RIVER CITIES ALLIANCE

NAMAMI GANGE

NIUA
National Institute of Urban Affairs

SUSTAINABLE URBAN RIVER MANAGEMENT FRAMEWORK

Living Rivers For Thriving Cities

SUSTAINABLE URBAN RIVER MANAGEMENT FRAMEWORK

Living rivers for thriving cities

2026

Acknowledgements

Title
Sustainable Urban River Management Framework
Living Rivers for Thriving Cities

About the document
This document presents the Sustainable Urban River Management (SURM) Framework, a city-level framework to guide the protection, restoration and sustainable management of urban rivers and their associated ecosystems. It provides a structured set of goals, actions, and indicators to help cities assess current river management practices, identify priorities, and strengthen river-sensitive planning and implementation.

Advisers
Shri Rajeev Kumar Mital, Director General, National Mission for Clean Ganga (NMCG)
Shri Nalin Kumar Srivastava, Deputy Director General, NMCG
Dr. Debolina Kundu, Director, National Institute of Urban Affairs, NIUA
Sh. Dheeraj Joshi, Director (Urban), NMCG
Sh. Rajiv Ranjan Mishra, Advisor, Water & Environment Vertical, NIUA

Authorship Team
Jyoti Verma, Jigya Talwar, Navaneeth A., Kriti Trivedi, Rahul Sachdeva, Victor R. Shinde

Design Team
Mani Chauhan, Riddhima Rana

The following organisations are gratefully acknowledged for their valuable contribution in developing the framework:
Partners: ADB, AIIB, CEEW, GIZ, IUCN, KfW, TERI, TNC India, UNEP, UN Habitat, World Bank, and WWF
Global River Cities Alliance member countries: Bhutan, Denmark, Netherlands

Publisher
National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, GoI
National Institute of Urban Affairs (NIUA), Ministry of Housing & Urban Affairs, GoI

Disclaimer
This document is a knowledge product intended to guide sustainable urban river management. It is based on a compilation of available knowledge, practices, frameworks and expert inputs, and is intended to support informed planning and decision-making. The publishers do not assume legal liability for the accuracy or completeness of the information contained herein, or for any consequences arising from its use.

This publication is prepared under the aegis of the River Cities Alliance (RCA), a platform for Indian river cities to ideate on and share urban management experiences.

Year of Publication
2026

सी आर पाटील
C R Paatil

सत्यमेव जयते

जल शक्ति मंत्री
भारत सरकार
Minister of Jal Shakti
Government of India

MESSAGE

It is a great pleasure for me to introduce the **Sustainable Urban River Management Framework**, which draws extensively from India's experience—and, more importantly, its learnings—in managing and governing urban stretches of rivers.

The true essence of sustainable river management lies in recognizing that the river is a system of interconnected elements comprising environmental, social, and economic aspects. Managing a river is fundamentally managing these elements and the interactions among them. In India, we have made significant progress in advancing this perspective, moving beyond conventional river-cleaning approaches towards more integrated and sustainable river management. National Mission for Clean Ganga has taken an all-encompassing approach to Urban River Management that goes beyond pollution abatement. This includes preventing pollution at its source, maintaining environmental flows, protecting floodplains and riparian zones, conserving biodiversity, managing wastewater and storm water, and restoring degraded river corridors.

I am very happy to note that in recent years, emphasis has been placed on urban river management, with the objective of fostering a mutually beneficial relationship between cities and their rivers. This approach seeks to ensure that urban development respects the river's ecological functions, and healthy rivers contribute to a resilient, inclusive, and liveable cities. Through a range of initiatives, programs, and projects, India has sought to create an enabling environment for building a more harmonious relationship between cities and their rivers.

Given that urban river management is a global imperative, I hope this framework will provide a practical and adaptable foundation for cities across the world to better integrate their rivers into the urban development landscape.

C R PAATIL

जल शक्ति अभियान
संचय जल, बेहतर कल

Office : 210, Shram Shakti Bhawan, Rafi Marg, New Delhi-110 001
Tel: No. (011) 23711780, 23714663, 23714200, Fax : (011) 23710804
E-mail : minister-jalshakti@gov.in

डॉ. राज भूषण चौधरी
Dr. Raj Bhushan Choudhary

सत्यमेव जयते

जल शक्ति राज्य मंत्री
भारत सरकार
नई दिल्ली–110001
MINISTER OF STATE FOR JAL SHAKTI
GOVERNMENT OF INDIA
NEW DELHI-110001

Message

River management today has emerged as a global priority. It features prominently in several global frameworks and commitments including the 2030 Development Agenda, Convention on Biological Diversity, Kunming-Montreal Global Biodiversity Framework, the Paris Agreement, and the Sendai Framework for Disaster Risk Reduction, among others. These frameworks recognize the fundamental importance of healthy and functioning river systems to water security, food production, biodiversity conservation, public health, economic development, and climate resilience.

As urbanization continues to accelerate across many parts of the world, the challenge of river management extends well beyond flood control or water supply. The imperative is to increasingly sustain healthy and resilient river systems while accommodating the legitimate needs of human development. Achieving this requires a decisive shift from fragmented, sector-specific interventions towards integrated approaches that recognize the interconnectedness of rivers with groundwater, wetlands, floodplains, cities, agriculture, and coastal ecosystems.

I am pleased to note that the **Sustainable Urban River Management Framework** adopts a multidimensional approach to establishing, and where necessary reconciling, the relationship between cities and their rivers. It recognizes that sustainable urban development and healthy river systems are not competing objectives, but mutually reinforcing priorities.

215, श्रम शक्ति भवन, रफी मार्ग, नई दिल्ली–110 001, 215, Sharm Shakti Bhawan, Rafi Marg, New Delhi-110 001
दूरभाष : (011) 23708419, 23718759, फैक्स : 011-23354496, Tel. :(011) 23708419, 23718759, Fax : 011-23354496
ई–मेल / E-mail : mos-mowr@nic.in

Going forward, river management will increasingly need to move beyond the traditional objective of controlling rivers towards a broader paradigm of living with rivers, working with their natural processes, and restoring their ecological functions. I hope this framework will serve as a valuable resource for cities and practitioners across the world as they navigate this transition.

(डा. राज भूषण चौधरी)

अर्चना वर्मा, भा.प्र.से.
सचिव
ARCHANA VARMA, IAS
Secretary

सत्यमेव जयते

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग
GOVERNMENT OF INDIA
MINISTRY OF JAL SHAKTI
DEPARTMENT OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION

MESSAGE

I am very happy to note that Urban River Rejuvenation is undergoing a significant conceptual shift. The traditional paradigm of exploiting rivers is increasingly being complemented—and, in some contexts, replaced—by approaches that recognize rivers as dynamic, interconnected ecological and social systems. This shift is particularly relevant in urban contexts, where rivers are deeply intertwined with the physical form, infrastructure, economy, and environment.

The central idea is that the future of river management lies not in choosing between development and conservation, but in designing cities that can function within the ecological limits and natural dynamics of river systems. This is not only an environmental imperative; it is also an opportunity to build healthier, more resilient, inclusive, and sustainable cities for generations to come.

As we progress ahead, the success of river management will be measured by how healthy rivers, resilient cities, and thriving communities coexist over the long term. The task before us is, therefore, not just to manage rivers, but to redefine the relationship between rivers and cities. Our collective responsibility is to ensure that urban development and river conservation advance together, so that future generations inherit cities in which rivers are valued and meaningfully integrated into the urban fabric.

In this context, the **Sustainable Urban River Management Framework** presented in this document provides a valuable reference for cities seeking to take the incremental yet meaningful steps required to respond to an ever-evolving landscape of environmental, social, and developmental change. I encourage the widespread adoption and application of this framework by cities, institutions, practitioners, and other stakeholders. Rivers are among the most valuable natural assets a city can have.

(Archana Varma)

श्रम शक्ति भवन,रफी मार्ग, नई दिल्ली-110 001 / Shram Shakti Bhawan, Rafi Marg, New Delhi-110 001
Tel. : 011-23710305, 23715919, Fax : 011-23731553, E-mail : secy-mowr@nic.in, Website : http://www.mowr.gov.in

राजीव कुमार मित्तल, भा.प्र.से.
महानिदेशक
राष्ट्रीय स्वच्छ गंगा मिशन

Rajeev Kumar Mital, IAS
DIRECTOR GENERAL
NATIONAL MISSION FOR CLEAN GANGA

सत्यमेव जयते

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन,
नदी विकास और गंगा संरक्षण विभाग
GOVERNMENT OF INDIA
MINISTRY OF JAL SHAKTI
DEPARTMENT OF WATER RESOURCES
RIVER DEVELOPMENT & GANGA REJUVENATION

MESSAGE

India's journey in river rejuvenation has reinforced the importance of viewing rivers as living systems and as integral components of urban development. The National Mission for Clean Ganga has pioneered this shift in India by adopting a holistic approach to the rejuvenation and management of the river basin. The Mission has progressively expanded its focus to include river-sensitive urban planning, ecological restoration, biodiversity, cultural heritage, public participation, and strengthening the river–city connect.

As part of this journey, we developed the Urban River Management Plan (URMP) Framework, which provided cities with a structured approach to mainstream rivers into urban planning and development. Its implementation and growing acceptance across Indian river cities have demonstrated the value of a city-specific yet integrated approach to urban river management. Building on these experiences, the **Sustainable Urban River Management Framework** takes the river–city agenda beyond India and onto a global platform.

The Framework provides a shared direction for river cities across the world, encouraging them to identify their priorities, strengthen partnerships, integrate rivers into urban planning, and develop locally appropriate pathways for sustainable river management. I hope this framework will facilitate greater collaboration, knowledge exchange, and collective action among river cities globally. Healthy rivers are fundamental to resilient and sustainable cities, and sustainable cities, in turn, have a vital role to play in securing the future of their rivers.

I encourage river cities across the world to make use of this framework, adapt it to their contexts, and become active partners in building a future where cities and rivers thrive together.

(Rajeev Kumar Mital)

राष्ट्रीय स्वच्छ गंगा मिशन
प्रथम तल, मेजर ध्यान चंद नेशनल स्टेडियम, इंडिया गेट, नई दिल्ली–110002
NATIONAL MISSION FOR CLEAN GANGA
1st Floor, Major Dhyan Chand National Stadium, India Gate, New Delhi - 110002
Ph.: 011-23049528, Fax : 23049566, E-mail : dg@nmcg.nic.in

राष्ट्रीय नगर कार्य संस्थान
NATIONAL INSTITUTE OF URBAN AFFAIRS

MESSAGE

Across the world, cities are transforming rapidly. Urban rivers are central to this urban transformation. From rivers that have shaped great civilizations to streams that sustain local communities; they support ecosystems, livelihoods, water security, culture, and public life. Yet, mounting urban pressures threaten the health of these vital systems.

The way forward is to reconcile urban growth with the long-term health of our rivers. Since its establishment in 1976, the National Institute of Urban Affairs has been supporting cities in advancing sustainable urban development. We are pleased to have co-developed this Sustainable Urban River Management Framework with National Mission for Clean Ganga to inspire a new generation of river-sensitive urban development by bringing together knowledge, experience, and action from river cities around the world.

The framework is not intended to prescribe a single model for urban river management. Rather, it seeks to enable river cities across the world to understand their rivers, identify their priorities, share knowledge, and develop their own pathways towards sustainable and resilient urban futures. The future of our cities and rivers are intrinsically connected. Building river-sensitive cities is, therefore, not only an environmental imperative, but an essential pathway towards a sustainable urban future.

Debolina Kundu
Director,
National Institute of Urban Affairs

कोर 4बी, प्रथम तल, भारत पर्यावास केन्द्र, लोधी रोड, नई दिल्ली-110003, भारत
Core 4B, 1st Floor, India Habitat Centre, Lodhi Road, New Delhi-110003, India
Tel: 91-11-24617517, 24617543, 24617595 • Fax: 91-11-24617513
Email: niua@niua.org • Website: www.niua.org

TABLE OF CONTENT

Section 1: Background and Context

1.1. Introduction to River Management Challenges 15

Section 2: Rationale for a Common River Management Framework

2.1. Understanding the Existing Ecosystem of River Management 17

2.2. Need for a Global Framework for Managing Urban Rivers 20

Section 3: Introduction to the SURM Framework

3.1. Scope of the Framework 23

3.2. SURM Framework in Detail 24

Section 4: Monitoring and Evaluation 59

Section 5: Implementation of SURM Framework 68

5.1. Institutional and Stakeholder Arrangements

5.2. Integration with Existing Planning

5.3. Implementation, Monitoring and Adaptive Management

LIST OF FIGURES AND TABLES

List of Figures

Figure 1	Global agendas and philosophies for river management	**18**
Figure 2	Landscape of river basin and city plans for river management	**19**
Figure 3	Suggested actions to implement the SURM agenda	**26**
Figure 4	Cross-cutting approaches for the SURM framework	**27**
Figure 5	Consolidated depiction of the SURM framework	**28**
Figure 6	Snapshot of the M&E scoring and interpretation mechanism of the SURM framework	**67**

List of Tables

Table 1	Interpretation of the URMindex of the SURM framework	**59**

SECTION 1
Background and Context

1.1. Introduction to River Management Challenges

Since the beginning of civilisation, populations have chosen to establish livelihoods in close proximity to rivers due to the rivers' abundance of resources, including water, agricultural support, and transportation routes. Yet the current state of rivers reveals a harsh reality: their ongoing degradation caused by anthropogenic activities and climate change. World Wildlife Fund (WWF) reported in 2020 that since 1970, 83% of freshwater species populations have declined, while the International Union for Conservation of Nature (IUCN) reported in 2025 that 25% of all freshwater species are at risk of extinction.[1] [2] The loss of freshwater species indicates degradation of freshwater biodiversity habitats and broken river ecosystems that will eventually harm humans. Additionally, urbanisation, with a significant proportion of artificial surface cover, like most cities, impacts biodiversity degradation at the highest degree, making urban freshwater biodiversity loss a significant threat.[3] The United Nations Environment Programme (UNEP) reports that loss of permanent surface water in 364 river basins across the world has impacted over 93 million people.[4] The World Resources Institute (WRI) found that 18 major river basins face severe depletion, putting $27 trillion (US dollars) of global GDP at risk.[5] In addition to the global impacts, there are many state- and city-specific challenges that illustrate the dire state of a lack of comprehensive river planning.

In California, USA, 73% of freshwater fish listed under the Endangered Species Act or considered species of special concern were reported extinct in 2021. In Hong Kong, urban water quality standards were significantly exceeded relative to the urban water quality objectives under the Water Pollution Control Ordinance due to stormwater runoff from roads. Urban road runoff was found to contain higher concentrations of iron, aluminium, lead and copper than natural rainwater. Often cited as one of the world's most polluted rivers, the Citarum River in Indonesia receives industrial waste, domestic sewage, and solid waste from rapidly urbanising areas. The river illustrates the consequences of poor waste management and industrial regulation. Encroachment and poorly planned infrastructure increase flood and erosion risks in Jakarta, Indonesia, and Mumbai, India. Over-allocation, urban growth, and prolonged drought have reduced water availability and increased water stress in the Colorado River Basin, USA. This set of examples does not show the extent of the issue, which is rooted in much deeper planning failures.

Along with these river-specific challenges in certain regions, there are overstressed groundwater and aquifers, and shrinking lakes and inland water bodies, creating an "Era of Global Water Bankruptcy," as warned by the UN University Institute for Water, Environment, and Health (UNU-INWEH). With thousands of cities worldwide situated on and dependent on rivers, this is a time of crisis and opportunity for interventions in urban river management. Since the issue is global in scale and rivers are transboundary geographic features, the interventions underscore the need for coordinated global commitments.

[1] https://wwf.panda.org/wwf_news/?804991/84-collapse-in-Freshwater-species-populations-since-1970
[2] https://iucn.org/press-release/202501/one-quarter-freshwater-animals-risk-extinction-iucn-red-list
[3] https://iucn.org/press-release/202501/one-quarter-freshwater-animals-risk-extinction-iucn-red-list
[4] https://unstats.un.org/sdgs/report/2025/extended-report/Extended-Report-2025_Goal-6.pdf
[5] https://www.wri.org/insights/worlds-18-most-water-stressed-rivers

The Sustainable Development Goals (SDGs) provide a global framework for sustainable development, and their relevance to urban river management spans several goals rather than being addressed through a dedicated city-level river management framework. SDG 6 (Clean Water and Sanitation) is directly relevant through its focus on improving water quality, increasing water-use efficiency, implementing integrated water resources management, protecting and restoring water-related ecosystems, expanding wastewater treatment, recycling and reuse, and strengthening community participation in water management. In particular, Target 6.6 calls for the protection and restoration of rivers, wetlands, lakes, aquifers and other water-related ecosystems.

The river agenda also extends beyond SDG 6. For example, SDG 14 (Life Below Water) is relevant because pollution generated on land, including plastics, nutrients and untreated wastewater, can ultimately reach downstream coastal and marine ecosystems. Likewise, SDG 15 (Life on Land) further strengthens the ecological dimension by calling for the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems, including wetlands and their associated biodiversity and ecosystem services.

However, perhaps the most critical implication for the river health agenda is SDG 11 (Sustainable Cities and Communities). There is growing realisation that many of the challenges that rivers face, mentioned in this section earlier, are due to detrimental anthropogenic activities in urban areas. In many ways, cities have been a part of the problem. They will, therefore, have to be part of the solution as well.

The Sustainable Urban River Management Framework is founded on this very notion.

SUSTAINABLE DEVELOPMENT GOALS

SECTION 2
Rationale for a Common River Management Framework

2.1. Understanding the Existing Ecosystem of River Management

The following section presents a cross-section of international frameworks, basin-level strategies, city-level plans, programmes, and planning approaches that have contributed to specific dimensions of river management. Their strengths include facilitating transboundary cooperation, improving water quality, restoring river ecosystems, integrating water-sensitive urban development, strengthening community participation, and establishing long-term institutional and governance mechanisms. Figure 1 illustrates these international frameworks, agendas, concepts, and approaches.

These examples offer valuable insights into effective practices, planning principles, and implementation approaches for sustainable river management. However, their objectives, scales of application, thematic focus, and institutional contexts vary considerably. This comparative review therefore identifies the complementary strengths and transferable elements across these approaches, providing the basis for developing a more integrated, comprehensive, and city-relevant framework for urban river management. The river-basin and city-level management plans reviewed are presented in Figure 2.

UN Sustainable Development Goals (SDGs)

- Global Sustainability Agenda for 2030
- Key goals: SDG 6 Clean Water and Sanitation, SDG 11 Sustainable Cities and Communities and SDG 14 life Below Water
- Shared foundation of protecting rivers and making cities resilient

Urban Nature Index (UNI) IUCN

- Global tool to measure biodiversity in cities
- Tracks ecosystem health based on 6 themes and 30 indicators
- Uses an interactive web platform to input data and monitor changes over time

EU Water Framework Directive (WFD)

- Statutory framework across EU member states through River Basin Management Plans, updated every 6 years
- Assess ecological status and water quality
- Integrates surface water and groundwater management

Rhine Action Programme

- Cooperative Programme among Rhine countries
- Joint monitoring of water quality and ecosystems
- Flood-risk management through basin-wide monitoring and early warning systems

Water Sensitive Urban Design (WSUD) Australia

- Integrates urban water cycle management (water supply, sewerage, stormwater) with urban planning.
- Uses rain gardens and tree pits for passive cooling, habitat creation, and pollutant filtration, aiming to replicate pre-development hydrology while preserving visual amenity

One Health Framing

- Links aquatic ecosystem health directly to human well-being, urban river biodiversity mitigates the heat island effect and provides therapeutic landscapes.
- Integrated monitoring includes tracking antibiotic resistance genes and bacterial communities in green infrastructure/ biofilters for public safety

Sponge City China

- Ecological infrastructure (urban parks, wetlands, permeable paving) absorbs, stores, and purifies water naturally, mimicking a sponge.
- National mandate: 80% of urban space to be "spongeadapted" by 2030, recycling 70% of annual rainfall

River Styles Framework

- Prioritisation of interventions based on the river's recovery potential
- Use of geomorphic assessment for the restoration interventions

Figure 1: Global agendas and philosophies for river management

ABC Waters Programme Singapore

- Mainstreaming the concept of Water Sensitive Urban Design into urban planning
- Promotion of nature-based stormwater treatment and management

Chicago River Management Plan Chicago, United States

- Tailored riverfront interventions to the local urban context
- Improving the river accessibility without degrading the existing habitats

Murray-Darling Basin Plan Australia

- Legally binding plan for Australian States and basin-wide governance
- Sets Sustainable Diversion Limits (SDLs) to balance water use with environmental water requirements
- Drought resilience, ecosystem restoration and climate adaptation strategies

Ganga River Basin Management Plan India

- Protect environmental flows and biodiversity
- Link livelihoods with river conservation
- Strengthen basin-city institutional coordination

Sabarmati Riverfront Development Plan Ahmedabad, India

- Integration of riverfront development with flood management
- Use of land value capture as a financing mechanism for the Operations and Management of the project

Cheonggyecheon Restoration Project Seoul, South Korea

- Prioritising the river renaturalisation for ecological restoration of the river
- Restoring the biodiversity within dense urban areas.

Brantas River Basin Development Plan Indonesia

- Integrated watershed, flood and water quality management
- Combined strategies for structural and non-structural measures for river management

Room for the River Programme Netherlands

- Prioritising floodplain demarcation and restoration before providing any hard infrastructure
- Integration of spatial planning with flood resilience and expanding Nature-Based flood management

Figure 2: Landscape of river basin and city plans for river management

2.2. Need for a Global Framework for Managing Urban Rivers

The river management initiatives described in the preceding section point to a fundamental lesson that rivers must be managed as an interconnected systems, and cities must be recognised as critical actors within them. Urban areas are among the most significant points of pressure on rivers. Land-use change, encroachment, wastewater discharge, solid waste disposal, water abstraction, altered drainage, loss of riparian ecosystems and poorly planned waterfront development can significantly influence the river health. At the same time, cities are uniquely positioned to influence these pressures through planning, infrastructure, service delivery, land management, and community engagement. This creates a clear case for a city-level, measurable and dedicated river management actions that complement broader basin-level efforts.

In the Indian context, the Urban River Management Plan (URMP) Framework provides an important example of how this city-level approach can be operationalised. Developed by the National Mission for Clean Ganga (NMCG) and the National Institute of Urban Affairs (NIUA), the URMP framework enables the cities to move beyond isolated river-cleaning or beautification projects and develop a structured, long-term approach to urban river management. It encourages cities to address multiple dimensions of river health, including water quality, floodplain protection, wastewater management and reuse, groundwater conservation, riparian restoration, river-sensitive urban development, public spaces, livelihoods, cultural connections and citizen stewardship. Importantly, it brings these considerations into a common planning framework, enabling river-related actions to be coordinated across municipal functions rather than implemented as fragmented sectoral interventions.

The URMP experience in India showed that cities can accelerate river restoration through structured planning while also benefiting from peer-to-peer learning and knowledge exchange. Building on this experience, the River Cities Alliance (RCA) was established as a platform for Indian river cities to share knowledge, practices, innovations and lessons from implementation. The success and relevance of this model subsequently inspired the establishment of the Global River Cities Alliance (G-RCA), bringing together 11 countries beyond India. As the G-RCA brings together countries across diverse geographical, ecological, institutional and socio-economic contexts, there is a need for a common reference point for understanding and advancing urban river management. A shared framework can provide this common ground by establishing a set of universally relevant goals, principles and approaches, while allowing individual cities to adapt actions to their local river systems and institutional realities.

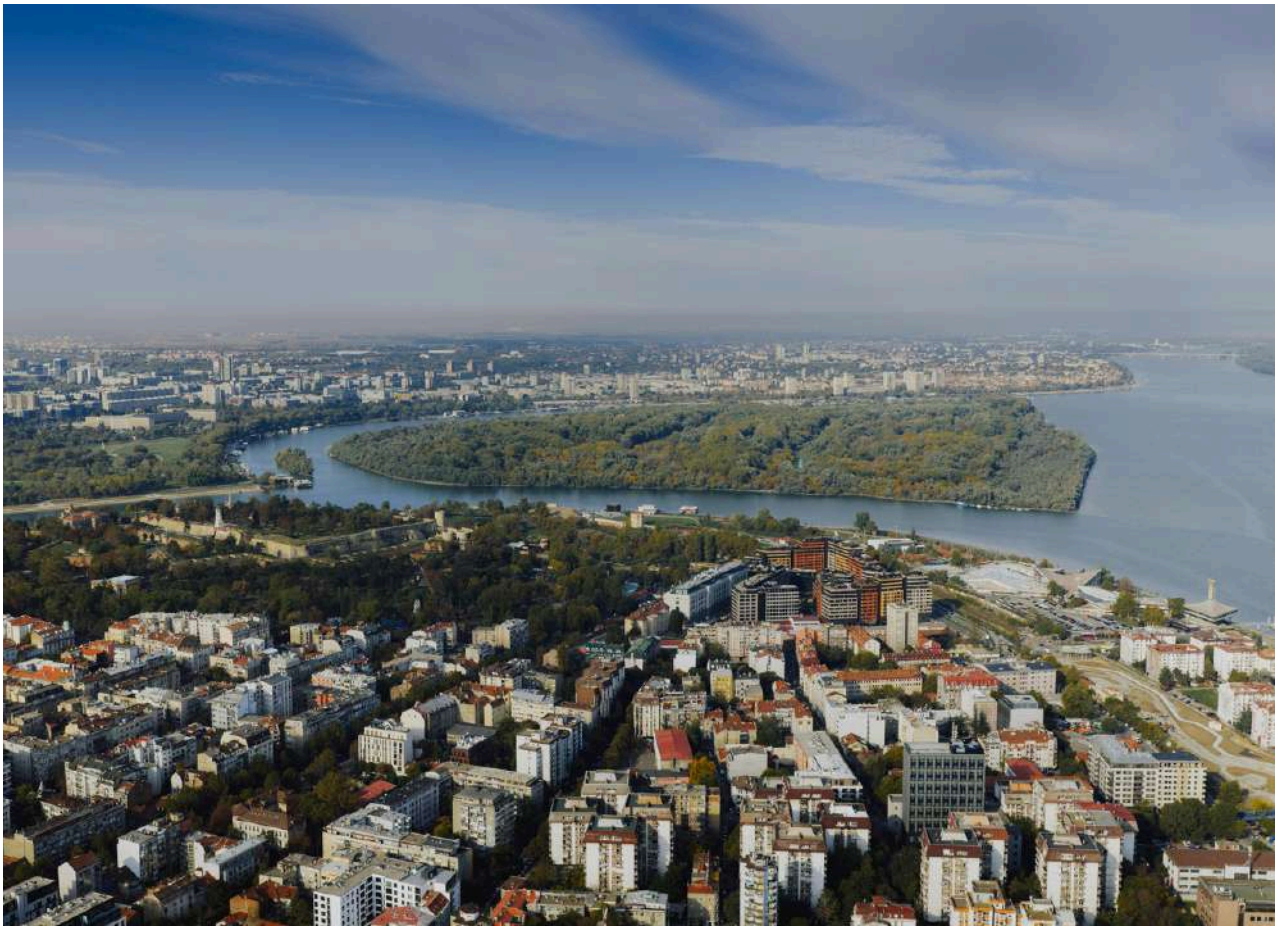
However, a global framework cannot simply replicate a single national or a city-level model. Urban rivers differ fundamentally in their physical, ecological and socio-economic contexts. They may be perennial or seasonal, snow-fed or rain-fed, braided or single-channel, regulated or free-flowing, or connected to estuarine, deltaic and coastal systems. Cities also operate within different legal and institutional arrangements, fiscal capacities, and relationships with basin, regional, and national authorities. A globally relevant framework must therefore establish common principles, goals and approaches while retaining sufficient flexibility for cities to define context-specific priorities and interventions.

A further challenge lies in the disconnect between basin-level governance and city-level implementation. Rivers cross administrative boundaries, and their hydrology, ecology and water quality are shaped by activities across the wider basin. No city can therefore manage a river in isolation from its upstream and downstream context. The city-level framework should therefore position the city as an accountable and active actor within the basin, while recognising the limits of its administrative mandate and the need for coordination with upstream, downstream and regional institutions.

There is also a need to move from demonstration projects to systematic river management. International examples such as Room for the River in the Netherlands, the ABC Waters Programme in Singapore, Ganga River rejuvenation in India and the Cheonggyecheon restoration in Seoul demonstrate the potential of integrated planning, institutional coordination, long-term investment and strong public engagement. However, their success cannot be replicated elsewhere through the same physical interventions. What is transferable is the planning logic behind them, understanding the river system, establishing clear objectives, coordinating institutions, prioritising interventions, monitoring outcomes and adapting actions to local conditions. Cities with very different levels of financial, technical and institutional capacity need a framework that can guide this process without prescribing a one-size-fits-all solution.

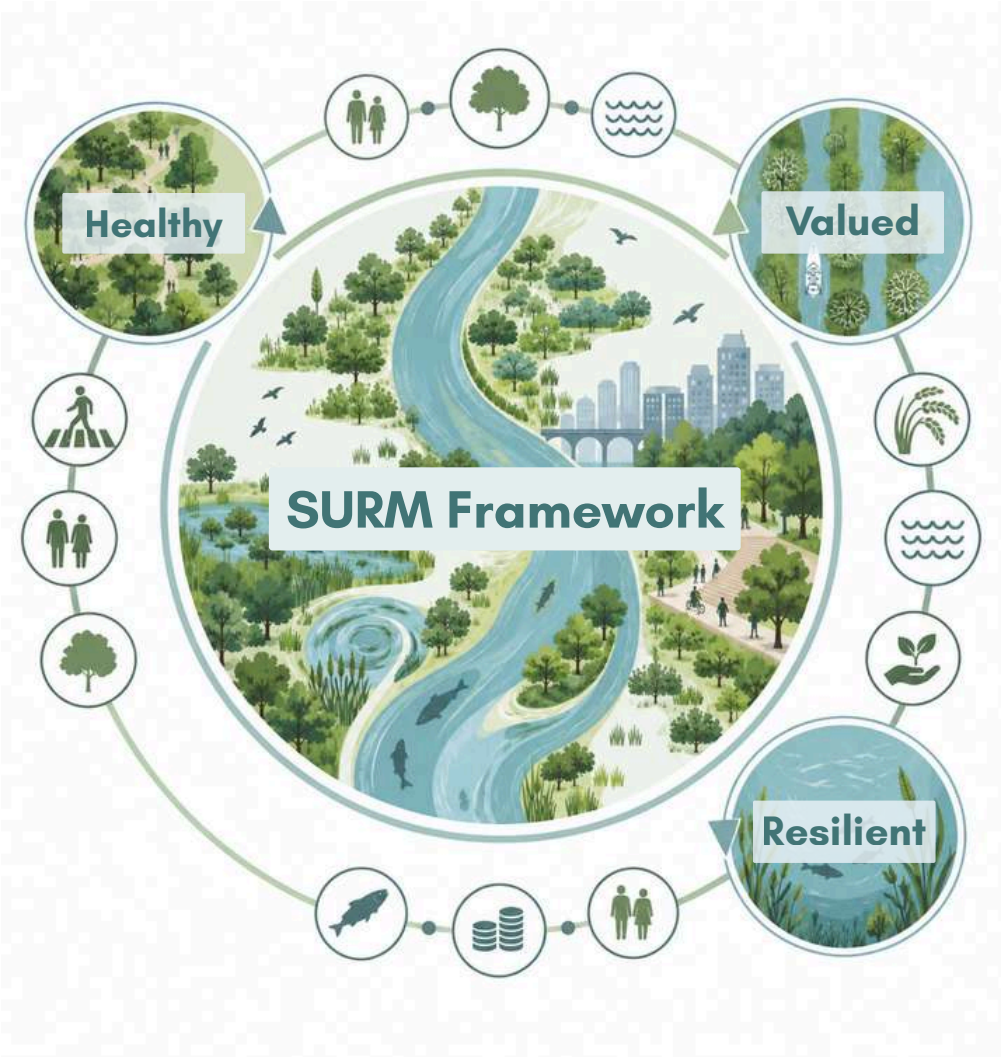
These gaps establish the rationale for a unified global framework for Sustainable Urban River Management (SURM). The SURM Framework is intended to provide the missing link between global sustainability commitments, basin-level river priorities and city-level implementation. Rather than prescribing identical interventions for every city, it provides a common structure through which cities can understand their river's condition, identify pressures and priorities, set measurable goals, select context-appropriate actions, assign responsibilities, and track progress over time. In doing so, SURM Framework establishes a common language for urban river management while preserving local flexibility.

The SURM Framework therefore seeks to shift the approach from project-based river improvement to integrated river management, and from viewing the river as an isolated environmental asset to recognising it as an integral component of the urban system. It positions cities not merely as beneficiaries of healthy rivers, but as active partners and accountable custodians of river health, working within the larger basin system. By bringing together ecological, social, and economic dimensions within a single planning framework, SURM provides a practical pathway for cities across different geographies and capacities to protect, restore and sustainably manage their rivers.



SECTION 3:
Introduction to the SURM Framework

The SURM framework envisions rivers that sustain biodiversity, support sustainable economic opportunities, and strengthen the social and cultural connection between people and their rivers. It seeks to make urban rivers living asset that enhance ecological resilience, livelihoods and the quality of urban life



Vision

"The river will thrive as a healthy, valued and resilient asset of the city"

3.1. Scope of the Framework

The analysis of various existing river management frameworks, plans and guidelines indicates that most approaches are developed at the river-basin or regional scale, where they identify priority areas and interventions in response to major challenges affecting river systems. While this scale is essential for understanding a river's wider hydrological and ecological context, a more explicit city-level perspective is still needed to address the relationship between the city and the river stretch passing through it. The core premise of the SURM Framework is therefore to strengthen this city-river connection and establish how a city can actively contribute to the health and resilience of the river within its area of influence.

The SURM Framework applies to river stretches located within a city's administrative boundary. The city is the primary unit of implementation, and the framework focuses on the pressures, opportunities, and interventions the city can address or influence in relation to the river stretch flowing through it. Examples include the Thames in Greater London, the Han River in Seoul, the Yarra River in Melbourne, and the Liesbeek River in Cape Town. The framework is therefore relevant to any city that contains a defined river stretch within its administrative jurisdiction. The presence of such a river stretch is a fundamental prerequisite for applying SURM framework.

While the geographical focus is city-based, the framework does not treat the river as an isolated urban system. The river stretch within the city remains physically, hydrologically and ecologically connected to upstream and downstream areas. Accordingly, SURM Framework encourages cities to recognise basin-level dependencies and align their actions, where relevant, with basin plans, environmental-flow requirements, regional policies and upstream-downstream priorities, while maintaining a clear focus on actions that fall within, or can be influenced through, the city's mandate.

SURM Framework is not intended to replace or duplicate existing city-level river management plans, programmes or projects. Instead, it recognises and builds upon the substantial work already being undertaken by the cities. Where a city has already taken initiatives for river ecosystem restoration, the SURM framework can serve as a reference to assess coverage, identify gaps, strengthen integration across sectors, and align ongoing actions with broader sustainable river management goals.

In cities with no dedicated river management initiatives, SURM can provide a structured starting point for developing one. In this way, the framework is designed to function both as a planning framework for new city-level river action and as an assessment and alignment framework for existing initiatives, enabling cities with different institutional and planning contexts to work towards a common vision of sustainable urban river management.

3.2. SURM Framework in Detail

3.2.1. SURM Framework Goals

The goals of the SURM Framework were derived by drawing inspiration from the different frameworks and approaches mentioned in the previous section. Seven goals for the sustainable management of the urban river have been derived and are referred to as the Sustainable Urban River Development Goals (SURDGs).

GOAL 1: PROMOTE RIVER-SENSITIVE URBAN PLANNING

All river cities are expanding and putting pressure on the river and its floodplain. Through this goal, a city needs to work toward river-sensitive planning by recognising the river, its floodplains, and associated ecosystems, and regulating them through policy guidelines.

GOAL 2: IMPROVE RIVER WATER QUALITY AND REDUCE POLLUTION

Rivers flowing through the city often become conduits of pollution, degrading the river's health and biodiversity. Thus, the city should aim to improve the river's water quality by reducing the pollution load coming from the city area.

GOAL 3: PROTECT AND RESTORE RIVER ECOSYSTEMS

Rivers are interconnected with various ecosystems through base flow, surface flow, and biodiversity. This goal promotes a systems approach that integrates water bodies, wetlands, natural drains, and groundwater into river management initiatives.

GOAL 4: PROTECT, ENHANCE AND MAINTAIN ECO-SENSITIVE RIVER EDGES

River edges are highly eco-sensitive areas. Effective management supports ecosystem services, helps control flooding and land degradation, and offers opportunities for the community to connect with the river.

GOAL 5: PROMOTE CIRCULARITY FOR TREATED WASTEWATER

Cities worldwide face water shortages and growing demand for water. Treated wastewater can be a reliable alternative water source, lowering the need for fresh water. Recovering resources from biosolids can also help create a circular, strong, and sustainable system.

GOAL 6: CELEBRATE THE RIVER AS A PUBLIC AND CULTURAL ASSET

Rivers have historically played a central role in people's cultural and recreational life. This goal seeks to restore that connection by raising awareness among local communities and encouraging stewardship to improve and restore the urban river system.

GOAL 7: ENSURE SUSTAINABLE USE OF RIVER

Rivers serve many purposes, including water supply, flood management, navigation, agriculture, fishing, recreation, etc. This goal aims to ensure that all uses remain sustainable and leverage the river economy without compromising the river's health.

RIVER-RELATED CHALLENGES ADDRESSED BY EACH GOAL

1 PROMOTE RIVER-SENSITIVE URBAN PLANNING

- Unplanned urban growth in the floodplains
- Inadequate regulation of floodplains and associated ecosystems
- Fragmented planning leading to urban flooding

2 IMPROVE RIVER WATER QUALITY AND REDUCE POLLUTION

- Discharge of untreated municipal sewage and industrial effluents
- Poor solid waste management
- Emerging contaminants
- Declining water quality and ecosystem health

3 PROTECT AND RESTORE RIVER ECOSYSTEMS

- Loss of waterbodies and wetlands
- Disrupted hydrological connectivity
- Degraded habitats and biodiversity loss
- Diminishing groundwater recharge and weak surface and sub-surface linkages

4 GOAL 4: PROTECT, ENHANCE AND MAINTAIN ECO-SENSITIVE RIVER EDGES

- Loss of natural riverbanks and riparian vegetation
- Modification of river edges leading to flood risk and reduced ecological functions
- Limited public access to riverfronts

5 PROMOTE CIRCULARITY FOR TREATED WASTEWATER

- Increasing water supply and demand gap in cities
- Limited reuse of treated wastewater and biosolids
- Low recovery of resources due to linear urban water systems

6 CELEBRATE THE RIVER AS A PUBLIC AND CULTURAL ASSET

- Poor public awareness and connection with the rivers
- Limited citizen participation and stewardship
- Loss of cultural, recreational and heritage value

7 ENSURE SUSTAINABLE USE OF RIVER

- Over-extraction of water and unsustainable use of river water
- Declining river-based livelihoods
- Low e-flow in the rivers

3.2.2. SURM Framework Actions

As mentioned above, the SURM Framework is structured around seven overarching goals that collectively address the key dimensions of sustainable urban river management. These goals provide a common direction for river cities while keeping the framework flexible and context-responsive. To translate each goal into implementable measures and address different river management challenges, the framework identifies 16 actions (Figure 3). The actions represent practical areas of intervention through which cities can address specific urban river pressures, restore river functions and strengthen the relationship between the city and its river. They are not intended as a prescriptive checklist; rather, each city can identify and prioritise the actions most relevant to its river characteristics, ecological condition, urban form, climate risks, development pressures, institutional responsibilities, and local priorities.

The seven goals provide the strategic structure, while the 16 actions provide the operational entry points for implementation. While the SURM framework goals are non-negotiable for cities to adopt, they may adopt all, or a selected combination, of the actions depending on the challenges and opportunities identified through its river assessment. The actions should then be translated into specific projects, programmes, regulations, planning measures, or management interventions, with clear responsibilities, timelines, resources, and monitoring mechanisms. This allows the SURM Framework to accommodate diverse river-city contexts while maintaining a consistent overall approach to urban river management.

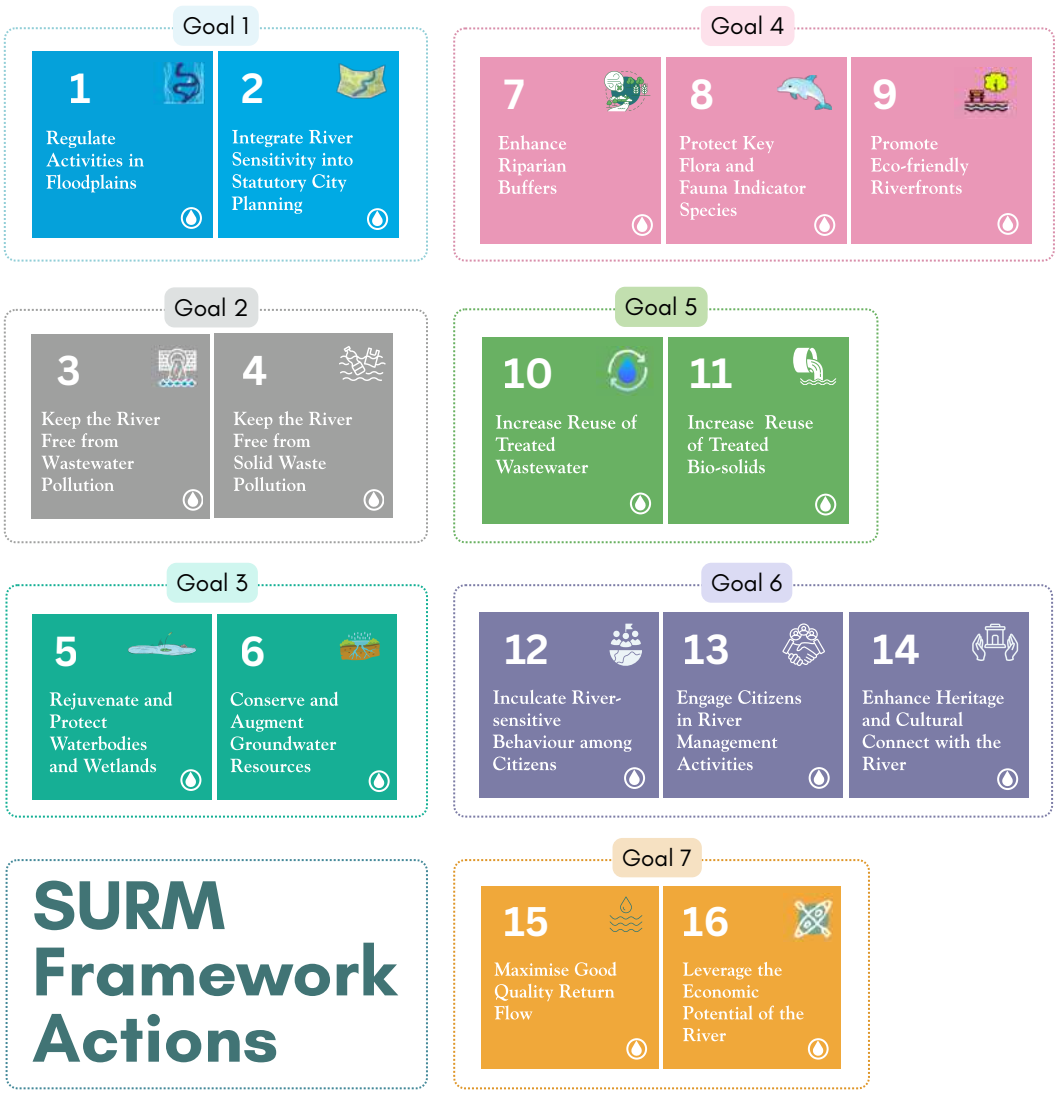


Figure 3: Suggested actions to implement the SURM agenda

3.2.3. SURM Framework Cross-cutting Approaches

In addition to the seven goals and 16 actions, SURM framework identifies six cross-cutting approaches (Figure 4) to integrate throughout the framework's preparation and implementation. These are

- Inclusive and Collaborative Governance
- Evidence-based Planning and Decision-making
- Biodiversity Protection
- Nature-based Solutions
- Climate Resilience and Ecosystem-based Adaptation
- Basin-connectedness

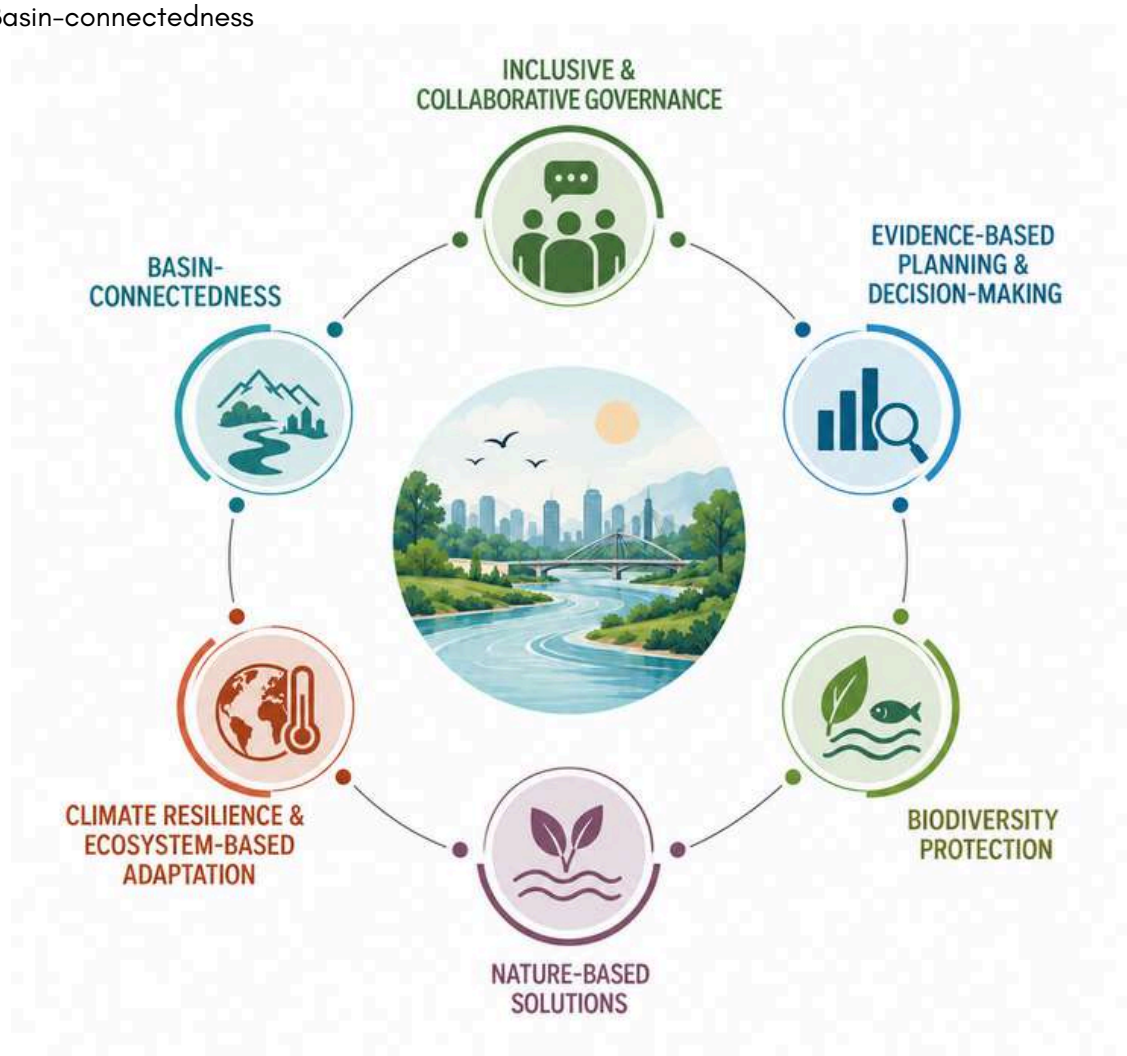


Figure 4: Cross-cutting approaches for the SURM framework

These approaches are not standalone goals or actions; instead, they provide the principles through which the goals and actions should be planned and implemented. For example, river restoration should consider biodiversity outcomes and nature-based approaches, planning decisions should be supported by evidence and data, interventions should account for future climate risks, communities and relevant stakeholders should be involved in decision-making, and city-level actions should recognise the river's wider upstream and downstream connections.

Together, the 7 Goals, 16 Actions and 6 Cross-cutting Approaches create the core architecture of the SURM framework (Figure 5): the goals define what a sustainable urban river should achieve, the actions identify where and how cities can intervene, and the cross-cutting approaches ensure that these interventions are integrated, evidence-based, climate-responsive and connected to the wider river basin system.

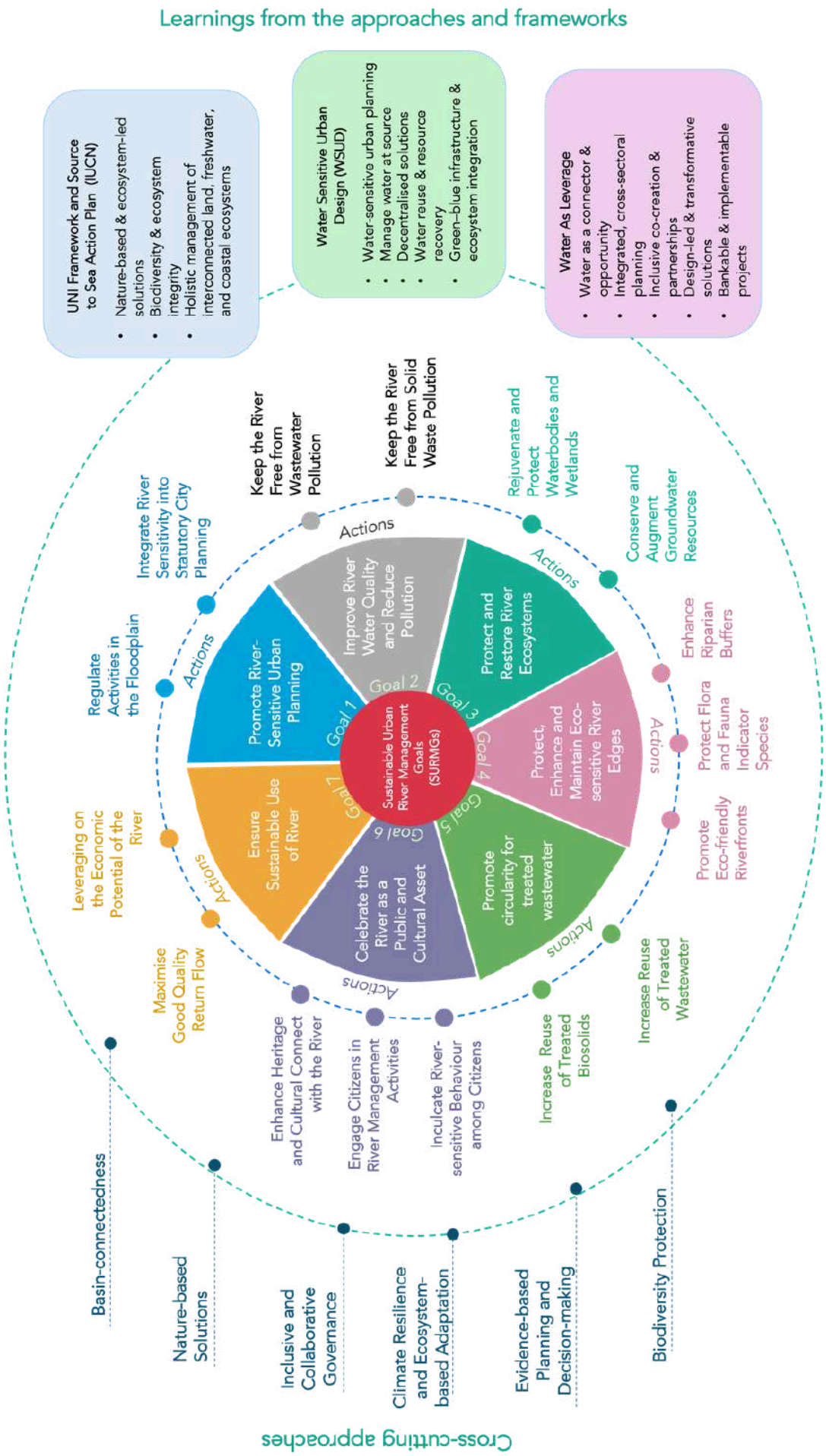


Figure 5: Consolidated depiction of the SURM framework

GOAL 1:
PROMOTE RIVER-SENSITIVE URBAN PLANNING

1
Regulate Activities in Floodplain

Action: Regulate Activities in the Floodplain

Objective

Floodplain is the area of land adjacent to a river that is naturally susceptible to inundation during flood events. Regulation of land use and development within the river floodplain based on flood risk, ecological sensitivity, and the river's natural functions. Maintaining the floodplain for effective flood storage, conveyance, and ecological processes.

Rationale

To reduce risks to people, property, and infrastructure, and prevent development from disrupting the river's natural hydrological functions. Effective regulation also conserves floodplain ecosystems and enhances the city's flood resilience.

Approach

Identify floodplain areas based on flood zoning and ecological characteristics. Specify permitted, restricted, and prohibited activities, and implement suitable development controls. Integrate these regulations into zoning, land-use plans, and development approval processes.

Case Example

Netherlands

The Room for the River, Nijmegen

The Waal River, which crosses the city of Nijmegen, bends sharply and narrows, historically causing flooding by creating a bottleneck.

Netherlands made a major policy shift from discharging surplus water to the sea to retaining and storing it before releasing the excess to the sea. The redesign of the Waal River reduces the water level by moving dykes inland by 350 m and creating new channels. Compensation schemes for land appropriations complemented this. The program ran from 2012 to 2016 and achieved a 35 cm reduction in river water levels. In cases of extreme flooding, one-third of the amount of water is discharged through a new ancillary channel of 150-200 m width and 3km length. A new urban river park was also created to provide space for living, recreation, culture, water, and nature. This effort was made possible by large funding from the national government. Major stakeholders and local communities actively participated through informational meetings and interactive workshops.

Source: *H+N+S Landscape Architects Website*

Action: Integrate River Sensitivity into Statutory City Planning

2
Integrate River Sensitivity into Statutory City Planning

Objective

Integration of river-sensitive principles into statutory plans, land-use regulations, and development controls. Acknowledging rivers, floodplains, riparian zones, and interconnected water systems as essential components of the city's spatial planning framework.

Rationale

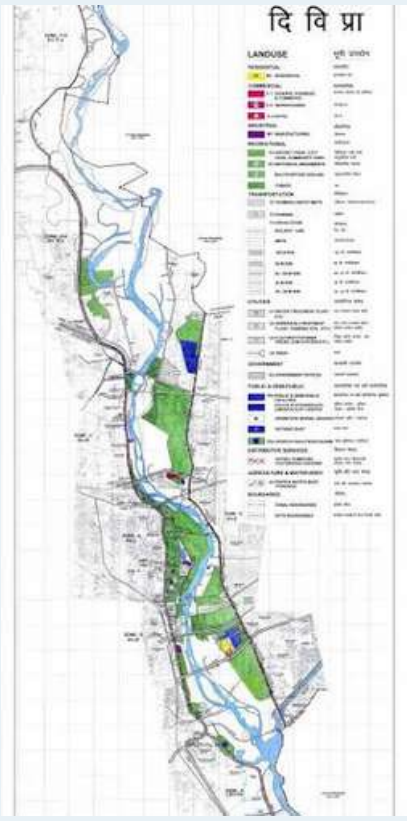
To ensure that urban growth and infrastructure development do not increase pressure on the river or compromise flood resilience and ecological functions. Early integration into statutory planning helps prevent encroachment and reduces the need for costly corrective measures in the future.

Approach

Identify river-sensitive areas, establish suitable land uses and development controls, and systematically integrate river-related considerations into statutory planning documents (master plan, development plan, zoning bylaws, floodplain maps). Utilise flood-risk and ecological assessments to inform zoning regulations, infrastructure planning, and development regulations.

Case Example

India



Master Plan for Delhi 2041

Delhi is among the few Indian cities that has explicitly integrated its river system into statutory urban planning through the Master Plan for Delhi-2041. The plan recognises the River Yamuna and its floodplain as a critical ecological and hydrological asset and designates the river corridor as Planning Zone 'O' for regulated development and conservation. The boundary of this zone has been delineated broadly on the basis of the 1-in-25-year flood line, providing a defined planning framework to safeguard the active floodplain. This designation is intended to prevent further encroachment, restrict incompatible land uses, and regulate floodplain activities so the river's natural flow regime, flood-carrying capacity, and ecological functions are protected within the urban context. To date, the Delhi Development Authority has reclaimed more than 630 hectares of encroached land. Along with floodplain mapping, the Master Plan has also mapped and integrated the protection of associated ecosystems, including water bodies, wetlands, and other eco-sensitive areas in Delhi.

Source: *Delhi Development Authority (DDA) Website*

Cross-cutting approaches to be integrated in the actions to achieve the Goal 1 (Promote River-Sensitive Urban Planning and Growth)

Climate Resilience and Ecosystem-based Adaptation

- Incorporate current and projected climate risks, such as extreme rainfall, flooding, and evolving flood patterns, into floodplain mapping and development regulations.
- Adopt adaptive land-use and infrastructure strategies to minimize exposure and vulnerability to future flood risks.

Inclusive and Collaborative Governance

- Engage all the relevant government departments, local communities, river-dependent groups, and other stakeholders while developing and enforcing floodplain regulations.
- Modify regulatory approaches to the local institutional and governance context, ensuring clear responsibilities for planning, enforcement, and monitoring.

Biodiversity Protection

- Identify sensitive floodplain habitats, biodiversity hotspots, and key ecological corridors to inform zoning regulations in the floodplain and associated ecosystems.
- Limit activities that fragment or degrade floodplain habitats, wetlands, and other river-dependent ecosystems, especially in high-value ecological areas.

Nature-based Solutions

- Incorporate nature-based solutions, floodplain restoration, wetland conservation, natural flood storage, and vegetated buffers into the city's statutory planning framework.

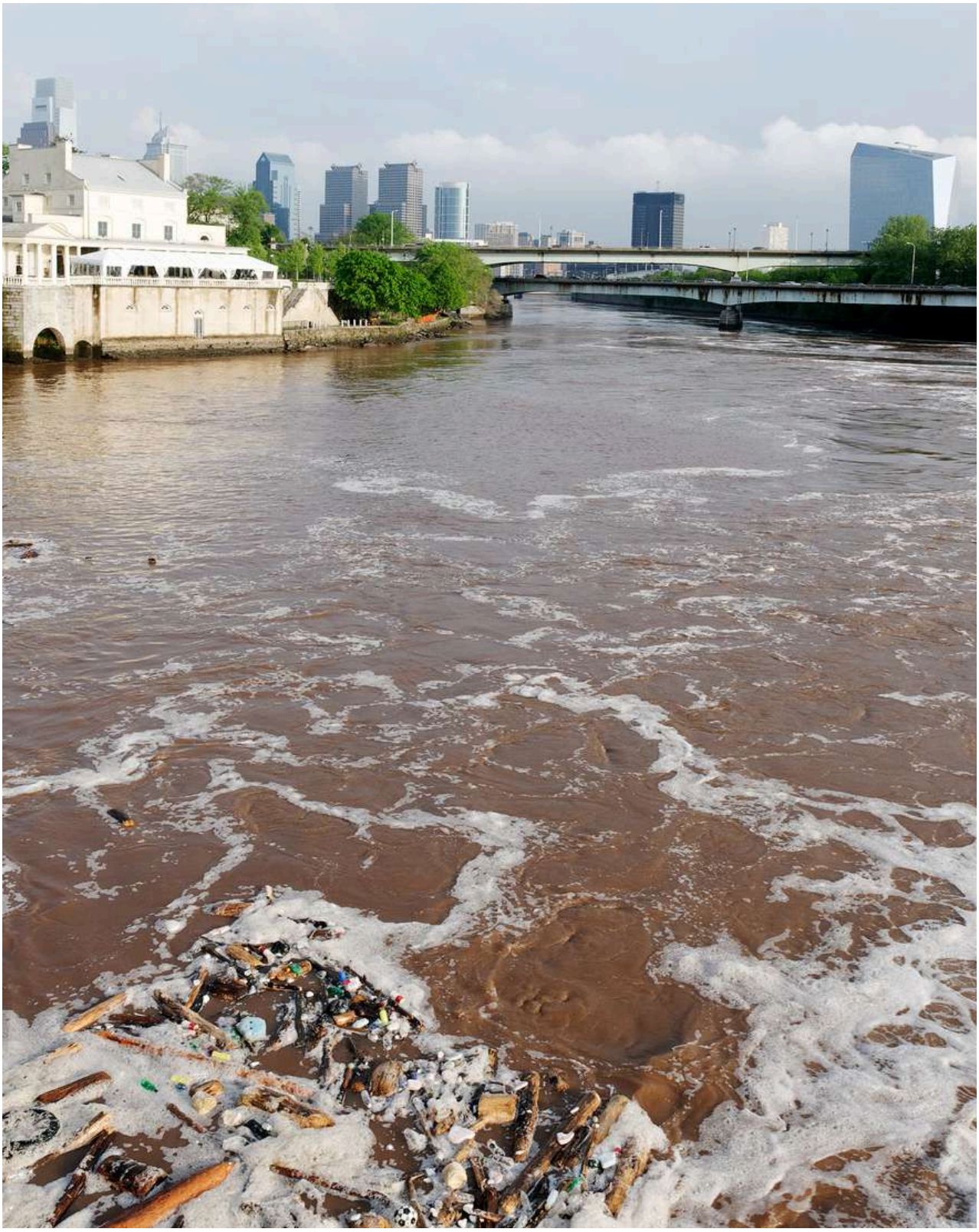
Basin-connectedness

- Consider upstream and downstream interactions, as well as basin-scale hydrological processes, when regulating development within the city's floodplain.
- Ensure city-level interventions do not transfer flood risk or reduce flood-storage and conveyance functions elsewhere in the river system.

Evidence-based Planning and Decision-making

- Utilise geospatial data, flood modelling, historical flood records, ecological assessments, and climate projections to delineate and classify floodplain areas.
- Establish monitoring and periodic review processes to ensure floodplain regulations are updated as risk, land use, and river conditions evolve.

GOAL 2:
IMPROVE RIVER WATER QUALITY AND REDUCE POLLUTION



Action: Keep the River Free from Wastewater Pollution

3 Keep the River Free from Wastewater Pollution

Objective

The collection, treatment, and safe discharge of municipal wastewater from households, commercial establishments, institutions, and other sources must be ensured. The city should manage the entire service chain, including generation, containment, collection, treatment, and final discharge.

Rationale

Preventing untreated or inadequately treated wastewater from entering rivers is essential to protect water quality and aquatic ecosystems. Municipal wastewater may introduce organic matter, nutrients, pathogens, and other pollutants that harm the ecological health of the river.

Approach

Expand and improve wastewater collection and treatment coverage. Implement conventional and nature-based treatment systems that are appropriately designed and maintained according to local conditions and treatment requirements. Strengthen the operation and maintenance of treatment systems and establish a monitoring framework to improve overall treatment performance.

Case Example

Brazil

Wastewater Treatment System, Lauro de Freitas, Bahia

The Vog Ville Wastewater Treatment Plant (WWTP) in Lauro de Freitas, Bahia, demonstrates the integration of conventional anaerobic treatment with nature-based treatment processes.

The project combines an Upflow Anaerobic Sludge Blanket (UASB) reactor with four horizontal subsurface-flow constructed wetlands to treat domestic wastewater from a community of about 1,000 people. The system uses gravel-based wetland cells planted with Typha and Cyperus to naturally polish the anaerobically treated effluent. The four wetland cells cover approximately 504 m^2 in total and operate at a design flow of around 96 m^3/day. Wastewater flows horizontally through the gravel and plant-root zone, where filtration and microbial processes remove residual organic matter and suspended solids. A final chlorination stage provides additional pathogen control before discharge. The case demonstrates how constructed wetlands can complement conventional treatment while providing a nature-based, relatively low-energy approach to decentralised wastewater management.

Source: Ferreira (2013), Universidade Federal da Bahia (UFBA), ETE Vog Ville/EMBASA

Action: Keep the River Free from Solid Waste Pollution

4
Keep the River Free from Solid Waste Pollution

Objective

Prevention of municipal solid waste, generated from households, commercial activities, institutions etc. from entering the rivers, drains and associated water systems.

Rationale

Preventing solid waste, plastics, and other pollutants from entering rivers is essential to protect water quality, aquatic habitats, and river landscapes. Such waste can obstruct drainage, harm aquatic and riparian ecosystems, and pose risks to public health and downstream water users.

Approach

Strengthen source segregation, collection, and processing systems. Identify locations where solid waste enters rivers and drainage systems. Interventions to prevent dumping along riverbanks, drainage channels, and waterbodies. Establish mechanisms to monitor, engage the community, and implement resource recovery initiatives.

Case Example

India

Floating Trash Barrier for Cooum River, Chennai

The Floating Trash Barrier is a low-energy intervention designed to intercept floating solid waste and plastics in rivers, lakes and storm-water channels.

The barrier was installed in the Cooum River to intercept plastics, solid waste and floating vegetation before they travelled downstream and entered the sea. After initial trials, the city installed barriers at nine locations along the Cooum River. The intervention demonstrated the potential for continuous, passive interception of river-borne solid waste before it reaches the coast and ocean. Reported results indicate that the Cooum installation intercepted over 22,000 tonnes of floating waste within one year, including approximately 2,000 tonnes of plastic. By capturing waste in the river and concentrating it at accessible collection points, the system made removal easier while also reducing the movement of plastic and other debris toward Chennai's coastline.

Source: The New Indian Express Article

Cross-cutting approaches to be integrated in the actions to achieve the Goal 2 (Improve River Water Quality and Reduce Pollution)

Evidence-based Planning and Decision-making

- Apply water-quality monitoring, geospatial analysis and predictive modelling to identify pollution hotspots, quantify pollutant loads and prioritise interventions.
- Leverage real-time sensors, remote sensing, digital platforms, data analytics and emerging technologies to enhance pollution surveillance and assess treatment performance.

Inclusive and Collaborative Governance

- Coordinate among government agencies responsible for sanitation, drainage, environmental protection, and public health, assigning clear responsibilities for pollution treatment, monitoring, and enforcement.
- Involve communities, businesses, and industries in source reduction, pollution reporting, compliance, and local water quality improvement initiatives.

Biodiversity Protection

- Set pollution-control priorities based on the sensitivity of aquatic habitats, riparian ecosystems and biodiversity-rich river stretches.
- Apply stricter controls where pollution threatens aquatic organisms, habitat quality, and ecological processes.

Nature-based Solutions

- Use natural systems to intercept, retain, and treat pollutants before they reach rivers, supplementing with conventional treatment as needed.

GOAL 3:

PROTECT AND RESTORE RIVER ECOSYSTEMS

Action: Rejuvenate and Protect Waterbodies and Wetlands

5
Rejuvenate and Protect Waterbodies and Wetlands

Objective

Restoration of waterbodies and wetlands within the city boundary, that are hydrologically and ecologically connected to the river to improve the overall health of the river system.

Rationale

Urban waterbodies and wetlands, lakes, ponds, marshes, perform critical functions including flood attenuation, groundwater recharge, biodiversity support, and local climate regulation. Rapid urbanization has led to widespread loss, encroachment, and degradation of these systems, reducing a city's ecological and hydrological resilience.

Approach

Mapping existing waterbodies, restoring degraded waterbodies, removing encroachments, rehabilitating wetland hydrology and vegetation, integrating waterbodies into stormwater and drainage master plans, and engaging communities in maintenance and monitoring.

Case Example
Singapore

Restoration of Alkaff Lake

Alkaff Lake, is a one-of-its-kind multifunctional freshwater lake designed to serve both as a public recreational space and a climate-resilient stormwater retention system.

The lake was created to manage rising flash-flood risks in the densely built Bidadari estate, driven by climate change and urbanisation. During heavy rainfall, runoff from nearly half of the estate is diverted into the lake, which can temporarily store up to 40,000 cubic metres of water, equivalent to about 16 Olympic-sized swimming pools, before releasing it gradually downstream. Beyond flood management, Alkaff Lake has been integrated into the landscape as a biodiversity-friendly urban park with wetlands, swales, viewing decks, and walking trails that reconnect people with water and nature. Features such as terraced wetlands and pollutant traps help improve stormwater quality naturally before the water enters downstream systems.

Source: PUB, Singapore's National Water Agency Website

Action: Conserve and Augment Groundwater Resources

6
Conserve and Augment Groundwater Resources

Objective

Manage groundwater through regulated abstraction, protection of groundwater quality, and enhanced aquifer recharge, while recognising its hydrological connectivity with the river system through baseflow contribution.

Rationale

Ground and surface water are hydrologically interconnected, yet urban planning frequently treats them as separate systems. Unregulated groundwater extraction, reduced recharge due to impervious surfaces, and contamination from waste disposal threaten both aquifer health and river baseflow. Integrated groundwater management is necessary to secure long-term water availability and river health.

Approach

Mapping of aquifer zones and recharge areas, regulating groundwater extraction through permitting systems, mandating rainwater harvesting and recharge structures in new developments, protecting recharge zones from construction and contamination and monitoring groundwater levels and quality.

Case Example
Spain

Llobregat River Managed Aquifer Recharge

The Sant Vicenç dels Horts Managed Aquifer Recharge (MAR) system is located along the lower Llobregat River, approximately 15 km inland from the Mediterranean coast.

It consists of two surface ponds: a settling/decantation pond of about 4,000-5,000 m^2 and an infiltration pond of about 5,000-5,600 m^2. River water is diverted upstream and transported by gravity to the settling pond, where suspended sediments settle before the water enters the infiltration pond and percolates through the alluvial sediments into the aquifer. The system uses the river-soil-aquifer interface as part of the treatment and recharge process. At the infiltration pond, the water column is typically maintained at around 40-70 cm, with a reported average infiltration rate of approximately 1 m^3/m^2/day. The design also includes an organic layer to enhance natural biogeochemical processes beneath the pond, supporting degradation and attenuation of certain organic contaminants and nutrients as water moves through the soil and aquifer.

Source: PROTECMED's website

Cross-cutting approaches to be integrated in the actions to achieve the Goal 3 (Protect and Restore River Ecosystems)

Climate Resilience and Ecosystem-based Adaptation

- Prioritise restoration measures that enhance the ability of rivers, wetlands, floodplains and riparian ecosystems to absorb climate-related disturbances and recover from extreme events

Inclusive and Collaborative Governance

- Engage local communities, landowners, Indigenous and local knowledge holders, environmental organisations, researchers and relevant government agencies in ecosystem assessment, restoration and long-term management

Biodiversity Protection

- Protect the biodiversity connectivity between the river and its associated ecosystems; restore native habitats, species diversity, and ecological corridors
- Use biodiversity assessments to set restoration targets and prevent the introduction or spread of invasive species and other pressures that may alter native ecosystems

Nature-based Solutions

- Use natural systems, processes and locally appropriate techniques to restore water bodies and wetlands to improve water retention, filtration, flood regulation and other functions, applying engineered measures only when necessary.

Basin-connectedness

- Protect ecological connections beyond city boundaries and coordinate with neighbouring jurisdictions where river habitats, wetlands, tributaries or ecological processes are shared.

Evidence-based Planning and Decision-making

- Use GIS, remote sensing, ecological surveys, hydrological and geomorphological assessments to identify degraded areas and prioritise restoration.
- Apply real-time environmental monitoring and digital mapping to track ecosystem condition and evaluate restoration outcomes

GOAL 4:

PROTECT, ENHANCE AND MAINTAIN ECO-SENSITIVE RIVER EDGES

7
Enhance Riparian Buffers

Action: Enhance Riparian Buffers

Objective

Riparian buffers are vegetated areas along riverbanks that form a transition between the river and surrounding land. They are crucial for protecting the river from adjacent land uses. Protecting existing buffers includes restoring natural vegetation and habitats. Riparian buffer development differs depending on the river edge and city context. Their width and composition should respond to river characteristics, ecological functions, flood dynamics, and local site conditions.

Rationale

Riparian buffers help reduce sediment, nutrients and pollutants entering the river, stabilise riverbanks and provide habitat and movement corridors for biodiversity. They also support flood regulation, improve water quality, and regulate microclimate along the river corridor. Conserving the existing buffers and developing need-based riparian buffers is a low-cost, high-impact nature-based intervention for river health.

Approach

Map and assess existing riparian vegetation, identify degraded and priority areas, and establish buffer requirements based on river morphology, flood risk, ecological sensitivity and available space. Conserve existing natural buffers and restore degraded stretches using locally appropriate native vegetation. Establish management arrangements for vegetation maintenance, invasive-species control, access, monitoring and long-term protection.

Case Example
Australia

Riparian Development along Yarra River, Melbourne

The Yarra River supports an extensive riparian ecosystem as it flows through the Melbourne region, with more than 25 vegetation occurring along the river, billabongs, wetlands and swamps.

However, urban development, agriculture and associated stormwater runoff have contributed to declining water quality and habitat degradation in its lower reaches. To strengthen the river's riparian corridor, the Lower Yarra Revegetation Project planted approximately 18,000 native plants along 14 km of the river. Revegetation helps restore the ecological functions of the river edge by improving habitat and water quality, while contributing to the recovery of vegetation along previously degraded sections of the river. Riparian vegetation along the Yarra includes River Red Gums, Silver Wattles, River Bottlebrush, rushes and sedges, which collectively provide habitat for the river's diverse species, including 38 mammal species within 50 meters of the river, 190 bird species, among other frogs and reptiles.

Source: Melbourne Water Website

8

Protect Key Flora and Fauna Indicator Species

Action: Protect Key Flora & Fauna Indicator Species

Objective

Protect key indicator species that reflect the river ecosystem's health and integrity by conserving their habitats, reducing threats, and maintaining the environmental conditions essential to their survival and recovery.

Rationale

Indicator species are sensitive to changes in water quality, habitat condition, flow regimes, and ecological connectivity, making them important signals of river health. Their decline may indicate broader ecosystem degradation. Protecting these species supports biodiversity, strengthens ecosystem resilience, and maintains essential ecological functions.

Approach

Identify and map key indicator species and their critical habitats. Assess major threats and population trends, and establish species-specific protection measures. Maintain suitable water quality and flow conditions, protect breeding and feeding habitats, control invasive species and disturbances, and integrate regular biodiversity monitoring into river management and urban planning.

Case Example

India

Dolphin Ambulance, Ganga River

The Gangetic Dolphin Conservation Initiative focuses on conserving the Gangetic river dolphin (Platanista gangetica), an important indicator of the Ganga River ecosystem's health.

Led by the National Mission for Clean Ganga (NMCG) in collaboration with the Wildlife Institute of India (WII) and State Forest Departments, the initiative combines scientific dolphin population surveys, habitat assessment, rescue and rehabilitation, community participation and awareness. Recent surveys covered 8,507 km across 28 rivers and estimated a population of 6,324 Gangetic dolphins. Conservation efforts have also included rescue facilities, community-based networks such as Ganga Praharis and Soons-Saathi, and India's first Dolphin Rescue Ambulance to enable rapid response to stranded or injured dolphins. These measures link species conservation with broader river restoration by addressing habitat quality, ecological flows, pollution and community stewardship.

Source: National Mission for Clean Ganga (NMCG) Website

9
Promote Eco-friendly Riverfronts

Action: Promote Eco-friendly Riverfronts

Objective

Development of safe, accessible, and inclusive public spaces along suitable river stretches while maintaining the river's ecological and hydrological functions. The design should address flood risk, ecological sensitivity, river dynamics, and the existing character of the river corridor.

Rationale

River edges hold significant potential as public spaces that can improve citizens' quality of life while fostering a sense of ownership and connection to the river. Poorly planned or inaccessible riverfronts often become sites of neglect, dumping, and unsafe activity, while well-designed public spaces can strengthen both ecological function and civic engagement.

Approach

Identify suitable locations based on flood risk, ecological sensitivity, accessibility, existing land use, and community needs. Use low-impact, flood-resilient, and nature-based design approaches such as permeable surfaces, native vegetation, minimal hardscape, and adaptable public infrastructure. Avoid intensive development in sensitive areas and set clear provisions for access, safety, maintenance, and long-term ecological management.

Case Example
USA

Eco-friendly South Park Waterfront in New York

Hunter's Point South Waterfront Park in Long Island City, Queens, is an 11-acre waterfront redevelopment on the East River that transformed a former industrial brownfield and contaminated landfill into a resilient public waterfront.

Key features include restored and newly created tidal wetlands, bioswales, native salt-tolerant vegetation, and naturalised shoreline elements to absorb, slow, and accommodate floodwater. The park includes approximately 1.5 acres of newly established wetlands, a nearly one-acre in-water habitat protected by a green-engineered causeway, and a newly created island sanctuary. Stormwater infrastructure includes bioswales, stormwater planters, porous pavement, enhanced tree pits and a constructed wetland, with the landscape graded to temporarily accommodate floodwater during extreme events. The project also reconnects people with the river through pedestrian and cycling paths, wetlands trails, a kayak launch, recreation areas, picnic terraces, overlooks and public gathering spaces.

Source: NYCEDC, Hunter's Point South Website

Cross-cutting approaches to be integrated in the actions to achieve the Goal 4 (Protect, Enhance and Maintain Eco-sensitive River Edges)

Climate Resilience and Ecosystem-based Adaptation

- Integrate flood risk, bank erosion, extreme rainfall, heat, and changing flow conditions into the planning and design of riverbanks, riparian buffers, and public spaces
- Prioritise flood-resilient, climate-adaptive river-edge measures to enhance bank stability, preserve natural flood functions, and support recovery from extreme events

Inclusive and Collaborative Governance

- Integrate the riparian community and other river-dependent communities as part of the planning, designing and implementing any initiatives

Biodiversity Protection

- Protect riparian habitats, native vegetation, ecological corridors and biodiversity-sensitive river stretches from degradation and fragmentation
- Apply biodiversity considerations to guide the location, extent, and design of riparian buffers and public spaces, and avoid interventions that may harm aquatic and riparian habitats

Nature-based Solutions

- Prioritise native vegetation, bioengineering, naturalised banks, and other nature-based approaches for erosion control, habitat improvement, and river-edge enhancement

Basin-connectedness

- Evaluate upstream and downstream effects of river-edge interventions, particularly changes to sediment movement, channel form, flow patterns, and erosion
- Avoid interventions that transfer flood, erosion, or ecological impacts to adjacent or downstream stretches

Evidence-based Planning and Decision-making

- Utilise bank-condition surveys, erosion assessments, flood modelling, ecological assessments, GIS, and remote sensing to identify priority areas and guide intervention design
- Apply drone surveys, real-time monitoring, and spatial data to track changes in bank stability, vegetation, and river-edge condition, and to inform adaptive management

GOAL 5:

PROMOTE CIRCULARITY FOR TREATED WASTEWATER

10
Increase Reuse of Treated Wastewater

Action: Increase Reuse of Treated Wastewater

Objective

Reuse treated wastewater as an alternative water source within the city. It can support non-potable uses based on required quality standards and the available water quality.

Rationale

Reusing treated wastewater reduces dependence on freshwater sources and provides a more reliable water supply, especially in water-stressed cities. It also lowers the volume of treated effluent discharged into rivers and other environments, reducing pollution. Integrating reuse into urban water management improves water security and supports a circular use of water resources.

Approach

Assess reuse demands and identify suitable applications based on water quality, quantity, location, and seasonal demand. Provide treatment, storage, and distribution systems and establish regular monitoring of water quality and system performance. Develop clear standards, risk-management protocols, and institutional responsibilities to ensure safe, reliable, and sustained reuse of treated wastewater.

Case Example
Cyprus

Recycled Water & Ezousa Aquifer Recharge, Paphos

The Water Development Department (WDD) manages tertiary-treated wastewater from major urban wastewater treatment systems, and the recycled water is used for agricultural and livestock irrigation, green areas, and groundwater recharge.

Treated effluent from the Paphos Wastewater Treatment Plant is channelled to the Ezousa aquifer, where it is stored underground and subsequently abstracted for irrigation. Government and European documentation reports that the Paphos Managed Aquifer Recharge system recharges the aquifer with approximately 2-3 million m^3 of treated wastewater per year. The recharge system uses artificial infiltration ponds in the Ezousa riverbed, allowing the reclaimed water to infiltrate through the alluvial aquifer before being recovered through nearby groundwater wells. The State General Laboratory also maintains a dedicated monitoring programme, demonstrating that groundwater quality is monitored as part of the system's management.

Source: ENVITEC S.A., Paphos WWTP, Cyprus

11
Increase Reuse of Treated Bio-solids

Action: Increase Reuse of Treated Bio-solids

Objective

Recovering and reusing treated biosolids, which are stabilised organic solids produced during municipal wastewater treatment. Reuse should focus on recovering their nutrient and organic matter content for applications such as soil conditioning, land restoration, and landscaping where permitted.

Rationale

Biosolids contain nutrients like nitrogen and phosphorus and organic matter that improve soil properties and reduce the need for conventional soil amendments and fertilisers. Reuse can also lower the volume of biosolids sent to landfills or incineration and reduce environmental impacts from disposal.

Approach

Establish systems for biosolids treatment, quality testing, and classification to ensure safe resource recovery. Depending on quality and feasibility, promote uses such as soil conditioning, landscaping, land restoration, anaerobic digestion for biogas, and biochar production. Develop safe processing, storage, transport, and end-use protocols supported by quality controls and monitoring.

Case Example
Malaysia

Biosolids-to-Organic Fertiliser, Titiwangsa, Kuala Lumpur

Indah Water Konsortium (IWK) has developed a pilot resource-recovery initiative at the Titiwangsa 1 Regional Sewage Treatment Plant in Kuala Lumpur to convert treated sewage biosolids into organic fertiliser.

The project involved a dedicated biofertiliser/biopellet plant at Titiwangsa, with the broader objective of reducing sludge disposal to landfill and recovering nutrients and organic matter for productive reuse. The Titiwangsa 1 pilot plant disseminated more than 240 tonnes of biofertiliser in 2023 and around 100 tonnes of biosolids in 2025, and produced approximately 60 tonnes of organic fertiliser, with a current production capacity of about 5 tonnes per day. The fertiliser is being evaluated for agricultural and landscaping applications, while the initiative is intended to support IWK's goal of eliminating sludge disposal to landfill by 2030.

Source: The City of Calgary Website

Cross-cutting approaches to be integrated in the actions to achieve the Goal 5 (Promote Closed-loop and Circular Use of Water)

Evidence-based Planning and Decision-making

- Use water-demand assessments, wastewater flow and quality data to identify viable reuse and resource recovery opportunities
- Apply smart metering, real-time water quality monitoring, digital platforms, data analytics, and emerging technologies to optimise treatment, track resource flows, and assess system performance

Inclusive and Collaborative Governance

- Facilitate coordination among water and wastewater utilities, industries, agriculture, regulators, and end users to establish reliable systems for reuse and resource recovery
- Establish clear responsibilities for quality standards, risk management, pricing, and actively involve end users in planning and implementation

Biodiversity Protection

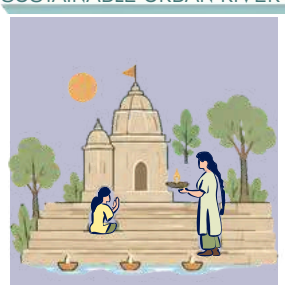
- Ensure wastewater treatment, reuse, and resource-recovery systems protect rivers, wetlands, groundwater, and aquatic ecosystems from untreated discharges and excessive resource extraction

Nature-based Solutions

- Integrate constructed wetlands, polishing wetlands, soil-based treatment, and other nature-based approaches where appropriate
- Combine nature-based and conventional systems to enhance treatment, reduce resource and energy demands, and support decentralised, locally appropriate reuse solutions

Basin-connectedness

- Plan treated wastewater reuse and resource recovery within the broader basin water balance, considering upstream availability, downstream needs, environmental flows, and receiving water conditions



GOAL 6:

CELEBRATE THE RIVER AS A PUBLIC AND CULTURAL ASSET

Action: Inculcate River-sensitive Behaviour among Citizens

12
Inculcate River-sensitive Behaviour among Citizens

Objective

Creation of public awareness of the river's environmental, social, cultural, and economic value, as well as the pressures on its health. Awareness efforts should move beyond general messaging to address specific behaviours, practices, and decisions that directly impact the river and its associated ecosystems.

Rationale

Limited awareness can contribute to behaviours such as littering, disposal of waste into drains, encroachment and unsustainable use of water resources. An informed public is more likely to adopt responsible practices, participate in river-related initiatives and support measures for river protection. Sustained awareness can therefore strengthen public participation and reinforce long-term river management.

Approach

Implement river-focused events to create awareness, such as river campaigns, river walks, public signages, digital campaigns, media outreach, etc. Develop targeted communications for groups such as youth, residents, businesses, industries, river-dependent communities, and visitors, addressing specific local river issues. Use citizen feedback, participation data, and behavioural indicators to evaluate and improve awareness initiatives over time.

Case Example
India

Kham River, Chhatrapati Sambhajinagar (Aurangabad)

The Kham River has historically been closely connected to the development and cultural identity of the city. However, anthropogenic pressures degraded the river to a sewage drain.

As part of the city's Urban River Management Plan (URMP), the city undertook restoration measures along the Kham River to improve the river ecosystem. The initiative has also helped reconnect people with the river through local cultural efforts, including the creation of a "Kham Song" and the popular use of "Aapli Kham" (Our Kham), reinforcing the river as a shared element of the city's identity and heritage. More than one million people have participated in the initiative, while the 5-km Riverside EcoPark incorporates three revived ponds, walking areas and an amphitheatre for community gatherings. Since 2020, approximately 54 acres of riparian zone have been restored, and the initiative was recognised as a finalist for the 2023-2024 WRI Ross Center Prize for Cities.

Source: Chhatrapati Sambhajinagar City Website

Action: Engage Citizens in River Management Activities

13
Engage Citizens in River Management Activities

Objective

The active participation of communities, institutions, businesses and other stakeholders in the protection, monitoring and management of the river. The objective is to establish sustained participation mechanisms that complement the statutory responsibilities of urban local bodies.

Rationale

Effective river management requires ongoing efforts that government agencies and projects alone cannot maintain. Local communities, civil society, businesses, academic institutions, and river-dependent groups possess valuable knowledge of river conditions and can contribute to monitoring, maintenance, and protection. Robust stewardship mechanisms improve accountability, foster local ownership, and support the long-term success of river management initiatives.

Approach

Form river stewardship groups, citizen monitoring programs, adopt-a-river stretch initiatives, and community-based restoration and maintenance programs. Create a platform for citizens and organisations to report pollution, encroachment, and other river-related issues, and connect these reports to city response systems. Develop small-grant, recognition, and volunteering programs to encourage and support local stewardship activities.

Case Example
South Africa

Adopt-a-River Programme for Apies River, Tshwane

The Apies River in Pretoria provides a strong example of citizen participation in urban river management through South Africa's Adopt-a-River and Clear Rivers initiatives.

The Department of Water and Sanitation (DWS) has encouraged communities to help protect rivers through clean-up activities, environmental stewardship, and citizen science. In its 2026 Clear Rivers Campaign, DWS brought together government agencies, schools, environmental organisations, community-based organisations and volunteers at the Apies River to undertake practical rehabilitation activities. The programme also promotes tools such as miniSASS, enabling citizens to assess river health through biological indicators and contribute to local water-resource monitoring. The initiative builds on sustained community involvement rather than a one-off campaign. DWS reports that the Environmental Warriors have conducted regular clean-up activities along the River since 2023, with volunteers removing litter and debris from riverbanks, bridges and sections of the river channel.

Source: Rekord / The Citizen, 2024, Apies River clean-up

Action: Restore Heritage and Cultural Connect with the River

14
Enhance Heritage and Cultural Connect with the River

Objective

Protection and restoration of the cultural and heritage connections between communities and the river. This includes both tangible heritage, such as bridges, religious structures, historic water structures, etc. and intangible heritage, such as traditions, festivals, skills, stories, etc., associated with the river.

Rationale

Urbanisation and changing river use have weakened long-standing cultural and historical ties to rivers. Protecting and restoring these connections strengthens city identity, preserves local knowledge, and increases public engagement in river conservation.

Approach

Mapping and documentation of river-related cultural and heritage assets. Restore historic riverfront structures and landscapes, revive traditional water-related practices, support river festivals and cultural programmes, and create heritage trails and interpretation centres. Provide appropriate funding, partnerships, and monitoring mechanisms to ensure that restoration and public use do not compromise the river's health.

Case Example

India

Kumbh: Intangible Cultural Heritage, Prayagraj

The Maha Kumbh 2025 in Prayagraj demonstrated how a river can function as a living cultural and heritage asset, with the Ganga-Yamuna confluence serving as the focal point for traditional rituals, and cultural expression.

UNESCO inscribed the Kumbh Mela as Intangible Cultural Heritage of Humanity in 2017; it embodies longstanding traditions and knowledge associated with sacred rivers. The 45-day Maha Kumbh 2025 brought more than 663 Million devotees to Prayagraj, reinforcing the river's central role in the city's cultural identity. Alongside the religious and cultural activities, the event incorporated measures to protect the river environment, including Ganga Seva Doots for the removal of offerings and waste from the ghats, plastic-free zones, large-scale sanitation infrastructure and river trash skimmers that removed around 10-15 tonnes of waste per day from the Ganga and Yamuna. The initiative shows how cultural events, heritage practices, and river stewardship can be integrated while reducing the environmental pressures of large-scale gatherings.

Source: National Mission for Clean Ganga (NMCG) Website

Cross-cutting approaches to be integrated in the actions to achieve the Goal 6 (Celebrate the River as a Public and Cultural Asset)

Evidence-based Planning and Decision-making

- Leverage cultural and heritage inventories, public-use data, accessibility assessments, and ecological assessments to identify priorities for public and cultural engagement
- Apply participatory mapping and digital interpretation tools to document river values, analyse usage patterns, and support adaptive management

Inclusive and Collaborative Governance

- Engage local communities, cultural groups, heritage organizations, river-dependent communities, and relevant agencies in planning and managing river-related public and cultural assets
- Establish clear processes for participation, co-management, programming, and maintenance of riverfront spaces and cultural initiatives

Biodiversity Protection

- Protect riparian habitats, wetlands, aquatic ecosystems, and biodiversity-sensitive areas from the negative impacts of public access and events and incorporate biodiversity-sensitive design and carrying-capacity considerations in event planning

Basin-connectedness

- Recognise the river's upstream and downstream ecological and cultural connections, including tributaries, associated water bodies, and communities beyond the city
- Develop connected river trails, cultural routes, and recreational networks

GOAL 7:

ENSURE SUSTAINABLE USE OF RIVER

15

Maximise Good Quality Return Flow

Action: Maximise Good Quality Return Flow

Objective

Management of water abstracted from rivers for municipal supply and ensuring its return to the river after use and treatment. Considering the quantity, quality, and location of return flows in relation to the river's natural flow, and environmental needs. Assess water withdrawals and return flows together as part of an urban water balance, rather than as separate activities.

Rationale

Urban water supply can significantly change river water quantity and quality, especially during low-flow periods when the river's capacity to absorb pollutants and support ecosystems is limited. Managing return flows ensures that water is returned, where appropriate, at a quality and quantity that meets the river's environmental and downstream needs.

Approach

Quantify river abstractions and return flows, prepare city water balance plan, and monitor the quantity and quality of discharged water. Set discharge requirements based on water quality, environmental flows, and downstream demands. Strengthen treatment where needed.

Case Example

USA

Jordan River Return Flow Study – Salt Lake Valley, Utah

The Salt Lake Valley's Jordan River Return Flow Study provides a strong example of managing urban water withdrawals and return flows as an integrated river-water balance.

Developed for the Jordan River system, the study modelled municipal and industrial water demands, water supplies, groundwater withdrawals and returns, wastewater flows, irrigation return flows, stormwater and imported water, together with potential future wastewater-reuse options. Rather than assessing water abstraction and wastewater discharge separately, the model evaluated how these components collectively affect streamflow along the Jordan River. This provides a practical example of using a city/urban-system water balance to understand the net effect of abstraction, consumption, wastewater return and reuse on river flows, helping inform decisions where reducing wastewater discharge through reuse may also reduce downstream river flows.

Source: Utah Division of Water Resources, Scoping Plan for the Water Resources Planning Tool (2023)

Action: Leverage the Economic Potential of the River

16
Leverage the Economic Potential of the River

Objective

Development of new, sustainable economic opportunities focused on the river and its surroundings, in addition to current livelihoods. Plan all activities with consideration for ecological sensitivity, safety, carrying capacity, and seasonal conditions. Support river-dependent livelihoods that rely on the river or its ecosystems for income, employment, food, or other resources, while maintaining river health.

Rationale

Rivers can be valuable economic assets for cities if used without compromising ecological functions. Diversifying river-based activities can create jobs, attract visitors and investment, support local businesses, and generate revenue for cities and communities. This approach also increases the economic value of maintaining a healthy, well-managed river.

Approach

Identify river-dependent communities and their livelihood activities, and assess their reliance on river resources and opportunities for greater sustainability. Identify underutilised river stretches and assess their potential for new economic activities based on flow, ecological sensitivity, and safety. Develop infrastructure and frameworks to support activities such as cruises, boating, water recreation, eco-tourism, etc. Use public-private partnerships, licensing, user fees, etc., to build viable business models while ensuring clear environmental and safety safeguards.

Case Example
United Kingdom

The Thames Vision, London

The Thames Vision 2050, developed by the Port of London Authority (PLA), demonstrates how an urban river can support a diverse riverine economy while maintaining environmental sustainability.

The Vision recognises the Thames as both a major economic corridor and a destination, creating opportunities through port trade, freight and urban logistics, passenger transport, tourism, recreation, sport, cultural attractions and riverside employment. The Thames already supports approximately 48,000 full-time equivalent jobs and generates more than £4 billion in annual gross value added, while port trade is forecast to 70-80 million tonnes by 2050. The strategy seeks to expand waterborne freight, including light freight and last-mile deliveries into central London, helping businesses use the river as transport infrastructure while reducing road congestion. At the same time, the Destination Thames component seeks to expand passenger travel, attract more visitors to riverside cultural destinations and increase participation in water-based sport and recreation, creating further opportunities for tourism and leisure economic activity.

Source: Thames21 Programme Website

Cross-cutting approaches to be integrated in the actions to achieve the Goal 7 (Ensure Sustainable Use of River)

Climate Resilience and Ecosystem-based Adaptation

- Consider drought, rainfall variability, extreme flows and seasonal changes when managing river abstractions, return flows and river-dependent activities
- Prioritise actions that enhance water-use efficiency, reduce climate-related water stress and sustain river functions during low- and high-flow periods

Inclusive and Collaborative Governance

- Coordinate water utilities, industries, agriculture, communities, livelihood groups, environmental authorities and other users to balance water demands
- Establish clear processes for water allocation, return-flow management, stakeholder participation, conflict resolution and compliance monitoring

Biodiversity Protection

- Ensure river abstraction and related uses maintain environmental flows, seasonal variability, water quality and habitat conditions necessary for aquatic ecosystems
- Assess ecological impacts of major water uses and implement safeguards to prevent over-abstraction and habitat degradation

Evidence-based Planning and Decision-making

- Apply water balances, abstraction and return-flow data, hydrological models, environmental-flow assessments, water-demand projections and ecological data to guide sustainable water-use decisions

Basin-connectedness

- Assess city-level water withdrawals and return flows within the broader basin water balance, considering upstream availability, downstream needs and cumulative impacts.

SECTION 4:
Monitoring and Evaluation

The SURM framework proposes a standardised Monitoring and Evaluation (M&E) mechanism to evaluate how well a city manages its river stretch. It uses seven **Outcome Indicators** to measure the river system's condition and sustainability, and seven **Process Indicators** to assess the effectiveness of planning, governance, implementation, and management. Outcome indicators track changes in the river, its corridor, ecosystems, public value, and sustainable resource use. Process indicators assess whether the city has the policies, plans, institutions, implementation mechanisms, monitoring systems, and partnerships needed to achieve better outcomes.

Each of the seven goals is measured by one Outcome Indicator and one Process Indicator for a total of 14 indicators. The indicators are measured on a scale from one to five. The scores of all indicators are aggregated and averaged to arrive at an Urban River Management Index (URMindex). Table 1 below provides the interpretation of the URMindex.

URMindex	Interpretation	What it means
<1.5	Unsatisfactory Urban River Management	The city is unable to meet basic requirements for river-sensitive urban management. The river is neglected, encroached upon, and used without planning or regulation. Serious concerns exist across all seven goals of the SURM framework
1.6-2.5	Basic Urban River Management	Basic actions toward river-sensitive planning, pollution control, and ecosystem protection are visible, but major gaps remain across most goals. Institutional mechanisms are largely absent or ad hoc, and outcomes on the ground remain limited
2.6-3.5	Moderate Urban River Management	The city has a satisfactory system in place for managing its river stretch, with functioning mechanisms for several SURM goals
3.6-4.5	Good Urban River Management	The city performs well across most SURM goals, with institutionalised planning, monitoring, and implementation mechanisms in place. Performance may vary across goals, but the overall river management system is robust and largely sustainable
4.6-5.0	Excellent Urban River Management	The city demonstrates exemplary performance across all seven SURM goals and cross-cutting aspects. Institutional mechanisms are fully embedded, outcomes are consistently achieved, and the city serves as a model for river-sensitive urban management

Table 1: Interpretation of the URMindex of the SURM framework

Goal 1: Promote River-Sensitive Urban Planning

Outcome-based Indicator 1: Status of River-Sensitive Development

Description of the indicator: Evaluates whether urban planning safeguards the river, floodplain, and related ecosystems (i.e. wetlands, water bodies, natural drains, paleochannels, groundwater, among others)

Parameters	Scoring
River channel, floodplain and associated ecosystems are extensively damaged	1
The river has been accorded some protection. However, the floodplain and related ecosystems remain largely exposed to development pressure	2
The river and floodplain have been accorded some protection. However, the related ecosystems remain largely exposed to development pressure	3
The river, floodplains, and related ecosystems are largely protected from development pressures	4
Urban growth retains the functional space of the river system, accommodates present and future flood conditions, and maintains river, floodplain and associated ecosystems with no significant new encroachment	5

Process-based Indicator 1: Integration of River Consideration in Statutory Planning

Description of the indicator: Assesses how effectively river sensitivity is integrated into the city's statutory planning framework, including the Master/Development Plan, land use and zoning provisions, and approval processes for the river, floodplain, and related ecosystems.

Parameters	Scoring
The river, floodplains, and related ecosystems are not addressed in the Development Plan, land-use plan or Development Control Regulations (DCRs) **or** no such plans exist for the city	1
Planning provisions for the river, floodplains and related ecosystems exist in isolated plans, without comprehensive statutory land-use or DCR provisions	2
Planning provisions for the river and its floodplain are incorporated in the Development Plan, zoning or DCRs; however, coverage of associated ecosystems is limited	3
River sensitivity is addressed through spatial delineation, land-use allocation, zoning and DCRs, for the river, floodplains, and related ecosystems	4
River sensitivity is fully embedded from strategic planning to development approval, with spatial controls, DCRs, site-level requirements, monitoring and periodic review based on flood, ecological and climate-risk evidence	5

Goal 2: Improve River Water Quality and Reduce Pollution

Outcome-based Indicator 2: Ambient River Water Quality

Description of the indicator: Evaluates the ambient water quality of the river based on **five** key parameters listed in SDG 6.3.2 (dissolved oxygen, electrical conductivity, nitrogen, phosphorus and pH)

Parameters	Scoring
Severe solid and wastewater pollution, most water-quality parameters fail to meet the requirement, and significant ecological degradation is evident	1
Poor water quality with visible pollution, less than 3 of the 5 key parameters meet applicable standards	2
No significant floating solid waste, 3 of 5 key parameters meet applicable standards	3
Floating waste is largely absent, 4 of 5 key parameters meet applicable standards, and aquatic ecosystems are generally healthy	4
River is largely free of solid, liquid and priority emerging pollutants; all 5 key parameters meet applicable standards, and the health of riverine biodiversity is improving	5

Process-based Indicator 2: Pollution Control Measures

Description of the indicator: Evaluates the extent to which the city identifies and maps pollution sources and ensures that wastewater and other pollution loads are effectively collected, treated and managed before entering the river, in compliance with applicable standards.

Parameters	Scoring
Major pollution sources are not mapped or monitored, wastewater and solid-waste collection/treatment systems are largely absent in the city	1
Major pollution sources are partly mapped, basic collection and treatment systems exist vis-à-vis wastewater generation, but monitoring is limited	2
All the major pollution sources are mapped, and collection and treatment systems coverage is only in the key area of the city, with basic effluent monitoring in place	3
Pollution sources are systematically mapped and managed, wastewater and solid-waste systems have high coverage, regular monitoring is in place	4
Integrated pollution management is in place, covering source mapping, collection, treatment, emerging contaminant monitoring, real-time monitoring, enforcement and coordinated management across agencies and the river basin	5

Goal 3: Protect and Restore River Ecosystems

Outcome-based Indicator 3: Restored and Functionally Connected River Ecosystems

Description of the indicator: Evaluates the functional condition of river's connected systems, including wetlands and water bodies, hydrological connectivity, groundwater-surface-water interactions, and habitat condition

Parameters	Scoring
Most water bodies and wetlands are in poor condition and have been largely lost to encroachment. Groundwater is depleted, with negligible baseflow contribution to the river	1
Half of the water bodies and wetlands are in poor condition and have been largely lost to encroachment. Groundwater is in a stressed condition	2
Some of the water bodies and wetlands are showing stress but not critical loss, both in terms of quality and area. Groundwater levels is improving but is inconsistent	3
Water bodies and wetlands are largely protected, with restoration underway. Groundwater levels are recovering and contributing to baseflow	4
Waterbodies, wetlands, and floodplain connectivity fully functional along the river stretch. Groundwater sustains consistent, healthy baseflow to the river	5

Process-based Indicator 3: Ecosystem Restoration and Groundwater Management Measures

Description of the indicator: Evaluates the extent to which the city has implemented measures to restore degraded ecosystems, including restoration of wetlands and waterbodies, improvement of hydrological connectivity, enhancement of groundwater recharge, regulation of abstraction, and protection of groundwater quality

Parameters	Scoring
No restoration plan for waterbodies/wetlands exists, and no measures taken to restore connectivity or manage groundwater abstraction or recharge	1
Isolated restoration or recharge efforts undertaken without a formal plan, connectivity and groundwater issues acknowledged but not addressed systematically	2
Restoration and groundwater management plans exist and are partially implemented, some connectivity restoration measures have been undertaken but not city-wide	3
Restoration, connectivity, and groundwater management measures are implemented across most of the river stretch and city area, with regular monitoring in place	4
Restoration, connectivity, and groundwater management are embedded in routine city processes, backed by dedicated budget, monitoring systems, and periodic review	5

Goal 4: Protect, Enhance and Maintain Eco-sensitive River Edges

Outcome-based Indicator 4: Ecological and Physical Condition of the River Edge

Description of the indicator: Evaluates the ecological and physical condition of the river edge, including the extent and continuity of riparian vegetation, habitat quality, bank stability, naturalness of the river edge, and the presence of encroachments, erosion or other physical disturbances that affect river health.

Parameters	Scoring
Riverbanks are eroding or destabilised; riparian buffers are largely absent or encroached upon. No usable public space along the edge, and the indicator species are absent from the river	1
Banks show visible erosion in stretches; riparian buffers are fragmented and narrow. Public space, where present, is poorly maintained or inaccessible, indicator species under significant pressure	2
The bank is stable in most stretches, with localised erosion; riparian buffers are present but inconsistent in width and continuity; indicator species are present but under pressure. Public space developed in parts, with moderate usability	3
Banks are largely stable, using a mix of structural and nature-based measures; riparian buffers are continuous along most of the stretch; indicator species are stable. Public spaces are functional, accessible, and reasonably maintained	4
Banks are stable and climate-resilient with changing river flow patterns; riparian buffers are continuous and dense; indicator species populations are healthy and sustained. Public spaces are well-maintained, inclusive, accessible, and integrated with the ecological edge	5

Process-based Indicator 4: Implementation of River Edge Management Measures

Description of the indicator: Evaluates the extent to which the city has implemented measures to protect, restore and manage the river edge, including riparian buffer development, and restoration of degraded edges.

Parameters	Scoring
No bank stabilisation measures undertaken, no measures for indicator species protection; no riparian buffer or public space plans exist for the river edge	1
Isolated bank stabilisation works are carried out reactively; riparian buffers and public spaces are not planned systematically; indicator species are not protected	2
A river management plan exists, covering protection of indicator species, bank stabilisation, buffers, and public space. However, there are challenges in implemeting the plan.	3
A river management plan exists, covering protection of indicator species, bank stabilisation, buffers, and public space, and the implementation of the plan is underway	4
The river management plan covering protection of indicator species, bank stabilisation, buffers, and public space, and the implementation of the plan is complete; The plan has a dedicated component for proper maintenance with an earmaked budget for upkeep	5

Goal 5: Promote circularity for treated wastewater

Outcome-based Indicator 5: Reuse of Treated Wastewater and Biosolids

Description of the indicator: Evaluates the extent to which treated wastewater and biosolids generated within the city are safely and beneficially reused, reducing dependence on freshwater resources and supporting circular water management.

Parameters	Scoring
Treated wastewater and biosolids are discharged or disposed of and there is no reuse infrastructure or reuse data available	1
Reuse is restricted to isolated cases, such as a single industry or facility. Biosolids are largely landfilled	2
Treated wastewater is reused across identifiable sectors such as industry or horticulture. Some biosolids are processed for agricultural or energy use.	3
A substantial share of treated wastewater and biosolids is reused across multiple sectors through dedicated distribution infrastructure. Reuse generates measurable revenue or cost savings, and freshwater withdrawal has decreased as a result	4
Treated wastewater and biosolids reuse is scaled city-wide, functioning as a revenue-generating or cost-recovering system and has become a second source for city's water supply	5

Process-based Indicator 5: Institutional, Infrastructural and Economic Readiness for Water Circularity

Description of the indicator: Evaluates the city's readiness to implement and scale water circularity through appropriate institutional arrangements, enabling policies and regulations, infrastructure and systems for wastewater treatment, reuse and resource recovery, and viable financial and economic mechanisms.

Parameters	Scoring
No existing policy, regulation, or pricing mechanism for reuse and treatment infrastructure is not designed for reuse	1
Reuse is referenced in city policy or planning documents, but standards, cost recovery, and infrastructure remain undeveloped	2
Reuse standards and permitting processes exist, along with early tariff or pricing structures and the distribution infrastructure is partially built	3
Regulatory and pricing mechanisms support reuse uptake, and partial cost recovery and robust infrastructure exist for reuse of treated wastewater in multiple sectors	4
A sustainable model is developed for the city for water circularity by integrating financing, robust infrastructure backed by long-term contracts, tariffs, or PPPs.	5

Goal 6: Celebrate the River as a Public and Cultural Asset

Outcome-based Indicator 6: Public Engagement and Cultural Connect with the River

Description of the indicator: Evaluates the level of citizen participation in river stewardship activities and public awareness and perception of the river's ecological and cultural significance. It also assesses the extent to which cultural, heritage, and historical connections have been restored.
.

Parameters	Scoring
The river holds no active place in civic or cultural life of the people and no stewardship activity or public engagement currently exists	1
Citizen engagement is limited to occasional events, and the cultural and historical ties to the river remain undocumented	2
Stewardship groups and awareness initiatives exist and draw steady local participation, and few heritage sites and practices have been identified	3
Stewardship is community-led and sustained, with rising public awareness reflected in participation levels. Cultural and heritage connections are actively restored through recurring festivals and events	4
The river is central to the city's identity, sustained by stewardship programs organised by people and the city government. Cultural and heritage connections are restored, drawing improved recognition and participation	5

Process-based Indicator 6: Stewardship, Awareness and Cultural Restoration Programmes

Description of the indicator: Measures whether institutional mechanisms exist to build stewardship, awareness, and cultural connection, independent of current engagement levels.

Parameters	Scoring
No stewardship, awareness, or heritage documentation programme exists.	1
Awareness events or stewardship drives occur occasionally, without government or community's support	2
A stewardship or awareness programme has been institutionally established, with initial multi-stakeholder participation. Heritage documentation has begun	3
Stewardship and awareness programmes run regularly, inclusively engaging diverse community groups. Cultural and heritage restoration is funded and actively implemented	4
Stewardship, and awareness are part of city planning and community development initiatives, backed by dedicated budgets and cross-basin collaboration, sustaining long-term public ownership of the river	5

Goal 7: Ensure Sustainable Use of River

Outcome-based Indicator 7: River-Based Livelihoods and Economy

Description of the indicator: Measures whether return flows, livelihoods, and the riverine economy are being sustained within the river's ecological and hydrological limits

.

Parameters	Scoring
River-dependent livelihoods are declining and at the same time the river health is also degrading due to overuse. No economic activity is organised around the river, and a huge gap between the water taken by the city and the return flow	1
Return flows are irregular or of poor quality. Livelihoods dependent on the river are vulnerable and informally sustained	2
River-based livelihoods are stable in select sectors, thus resulting in improved river use and the the city has started to reduce the gap between the return flow and water consumption	3
Livelihoods are diversified and show resilience to seasonal or climatic variability, and riverine economy generation initiatives have started. The gap between water consumption and return flow has significantly improved	4
Return flows are optimised to sustain river health under changing climate conditions. Livelihoods and the riverine economy are diversified, resilient, and integrated into the city's economic planning	5

Process-based Indicator 7: Implementation Mechanism for Sustainable Use of River

Description of the indicator: Measures whether institutional mechanisms exist to manage return flows, support livelihoods, and strengthen the riverine economy, independent of current outcomes.

Parameters	Scoring
No return flow assessment, regulation or monitoring exists. Livelihoods and economic activities linked to the river receive no support and are degrading the river's health	1
Return flow issues are acknowledged but unregulated. Livelihood support, where it exists, is informal and not part of the city's planning process	2
Return flow monitoring mechanisms are being established using the city's water balance plan. Livelihood support programmes exist for select groups, and riverine economic activities are being identified and documented	3
Return flows are actively regulated and monitored. Livelihood support programmes are institutionalised and inclusive, and new economic activities are being introduced in and along the river	4
Return flow management, livelihood support, and riverine economic development are part of the city planning process, coordinated with upstream/downstream (if applicable), and designed to remain viable under climate-driven hydrological change	5

Urban River Management Index for the City

Each indicator has a value between one and five. An average of all the indicators will yield the URMindex

- Average Score of Outcome-based Indicators (Olavg)= Score of all Outcome-based indicators/7
- Average Score of Process-based Indicators (Plavg) = Score of all Process-based indicators/7

$$URMindex = (Olavg + Plavg)/2$$

The interpretation of the URMindex is visually represented in Figure 6. It provides an overall measure of the outcomes achieved and the processes adopted by the city for sustainable urban river management.

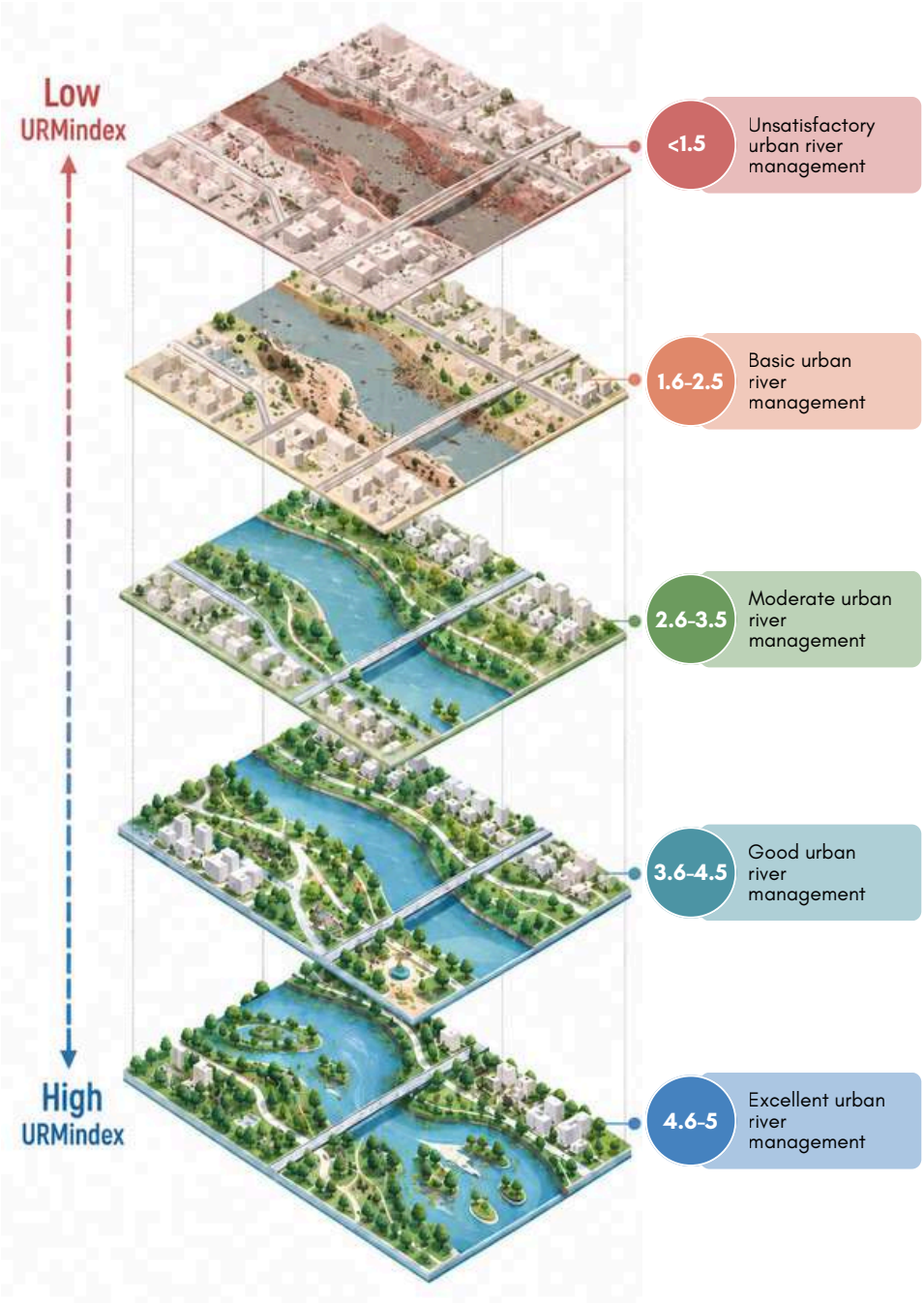


Figure 6: Snapshot of the M&E scoring and interpretation mechanism of the SURM framework

SECTION 5:
Implementation of SURM Framework

The SURM Framework provides a common structure for cities to plan and implement river management while allowing each city to respond to its river's specific characteristics and needs. The framework does not prescribe a uniform set of interventions. Instead, it establishes the seven SURM Goals as a common direction, and sixteen actions that cities can choose to adopt. Cities can identify, prioritise and sequence these actions according to the existing condition of their rivers, ecological context, urban form, climate risks, development pressures, institutional responsibilities and local priorities. This approach enables cities with very different river systems and capacities to work towards a shared vision of healthy and resilient urban rivers while retaining flexibility in implementation.

Implementation should ideally begin with a comprehensive baseline of the river and its associated urban systems. This assessment should establish the current condition of the river, identify major pressures and understand the relationship between the river and the city. Depending on the local context, this may include assessment of water quality and quantity, wastewater and stormwater flows, river morphology, flood and drought risks, groundwater interactions, riparian and aquatic ecosystems, biodiversity, solid waste, river-edge conditions, land use, development pressures, cultural assets, livelihoods and public access. The assessment should also identify the city's institutional and regulatory context, existing projects and programmes, available data, and ongoing investments that can contribute to river management. The objective is to establish an evidence base from which priorities can be identified, and actions can be designed.

Based on this assessment, cities may identify key pressures, river vulnerabilities and priority areas and map these against the seven SURM Goals. Not every goal or action will be equally relevant in every city. A city experiencing severe wastewater pollution may need to prioritise water quality and return-flow management, while another may require greater emphasis on flood resilience, riparian restoration, groundwater, biodiversity or river-sensitive urban planning. SURM therefore enables cities to prioritise the goals and actions most relevant to their river, while ensuring interdependencies between different river functions are recognised. For example, riparian restoration may simultaneously support biodiversity, bank stabilisation, flood resilience, public space and climate adaptation, while wastewater reuse may influence both freshwater demand and the quantity and quality of return flows to the river.

The identified priorities should then be translated into a **SURM Action Plan** that clearly connects each priority to specific actions. Each action should define the location or area of intervention, desired outcome, responsible institution, supporting stakeholders, implementation timeframe, indicative resources or financing requirements, and monitoring indicators. Actions can be structured into immediate, medium-term and long-term interventions to allow cities to sequence implementation according to urgency, feasibility, resource availability and expected impact. The plan should distinguish between actions that can be implemented directly by the city and those that require coordination with state, regional, basin or national institutions.

5.1. Institutional and Stakeholder Arrangements

Successful implementation requires SURM to be embedded within the city's institutional structure rather than treated as a standalone environmental initiative. A **city-level multi-stakeholder group** should therefore be established or designated to guide the preparation, implementation and periodic review of the SURM Action Plan. This mechanism should bring together relevant municipal departments, utilities, public agencies and institutions responsible for urban planning, water supply, wastewater, drainage, stormwater, environment, groundwater, land management, public spaces, infrastructure and river management.

The institutional mechanism should also provide opportunities for participation by communities, river-dependent groups, technical and research institutions, civil society organisations, academia and private-sector stakeholders, depending on the nature of individual actions. Their involvement can provide local knowledge, technical expertise, implementation capacity and opportunities for co-management. Stakeholder participation should extend beyond consultation during plan preparation and, where appropriate, continue through implementation, monitoring and stewardship.

5.2. Integration with Existing Planning

SURM should be implemented primarily through the city's existing planning systems, programmes and investments, rather than creating a parallel implementation structure. River-related priorities should therefore be integrated into statutory and strategic plans, infrastructure programmes, wastewater and solid-waste management plans, stormwater and drainage projects, urban development projects, climate action plans, biodiversity strategies, public-space programmes and relevant capital investment plans. This approach can help mainstream river management across municipal functions and improve the efficiency of existing public investments.

Where existing projects already contribute to SURM goals, they should be mapped and incorporated into the SURM Action Plan, with additional measures introduced where gaps remain. The framework can consequently function as a mechanism for alignment and convergence, bringing together otherwise fragmented investments and ensuring that sectoral projects contribute collectively to river health.

5.3. Implementation, Monitoring and Adaptive Management

Implementation of the SURM Action Plan should be supported by a robust review process. Progress should be assessed against agreed SURM indicators, actions and outcomes rather than only against expenditure or completion of individual projects.

The SURM Action Plan should be treated as a living document rather than a static plan. Periodic reviews should assess changes in river condition, progress of interventions, emerging risks, effectiveness of implemented measures and changes in city priorities.

The plan should ideally be reviewed and updated every five years, or earlier where significant changes occur, such as major climate events, changes in river behaviour, new infrastructure, changes in regulatory requirements or emerging environmental pressures. This adaptive approach allows cities to learn from implementation, modify interventions where necessary and continuously strengthen their contribution to river health.

NATIONAL MISSION FOR CLEAN GANGA
Ministry of Jal Shakti (Department of Water Resources, River Development & Ganga Rejuvenation) Government of India, 1st Floor, Major Dhyan Chand National Stadium India Gate, New Delhi - 110002
Telephone:+91-011-23072900-901
admin.nmcg@nic.in; www.nmcg.nic.in

National Institute of Urban Affairs (NIUA)
Ministry of Housing and Urban Affairs, Government of India, Core 4B, 1st Floor, India Habitat Centre (IHC), Lodhi Road, New Delhi – 110003
Telephone: 011 2461 7517 (ext. 214)
urvers@niua.org, https://niua.in/waterandenvironment/