networks of women and gender equality groups, OPDs and other discriminated groups with specific water needs (e.g. public housing or informal settlement areas).

- Empower and assist individuals who are often excluded to contribute to strategy development by managing and mitigating barriers to their involvement.

- Adapt project activities and processes to ensure everyone can participate and there is diverse representation in decision making processes.

- Take the time to explore and understand diverse needs of people in urban water management contexts (e.g. suburbs, communities, household (inter and intra), business and government) and to establish a range of GEDSI indicators and qualitative monitoring methods to assess and monitor these needs and urban water uses.

- Take steps to reduce attitudinal, physical, communication and institutional barriers to inclusive strategy development.

- Raise awareness and build capacity among project participants so that 'water literacy' is increased across the community, including Indigenous and cultural knowledge.

- Ensure the options reflect the overall vision for the context, including a vision around health and wellbeing, access and participation for all citizens and environmental sustainability.

- Conduct joint advocacy and policy engagement on GEDSI issues related to urban water to promote greater understanding and consideration by all decision making stakeholders.

5.4   Develop a water cycle strategy

Individual strategies are often developed for water supply, sanitation, drainage and flood management functions in cities. Some cities also have waterway management strategies. In each case, the strategy describes how the water itself, and the accompanying infrastructure, will be managed. Ensuring public and environmental health is a common driver for each of these strategies, from delivering safe drinking water and managing flooding to safely treating wastewater.

Strategies for the urban water cycle generally start by **addressing water quantity** when there is too much or too little water. Objectives might be to match supply and demand, to manage sewer flows in dry or wet weather or to manage flood risk. Increasingly, the major issue is dealing with variability and extremes. Quantity is also a significant environmental issue for waterways with inadequate environmental flows or excess urban stormwater being a key determinant of ecosystem health, depending on the nature of development in the catchment.

Second, these strategies **deal with water quality**. Pollutants vary in their source and type, but it is always important to identify which ecological or health values to protect from pollution, the risks to each posed by poor water quality, and the pollution pathways from source to impact. Examples include providing safe drinking water, protecting ecosystems or safely treating wastewater.

A third aspect is **managing demand** (efficiency), **behaviour** (e.g. handwashing behaviours) or even **structural measures** not directly related to water infrastructure (e.g. catchment revegetation or adopting flood-resilient building designs).

Integrated strategies

An integrated strategy looks for opportunities to do things in one part of the water cycle that benefit other parts. For example, reusing treated wastewater as a water resource achieves two objectives—managing waste and securing water supplies. Value can also be created beyond the water cycle itself. Many cities are adopting urban greening strategies, and water is essential to grow urban forests that, in turn, provide shade which reduces the urban heat island effect. Recovering and reusing resources from wastewater, such as biogas recovery, is another example.

An integrated strategy links individual actions through a suite of **shared water cycle management objectives or targets**. An example is a drainage strategy that incorporates water sensitive urban design so that each individual drainage project helps meet water quality objectives for the city's waterways, provides flood protection and also harnesses stormwater as a resource. Examples of how this approach can be applied to each part of the urban water cycle are provided in Table 2, using assumed high-level objectives of resilience, sustainability and liveability. Box 7 then demonstrates how these strategies have been applied in a case study in India.

Table 2. How to apply integrated water cycle thinking to each element of the urban water cycle

Water cycle component	Core services and uses	Building resilience	Improving sustainability	Enhancing liveability
Water supply	Reliable water access Clean and safe drinking water (for drinking, washing, cleaning, sanitation, hygiene, home use, fire protection)	Improve water efficiency Reduce reliance on rainfall-dependant water sources Establish a portfolio of different water sources, including demand reduction strategies	Use low carbon water production sources Reduce demand on external water catchments through improved efficiency and source substitution	Recognise water for green urban spaces as a legitimate water demand
Wastewater	Public health Safe disposal and/or reuse of faecal and trade wastes (to separate people, animals and the environment from harmful pollutants)	Use distributed systems of wastewater treatment Consider exposure of wastewater treatment assets to climate change impacts Build in redundancy or flexible operation and management	Reduce impact of wastewater by reducing inflows Promote a circular economy by considering water quality, nutrients and energy Use pollutant trading models in catchments	Use land associated with wastewater treatment plants as community or economic resources Improve the amenity of wastewater treatment plants including visual, smell and health
Drainage	Protect life and property from flooding from rising waters and large rain events	Apply flood resilient urban design to withstand floods Rehabilitate the functions of floodplains	Use water sensitive urban design to treat and reuse stormwater	Use nature-based drainage solutions to improve amenity in cities
Waterways	Protected aquatic ecosystems and biodiversity Stable waterways	Build the resilience of aquatic ecosystems to extreme events	Regenerate ecosystems Use integrated catchment management principles to protect waterways	Provide amenity and access along waterways and clean rivers for swimming and boating Reduce heat in a city

Box 7. Rainwater harvesting at Goa University, India

Relevant SDGs:

Located along India's western coast, Goa relies on groundwater for 33% of its water supply. However, growing water demand, a steep hydraulic gradient and highly permeable local aquifers deplete groundwater resources quickly during summer.

Goa University is located on the outskirts of the capital city, Panaji. In the past, the university relied on overstretched municipal water supplies to meet its water needs. To reduce its dependence on the municipal water supply, the university created its own sustainable water supply by harvesting rainwater and recharging local aquifers for future reuse. The university's system harvests runoff from a 1.5 ha unpaved catchment area on campus as well as rooftops in the built-up campus areas.

The system has operated since 2007 and captures around 21.1 million litres of rainwater each year. Since its introduction, the university has enjoyed an uninterrupted water supply and no longer depends on external water. The reduced demand eases pressure on the public water system, particularly during summer when supply falls to less than 50%. It also benefits the university financially. The average cost of a 10,000 litre water tanker is estimated to be in the range of Rs 800–10,000. Using the rainwater as alternative water source saves approximately Rs 2.36 million annually.

Source and image: Centre for Science and Environment

5.5 Develop an urban strategy

Urban planning is concerned with shaping cities by coordinating development, infrastructure and services for the community. It adopts a spatial perspective that brings different sectors (such as transport, land uses and services) together to organise and integrate their individual functions in a city.

5.5.1 Why is better integration with urban planning important?

In many cities, water sector planning is isolated from broader urban planning activities and focuses on ways to optimise its own infrastructure to deliver services for which it is directly responsible. But in a planning sense, the urban water cycle comprises multiple aspects that should be explicitly addressed in urban planning, including:

- service aspects—drinking water, sanitation, drainage

- built aspects—residential and commercial buildings, roads and water utility infrastructure

- natural aspects—waterways, open space, parklands and sport spaces

- behavioural aspects—water conservation, littering, hygiene and handwashing.

Conventional planning approaches can also reinforce disjointed considerations of urban form and water servicing by planning one aspect first, followed by the other. This sequential process means urban layouts that assume conventional servicing solutions become 'locked in' before perspectives of the water sector are sought; eventually it becomes too late to explore different water servicing options. Similarly, conventional water planning practices tend to narrow investigations to a limited set of servicing options, without considering opportunities that could be provided by different urban forms.

5.5.2 Plan concurrently to achieve better integration

Thinking concurrently about urban form and water systems creates a space to think about whether water services could be delivered more effectively through a different urban design (or vice versa—could urban design and community wellbeing be enhanced if water services were delivered differently?) (Figure 15) (Chesterfield et al., 2021). This requires an iterative approach to refining development scenarios and water servicing options to optimise performance across multiple outcomes (see section 6.2.1).

To facilitate integration, water managers can be proactive by developing their understanding of the urban planning framework in the city, and how urban planning decisions are made. Urban planning often uses a range of regulatory and guidance tools in a process that is usually well structured but complex. These instruments work in a hierarchy from long-term spatial visions and infrastructure strategies at different scales, through to regulations and codes applied at lot scales. A state government policy, for instance, influences development permits through a series of strategies, plans and guidelines at different spatial scales.

It therefore follows that integration is more likely when tools used by the water sector align well with each stage of the urban planning process. An example is translating water outcomes (e.g. reusing treated wastewater) into infrastructure funding requirements and delivery actions at the metropolitan, precinct and lot scales.

Water managers can further facilitate integration by deliberately collaborating with architects, urban planners and landscape architects and creating spaces for these professionals to work alongside community members, engineers and scientists to find an optimal mix of design and technologies for a place, informed by inclusive co-design processes.
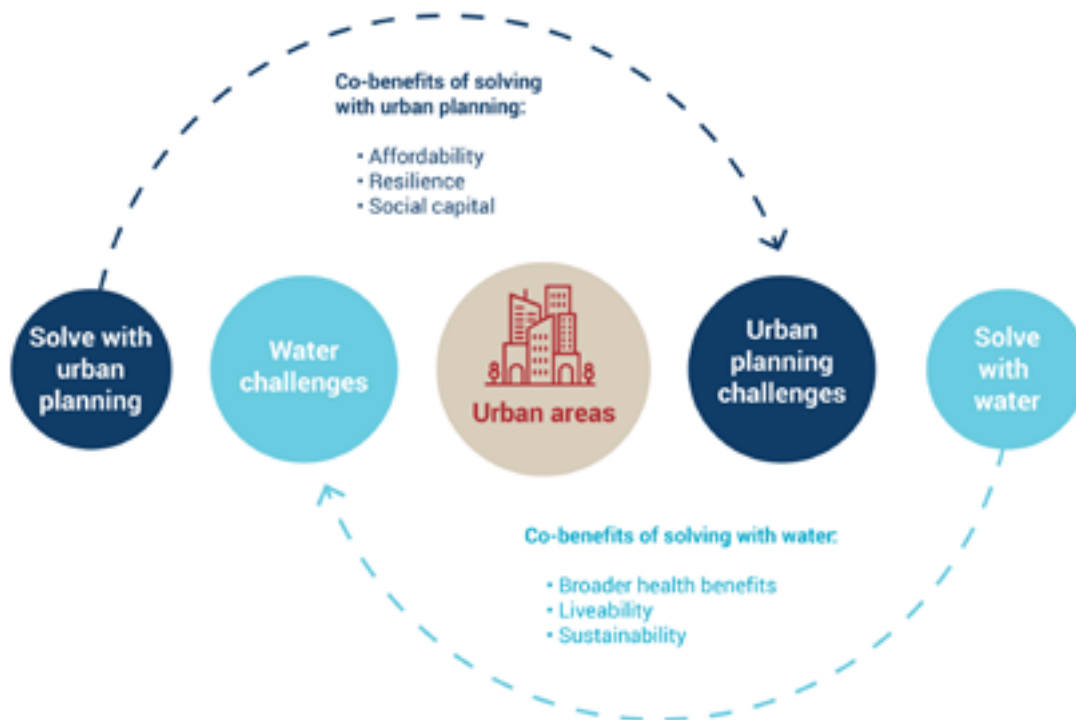
Figure 15. Integrating water planning and urban planning. (Source: Adapted from: Trommsdorf, 2020)

5.5.3 Embed agreed actions in statutory instruments

An urban strategy, in the context of the Guide, intentionally integrates water management with these urban planning instruments as a way to deliver broader community outcomes. As a general rule, the earlier the water cycle is considered in the urban planning hierarchy, the more likely its outcomes will be incorporated.

The preferred urban development scenario and servicing options can be implemented by embedding them within the policies, plans, guidelines and service delivery arrangements that make up the urban planning framework. A key step is in deciding which instruments to target, because each works differently through economic, regulatory or informational means (Tawfik & Chesterfield, 2020). The best instruments are those that are easily interpreted by others as intended, properly address the issues of concern and consistently relate to other instruments without contradictions.

An urban strategy can further assist by establishing technical guidelines that can be mandated in the 'water' or 'sustainability' provisions of planning codes and standards. This guidance can define what 'best practice' looks like, covering the design, installation and operation of water systems.

Box 8 describes the urban and water planning process for a development in Perth, Australia.

Box 8. Waterwise urban development at White Gum Valley, Perth, Australia

Relevant SDGs:

White Gum Valley (WGV) is a 2.3 ha medium-density housing development specifically designed to lower energy and water use and increase biodiversity and tree retention. When the site was earmarked for development, a traditional 'top down' approach to community engagement was not considered acceptable. A precinct design process was undertaken with the local community, which highlighted retaining tree canopy cover as an important outcome. Water sensitive landscaping features were integrated into the site's urban design using waterwise vegetation in public areas and passively irrigated street trees that collect stormwater runoff.

The design of WGV homes reduces mains water consumption by 65%. Key water-saving initiatives include a community groundwater bore for irrigating public and private gardens, and lot-scale rainwater harvesting systems for toilets and washing machines. In addition, homes have efficient internal water fixtures.

Source: Water Services Association of Australia
Image: DevelopmentWA

5.6 Leapfrogging as a strategy

A special example of an integrated strategy is leapfrogging (Wong, 2016b). A number of developed cities are discovering the need to retrofit outdated water technologies to adapt to changing circumstances and new community attitudes. Singapore, for example, is transforming its steep-sided, concrete canals back into meandering natural waterways as part of the city-wide Active Beautiful and Clean Water Programme to create places for the public to enjoy while maintaining the important drainage function of these canals (Figure 16) (PUB, 2018).

'Leapfrogging' refers to the strategy of bypassing these traditional stages of development and jumping directly to the most modern approaches available. In this way, water managers can immediately enjoy the benefits of having water systems that are adapted to climate change impacts and avoid the risks associated with investing in familiar but outdated technologies that will inevitably need to be retrofitted in the future. Leapfrogging also benefits community members themselves in terms of having lower cost and multi-functional systems.

In practice, leapfrogging is often matter of adopting innovative policies and technologies that are multi- rather than mono-functional. A city-wide approach to integrating water infrastructure with urban planning is also essential. In the Singapore example, urban designs that include nature-based solutions are used to capture and detain floodwaters and reduce flood risk. Cities that adopt this approach can avoid the costs of flood damage and expensive flood mitigation works. As an added bonus, the water that is harvested can become an alternative water source, and waterways can be transformed into urban parks.
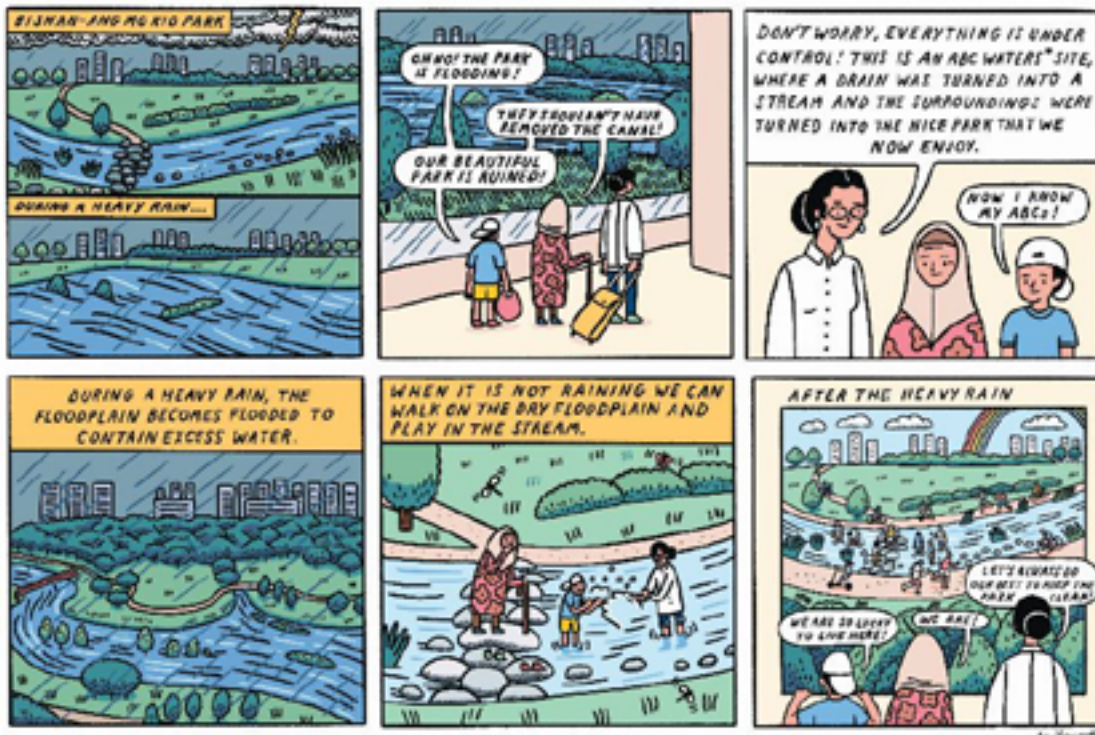

Figure 16. Explaining Bishan Park's multiple functions to community. (Source: CLC, nd)

6 Co-design project-level solutions that perform multiple functions

Key messages

- Part three of the Urban Water Guide introduces solutions that are multi-functional and operate at different scales.

- This outcome can be achieved through inclusive co-design approaches drawing input from multiple disciplines and end users, and by evaluating value beyond the core service being delivered.

Importance

- This part of the Guide operationalises the vision by showing what will happen on the ground and what the costs and benefits will be for each of the possible solutions.

- Inclusive co-design needs to be adequately resourced and is a key method to design for users, as well as to increase stakeholder support for adopted strategies.

Milestones

- The co-design process has been established.

- Stakeholders agree on how options will be compared and valued (involving GEDSI groups).

Activities

- Co-design options with diverse stakeholders.

- Evaluate options against the indicators developed (including GEDSI indicators).

- Develop the value proposition (also known as the business case) for the preferred options.

6.1 Introduction

This part of the Guide helps to shift practice away from developing one-size-fits-all solutions and towards solutions that use different forms and modes of service provision to suit local context. Unlike familiar, linear planning processes—in which options are developed, shortlisted and evaluated and a winner is chosen—planning multi-functional solutions requires an iterative process that encourages debate among different technical experts and end users about the preferred solution (Figure 17).
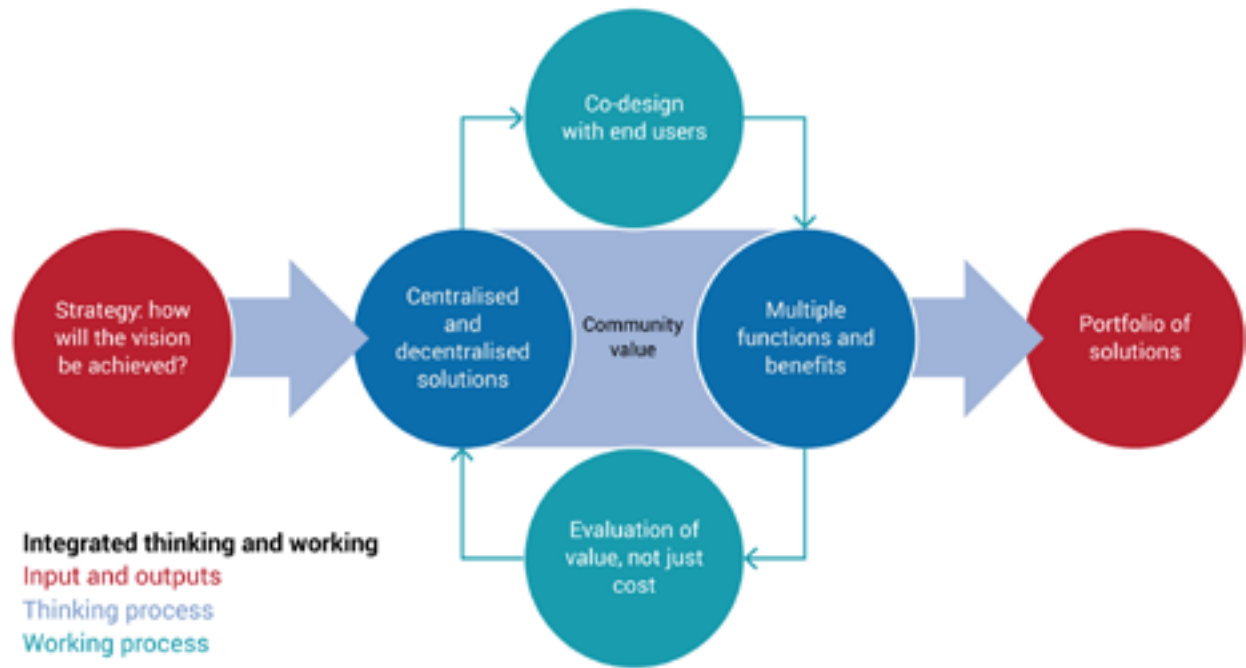

Figure 17. Developing multi-functional solutions.

6.2 Identify options that support integrated water management

Integrated water management uses combinations of blue, green and grey infrastructure and work across different scales of operation. Figure 18 provides a framework to identify potential options. Different combinations of these options can be inclusively designed to suit local context, citizens' needs and the water sector's capabilities. Box 9 provides an example of this thinking in action.

	Structural	Non-Structural
Centralised	E.g. Reservoirs, desalination plants, interbasin pipelines.	E.g. Planning provisions, pricing, water conservation, trading, regulations, social licence, offsets, system efficiencies.
Decentralised	E.g. Local stormwater capture, sewer mining, water sensitive urban design.	E.g. Building regulations, regulatory offsets, operating efficiencies.

Figure 18. Matrix to scan for possible options. (Source: Monash Sustainable Development Institute)

6.2.1 Design for multiple functions …

The aim is to deliver a mix of social, economic and ecological benefits across sectors and community groups. To design a solution that has multiple functions:

1. Explicitly respond to local contexts of socioeconomic, political, biophysical and climate vulnerability. At this local scale, consider how communities might interact with the technologies, highlighting their specific needs and the opportunities for additional benefits for all citizens.

2. At the city-wide scale, look beyond the water sector to consider interactions between water and other urban sectors such as energy, waste, food, transport and the built environment. For instance, transport corridors can be enhanced with nature-based flood infrastructure to improve flood resilience and safe passage of flood water, urban amenity and ecosystems.

3. Translate these value creation opportunities into performance metrics to compare different options. Adopting indicators for urban heat mitigation, quality of open space, energy generation, human health, social equity or sustainability are examples, even if some indicators are qualitative.

6.2.2 … at multiple scales

Centralised infrastructure is generally a reliable and efficient way to deliver core services. But an overdependence on centralised measures reduces a city's agility in responding to extreme conditions. Alternatively, decentralised solutions can be implemented as and when needed, and these investments will accumulate into large systems over time. This is not to say that centralised systems are redundant. Coupling decentralised infrastructure with existing networks can increase overall system resilience by using localised investment to resolve specific servicing problems.

6.3   Combine individual options into multi-functional solutions

Developing multi-functional solutions involves **co-designing** and **evaluating for value**, rather than just least cost.

6.3.1 Co-design

Co-design actively invites participation from diverse community stakeholders who will be affected by the solution. It is also an interdisciplinary process—experts from a range of fields will contribute. A co-design process brings these perspectives together to develop early concepts that are tested and refined with feedback from diverse end users. It quickly generates innovative ideas, such as novel urban design configurations, technical innovations or community engagement approaches that incorporate a range of functions and benefits.

The Asian Development Bank (ADB) and the Revitalising Informal Settlements and their Environments (RISE) project (see Box 4 above) successfully used community co-design to develop sanitation solutions in informal settlements. ADB and RISE's lessons on co-design include:

- **Meaningfully reach everyone through co-design**: Co-design should include many different perspectives and foster inclusion so that all voices are heard and included, such as those of women and girls, people with a disability, the poor and marginalised people.

- **Involve diverse stakeholders**: Include stakeholders at a range of levels, from leaders and champions through to residents. Include these people in the process early, paying close attention to GEDSI considerations and meaningful ways to engage (as outlined above).

- **Engage a range of technical and social expertise**: Co-design requires a range of skill sets—engineers, social scientists, urban planners, landscape architects, ecologists, community organisations and economists, among others. These skill sets will become complementary during the process and will lead to more innovative and integrated options (ADB & RISE, 2020).

- **Ensure co-design is locally anchored and implemented**: Options that are designed by local stakeholders will resonate with the community and are more likely to succeed.

Box 9 describes a co-design process used to develop a water security strategy in São Paulo, Brazil.

Box 9. A water security roadmap for São Paulo, Brazil

Relevant SDGs:

In 2014, São Paulo endured its most severe drought ever. The city was unprepared for two consecutive seasons of extremely low rainfall and came perilously close to a crisis situation of widespread water shortages.

To manage this crisis, the state government used tariffs to create incentives to conserve water, and inter-basin water transfers to secure supplies. However, these projects raised concerns about ongoing costs and affordability, and the sustainability of water resources at a river basin scale.

Following the drought, the state government explored alternatives. The Institute for Sustainable Futures helped develop a Roadmap for Urban Water Security using integrated urban water security planning to build a portfolio of drought management options.

The planning activity canvassed a wide range of water efficiency, wastewater reuse and water supply options and assessed them against criteria including water saved/supplied, unit cost, and environmental and equity implications. Participants in the process identified the potential for greater water recycling in São Paulo. Rates of sewage treatment are currently low, and this impacts water security because a reservoir affected by these discharges cannot be used as a water source during drought.

The roadmap also introduced a staged investment approach as a way to deal with uncertainty about the frequency and severity of future droughts. Future augmentations will be activated in stages only as drought conditions deteriorate. For example, at 50% dam storage levels, tenders are issued for design; if the dams drop further to 40%, design starts. Contracts are developed in such a way that the government is not obliged to progress with construction if the drought ends.

In São Paulo, significant investment has occurred on supply infrastructure to create 'readiness' for the next drought—e.g. by creating the potential for inter-basin transfers. Due to high energy costs, these options will be 'turned on' only if needed.

Source: Institute for Sustainable Futures, University of Technology Sydney (Chong & White, 2017)

6.3.2 Quantify each benefit

If the framework for developing and evaluating options focuses on a narrow range of outcomes, it will constrain the possible solutions. An approach that references a wider range of outcomes and makes community value explicit allows stakeholders to make more informed decisions about the types of solutions they want (Figure 19).

These outcomes are not always easy to quantify. Evaluation frameworks are emerging that emphasise city-wide impact rather than outcomes for a single part of the water cycle. Interpreting the outputs often needs an interdisciplinary approach to understand the trade-offs. Ideally, evaluation will compare options from a place- and person-based perspective, using metrics and language that are directly relevant to people outside the water sector, such as sustainability officers, planners, architects, designers, landscape architects, developers and policy makers.

UTILITY VALUE
- Leaders in innovation
- Drivers of transformational change
- Optimised operational cost
- Deferred capital inverstments
- Resilience to resource shocks
- Revenue opportunities
- Business diversification opportunities
- Increased adaptability
- Inspired workforce
- Community trust

CUSTOMER AND COMMUNITY VALUE
- Affordable serivces
- Reliable and resilient services
- Liveability outcomes - greening and cooling
- Increased local jobs

ENVIRONMENTAL VALUE
- Lower GHG emissions
- Reduced landfill disposal
- Improved waterways and ocean health
- Sustainable resources through reuse
- Ecosystem protection and regeneration
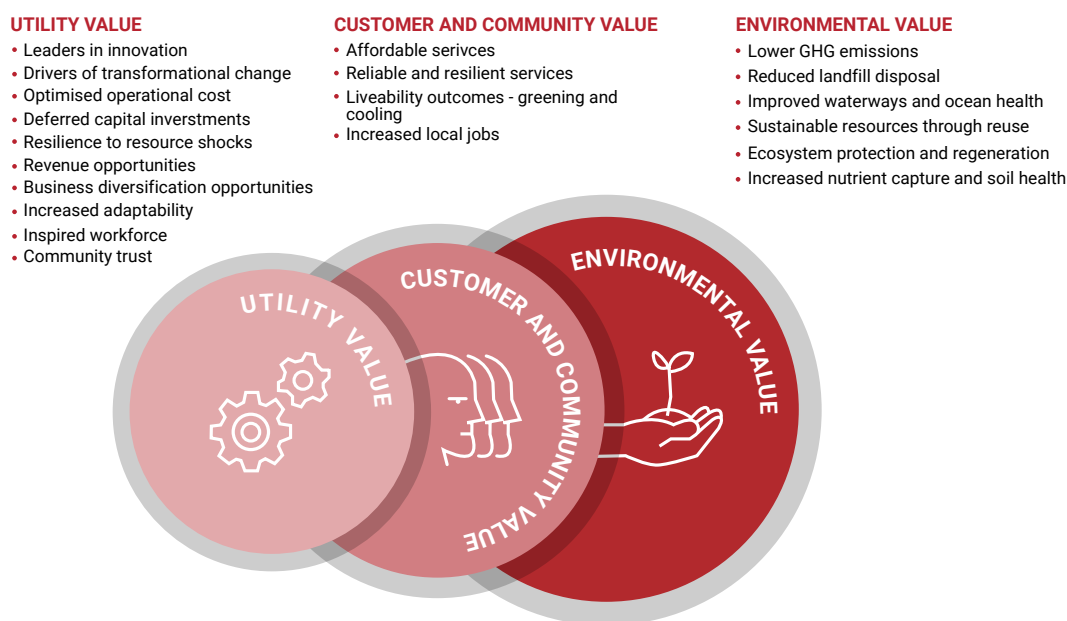- Increased nutrient capture and soil health

Figure 19. Example of creating value by adoption a circular economy model when identifying options. (Source: Water Services Association of Australia)

6.3.3 Value these benefits so they can be counted

An economic evaluation comes next to determine whether a project is worth undertaking. It includes:

- **Conducting a whole-of-life-cycle assessment**: The first task is to confirm *how much* money is required over the life of the project. In addition to the upfront capital costs of designing and building the infrastructure, also consider how long the infrastructure (or other activities) will last and the cost of day-to-day operations, maintenance, asset renewal and servicing finance payments over this time. Different projects can also generate benefits at different times.

- **Accounting for all benefits and costs**: Projects can provide tangible effects that are easily counted (e.g. avoided pumping and treatment costs). They also produce intangible effects that can be difficult to quantify (e.g. the amenity benefits of having access to green space). Estimating these intangible benefits requires two types of information; the additional quantity of the benefit that results from the project and the monetary-equivalent value of that additional benefit.

- **Reporting the level of benefits to the funding agency as well as to the wider community**: Reporting the distribution of costs and benefits highlights opportunities for value creation, risk sharing and coinvestment.

This information on life cycle costs and the distribution of benefits is highlighted in the case study in Box 10 and can also be used to select funding and finance options (see section 7.3).

Box 10. Assessing multiple benefits of the Can Tho wastewater system, Viet Nam

Relevant SDGs:

Often the technological solution for wastewater in urban areas in developing countries is assumed to be large-scale systems. The findings of a two-year assessment of wastewater options in Can Tho show decentralised systems can be more cost-effective, sustainable and adaptable in the face of uncertain rates of urbanisation and climate change.

The project, led by the Institute for Sustainable Futures at the University of Technology Sydney, assessed wastewater solutions for a 2,080 ha urban area in south Can Tho that was anticipated to house more than 250,000 people.

Four wastewater infrastructure options were considered, comprising combinations of centralised and decentralised treatment as well as an option with resource recovery involving urine diversion for use as fertiliser in nearby agricultural areas.

Options were compared in terms of cost effectiveness and sustainability. Analysis showed a combination of centralised and decentralised solutions had the lowest overall cost, while the resource recovery option provided additional revenue benefits from sales of fertiliser that outweighed the operation and maintenance costs.

The participatory sustainability assessment involved several government agencies. It considered the wider benefits of each option using triple bottom line criteria as well as criteria that considered the 'city's future'. The best option was a combination of centralised treatment for the dense population areas close to existing infrastructure, with decentralised treatment elsewhere. Centralised treatment uses proven decentralised technology. Socially, public health would be protected and affordability is ensured through low operation and maintenance costs.

Environmentally, the energy requirement for pumping is significantly less than for a fully centralised system. Financially, this option was the most desirable. Finally, in terms of Can Tho's future, the preferred option provides flexibility to adapt to uncertainties such as the rate of urbanisation and climate change impacts.

Source: Willetts et al. (2010)

6.4 Use GEDSI to help develop multi-functional solutions

Practitioners can apply GEDSI principles when developing, considering and evaluating options as follows:

- Consider options that address behavioural as well as regulatory or policy barriers to inclusion.

- Empower individuals with special or different water and infrastructure needs, so they can contribute to option design. Ensure co-design facilitators are trained in GEDSI techniques.

- Draw on the values co-created by diverse community members to assess the options.

- Adapt co-design activities so that everyone can participate, considering location, timing and how information is shared or collected.

- Consider the diversity of disability and situation (e.g. geographic differences and the different impacts of water management), including the contexts and experiences of the most marginalised.

- Understand the barriers people might face using existing and new options.

- Understand the distribution of disadvantages across different locations, times and social groups as well as the impact of different options.

- Ensure costing and price mechanisms are sensitive to people's ability to pay.

Box 11 illustrates a GEDSI approach to developing water services in Makassar, Indonesia.

Box 11. Safeguarding gender and social inclusion, Makassar, Indonesia

Relevant SDGs:

Understanding neighbourhood dynamics relating to leadership, inclusion and gender is key. In Makassar, the RISE team found meetings with formal (elected) and informal community leaders and elders within the neighbourhood provided useful information on history, projects that did and did not work and minority groups in the community.

The RISE team also conducted a water and sanitation discussion with the community in each neighbourhood. These discussions helped the team to understand challenges and aspirations relating to water supply, use, contamination pathways and sanitation. Engagement provided deep insights into the sensitivity of these topics and issues that could not be discussed in a larger group. These activities helped the team to cross-reference information—such as understanding vulnerability—on multiple levels: neighbourhood, community and cluster.

Source and image: Asian Development Bank and RISE (2020)

7 Build support to deliver and evolve integrated solutions

Key messages

- Successful delivery ensures citizens and communities receive the intended benefits.

- The theme of integration continues through to delivery phases by harmonising activities and establishing feedback loops to ensure the agreed outcomes are being achieved.

- Innovative water management solutions can be deliberately guided and scaled up during the delivery phase.

Importance

- Implementation planning ensures stakeholders have a line of sight between their role and the vision.

- The resourcing step enables a discussion about who benefits and who pays.

- Involving government, non-government organisations, community groups and water utilities helps to build a mandate for action.

- The private sector can assist in the delivery phase provided its involved is well-managed.

Milestones

- Ongoing implementation, co-governance and co-investment structures have been agreed.

Activities

- Convert individual solutions into actions, priorities and accountabilities, with clarity on the delivery and funding responsibilities for individual agencies.

- Decide on community participation, the role of the private sector and funding mechanisms.

7.1   Introduction

Part four of the Urban WaterGuide ensures the successful implementation of integrated, multi-functional systems, being mindful of potential barriers related to complexity, change management and funding.

7.2 Convert planning solutions into actions and an implementation plan

Once a portfolio of solutions has been developed (see section 6.2), delivery will occur through an implementation plan that includes:

- a works program outlining individual actions, tasks and outputs
- budgets and resources required to deliver each action
- responsibilities: who will lead, and which stakeholders must be involved to ensure success
- review mechanisms: how progress will be reviewed to ensure accountability and adaptation over time.

Ensuring priority actions have the necessary resources and accountabilities is especially critical when multiple agencies are responsible for delivery. A memorandum of understanding between the major stakeholders can be attached to the implementation plan to formalise these commitments and to communicate that the project has shifted from the 'planning phase' to the 'delivery phase'.

7.2.1 An implementation plan requires co-governance

It is common to appoint a program manager (or team) to oversee the delivery phase. Having a program manager ensures effective communication occurs between individual project teams and good governance is followed, such as regularly communicating with stakeholders. Some further principles for designing the right co-governance arrangement include (Melbourne water corporations, 2018):

- empowering the individuals working on each action so they have autonomy to act
- coordinating individual projects to ensure there is no scope creep
- collaborating with stakeholders to address barriers to project delivery in a timely manner
- ensuring representation of diverse community groups in program management advisory groups and considering the gender balance and representation of diversity in the program management team.

7.2.2 Foster community support and water management capabilities

Community support and partnerships are required to successfully deliver urban water services (see section 3.1 and 3.2). The Australian experience provides multiple examples of failures to effectively engage the community, resulting in halted, delayed or underused large investments. These failures could have been avoided by careful, long-term and inclusive community engagement.

For this reason, communities have become more active in urban water management in Australia (and elsewhere), especially in designing demand management and decentralised solutions. Utilities now regularly engage communities in decision making and even in service delivery (e.g. installing rainwater tanks on homes and community-led flood clean-up are city-wide examples from Australia).

The role for community can be embedded from the outset through partnerships with land owners and community organisations. Further information on community engagement lessons and techniques is provided in section 3.2 as well as in Box 12 and Box 13.

Box 12. The importance of community support—Toowoomba water recycling scheme, Toowoomba, Australia

Relevant SDGs:

Toowoomba is a city of 95,000 people located 100 km west of Brisbane, Australia. During the Millennium Drought (which affected Australia between 1996 and 2010), the city faced critical water shortages and decision makers explored novel solutions, including introducing highly treated recycled water into the drinking water supply. This case study describes the public opposition to, and subsequent failure of, the recycled water proposal.

The city's main water sources are surface water bodies, and these were heavily impacted by drought in the early 2000s. Facing critical water shortages, the city council introduced a range of water conservation measures in 2003, including rebates for rainwater tanks and water efficient fixtures. In 2005, the council approached the Australian Government to explore the option of an advanced water treatment plant to provide drinking-quality recycled water. A 3-year community consultation was included as part of the proposal.

Within 12 months, community groups had mobilised against the proposal; 10,000 signatures were collected in a petition against reuse for drinking and the focus of the project quickly shifted from technological feasibility to politics. In 2006, Australia's Prime Minister announced a local referendum asking Toowoomba residents whether they supported the reuse for drinking proposal. The proposal was defeated by the referendum results.

The failure of the reuse plan was not only due to public opposition. The council's public consultation process was caught off guard after public interest groups began mobilising support to vote against the recycling scheme and the process was rushed. As a result, residents had difficulty knowing which information to trust. Politics, timing, vested interests and information manipulation also played a part.

Source: Hurlimann and Dolnicar (2010)

Box 13. Capacity building for collaborative infrastructure management

Relevant SDGs:

The application of small, local-scale pressure sewer systems is novel, and Revitalising Informal Settlements and their Environments (RISE) is one of the first programs to trial this approach in informal settlements in Fiji and Indonesia. Having clear responsibilities for who will operate and maintain this infrastructure has been one of the most important factors in the success of RISE. Training sessions on technology such as the pressure sewer system were undertaken in Makassar and Suva. These sessions were supported by South East Water, an Australian water utility and RISE industry partner. The sessions included conversations about operation and maintenance to see who people thought should be responsible, and to create an environment in which everyone could share ideas about future management arrangements.

For the RISE Makassar project, the process included a training day on pressure sewer installation, commissioning and operation and maintenance. It was attended by community representatives and staff from the technical implementation unit for wastewater treatment (UPTD PAL). The RISE team were later invited as guest speakers at a UPTD PAL Management and Information Systems training session, where they discussed the operation and maintenance of the pressure sewer system.

For the RISE Fiji project, community representatives came together with local RISE partner organisations (the Water Authority of Fiji, the Department of Water and

Sewerage, Suva City Council and the project engineering consultant) for two days of training on infrastructure operation and maintenance. Participants engaged in hands-on learning about the technical aspects of RISE's infrastructure and discussed shared responsibility for its maintenance. After opening remarks from the Ministry of Waterways and Environment and the Water Authority of Fiji, participants were shown how the systems worked. They then broke into groups to discuss where maintenance responsibilities might lie. These newly trained teams are regularly maintaining and monitoring the treatment systems and collecting the first data that will show the impact of the RISE intervention on the health of local residents and the environment.

Sources: Asian Development Bank and RISE (2020) Image: Kerrie Burge

7.3   Determine how to pay for multi-functional solutions

Once the cost and business case for a project is demonstrated (see section 6.3.3), the next question is how to pay for it? This can be answered by considering the following.

Timing—when is the money required?

Understanding the 'life cycle costs' might lead to a discussion about staging the project over time to reduce 'price shocks' to customers. Price shocks have been observed in Australia when big investments in centralised systems to create capacity for 20–30 years' future growth were accompanied by sudden increases in prices to customers, resulting in affordability challenges.

Who will pay? What can they afford?

Once the cost has been established, it is time to think about *who will pay* and *what they can afford*.

Aspects to consider are finance and funding. *Finance* refers to the upfront source of money, from debt (borrowing), equity (savings or investor ownership) or other sources such as bonds or insurance. Finance is a question of investment: who is investing in the project and what return are they seeking? It is also about risk, and what makes the investment more or less risky to those providing the finance.

Funding is about who eventually pays for the project through a mix of:

• tariffs (e.g. access and use charges)

• taxes that collect funding from either beneficiaries or polluters

• transfers (e.g. government subsidies)

• collateral revenue (e.g. earnings derived from co-generation of energy or nutrients).

Thinking about this issue raises questions about whether the sources of funding are sustainable and equitable over time. Decision makers should consider the human right to water and sanitation, and the foundational role that water plays in society (economy, health, livelihoods, education etc.) (UN Water, 2018).

Table 3 provides a framework for determining the appropriate mix of funding and financing.

Securing finance

After a preferred financing and funding approach has been identified, water managers may find creditworthiness remains a barrier to securing finance. In some jurisdictions, water agencies are seen as using poorly performing systems, creating a risk that infrastructure will inevitably deteriorate. In other circumstances, citizens may not value the investments and may not pay for the services provided. Without secure funding, cost-effective finance will be difficult to obtain.

The risk can be lowered by:

• determining the funding source first—financiers want to know how their money will be repaid

• using blended finance that matches government and private sector investment, demonstrating government has faith in the investment

• presenting projects that are backed by a long-term plan that considers strategic risks such as climate change (see section 5.4): e.g. investors may want to see that water supply network losses have been addressed before making investments in new water sources

• demonstrating how individual projects will deliver customer value beyond core services (see section 6.2): e.g. investment to address flooding may utilise nature-based solutions

• pooling individual projects, or projects from multiple uses, to create investment diversification.

Table 3. A framework to select financing and funding

Step	Considerations in that step
1. Define how context influences funding and financing	• Macroeconomic outlook (e.g. trends in interest rates, inflation, exchange rates) • Industry specific constraints and opportunities (e.g. policy priorities, customer willingness to pay, capital constraints such as existing debt) • Technology and science driven opportunities (e.g. smart meters) • Broader community attitudes (e.g. around fairness and equity)
2. Clarify who should pay?	• Identify the unique attributes of the project (e.g. multiple benefits). • Are the benefits public or private goods, or both? What is the agreed cost allocation principle—beneficiary or polluter pays, capacity to pay or a combination? • Are there material differences in the distribution of impacts across scales, stakeholder groups, location and generations?
3. How and when should people pay?	Examples may be: • recover project life cycle costs • provide a return on equity • encourage change in behaviour (e.g. encourage water use efficiency) • minimise cost of finance • raise money quickly for a priority investment (e.g. upgrade a noncompliant dam) • provide for a future event (e.g. future renewal of an asset) • ensure equitable access • promote allocative, technical or dynamic efficiency.
4. Risk management	• Consider the different types of risk (e.g. technical, regulatory reputational, operational) and the implications for funding and finance. • Consider risk allocation and implications for choice of funding and financing. • Are risks allocated to the party best placed to manage them? • Do all parties understand and agree on mitigation measures?
5. Choose funding and finance options	• Evaluate a broad range of different funding and finance options against your objectives. • Can your chosen funding and finance solution be implemented and maintained in a sustainable, efficient and fair way? • Partnerships can increase options and effectiveness.

7.4 Partner with the private sector for implementation

If there are capacity or resourcing gaps in a city, water managers might consider partnerships with the private sector as a way to delivery new water projects. Private sector partnerships can deliver projects quickly, bring innovation and provide access to the increasingly specialised technical and engagement skills needed to manage modern urban water projects. For instance, in Australia, the private sector is increasingly taking a role in water services associated with digital technologies or bundled urban water services as part of urban development (Box 14).

A partnership can involve fully privatising water utilities or infrastructure, with government defining what successful outcomes look like and providing a framework within which the private sector can operate. Alternatively, it can involve outsourcing individual services, such as maintenance activities. An example of this is provided in Mackay Council's digital metering case study (Box 15).

Australia's experience with private sector involvement has been mixed. While there are many success stories, private sector partnerships have not always delivered the expected benefits or savings. One lesson is that allocating the responsibilities and risks of a service to a party that cannot manage them can result in poor outcomes. To avoid this situation, be clear on the following questions (Woolston et al., 2018:

- Why is the private sector involved: what are the likely benefits?
- How will these benefits be evaluated to ensure satisfactorily delivery?
- What are the responsibilities involved in delivering each function and the associated risks?
- Who is best placed to manage each responsibility or risk?
- How will GEDSI be incorporated into the contracting, monitoring and evaluation process?
- What model of private sector involvement best allocates these considerations?

Box 14. Exploring new business and operating models in Sydney, Australia

Relevant SDGs:

The A$2 billion Central Park development sits on a 5.8 ha site in inner Sydney and aims to achieve a five star Green Star rating for each building in the development.

Water management is central to this aim, and a private utility has been established to own, operate and maintain the development's water infrastructure. This infrastructure incorporates wastewater and stormwater harvesting.

Wastewater is collected from the residential, commercial and retail buildings in the development, an adjacent wastewater pipeline owned by the city's water utility, and stormwater runoff and rainwater. These raw water sources are treated through eight filtration and purification processes in a small treatment facility located in the basement of one of the buildings.

The treated recycled water is used fo rirrigation and toilet flushing, an in cooling towers. Although drinking water is still sourced from the city's drinking water network, the development uses 40–50% less drinking water than a comparable site. As an added benefit, the recycled water is also used for the development's central thermal plant, which in turn powers some of the water network infrastructure.

Central Park provides insight into new business models. The developer funded the servicing infrastructure as a way to achieve a five star Green Star rating, which in turn allowed more floor area for the development. A private utility associated with the developer charges customers directly to manage the entire water cycle, although the city's publicly owned utility still charges residents to manage trunk stormwater.

Source: Water Services Association of Australia (2020)
Image: SAKARET/Shutterstock.com

7.5   Accelerate innovation when novel solutions are being used

Integrated strategies and multi-functional solutions can give rise to novel technologies that, in turn, challenge existing norms and regulations. There is always a risk that these innovations are abandoned before reaching scale, regardless of the potential benefits to citizens. To avoid this outcome, innovation can be deliberately guided and nurtured at a project level via pilot projects, and at a city-wide scale by strategically addressing deeply embedded barriers to change.

7.5.1 Scale up from initial pilot projects

When promoting innovation, it can be useful to implement pilot projects before full-scale implementation occurs. Pilot projects are a tangible way to demonstrate the feasibility of a new solution and ensure practitioners and community are bought along rather than having new technologies and services imposed upon them.

But traditional approaches to piloting often focus too much on technical feasibility. These pilots often create technical demonstrations of the possibilities but do not automatically generate real change. Instead, include actions within the pilot project to identify barriers to widespread implementation of the new approach. Then work with community, regulators and policy makers to make the case for change. Box 16 describes how this approach was used in Kunshan, China.

Box 16. Scaling up innovation in Kunshan, China

Relevant SDGs:

The City of Kunshan demonstrates how implementing new water approaches can move from discrete projects to larger pilots and finally to mainstream practice.

Kunshan has an extensive network of canals that are affected by catchment pollution and poor water circulation. The Kunshan City Construction, Investment and Development Company (KCID) decided to incorporate water sensitive urban design (WSUD) into the city's open spaces to manage wastewater and stormwater pollution. The WSUD was coupled with the recirculation of canal water through regional and precinct-scale wetlands, enabling the cleansed water to be harvested for non-drinking use. This project established a city-wide strategy for Kunshan to reduce pollution into regional waterways and mitigate flood risks for downstream cities.

KCID initially implemented a pilot project to embed WSUD into the landscape architecture of the Opera House and Cultural Plaza in Kunshan. The project demonstrated how public open space can be designed to provide ecological functions. The project has since improved water quality, created biodiversity, introduced food production and influenced the urban microclimate.

The performance of the pilot project had a significant effect on the organisational response to future KCID projects. The project gave the city government evidence to transform what was once perceived as innovative but risky technology into standard practice, which in turn authorised the next wave of innovation. This evidence underpinned subsequent policy development, helping to overcome the regulation barriers, community perceptions and institutional risk aversion. As a result, the concept of ecological landscapes is now being widely adopted by KCID.

Source and image: CRC for Water Sensitive Cities (2021)

7.5.2 Support innovation by strengthening the enablers of change

Pilot projects support innovation one project at a time. Achieving a city-wide shift from conventional water management approaches to integrated approaches requires additional action, especially if the innovation is likely to challenge existing structures, cultures and practices. Achieving change at scale requires overcoming these barriers and typically emerges over six phases (Figure 20) (Brown et al., 2016):

1. An **issue with old practice emerges**. In the first phase, a particular problem is identified (e.g. poor waterway health).

2. **Issue becomes more defined**. In the second phase, the cause of that problem is identified (e.g. stormwater pollution).

3. **People develop a shared understanding**. Next, a diversity of stakeholders and end users develop a common agreement on the problem, its causes and repercussions. The need for action is acknowledged.

4. **Knowledge about solutions is disseminated**. Over time, the focus of activity shifts towards potential solutions and the benefits they may bring.

5. New **solutions are diffused through policy and practice**. Once proof of concept is established, agreement on the implementation pathways for different solutions follows.

6. The final phase involves **making the new practice(s) mainstream.**

Figure 20. The six phases of transition. (Source: Brown et al., 2016)

The transition process can be sped up using six enabling factors as catalysts for adopting innovation (Brown et al., 2016):

1. **Champions**: individual people, organisations and networks who are involved in or engaged with a change in practice (considering GEDSI to involve a broad range of champions).

2. **Platforms for connecting**: formalised or semi-formalised organisations, structures and processes that facilitate collaborations across science, policy and industry.

3. **Knowledge**: scientific understanding of the problem and potential solutions, along with contextualised knowledge informed by local research activities.

4. **Projects and applications**: experiments, demonstrations and focus projects that test the viability of new technologies or approaches.

5. **Implementation guidance**: practice tools including models and best practice guidelines to deliver the new practice.

6. **Administrative tools**: such as legislative and regulatory instruments and market mechanisms to help embed the new practice.

These enabling factors can be strategically implemented to counteract barriers and to reinforce change that has already been achieved. Presenting the transition phases and enabling factors as a matrix provides a way to systematically map their presence or absence, build actions to address gaps and incrementally move towards the final stage of embedding new practice (Table 4).

Table 4. Transition Dynamics Framework

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Practices and tools – technical	Practices and tools – administrative
1. Issue emergence	Issue activists		Issue highlighted	Issue examined		
2. Issue definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	Data and evidence collected	
3. Shared understanding & issue agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance	Administrative instruments explored
4. Knowledge dissemination	Influential champions	Building broad support	Solutions advanced	Solutions demonstrated at scale	Refined practical guidance and design tools	Early policy and performance standards
5. Policy & practice diffusion	Government agency champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Implementation guidance for multiple sectors	Refined policy and standards, early regulation
6. Embedding new practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive/ standardised design guidance	Comprehensive policy and regulation

(Source: Wong et al., 2020)

7.6 Support successful implementation using GEDSI

The GEDSI focus in implementation is on addressing the barriers faced by people in individual project contexts (community, household, organisation and government) and evaluating equity of outcomes. GEDSI can be maximised by:

- incorporating inclusion activities in project budgets, including paying advisors and collaborators

- using governance models that highlight GEDSI in project steering committees and working groups

- allocating staff or project team responsibility for inclusion actions

- ensuring champions represent the diverse needs of end users. e.g, disability action groups

- including people representing GEDSI issues in key implementation activities to mainstream the approach and ensure it is followed through (e.g. reporting, key performance indicators and accountability mechanisms)

- raising GEDSI awareness among project staff and community, including by providing training

- taking steps to reduce attitudinal, physical, communication and institutional barriers in projects

- partnering with OPDs in delivery, monitoring and evaluation activities

- monitoring and evaluating inclusion outcomes, drawing on a range of tools and approaches.

Success also requires having the necessary resources and collaborating with rights holder organisations (e.g. women's organisations or OPDs) to monitor outcomes.

8 Establish an enabling environment

Key messages

- The enabling environment refers to the political legitimacy of and community support for a program. It includes having political decision makers on board, a social licence to operate and the certainty of supporting legislation, regulation and policy.

- Water practitioners can influence the enabling environment by thinking and working politically.

Importance

- Unless there is political will and broad community support, the project is unlikely to happen.

Milestones

- Thinking and working politically is an ongoing process.

Activities

- Thinking politically involves understanding the rules of the political game and the current status of the political landscape.

- Working politically is about building networks and being adaptive to inevitable change.

8.1 Introduction

The Guide has so far focused ways to facilitate integration across the urban water cycle. But urban water projects remain complex, and this part of the Guide focuses on the political will, executive leadership, commitment of decision-makers and cross-sectoral relationships that also influence a project's success.

8.1.1 Why is the enabling environment important?

Taking a purely technical approach to a project is insufficient to achieve change where there are deeply entrenched norms. This observation is especially true for projects that involve major innovations that challenge current practice. But by thinking and working politically, it is possible to align the project with the interests of influential stakeholders, thereby building political will and community support. Support also helps to ensure funding is available for project implementations.

8.1.2 Understand the policy and regulation landscape

By their nature, multi-functional water projects will be subject to a range of environmental, public health, economic and built environment policies and regulations. Building an enabling environment often involves influencing these existing systems of policy and regulation.

If conflicts with existing policy are envisaged, build a mandate for the project. Understanding the regulatory and policy landscape helps to ensure compliance and to identify what outcomes the regulations and policy aim to achieve. Beyond the formal regulation and policy landscape sits informal authorisation of the project by regulators and political leaders, and in-principle acceptance by community and consumer groups. This is achieved through early engagement and by having a clear and simple case for change. These outcomes require project managers and project champions to be actively thinking and working politically from the beginning.

8.2 Thinking and working politically

Astute water managers understand 'how change actually happens' in the day-to-day reality of politics. They use this thinking during the scoping, planning and delivery activities of the project, and it becomes a continuous process of monitoring and responding to change that supports a broader adaptive management approach.

There are two ways to think and work politically within an overall approach (Teskey, 2017).

The first occurs during the vision development (part one), when problems and potential solutions are being framed. When developing a shared vision, identify the interests, incentives and issues of the major stakeholders and institutions: who stands to gain or lose? And what are the informal rules that determine 'how things get done'? These questions help to identify which stakeholders to involve and what issues to discuss. The result is a vision framed in a way that attracts political support; powerful stakeholders can see how it helps them achieve their own objectives. The information collected in part one is then used in part two. Here, an assessment of political feasibility forms part of the option evaluation. If a project's political feasibility is very low, then do not proceed. Instead, rescope the project.

Second, thinking and working politically involves continually engaging with the enabling environment throughout the project (Figure 21). The political landscape can change quickly; if this happens, pause and reflect on why the change has occurred. Potential fallout can be mitigated by building networks with key stakeholders and strong working relationships with locally legitimate institutions. Further tactics for political influence are provided below.
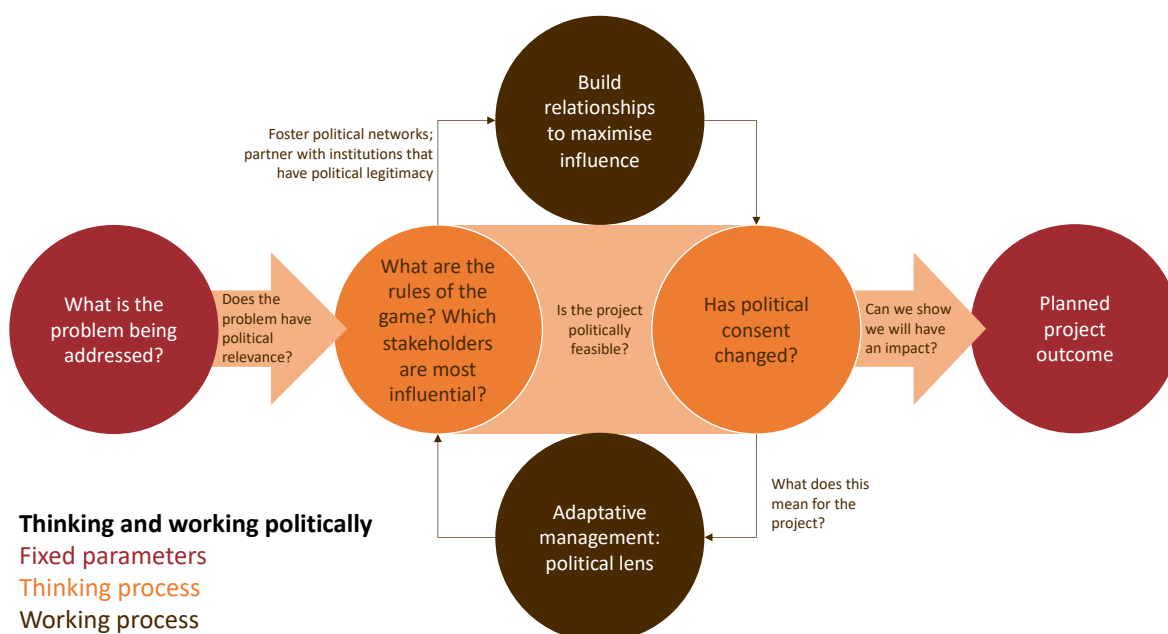

Figure 21. A framework for thinking and working politically. (Source: Teskey, 2017)

8.2.1 Being more influential

Establishing an effective enabling environment has a lot to do with influence. Tactics that water managers can adopt to increase their influence include (Laing & Walter, 2018):

- **Knowing what you want to achieve**: Decision makers and policy makers must work in specifics, so provide concrete recommendations for the grand vision, and what it looks like in specific cases.

- **Bringing solutions, not problems**: Frame a problem, and its workable solution, within the context of a wider government issue or community agenda.

- **Understanding the decision makers**: Identify who the key decision makers are, what they need and what they will be receptive to. Stakeholder networks provide insight into these factors.

- **Working with certainty and risk**: Certainty and risk are measured differently in the political domain, compared with risk in engineering and science. Be willing to provide concrete recommendations to decision makers, even if these ideas are still evolving. Use precedents from case studies to improve confidence in new ideas.

- **Translating the technical aspects**: Convert ideas into terms that make sense to, and are useful to, decision makers, often by fitting them into a bigger picture they already understand.

- **Finding the business case**: As part of translation, describe how an innovation translates into economic realities (such as creating new jobs in the community). Consider how the decision makes can tailor the value proposition to a range of stakeholders, including end users and consumer groups.

- **Making the political case**: Even if an idea stacks up technically and financially, political factors usually come into play. Establish a political case by understanding how the relevant stakeholders can be part of an outcome and anticipating their likely reactions. Also understand who makes the final decision.

- **Communicate clearly**: How ideas are communicated is crucial to their success. Information that does not require technical expertise to understand is most likely to be influential.

Conclusion

Cities that thrive are those that have healthy, resilient and inclusive communities, infrastructure and services, growing economies and sustainable futures. For cities that are not yet at this point, the UN SDGs provide a framework to consider the interrelated elements that need to be considered and achieved. A key message from the SDGs is that they are a comprehensive framework. It is not for cities to pick and choose which to apply; concurrent progress must be made towards all of the goals to 'leave no-one behind'. The integrated nature of the SDGs underscores the value of integrated solutions that work harmoniously across the various sectors and diverse communities in cities.

Integrating the urban water cycle is a way to consider multiple objectives and deliver multiple benefits for the whole community. With public health as a foundation, integrated urban water approaches provide a way to deliver a much broader range of outcomes in cities by bringing together services, infrastructure and resources across the water cycle for the benefit of all citizens.

To do this, the water and sanitation infrastructure and services chosen for a context need to be informed by an inclusive vision for the city: a city that is safe for people, improves resilience, liveability and amenity, and does not deepen inequalities. By meaningfully including a broad range of stakeholders at all stages of the process (with particular attention to GEDSI and Indigenous voices, knowledge, needs and ways of using and depending on water and sanitation), an integrated urban water management approach can deliver multiple, long-term benefits.

The Urban WaterGuide shows how to operationalise this approach. The Guide helps urban water managers, policy makers and decision makers to develop and implement an integrated and inclusive agenda through processes of vision-setting, strategy, developing multi-functional solutions and delivery through five main activities:

- The vision section frames urban water challenges in terms of city-wide and inclusive community-level outcomes: water is an enabler of a wide variety of outcomes in a city and it is important for the water sector and diverse stakeholders to have a say.

- The strategy section describes how the city can move to a more integrated management of the urban water cycle: harnessing the whole of the water cycle to deliver the vision and to open up new pathways to deliver services for the whole community.

- The solution development takes the concept of creating value to a project level, detailing how projects can be multi- rather than mono-functional through inclusive design.

- The delivery section discusses practical ways to fund and de-risk the implementation of the new agenda so that actions can be delivered on the ground, and thereby realise the intended benefits for communities.

- Building the enabling environment ensures political and community support for the new initiatives.

Cities can easily adapt each part of this process to their current situation, in large part by working collaboratively and inclusively with stakeholders and communities to find appropriate solutions to local water challenges. A city can also begin at any point in the process and build momentum by extending into and implementing the remaining parts as opportunities arise.

Australian cities have been on a journey using versions of this process for more than a decade, and are committed to advancing more integrated urban water management. The five parts of the Urban WaterGuide bring together lessons from these cities and beyond, and incorporate best practice methodologies that have been developed through research and experience. Australia is committed to working with other countries to apply the Guide, and to work together to reach global solutions for creating more inclusive, liveable, sustainable, productive and resilient cities and towns.

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Appendix 1. Summary of Australia's urban water story

Introduction

Urban areas account for 90% of Australia's population and generate much of our gross domestic product. Australia's cities are also recognised as being among the world's most liveable. Water has shaped these cities, by providing essential services and also by creating liveability.

All urban areas in Australia—from major cities to regional centres and rural towns—face a similar water challenge: how to develop resilience to Australia's variable climate in a way that captures the liveability value of water. Because of our climate, Australian cities and town have adopted various approaches to supplying water.

- Some (e.g. Sydney, Melbourne and south east Queensland) rely on large water storage capacity in rainfall-fed dams. Dams are also used to manage floods in some cities.

- Others rely on river water systems, such as Hobart, Adelaide and many inland cities.

- Natural storage in groundwater aquifers is a vital component of urban water supplies in some places, most notably Perth.

- Perth is also among Australia's coastal cities that have adopted desalination as a new water source.

Increasingly, Australian urban centres are adapting their water systems to meet the needs of growing populations, together with managing the extremes of droughts and floods exacerbated by climate change. In doing so, Australian water strategies, infrastructure and services have progressed from a conventional linear and siloed approach to a more integrated and adaptive approach.

Australia's evolving urban water journey

For many millennia, Aboriginal and Torres Strait Islander communities existed and thrived on the resources of their land and water environments. Local waterways and water bodies often defined their ways of life. When Europeans arrived, they disrupted natural water systems by damming rivers and creeks for farming and water storage to support growing settlements. These settlements also needed waste collection and, ultimately, sewerage systems to protect the community from disease. What started out as small groups of people surviving on local water sources and features quickly became colonies and towns with centralised water systems.

In the first half of the 20th century, World War I, the Great Depression and World War II held back urban growth and investment. But the post-war population boom during the 1950s and 1960s drove significant investment in water infrastructure. As cities around the country rapidly grew, so did the footprint of the water system infrastructure, along with the size of influence of public water utilities.

As well as to support population growth, water infrastructure systems were augmented to manage extreme conditions—in other words, to drought- and flood-proof our urban areas. During this period, suburban growth doubled the physical footprint of major cities and pushed development into more marginal lands, requiring more coordinated planning and investment.

The phase of rapid urban development also increased impervious surfaces (e.g. roads, footpaths and roofs), altering natural flow paths and increasing pollution in runoff. Altering the imperviousness of the catchments had significant impacts on downstream water quality and flows, degrading the health of once pristine rivers and waterways. Media and community concern about the environment led to demand for government action to address poor water quality in the 1970s. State-based Environment Protection Authorities were established to prevent and reduce negative impacts on the environment, including waterways. Increasingly, work was directed at managing diffuse water quality risks. Water sensitive urban design (WSUD) approaches that demonstrated significantly improved water quality and flows became accepted as best practice in our larger cities.

From 1997 to 2010, much of Australia experienced the longest drought in its history—the so-called 'Millennium Drought'. Water strategy changed in response. Water managers adopted water conservation measures (demand management), but also explored new water resource options that no longer relied on rainfall inflows (supply management).

Demand management included water restrictions, public education programs to change consumer behaviour and retrofit programs to introduce water efficient appliances. The water savings were significant and the behavioural impacts remain, with current water consumption in Australian cities less than it was before the drought.

Supply management primarily involved constructing desalination plants. Ultimately, the drought ended before many of these plants were commissioned, which fuelled community and political backlash against what was perceived as unnecessary infrastructure. But other options were also considered, including groundwater resources and alternative resources such as recycled wastewater. Wastewater treatment plants and drainage systems were also redesigned to harvest and purify water for reuse.

One limitation to the widespread uptake of these resources was storage. As a result, distributed storage space was created within cities. Household rainwater tanks and managed aquifer recharge schemes became popular, and new housing estates implemented distribution schemes (called a third pipe) to supply treated (recycled) wastewater to homes.

Water managers quickly realised they needed to work alongside urban planners to make these new solutions work. Building regulations and urban planning instruments were changed to encourage WSUD, rainwater tanks and third pipe distribution schemes. Training and certification schemes were introduced to ensure the building industry had the skills to deliver the new types of infrastructure.

Experience in Australia shows major droughts are often broken by floods. In flood-prone cities, these same investments have helped to keep rainfall where it lands in the catchment, reducing downstream flooding.

Droughts and floods are not the only natural hazards. Bushfires such as the 2009 'Black Saturday' fires also affect the urban water cycle. The drinking water catchments of some Australian cities are forested, and rainfall following bushfires in these forests washes debris into dams and waterways, affecting drinking water quality.

The Millennium Drought, floods and bushfires have increased the water sector's focus on building the resilience of water systems. Drought and flood planning is now more sophisticated, using different climate scenarios and long-term climate records in modelling. Water supply, wastewater and drainage systems are managed in a more integrated way, using common objectives for the water cycle.

Governments and water sector organisations are also adopting policies to improve urban liveability, particularly around greening, cooling, improved amenity, equity, affordability and safety. New approaches can include:

• providing water and land for green space to support active healthy lifestyles

• supporting blue infrastructure including clean healthy, beaches and waterways

• supporting cool environments by using water to provide respite from heat waves.

These liveability outcomes are sometimes the responsibility of water utilities, but most often local government or the private sector who must find new ways to work together and to inclusively engage non-traditional stakeholders.

These ideas have coalesced into an integrated water management approach, made possible by:

• new, collaborative planning approaches involving the community and other sectors, which have strengthened the enabling environment for the urban water sector, enabling innovative approaches to be trialled

• major investments in augmentation showing that dams were no longer the preferred option and opening the door to a range of alternative water supplies sources

• proofs-of-concept that demonstrated managing demand for water (or living with flooding) can be just as effective as increasing infrastructure capacity, but can be rolled out more quickly

• steps to incorporate water efficiency and flood resilience into the structure of the city, at various scales, by harnessing urban planning and design as a part of the water solution.

Case studies of integrated water management can now be found across Australia's cities. These case studies highlight a more decentralised approach, that uses smaller, local-scale projects. These can be found at the lot scale, at street scale and at precinct scale, and support existing, centralised approaches by 'filling gaps' or extending systems at the margins.

Appendix 2. Linking sustainable urban water management to the UN SDGs

Water Services Association of Australia and Monash Sustainable Development Institute (Satur & Skinner, 2020) have identified the links between common sustainability strategies pursued by urban water utilities in developed cities and the UN SDGs. This mapping clarifies the contribution that urban water utilities can make, and helps these agencies identify and report on outcomes beyond core water services.

Strategy	Linked SDGs
Workplace inclusion and diversity	5 Gender Equality; 8 Decent Work and Economic Growth; 10 Reduced Inequalities; 11 Sustainable Cities and Communities; 16 Peace, Justice and Strong Institutions
Education, training and capacity building	4 Quality Education; 8 Decent Work and Economic Growth; 10 Reduced Inequalities; 12 Responsible Consumption and Production
Occupational health, safety and wellbeing	3 Good Health and Well-being; 8 Decent Work and Economic Growth; 10 Reduced Inequalities; 16 Peace, Justice and Strong Institutions
Job creation and decent work	5 Gender Equality; 8 Decent Work and Economic Growth; 9 Industry, Innovation and Infrastructure; 10 Reduced Inequalities
Diversification and innovation	8 Decent Work and Economic Growth; 9 Industry, Innovation and Infrastructure
Empowering vulnerable customers	1 No Poverty; 5 Gender Equality
Helping communities participate in water cycle planning	1 No Poverty; 4 Quality Education; 6 Clean Water and Sanitation; 10 Reduced Inequalities; 11 Sustainable Cities and Communities; 12 Responsible Consumption and Production; 13 Climate Action; 14 Life Below Water; 16 Peace, Justice and Strong Institutions; 17 Partnerships for the Goals
Strengthen efforts to safeguard cultural and natural heritage	6 Clean Water and Sanitation; 11 Sustainable Cities and Communities; 12 Responsible Consumption and Production; 14 Life Below Water; 15 Life on Land
Uptake and implementation of sustainable development	1 No Poverty; 2 Zero Hunger; 3 Good Health and Well-being; 4 Quality Education; 5 Gender Equality; 6 Clean Water and Sanitation; 7 Affordable and Clean Energy; 8 Decent Work and Economic Growth
Universal access to safe and affordable drinking water	1 No Poverty; 3 Good Health and Well-being; 4 Quality Education; 6 Clean Water and Sanitation; 9 Industry, Innovation and Infrastructure
Universal access to adequate and equitable sanitation	1 No Poverty; 3 Good Health and Well-being; 6 Clean Water and Sanitation
Improve water quality by reducing pollution and increasing safe reuse	3 Good Health and Well-being; 6 Clean Water and Sanitation; 11 Sustainable Cities and Communities; 12 Responsible Consumption and Production; 14 Life Below Water
Substanatially increase water use efficiency	2 Zero Hunger; 6 Clean Water and Sanitation; 4 Quality Education; 9 Industry, Innovation and Infrastructure; 14 Life Below Water
Implement integrated water management at all levels	1 No Poverty; 6 Clean Water and Sanitation; 11 Sustainable Cities and Communities; 13 Climate Action; 14 Life Below Water; 16 Peace, Justice and Strong Institutions; 17 Partnerships for the Goals
Integrated and inclusive climate planning and management	1 No Poverty; 6 Clean Water and Sanitation; 11 Sustainable Cities and Communities; 12 Responsible Consumption and Production; 13 Climate Action; 15 Life on Land; 16 Peace, Justice and Strong Institutions; 17 Partnerships for the Goals
Climate resilient utility infrastructure and services	9 Industry, Innovation and Infrastructure; 11 Sustainable Cities and Communities; 13 Climate Action
Liveable and healthy places	1 No Poverty; 4 Quality Education; 6 Clean Water and Sanitation; 10 Reduced Inequalities; 11 Sustainable Cities and Communities; 12 Responsible Consumption and Production; 13 Climate Action; 14 Life Below Water; 16 Peace, Justice and Strong Institutions; 17 Partnerships for the Goals
Restore, protect and enhance water related ecosystems	6 Clean Water and Sanitation; 14 Life Below Water; 15 Life on Land
Increase energy efficiency	7 Affordable and Clean Energy; 9 Industry, Innovation and Infrastructure; 12 Responsible Consumption and Production; 13 Climate Action
Increase renewable energy production and reduce GHG emissions	7 Affordable and Clean Energy; 9 Industry, Innovation and Infrastructure; 12 Responsible Consumption and Production; 13 Climate Action
Sustainable consumption and production	6 Clean Water and Sanitation; 8 Decent Work and Economic Growth; 11 Sustainable Cities and Communities; 12 Responsible Consumption and Production
Waste recycling and circular economy	3 Good Health and Well-being; 6 Clean Water and Sanitation; 11 Sustainable Cities and Communities; 12 Responsible Consumption and Production