

# Compendium of Good Practices on Urban Water Supply and Wastewater Infrastructure

---

## I. Definition

Water infrastructure systems perform a dual role: they provide water services while also reducing risks to other services from natural hazards such as floods and droughts.

The availability of safe and sufficient water provision is inextricably linked to how wastewater is managed. Water must be carefully managed during every part of the water cycle: from freshwater abstraction, pre-treatment, distribution, use, collection and post-treatment, to the use of treated wastewater and its ultimate return to the environment, ready to be abstracted to start the cycle again. The opportunities from exploiting wastewater as a resource are enormous. Safely managed wastewater is an affordable and sustainable source of water, energy, nutrients and other recoverable materials.

## II. Relevance

Water supply and sanitation are vulnerable to a wide range of natural hazards, particularly flooding, but there are many opportunities for enhancing resilience. The goal for urban planners is to understand the full water supply and sanitation systems in an urban area and develop clear strategies to address deficiencies.

Improved water supply and wastewater infrastructure generates social, environmental and economic benefits essential for sustainable development. These water systems reduce the risks associated with certain natural hazards to other services like power, transport and water itself, such safeguard services should be accounted for when making the case for resilience investments in water systems.

Urban areas must develop resilient and varied portfolios of water resources to prepare for growing scarcity (linked to quantity and quality) and water-related risks. Given the many stakeholders involved both at the city and basin level—sometimes even several basins—cities are seeking increasing control over water management and planning by maximizing local water sources, among others, through demand management and reuse.

## III. Key principles emerging from the review of best practices

Technical solutions alone are unsustainable. For improved measures to persist through time, it is essential for positive incentives in water supply and wastewater infrastructure to be embedded in policy, institutional, and regulatory structures.

**Systematic.** Clean, safe water depends on many factors that impact the entire water cycle and reach well beyond the water sector. While utilities are at the forefront of providing services like drinking water and wastewater, they don't operate in isolation—they are heavily influenced by other sectors. As increased pressure on the quality and quantity of water supplies drives the need for more efficient and effective processes, many utilities are recognizing the need to not only integrate their drinking water, wastewater, stormwater, and reuse operations—but also to

coordinate with other sectors, including energy, agriculture, industry, and municipalities. For example, there is a need to move from ad hoc and isolated wastewater solutions (such as one treatment plant per municipality) to fully integrated river basin planning approaches, which yield more sustainable and resilient systems. This recent shift in thinking involves water management that includes unified, sustainable systems.

**Integrated.** Adopting an integrated approach supports proper system design from the start and ensures capacity to respond to disasters throughout a system's life cycle. At the system level, centralizing information and enhancing stakeholder coordination builds institutional capacity, which in turn allows for integrated planning and service delivery. At the sector level, systems planning considers the vulnerability of areas where infrastructure is deployed, as well as the integration and redundancy of critical infrastructure to offer alternatives. At the project level, resilience can be built through proper engineering and design (for example, by carefully selecting materials and adapting design specifications), asset management (inventory, mapping, and vulnerability assessment of the infrastructure assets; prioritization of maintenance and repairs) and contingency programming (by developing the tools/protocols for emergency preparedness and response).

**Strong Enabling Environment.** There is a need for strong leadership of national and local water authorities, strong ownership of experienced water resources management institutions, and strong experience of public funding agencies. Increasing the resilience of water provision and wastewater requires implementation of necessary policy, institutional, and regulatory frameworks to promote these changes. Regulations and standards need to be tailored to the needs of the region and trends in the sector, including barriers to nature-based structures. They need to embrace and promote gradual compliance and foster reuse and resource recovery. A strong regulatory environment is also considered one of the major pillars in a successful public-private partnership arrangement. Regulation protects consumers from unreasonable pricing and it also ensures a level playing field for the private sector so companies can operate in an efficient and prudent manner, while also encouraging more firms to invest.

**Risk Assessment and Planning.** Risk assessments should examine the effectiveness in reducing risks, feasibility of design and maintenance, urgency of risks, and other externalities such as providing benefits to the ecosystem and minimizing unintended negative consequences. Locational mitigation and structural mitigation are the critical first steps in understanding what types of hazards present risks and how critical infrastructure may be enhanced. A structural approach for increasing the resilience of water supply and wastewater systems will involve strengthening measures and building codes. This approach will be particularly effective for risk reduction from flooding, earthquakes, landslides, and storms. Operational mitigation addresses the possibility of system failure and plans contingencies once that failure has taken place.

**Demand Management.** When considering water supply, it is critical to understand daily, monthly, and long-term demand when evaluating the resilience of water supply. A focus on demand management recognizes the central role of customers in building resilience in their water system. Involving the public early on can also help avoid future failures through increased accountability. Involving users in decision making ensures transparency and ownership in the process of building resilience of water supply systems. Users of water services also play an important role in managing the demand side of that service. In the same way that water consumption has been successfully reduced in several places, thus reducing the need for costlier infrastructure-based supply augmentation schemes, users can provide inputs on the way services can be adapted to better serve them and the environment.

**Water Governance.** Improving governance of water systems considers corporatization, full cost recovery, and connection fee waivers. It has also introduced new and innovative utility structures that seek to reduce bureaucracy by including consulting and contracting services within the company, and to integrate water supply and sanitation.

**Decision Making Under Deep Uncertainty.** DMDU principles provide guidance on integrating such sources of uncertainty in the planning process for infrastructural assets, including water systems. DMDU proposes accounting for different possible futures and testing the impacts of different variables on proposed actions and measures to see how their performance is affected. Planning for multiple scenarios avoids costly surprises and helps reach consensus. People can agree on a strategy or a project for different reasons. Exploring different futures enables possibly diverging future scenarios to be considered. This helps avoid gridlock and leads to a better understanding of how to prioritize beneficial actions across plausible futures.

**Innovative Financing and Contingency Funding.** Explore and support the development of innovative financing and sustainable business models in the sector. Financing water supply and sanitation infrastructure and recovering its costs is a challenge. Preparing contingency funds and subsidy programs for water infrastructure assets is critical for building system resilience and inclusive communities.

**Asset Management and Maintenance.** To maximize the operational life of water infrastructure assets, there is need to establish systems, mechanisms, and procedures for effective and efficient capital maintenance. Operators must be prepared to react to any given situation. Timely replacement and rehabilitation of the water distribution network and water treatment plants/machinery is crucial for providing adequate levels of service to existing and new consumers. Improved asset operation and maintenance is a priority to avoid wasted capital as a result of a design, build, neglect, rebuild mentality. For example, water pipes make up the majority of asset value in a water supply system. The prevalence of high levels of physical leakage in the sector is an indicator of poor operation and maintenance of these pipes resulting from a long response time to repair leakages; no or poor active leak detection; no or poor pressure management of the distribution system; and no systematic

**Storage.** Increasing the capacity to store water is an important factor for resilient water supply systems, but the ability to keep water potable must also be considered. Both storage and treatment facilities will depend entirely on the type of water source and transmission-distribution systems. In more complex water supply systems, large storage tanks of finished water can hold enough drinking water for the whole population for a week, but other simpler systems will convey water to local storage tanks that hold water for a few families.

**Gender.** Evidence shows that investing in the nexus between water and gender is crucial to achieving the 2030 Sustainable Development Agenda. In fact, enabling fair access and control of water resources is necessary to achieve women's empowerment and gender equality worldwide. Having inclusive institutional structures in place for multi-stakeholder dialogue and cooperation is essential to ensuring equitable access to sustainable water supply and sanitation services.

**Nature-based Infrastructure.** Nature-based infrastructure can provide an effective complement or alternative for traditional built (or "grey") infrastructure. The use of these solutions can help reduce risks, enhance resilience, and support other objectives, including ecosystem restoration, protection or creation of green space and recreation areas, and climate change mitigation through carbon sequestration. On its own, green infrastructure may be able to reduce risks from some hazards. A combination of nature-based and conventional infrastructure is under experimentation to increase overall resilience. This combined approach can provide redundancy and improve resilience to unexpected events that coincide or cascade.

**Retrofitting and Green Infrastructure.** Green infrastructure can be retrofitted to improve the hydrological performance of older urban landscapes or incorporated in the design of new areas, due to its cost-effectiveness and its multiple benefits. There is significant scope to expand the retrofitting of green infrastructure or for incorporating it in an initial planning stage, together with

improved urban and peri-urban landscape management, to achieve sustainable urban settlements with a proven track record of making significant contributions to urban water management and resilience, including risk reduction.

## IV. Examples of best practices & resources

### Resources

1) [Lifelines: Water Infrastructure Resilience](#)

*Developed by the World Bank – 2019*

This report aims to inform water system managers on the importance of and measures to build the resilience of water service provision to natural hazards and climate risks while ensuring that water systems can safeguard service provision by reducing their exposure to the risks associated with natural hazards. Highlights include: Conducting network and criticality analysis to identify where to invest in strengthening or redundancy; Improving maintenance, to reduce vulnerability; Managing demand, to mitigate the impact of interruptions; Working with nature and better integrating water systems with the management of the water sources; Focusing on planning and institutions; Testing new technologies and innovations such as decentralized sanitation.

2) [Reform and Finance for the Urban Water Supply and Sanitation Sector](#)

*Developed by World Bank – 2019*

Since 2016 the World Bank has explored a wide range of country experiences in delivering better water supply and sanitation services. The analyses led to publication of three new global frameworks for designing water reforms: Policy, Institutional, and Regulatory Incentives, which looks at the broader sector enabling environment; Water Utility Turnaround Framework, which looks at utility-level reforms; and Maximizing Finance for Development, which looks at shifting the financing paradigm to reach the Sustainable Development Goals. This summary note integrates the three lines of work—utility reform, sector reform, and sector finance—for readers to understand the critical links between the three spheres.

3) [Aligning Institutions and Incentives for Sustainable Water Supply and Sanitation Services](#)

*Developed by World Bank – 2018*

The objective of this study is to analyse how integrated policy, institutional, and regulatory interventions (institutional interventions in brief) can help align incentives for more sustainable water supply and sanitation (WSS) service

delivery. The context for the study is the enhanced global concern about the sustainability of attempts to increase access to, and improve the quality of, WSS services, as exemplified in the sustainable development goals. Aligning institutional interventions refers to harmonization among the objectives for the sector, agreed principles established through political and social processes, and the organizations and mechanisms that implement actions based on such objectives and principles. This report focuses on the formal policy, institutional, and regulatory interventions available to and or prevalent in the water sector, recognizing the critical importance of the informal conventions that will be key factors in the success of any incentive regime.

4) [\*\*Integrated Green and Grey: Creating Next Generation Infrastructure\*\*](#)

*Developed by World Bank and World Resources Institute – 2019*

This report is for those responsible for delivering infrastructure services. Water and power utilities, storm and flood management agencies, and irrigation departments can use the guidelines to integrate natural approaches into their plans. Public officials can learn to how to enable green-grey infrastructure development through improved policies, laws, and regulations. Ministries of Finance and Budget can gain insights on how to approach financing, often a major barrier for infrastructure, by opening new financing channels from mission-driven investors and governments.

5) [\*\*Wastewater: The Untapped Resource\*\*](#)

*Developed by UN-WATER – 2017*

The report focuses on the critical role that wastewater is poised to play in the context of a circular economy, whereby economic development is balanced with the protection of natural resources and environmental sustainability, and where a cleaner and more sustainable economy has a positive effect on the water quality. Access to improved sanitation services can contribute significantly to the reduction of health risks. Further health gains may be realized through improved wastewater treatment.

6) [\*\*Nature-based Solutions for Water\*\*](#)

*Developed by UN Water – 2018*

The 2018 edition of the United Nations World Development Report focuses on opportunities to harness the natural processes that regulate various elements of the water cycle, which have become collectively known as nature-based solutions (NBS) for water.

- 7) [\*\*Wastewater Report 2018: The Reuse Opportunity\*\*](#)  
*Developed by the International Water Association – 2018*

This report aims to illustrate the wastewater challenge and reuse opportunity in eight cities across the globe, presenting a reuse roadmap and identifying priorities and benefits to meeting SDG target 6.3. The cities profiled in this report are not the ‘usual suspects’ of pioneering cities who have been on this trajectory for some time, but rather cities small and large from developing countries where the existing and future challenges are felt more acutely and the need for change is pressing.

- 8) [\*\*Resilient Water Supply and Sanitation Services: The Case of Japan\*\*](#)  
*Developed by World Bank Disaster Risk Hub, Tokyo – 2017*

Japan has built the resilience of its water supply and sanitation services through an adaptive approach based on lessons learned from past natural disasters. This experience offers key insights for low- and middle-income countries seeking to reduce their vulnerabilities in essential service provision.

- 9) [\*\*2018 Annual Report: Local Innovations for Global Water Security\*\*](#)  
*Developed by 2030 Water Resources Group – 2018*

This report presents the track record of the 2030 WRG in stewarding multi-stakeholder platforms from dialogue to action. This is a summary of significant results that have been shown in 2018.

- 10) [\*\*Building Resilient Infrastructure for the Future\*\*](#)  
*Developed by Asian Development Bank – 2019*

This working paper focuses on building resilient infrastructure and opportunities for future partnerships and synergies regionally and internationally. It provides insights on the experience of and lessons learned by the Asian Development Bank on resilient infrastructure and highlights opportunities for future partnerships and synergies with partners in the development and finance communities regionally and internationally. It also explores new financing modalities for building resilient infrastructure.

## **Best Practices/ Tools**

- 1) [\*\*Building Urban Resilience: Principles, Tools and Practice: Managing the Risks of Disasters in East Asia and the Pacific\*\*](#)  
*Developed by the World Bank and DFAT – 2012*

This Handbook is a resource for enhancing disaster resilience in urban areas. It summarizes the guiding principles, tools and practice in key economic sectors that can facilitate the implementation of resilience concepts into decisions over infrastructure investments and general urban management as integral elements of reducing disaster and climate risks. The objective of the initiative is to demonstrate a scalable methodology and practical tools for risk assessment, which can be used for city-level investment decisions.

#### Highlights:

- ✓ Designed to give urban planners and practitioners an intuitive and easy way to build elements of resilience into their urban governance and city planning.
- ✓ Major sections include: Principles for Urban Resilience; Tools for Building Resilience; and Practice of Urban Resilience.

#### 2) [Guidelines for Climate Proofing Investment in the Water Sector: Water Supply and Sanitation](#)

*Developed by the Asian Development Bank – 2016*

This publication presents a step-by-step methodological approach to assist project teams in managing climate change risk in the context of water supply and sanitation investment projects.

#### Highlights:

- ✓ the approach for climate proofing water supply and sanitation investment projects is divided into five sets of activities and 20 steps
- ✓ The process begins with initial climate risk screening. The core activities pertain to vulnerability assessment, impact assessment, and climate-proofing assessment. The process ends with defining implementation arrangements and monitoring frameworks.

#### 3) [Incentives for Improving Water Supply and Sanitation Service Delivery: A South American Perspective](#)

*Developed by World Bank Group – 2018*

This analysis is based on the premise that strengthening the water supply and sanitation (WSS) sector, its institutions and stakeholders, calls for the alignment of sector incentives. The objective of this Knowledge Brief is to introduce how integrated policy, institutional, and regulatory (PIR) interventions can help align incentives for more sustainable WSS service delivery. Ultimately, the objective for governments is to design incentives that motivate people (as individuals or as part of an institution) to provide universal and sustainable services.

#### Highlights:

- ✓ This brief provides a snapshot of sector experiences gathered from five South American country case studies—Argentina, Brazil, Chile, Colombia, and Peru.
- ✓ Those interested in exploring and understanding the current policy, institutional, and regulatory situation in a specific client country, may start by employing the Institutional



Diagnostic Tool (IDT) developed by the World Bank’s Water Global Practice. The IDT may serve as a first step to understanding the water supply and sanitation (WSS) sector enabling environment and institutional dimensions.<sup>1</sup>

4) **ThinkHazard**  
*Developed by GFDRR*

ThinkHazard is an intuitive, easy tool to identify natural hazards in a project area and understand how to reduce their impact. It provides a general view and risk level of the hazards, for a given location, that should be considered in project design and implementation.

5) **Urban Water Supply and Sanitation in Southeast Asia: A Guide to Good Practice**  
*Developed by Asian Development Bank – 2014*

This book provides stakeholders (governments, development partners, utilities, consultants, donors, academia, media, civil society, and non-governmental organizations) with a point of reference and some tools for moving forward effectively and efficiently in the urban water supply and sanitation sector in Southeast Asia. This book focuses on six countries in Southeast Asia—Cambodia, Indonesia, Lao People’s Democratic Republic, Philippines, Thailand, and Viet Nam. Field data were obtained from 14 utilities in these six countries.

Highlights:

6) **Gender-responsive indicators for water assessment, monitoring and reporting: UNESCO Wwap Toolkit on Sex-disaggregated Water Data**  
*Developed by UNESCO – 2019*

These innovative tools and indicators are designed to help decision makers adopt data-driven, gender-transformative water policies and reach those left behind.

Highlights:

- ✓ Filling the gap of sex-disaggregated water data of national/regional water statistics
- ✓ Creating a gender baseline knowledge related to water at the regional and national level and a global standard for gender-responsive/transformational water assessments
- ✓ Strengthening capacity for the collection and analysis of sex-disaggregated water data, and providing tools to users in different regions and climates
- ✓ Empowering women for their role and contribution in the field of water, which connects all SDGs, with particular focus on the SDGs 6 and 5
- ✓ Informing national and regional water policy frameworks, plans and strategies to enable gender-transformative actions to achieve the 2030 Agenda

7) **Forging Partnerships Among Water and Wastewater Operators**  
*Developed by Asian Development Bank – 2017*

This is a compendium of twinning arrangements successfully formed under the ADB’s Water Operators Partnerships (WOPs) Program. Country experiences from Bangladesh, Fiji, Indonesia, the

---

<sup>1</sup> The tool is available to sector practitioners on request as a “beta test version” with the aim to stimulate discussion among key stakeholders on possible reform approaches and project interventions. The IDT tool will be tested in several countries, and lessons learned will be incorporated into future updates of the tool. For more information please contact Gustavo Saltiel (Lead Water and Sanitation Specialist, Water Global Practice).



Lao People's Democratic Republic (Lao PDR), Myanmar, Nepal, Papua New Guinea (PNG), the People's Republic of China, the Philippines, Sri Lanka, Thailand, and Viet Nam are cited to highlight successful partnerships forged between local operators and recognized water utility experts in generating tangible results and significant improvements in service provision.

Highlights:

- ✓ The WOPs Program is an example of an innovation focusing on building capacity of operators to complement engineering and technological advancements. This knowledge sharing, experience-based twinning platform brings together experienced and efficient utility operators to mentor utilities (recipients) on specific aspects of their operations.
- ✓ Areas of operation covered include asset maintenance, nonrevenue water (NRW), operational efficiency, public–private partnership, and wastewater management.
- ✓ The examples clearly prove that the program is truly a cost-effective mechanism in building capacities and bridging the knowledge gap of water utility operators towards a more efficient and effective delivery of services to their customers.

8) **[Water Sensitive Cities Scenario Tool - TARGET](#)**  
*Developed Water Sensitive Cities – 2020*

The WSC Scenario Tool is an online planning-support tool that enables users to simulate urban development and the performance of green and blue infrastructure interventions. TARGET is an integral component that can produce a time series of air temperatures and human thermal comfort indicators for any given case study by assessing the microclimate impacts.

Highlights:

- ✓ [Several regions](#) have adopted the water sensitive cities principles, including areas of Australia and countries such as China, India Lebanon, Iran, Indonesia, Jordan and Singapore.

9) **[Building Nature-based, Resilient Water Systems: Catalysing the Role of Water Regulators](#)**  
*Developed by International Water Association – 2018*

This technical brief sums up the work being conducted by the International Water Association (IWA) and The Nature Conservancy (TNC) with the aim of advancing sustainable catchment management through nature-based solutions (NBS). The initiative aims to contribute new insights to the body of knowledge against which NBS can be assessed, a critical element for mainstreaming these practices. The partnership also aims to support those water utilities and water regulators looking to harness nature as a means of ensuring water security.

10) **[Water and Sanitation – PDNA Guidelines Volume B](#)**  
*Developed by GFDRR*

The WASH Post Disaster Needs Assessment (PDNA) uses an approach to analysing disaster effects that combines quantitative data with qualitative information and analysis which, when combined with assessments from other sectors, contributes to providing a comprehensive picture of post-disaster conditions. The quantitative data are combined with qualitative information and analysis and include

the collection of pre-disaster baseline data to compare with post-disaster conditions and evaluate disaster impact to determine the overall recovery needs.

11) [\*\*From Waste to Resource: Shifting Paradigms for Smarter Wastewater Interventions in Latin America and the Caribbean\*\*](#)

*Developed by World Bank Group – 2018*

The report summarizes the work of the World Bank's initiative "Wastewater: From Waste to Resource," launched in 2018 to raise awareness among decision makers regarding the potential of wastewater as a resource.

Highlights:

- ✓ [technical background reports](#)
- ✓ in-depth analysis of several [case studies](#)
- ✓ feedback received during [workshops and seminars](#) with main stakeholders.