Strategic Guidelines for

MAKING RIVER-SENSITIVE MASTER PLANS

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June 2021

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"There is a need for new thinking for "River Cities". There is need for the residents of these cities to ask, "What can we do for the rivers?" There is a need for a new river centric thinking in planning for cities on the banks of rivers. The river health needs to be mainstreamed into urban planning process by developing Urban River Management Plans. Cities should be responsible for rejuvenating their rivers. It has to be done not just with the regulatory mindset but also with developmental and facilitatory outlook."

Hon'ble Prime Minister during the first meeting of National Ganga Council held on December 14, 2019

Message from Hon'ble Minister for Jal Shakti, Government of India

गजेन्द्र सिंह शेखावत
Gajendra Singh Shekhawat

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

MESSAGE

24 FEB 2021

The urban blueprint of river cities has been entrusted with a distinct perspective in planning – incorporating a river in their midst. Although a widely recognized and valued asset, not many cities realize the latent transformative powers of rivers and account for river sensitive planning. The urban development in our towns and cities, particularly those on banks of rivers, has been increasingly exerting anthropogenic pressures on rivers across India. With Indian cities expected to cross 50 percent urbanization levels by 2050, one out of every two Indians would be living in cities and this will put further pressures on the rivers.

Namami Gange mission has been working with an integrated approach to river rejuvenation. Involving cities in river sensitive planning will create a sense of collective responsibility and evolve into a long term planning approach. It is time for cities to bring rivers from the backyard to the forefront by integrating river-centric management approaches within the ambit of their planning framework. A paradigm shift is needed in the way we perceive our rivers, and the first step envisaged would be to Mainstream River thinking in a city's development landscape. This is a stepping stone in achieving our vision of a healthy river that is anchored in the principles of sustainable development.

I am pleased to unveil this strategic guidance document, which has been prepared to assist city planning authorities in designing the growth trajectory of cities by considering river-sensitive approaches in a city's long-term planning. I congratulate National Mission for Clean Ganga, Ministry of Jal Shakti and National Institute of Urban Affairs, Ministry of Housing and Urban Affairs for their efforts in producing this timely and pertinent document. I hope that this document, which emphasizes on the role of a city's Master Plan and its instruments for creating a value for the river, will find widespread acceptation across the country and be a guiding tool for Indian cities towards a common vision of Healthy Rivers.

(Gajendra Singh Shekhawat)

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Message from Hon'ble Minister for Housing & Urban Affairs (MoHUA), Government of India

हरदीप एस पुरी
HARDEEP S PURI

आवासन और शहरी कार्य राज्य मंत्री (स्वतंत्र प्रभार)
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भारत सरकार
Minister of State (I/C), Housing & Urban Affairs
Minister of State (I/C), Civil Aviation
Minister of State, Commerce & Industry
Government of India

Message

The importance of environmentally sensitive and responsive urban development cannot be overemphasized. This is all the more important in India and is crucial for India to sustainably achieve its development agenda. By 2030, when work is completed on the UN Sustainable Development Agenda, nearly 600 million Indians or 40 per cent of our population will reside in urban spaces. To cater to this growing urban population, we have to build 700-900 million square meters of urban space every year until 2030.

Cities and metropolitan areas are a natural focal point for implementing key environmental mandates, given that they are the sites of bustling socio-economic activity. India has 53 metropolitan cities (Million Plus population) of which 42 cities are river centric which signifies that the interactions between the river and its dependent urban centre are complex, collaborative and mutually reinforcing. This dependency needs to be transformed into sustainable symbiotic relationships.

Addressing challenges emerging from rapid urbanisation such as water pollution, loss of natural assets, and disappearing open spaces is vital to improving our urban citizens' living standards.

Our existing national urban initiatives such as the Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation, and Swachh Bharat Mission-Urban are helping cities with state-of-the-art interventions to enhance liveability. I am delighted to see this strategic document for making river-sensitive Master Plans, which will serve as an excellent decision support system for city officials and other stakeholders to take up environmentally-sensitive development.

Healthy rivers are a vital cog in the wheel of our sustainable development agenda. The social, economic and environmental benefits that healthy rivers provide are crucial for achieving a sustainable urbanity.

The interdisciplinary work that has helped develop this strategic framework reinforces the notion that urban issues are best solved using a systems approach that looks at the problem in its entirety. I congratulate the National Institute of Urban Affairs and National Mission for Clean Ganga teams for producing this handy document.

(Hardeep S Puri)

New Delhi
19 February 2021

Message from Hon'ble Minister of State for Jal Shakti, Government of India

रतन लाल कटारिया
RATTAN LAL KATARIA

जल शक्ति
और सामाजिक न्याय एवं अधिकारिता राज्य मंत्री
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MINISTER OF STATE FOR
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Message

Since time immemorial, rivers have been a crucial asset to many civilizations. Their significance in day to day life has only grown over the years. For India, rivers are the epitome of Mother Nature. Be it India's religious ethos, cultural identity oreconomic aspirations, rivers will always be integral to any city of India. It is therefore, no wonder that 293 out of 504 Class I towns of India are river cities. The safety and conservation of this valuable asset needs to be priority in all long term planning processes of cities.

Sustainable planning for River cities, is a paradigm shift, evident in the efforts of NamamiGange. I am happy to note that, priority has been accorded to mainstreaming river centric thinking in cities. It is with pleasure, I introduce this book **"Strategic Guidelines for making river-sensitive masterplans"**, a crucial link in our times. I am also aware that master planning practitioners often need to work across disciplines. An approach has therefore been taken to allow individuals and city officials to understand specific aspects of river centric master planning, existing policy frameworks in India and abroad, and various tools to create a holistic masterplan. The purpose is to inculcate a sense of responsibility in the city towards safeguarding rivers.While the central focus is on Ganga basin towns, the document is applicable to all Indian River cities.

I warmly convey my special acknowledgement to the authors of this book, the National Mission for Clean Ganga and the National Institute of Urban Affairs, and hope the knowledge it carries will be beneficial to city authorities and stakeholders.

(Ratan Lal Kataria)

Message from Secretary, Ministry of Jal Shakti, Government of India

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1st April, 2021

MESSAGE

The Ganga River Basin is amongst the largest river basins in the world. The basin is home to close to half of India's population. The Namami Gange Initiative has lifted the management of Ganga River Basin to a new level. It is, therefore, in the fitness of things that this basin serves as a model for other basins in India for devising sound river management strategies, as well as leading the river rejuvenation initiatives.

I am happy that NMCG and NIUA have worked on integrating river development plan in the overall development landscape of the city. A Master Plan is a legally binding framework and a standard planning instrument for a city. This document makes valuable suggestions to address the management of a city's riverine resources comprehensively in the Master Plan. I am sanguine that this document will serve as a useful resource for holistic development of Master Plan and will help in realizing the vision of a river friendly city.

PANKAJ KUMAR

Message from Secretary, Ministry of Housing & Urban Affairs (MoHUA), Government of India

दुर्गा शंकर मिश्र
सचिव
Durga Shanker Mishra
Secretary

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MESSAGE

India is among the world's fastest growing major economies in the world, and by several estimates this trend is likely to continue in the near future. As the nation prepares itself to embrace this growth, our urban policies, initiatives, and missions have begun to increasingly emphasize on contemporary urbanization processes that are inclusive and sustainable. The overarching vision is to create a new brand of cities that are not only productive but both liveable and resource-sensitive as well.

There is perhaps no other natural resource that propels a city's development trajectory more comprehensively than a river. The ecosystem services that a river provides to cities, and the livelihoods it supports are unrivalled. It is, therefore, for good reason that rivers have been widely acknowledged as the cradle of civilization, which accentuates the intrinsic relationship between rivers and cities. As our river cities progress up the development ladder, it will be important for them to take cognizance of this vital resource and mainstream it within the development landscape. This document, therefore, comes at a very opportune time when cities are shaping their strategies to set ambitious and forward-looking development targets. As cities begin to adopt the river-sensitive city planning approach introduced in this document, it will become quite apparent that the river has a vital role to play in helping cities achieve their development targets.

I congratulate and commend NIUA and NMCG for producing this document, and hope that it will be adopted by river cities not just in the Ganga River Basin but across the country.

(Durga Shanker Mishra)

New Delhi
February 02, 2021

Message from Director, National Institute of Urban Affairs (NIUA), Ministry of Housing and Urban Affairs, Government of India

राष्ट्रीय नगर कार्य संस्थान
NATIONAL INSTITUTE OF URBAN AFFAIRS

Hitesh Vaidya
Director

MESSAGE

India is poised to become the most populated country by the turn of the decade. This burgeoning population is also matched by an expanding rate of urbanization. In the next few years, many cities in India will witness a rapid transformation in their structure and urban fabric as a result of development processes. As the cities plan their development trajectories, it will be important for them to look at the broader picture of sustainability, and develop a long-term vision and associated actions, to ensure high quality liveability for the residents.

Since its establishment in 1976, NIUA's mandate has been to provide contemporary state-of-the-art knowledge and capacity development support to our cities as they define their development trajectories. Over the last few years, our focus has been on proliferating sustainable and integrated solutions in cities that make optimal use of natural resources, and are environmentally friendly.

From experiences around the world, it is quite evident that natural assets such as rivers have a vital role to play in enhancing the liveability of a city. The tangible and intangible benefits that rivers bring to a city are hugely significant in the larger scheme of things. City planners and development authorities would, therefore, be well-advised to mainstream river thinking into the long-term strategy for urban development. The relationship between a city and the river is symbiotic, and the sanctity of this relationship must be reflected in the Development Plan or Master Plan for the city.

The Master Plan of a city is a very powerful instrument for shaping urban development. Not only is it a legally binding document, it also cuts across different planning sectors and sections of society, making it an all-encompassing long-term plan for the city. This document, developed by NIUA and NMCG, will serve as a useful reference for river cities in developing their Master Plans that acknowledge and integrate river-sensitive design. The document highlights a set of planning tools that can be leveraged, elaborating on their application in cities, both in India and abroad. It provides a comprehensive description of the entire spectrum of urban river challenges commonly faced by our cities, and does a matchmaking to present how specific aforementioned planning tools can help address those challenges.

Through this document, we hope to usher in an era where cities are sensitive to the needs and requirements of rivers, and willing to adjust their urban planning approach to address these needs. Healthy riversare a wonderful indicator of healthy cities, something that our cities must strive to achieve going forward.

(Hitesh Vaidya)
Director.

New Delhi
4th March, 2021

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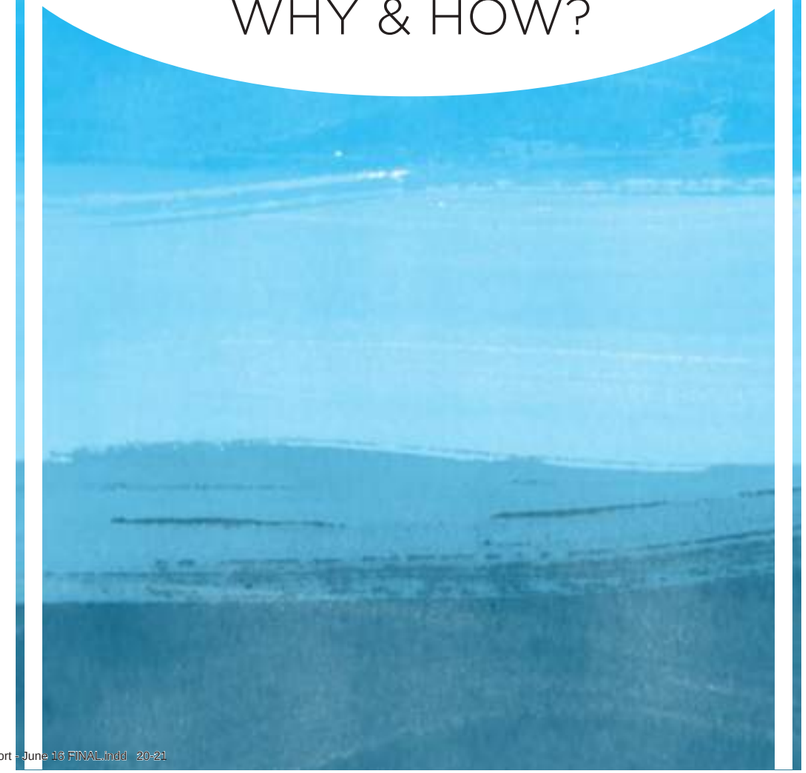
ACRONYMS

CETP:	Common Effluent Treatment Plant
cGANGA:	Centre for Ganga River Basin Management and Studies
CSP:	City Sanitation Plan
DCR:	Development Control Regulations
DEWATS:	Decentralised Waste Water Treatment System
FAR:	Floor Area Ratio
GC:	Ground Coverage
HFL:	High Flood Line
HIZ:	High Impact Zone
IWRM:	Integrated Water Resource Management
JNNURM:	Jawaharlal Nehru National Urban Renewal Mission
MIZ:	Medium Impact Zone
MoEFCC:	Ministry of Environment, Forest and Climate Change
MoHUA:	Ministry of Housing and Urban Affairs
MoUD:	Ministry of Urban Development (former)
NDMA:	National Disaster Management Authority
NDZ:	No Development Zone
NIUA:	National Institute of Urban Affairs
NMCG:	National Mission for Clean Ganga
RRZ:	River Regulation Zone
SPA:	School of Planning and Architecture
STP:	Sewage Treatment Plant
TCPO:	Town and Country Planning Organization
UDPFI:	Urban Development Plans Formulation and Implementation
URDPFI:	Urban and Regional Development Plans Formulation and Implementation
URMP:	Urban River Management Plan
WTP:	Water Treatment Plant

LIST OF FIGURES

CHAPTER 1

NEW THINKING IN PLANNING FOR RIVER CITIES: WHY & HOW?



One of the most beautiful and apt description of a river is that made by the Canadian writer and conservationist Roderick Haig-Brown when he said, *"A river is water is its loveliest form, rivers have life and sound and movement and infinity of variation, rivers are veins of the earth through which the lifeblood returns to the heart."*

This, in a nutshell, captures the ethos and significance of the Namami Gange Mission and the work that we have carried out since its inception in 2015. What began as a mission to clean up the Ganga soon transformed into a mission that looks far beyond mere cleaning. It aspires to restore the wholesomeness of River Ganga, the collective consciousness of our country. The Ganga is not just a river but gives us our sustenance. It is not just one river but represents rivers and water.

Drawing from a comprehensive Ganga River Basin Management Plan developed by a consortium of 7 IITs, Namami Gange mission seeks for complete rejuvenation of not just the Ganga but its tributaries as well with multiple interventions for pollution abatement (Nirmal Ganga), improving ecology and flow (Aviral Ganga), strengthening people-river connect (Jan Ganga) and promoting Research, development and knowledge management (Gyan Ganga). The Mission is doing so by addressing the major drivers, push and pull factors, and interactions that have a bearing on the river's overall health. Perhaps the biggest driver, in this context, is the urban sector which brings in large pollutant load into rivers, and also adversely impacts the urban wetlands and floodplains.

Cities have largely been held responsible for the deteriorated state of rivers, and therefore, will need to play a vital role in the rejuvenation efforts as well. Several innovative steps have been taken up in Namami Gange to make the investments in municipal waste management sustainable for long term by making 15-year operation and maintenance as part of project, ensuring performance-based contracts through introduction of PPP through Hybrid Annuity Mode (HAM) and improving governance through one city-one operator approach. But we realized the need to mainstream river in the thinking and the processes of urban planning, otherwise we would neither be doing justice to the city nor the river. A concept of Urban River Management Plan started taking shape. We started interacting with several relevant expert institutions such as National Institute of Urban Affairs (NIUA), School of Planning & Architecture (SPA), World resources Institute (WRI), IITs etc.

It is against this backdrop that in 2019, NMCG entered into a partnership with NIUA sanctioning a project to look at the river-city interaction closely, and arrive at solutions to enhance this interaction in a more sustainable manner.

As we started the project, a couple of interesting things became quite apparent. First, managing an 'urban stretch' of river is quite different from managing it on a basin scale. This is largely because of the 'influence zone' of management wherein a city can only manage what is within its administrative boundaries. This means a city has to tackle very unique challenges like what does it do when the water

entering the city is already in a polluted state? Or what does it do when there is inadequate flow in the river because of allocation decisions taken by an upstream authority?

To address such challenges, and a number of others, we developed a strategic framework called *"Urban River Management Plan (URMP)"* that requires cities to take actions against a common 10-point agenda. Since all cities need to follow the same agenda, beneficial actions taken by upstream cities will have a cascading effect on the downstream cities. This way, cities act as interconnected units, all working together, to achieve a common vision for the river. The plan has Environmental, Economic and Social elements with vision, objectives and interventions for each of them. These include both pan city and riverbank specific actions. The URMP framework has already been launched last year, and Kanpur will be the first city in India to adopt this framework for making a city-specific URMP.

Second, a number of interventions required for rejuvenating urban rivers cannot be achieved by infrastructural projects and engineering solutions alone. A typical case in point is regulating, and if required restricting, development activities in the flood plains of rivers to ensure 'room for the river'. Likewise, conservation of water bodies and wetlands, which are deeply interlinked to the river anyway, requires a different management approach. We developed with the help of SPA, Delhi a guide book for protection and conservation of urban wetlands which has also been shared with municipal commissioners through Ministry of Housing and Urban Affairs. Similarly, with WRI, we have developed guideline for eco-friendly river front development.

A large number of these 'softer' solutions can be incorporated through sound city planning, i.e. through a city's Master Plan. Our team carried out a comprehensive analysis of the Master Plans for major river cities in India, and found that most of these do not have adequate river-specific provisions. A river is, undoubtedly, among the city's greatest environmental assets, which certainly deserves to be given due importance in a city's Master Plan, given that the Plan defines the long-term broad contours of development trajectory of the city. Unfortunately, the Master Plans for many river cities are found wanting in this regard.

This idea was most aptly captured by the Hon'ble Prime Minister while chairing the meeting of National Ganga Council on 14th December, 2019 providing invaluable guidance to us in this endeavour:

"There is need for new thinking for 'river cities'. There is need for the residents of those cities to ask, 'What can we do for the rivers'. Learning from experience of Namami Gange, there is need for a new river centric thinking in planning for cities on the banks of rivers, the city master plan, at present, does not adequately address this. The river health needs to be mainstreamed into urban planning process by development of Urban River Management Plans. Cities should be responsible for rejuvenating their rivers. It has to be done not just with the regulatory mindset but also with development and facilitatory outlook."

The purpose of this guidance document is to help address this. It is meant to help city planners across the Ganga River Basin, and the country at large, understand how to integrate river sensitive thinking

into a Master Plan. It seeks to leverage on the legal sanctity of the Master Plan to ensure a harmonious relationship between cities and rivers. The document highlights a set of planning instruments and tools that planners can use to plan for and manage different river-related aspects in the city.

The second chapter sets the background and context to the guidance document by introducing urban rivers, and the challenges and issues faced in managing such rivers.

The third chapter looks at how river management has been traditionally considered in India's planning landscape, which has usually been either at a river basin scale or in the form of small projects in the river zone. The chapter identifies the gap in the planning landscape for river management and introduces the role and significance of a city's Master Plan in plugging this gap.

The fourth chapter elaborates on following seven planning tools and instruments within the Master Plan that can be used to effectively plan and manage urban rivers.

1. Localising national policies and instruments: A number of national policies (e.g. National Water Policy 2012, National Policy on Faecal Sludge and Septage Management 2017, The Water (Prevention and Control of Pollution) Act 1974, National Tourism Policy 2002, River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016 among others) have provided key river-related directions for cities to adopt. It is important for the Master Plan to acknowledge and incorporate these.
2. Developing city-specific sectoral strategies: elaborating on specific key strategies (e.g. for riparian buffer development; for relocating encroachments in the river zone; among others) that are required in the city for sustainable management of the river.
3. Land use assignment: including the appropriate land use categories, use zones, use premise, and associated permissible/non-permissible activities in the flood plain as well in areas in other parts of the city that have a bearing on river management.
4. Development control regulations: to manage the FAR, ground cover and height restriction in the relevant areas.
5. Norms and standards: such as setback distances, buffers, width of no development zones, discharge standards, among others that are required to conserve and protect rivers and its associated elements.
6. Recommendations and directions: to influence aspects that the Master Plan cannot directly control (e.g. citizen engagement in river management; CSR activities for river rejuvenation; among others).
7. Special projects: for key big-ticket iconic endeavors that a city should undertake in order to enhance the river-city relationship (e.g. riverfront development project; reviving historic water bodies; developing a constructed wetland; among others).

The fifth chapter contextualizes the use of the seven planning tools and instruments mentioned above for managing associated elements of the rivers such as water bodies and wetlands.

The sixth chapter delves into specific river-related challenges and issues that cities typically face, and

elaborates on how the seven planning tools and instruments can be employed to address the challenges. Seven diverse issues have been taken up. These include restriction of river channels and natural drains; pollution in rivers and drains; drying up of rivers and streams; degrading water bodies and wetlands; depleting green cover; weak citizen-river connect; and inefficient river management and governance.

The seventh chapter highlights some practical implications for making river sensitive Master Plans. These include handling informal encroachment sensitively; ascertaining land ownership in the relevant areas; developing a framework for implementation; allowing for course correction; leveraging on technological advances; and climate change implications on river management.

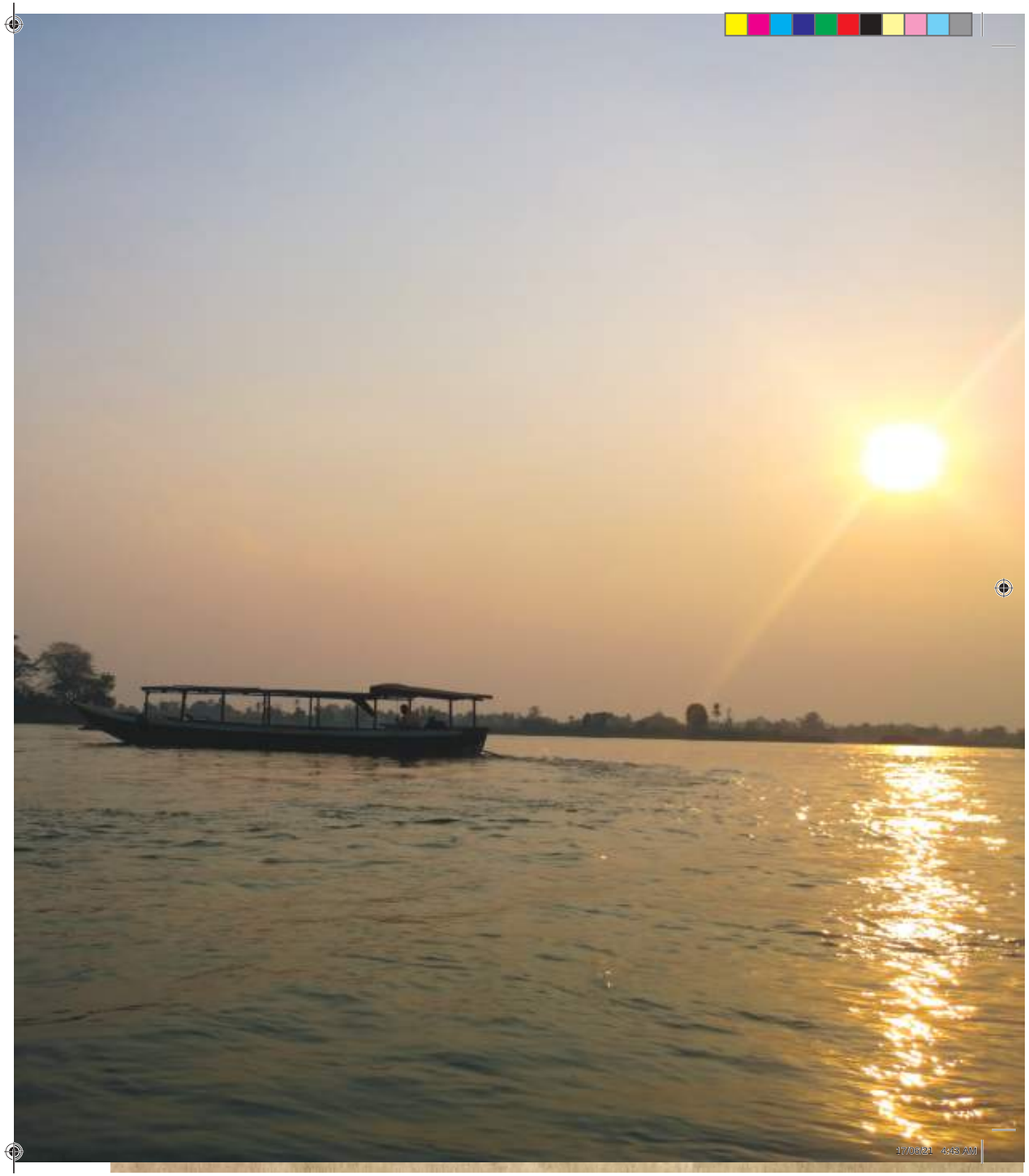
The tools and instruments described in this document are not an exhaustive list but are certainly sufficient and relevant to help planners take those initial steps in mainstreaming river thinking into Master Plans. To conclude, managing urban rivers is complex given the multiple physical, socioeconomic and meteorological drivers that have an impact on the river's condition. Making river sensitive Master Plans can go a long way in easing out the complexity to a large extent.

It is essential for city managers to acknowledge and respect rivers, water and ecology for having a truly smart and sustainable urbanisation. Rivers and urban development are both are important. Both are needed but we should ensure that civilizations that have developed on banks of rivers do not find themselves in a situation when river gets lost in the city, and people turn their back on rivers. Yamuna river has been facing this unfortunate fate in Delhi. It is heartening to see that Delhi Development Authority has released recently the new draft Master Plan 2041 for Delhi supported by NIUA, acknowledging these aspects and giving importance to rejuvenation of Yamuna, developing a green belt, biodiversity parks, protection and development of water bodies, trees, heritage conservation etc. This is an important step in right direction.

Our project and this document are a step in our endeavour to strengthen city-river and people-river connect. This approach can also provide an opportunity for cities to transform their role from present perception of negatively impacting the river basin management to making positive contribution to river basin health. The solution starts with the understanding that a river cannot be managed in isolation. It is a system encompassing diverse elements from river, surrounding ecosystem and related services including livelihood. It is to bring better understanding between approaches for Integrated River Basin Management and Integrated Urban Water Management. This is essential for sustainable development of cities and habitations.

"Water is the critical resources issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land." - Luna Leopold, Noted Geomorphologist and Hydrologist

Sh. Rajiv Ranjan Mishra
Director General, National Mission for Clean Ganga



CHAPTER 2

INTRODUCTION TO URBAN RIVERS

2.1 Rivers and Cities

Throughout the history of civilizations, rivers have been at the centre of human settlements, owing to easy availability of water for subsistence, agriculture, navigation and other basic necessities required for existence. A number of the earliest and most prominent ancient cities were established along the banks of rivers, which include the Euphrates-Tigris rivers in Mesopotamia, Nile in Egypt, Ganga in India, and Huang-Ho in China. Even today, there are several examples of cities, where the rivers have played a vital role in defining their development contours. Examples of these include the Thames in London, Seine in Paris, Hudson in New York, Yarra in Melbourne, Ganga in Varanasi, Yamuna in Delhi, and many others.

There is an intrinsic relationship between rivers and cities, which is symbiotic in so many ways. On the one hand, rivers provide cities with a wide range of services resulting in both tangible and intangible benefits, and support the livelihoods of a large number of people. These benefits include assured water supply for residents, businesses, agriculture, and public places; fish and other riverine resources; flood control; recreational areas; and carbon sequestration, among others (*Figure 1*). Additionally, there are numerous social and religious benefits of rivers. On the other hand, rivers rely on the good practices in the city to help preserve their natural character and profile, and sustain their ability to continue to offer various ecosystem services. The rivers, for their part, have always fulfilled their role in this symbiotic relationship. However, cities, in general, have failed to match this commitment. This has led to a state where many rivers have been exploited indiscriminately, without any consideration for their carrying capacity.

Today many of our rivers are facing threats on multiple fronts. There are concerns regarding pollution in the rivers, drying up of river stretches, encroachment into floodplains, loss of river-related biodiversity, and several others. Invariably, development activities in cities are the biggest cause for these issues and challenges. In the quest for economic development, somehow cities have bitten the hand that feeds them. For example, only 22 kilometres of the Yamuna river that flows through Delhi is responsible for 70% of the pollution in the entire river. Likewise, the last 120 kilometres of the Sabarmati river before it meets the Arabian Sea, comprises of just industrial effluents and sewage originating from Ahmedabad and other towns in the vicinity.

As highlighted before, healthy rivers are an absolute necessity for healthy and liveable cities. Cities will, therefore, need to plan their development activities with due consideration for the river, respecting the threshold of disturbance that it can handle naturally without any alteration in its properties, or ability to function. The importance of integrating the river within the 'planning' mechanism of the city is, therefore, of paramount importance. This will not only help in long-term conservation and preservation of the river; it will also help leverage the economic, social, and environmental value of the river in a sustainable manner.

Figure 1: Benefits of Urban Rivers

Denser vegetation and the transport of fresh air along the river corridor leads to **IMPROVEMENT IN AIR QUALITY**

Rivers have a cooling effect in the vicinity, thus mitigating Urban Heat Island effect, and ensuring **MICRO-CLIMATE REGULATION**. They also act as carbon sinks

River landscapes are one of the most attractive landscapes, and this **AESTHETIC QUALITY** makes rivers an ideal recreational avenue

Rivers help to **REDUCE SEVERITY AND INSTANCES OF URBAN FLOODING** by regulating drainage and flows

A clear view of a river or adjacent greens can significantly **INCREASE PROPERTY VALUES**

Rivers serve as the **HABITAT FOR BIODIVERSITY** – aquatic, terrestrial and avifauna

River floodplains are naturally conducive for **GROUNDWATER RECHARGE**

Rivers help in **RECONNECTING PEOPLE TO THE NATURAL ENVIRONMENT**, and increase the possibility to use them for educational, cultural, traditional purposes

Rivers are a key source for **GENERATING ECONOMY** and **SERVING LIVELIHOOD DEPENDENCIES**

In many cities rivers are the **PRIMARY SOURCE OF WATER SUPPLY** for people, industries, commerce, and livestock

Natural environmental features like rivers can serve as an avenue for **IMPROVING MENTAL HEALTH AND WELLBEING** of people

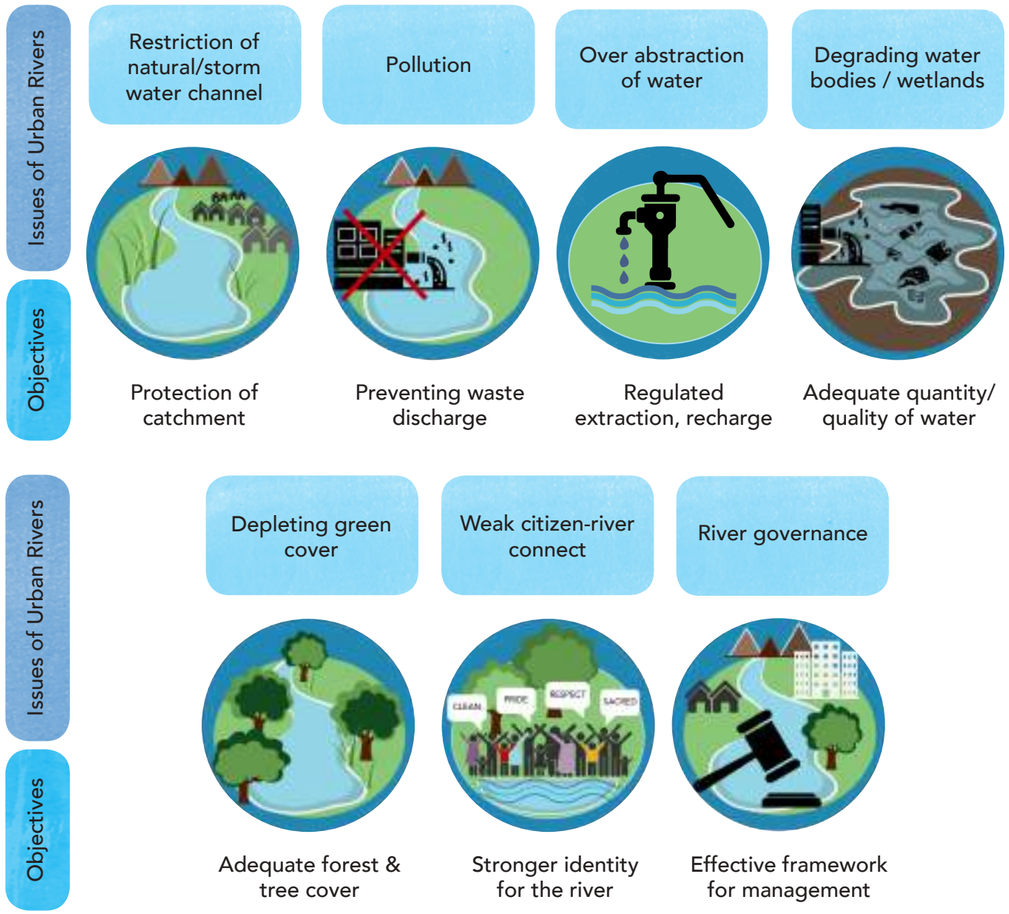
Riverbanks are good locations for social activities to **FOSTER SOCIAL COHESION**

Healthy rivers have the potential to enhance the city's outlook to **ATTRACT INVESTMENT OPPORTUNITIES**

Source: Developed by the authors

2.2 Challenges for River Management in Cities

Figure 2: Challenges for River Management in Cities



Source: Developed by the authors

2.2.1 Restriction of natural/ storm water channels

River needs its space to perform its natural functions, one of which is to act as a sponge to prevent flooding. However, in many towns, unplanned development and encroachment along riverbanks have severely restricted the natural channels (*Figure 3*). Furthermore, channelization and excessive concretization confine the river because of which the entire geomorphology and ecology of the river gets disturbed. This impermeable nature of the landscape leads to excess runoff and fluvial flooding, thus causing loss to property and life.

2.2.2 Pollution

Pollution, unarguably, is one of the most severe concerns in Indian rivers, especially in the Ganga River Basin. Pollution from various sources - domestic sewage; industrial effluents; agricultural runoffs; solid waste dumping; among others - are taking a toll on the rivers (*Figure 4*). Floral offerings and waste generated by religious activities add to the problem. In many cases, large stretches of the rivers have literally turned into flowing sewers. As the cities heavily depend on these rivers, river pollution poses serious health issues. More importantly it is not just the river, but the entire riparian ecosystem[1] that is heavily affected.

2.2.3 Over-abstraction of water

As the rate of urbanization in cities increases, the stress on water resources to meet the rising demand also increases. In peri-urban areas, agricultural water demand particularly aggravates the situation. As a result, rivers and aquifers are fast depleting, causing changes in hydro-morphology and the natural hydrological regimes of water channels.

2.2.4 Degrading lakes, ponds and wetlands

Lakes, ponds and wetlands are important features that help stabilize the groundwater levels, in addition to providing various social and environmental benefits. They serve as an important source for groundwater recharge, augmenting groundwater levels, and thereby reducing the stress on river water resources. However, in several cities, these water bodies are in a severely dilapidated state - resulting from encroachment and pollution. Loss of catchment basins, change in quality of water, as well as loss of natural flora and fauna raise concerns about the impacts of rapid urbanization over these vulnerable ecosystems.

1 Riparian ecosystems encompass a diverse suite of ecosystem types, including river banks, floodplains and wetlands, which are characterized primarily by being ecotones, or transitional zones, between adjacent terrestrial and aquatic realms. (Capon, 2020)

1.2.5 Depleting green cover

Green cover is very important from a river management point of view. On riverbanks, it serves as an erosion control mechanism. In other areas, it helps augment groundwater levels, and provides a habitat for biodiversity to thrive. Unfortunately, the cities today have been trapped in a vicious green-grey debate. The general trend is that as the cities add to their built-up spaces, the green cover continues to decline.

1.2.6 Weak citizen-river connect

Traditionally, the river was at the centre of various societal practices - cultural, religious, livelihood and recreational. This citizen-river connect is very important to establish the identity of the river, giving it a societal value. This value helps inculcate a sense of ownership of the river among the residents, which is beneficial in the long run. While this is still prevalent in some cities, somehow many cities (especially larger cities) have lost their connect with the river.

1.2.7 Piecemeal governance

Holistic river management requires concerted and coordinated efforts from diverse government agencies related to irrigation and flood control, groundwater, pollution control, tourism, public works, horticulture, forestry, and others. Additionally, non-state actors such as NGOs, citizen groups and religious bodies also have a vital role to play. Unfortunately, in most cities there is hardly any communication and coordination among these stakeholders, which leads to a "silos" approach of management.

1.2.8 Vulnerability to climate change

Water bodies and water channels are vulnerable to rising temperatures and fluctuating precipitation levels. Due to anthropogenic factors, the frequency and intensity of these changes in climatic conditions and extreme weather events have increased. This has a tendency to increase the risk of catastrophic floods, increased droughts, drying-up of streams, cyclones, or the spread of waterborne diseases. Understanding these risks and impacts on river-ecology, climate resilience is an important parameter in planning for urban rivers.

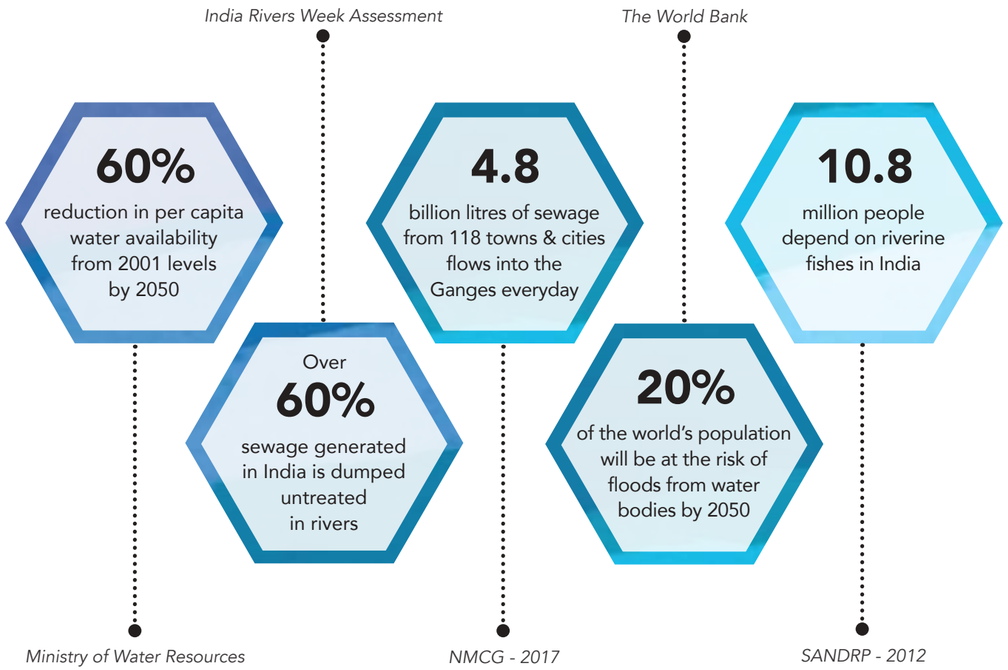
Figure 3: Restriction of natural water channel in urban areas

Figure 4: Pollution in Urban Rivers

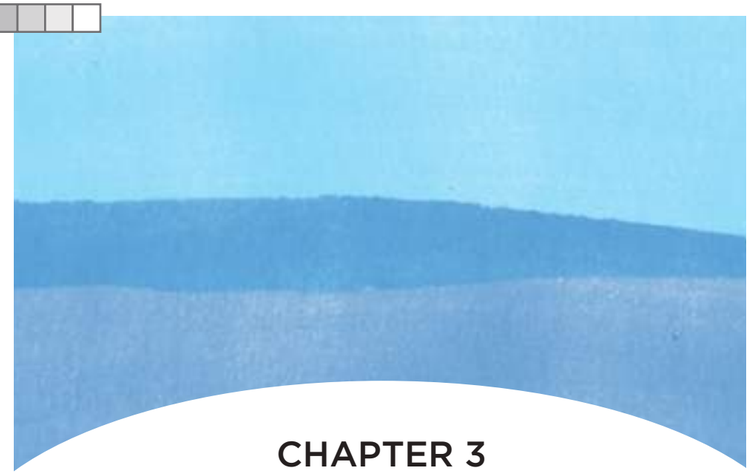
2.3 Snapshot of the State of Rivers in Indian Cities

Figure 5 presents a snapshot of the key statistics related to Indian rivers. As per India Rivers Week Assessment *"70 per cent of our rivers are facing existential threats. Over 60 per cent of sewage generated in India is dumped untreated in rivers and water bodies. The number of polluted river stretches in country has increased to 352 from 302 two years ago."* Another major concern highlighted earlier is the urban flooding scenario. As per World Bank statistics, *"By 2050 nearly 20% of the world's population will be at the risk of floods."* Some major statistics highlighting the seriousness of these concerns are shown below.

Figure 5: Key statistics related to urban rivers

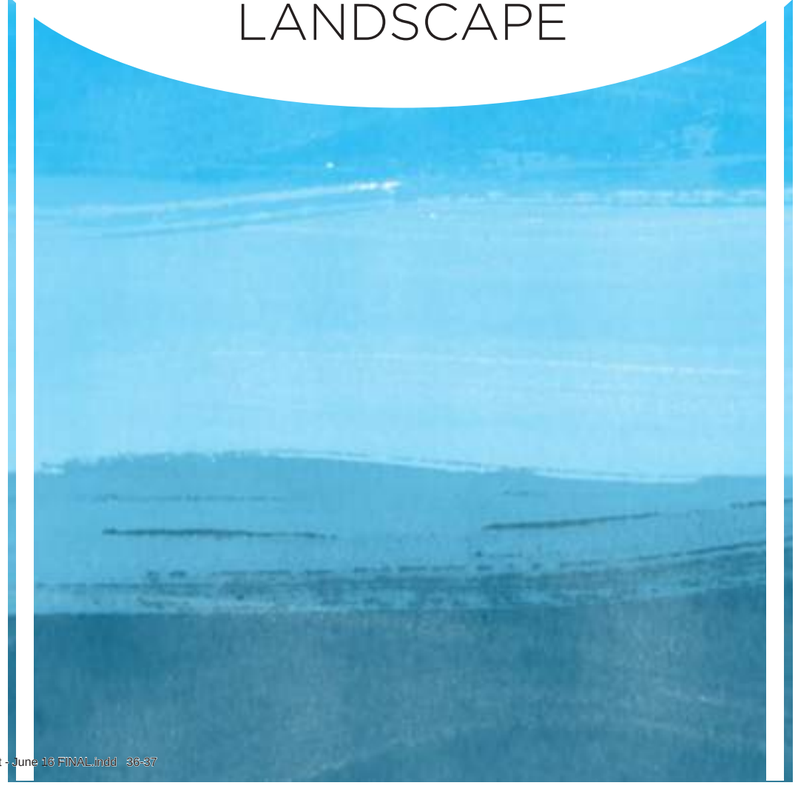


Source: Developed by the authors



CHAPTER 3

RIVER MANAGEMENT IN THE PLANNING LANDSCAPE

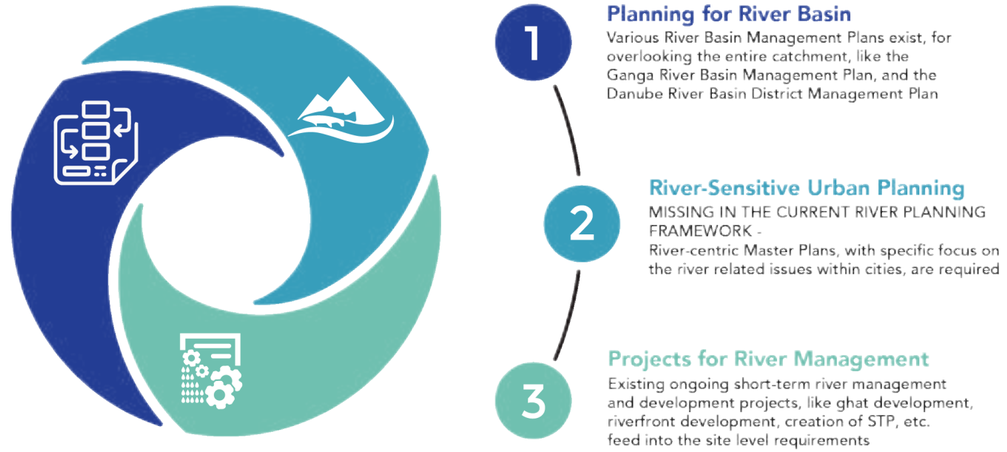


3.1 Comprehensive Planning for Urban Rivers

Planning in the context of urban river management has two broad objectives. The first is to rejuvenate and restore degraded riverine stretches that have been rendered inefficient to serve their core functions, mostly due to disruptive human activities. The second is to develop a long-term strategy to ensure that the rejuvenated stretches of rivers are maintained efficiently.

Holistic river management will require interventions and co-ordination at diverse spatial scales, e.g. national scale, basin scale, city scale, river zone, etc. In India, however, river management is usually considered at the river basin scale comprising of the entire catchment, or along the river channel and its immediate vicinity in the form of special projects. River management at a city scale is hardly seen anywhere. *Figure 6* presents an overview of these spatial scales.

Figure 6: Spatial scales of planning for river management



Source: Developed by the authors

3.1.1 River management at basin scale through Integrated Water Resource Management (IWRM) Plans

Various River Basin Management Plans are already being prepared in India for revitalising the entire catchment of rivers and their tributaries, as advocated by national policies and priorities. For example, the National Water Policy (2012) prescribes that *"Integrated Water Resources Management (IWRM) taking river basin/sub-basin as a unit, should be the main principle for planning, development and management of water resources."* Similarly, one of the goals of the National Water Mission (2008) is the "*promotion of basin level integrated water resources management,*" which is also achieved through river basin management plans. Currently, there are management plans for several basins such as the Ganga, Rukmavati, Pamba and Cagayan River Basin.

3.1.2 River management at river zone scale through special projects

River management projects within the river zone are mostly in the form of riverfront development, riparian landscaping, installation of STPs, ghat development, etc. Examples of such projects include the Dravayavati Riverfront project (Jaipur), Sabarmati Riverfront project (Ahmedabad), Yamuna Biodiversity Park (Delhi), etc. However, the aim of these projects is usually limited to developing a beautiful, healthy and usable river bank for the city inhabitants. While these projects are essential for the development of a healthy river infrastructure, they alone are not sufficient for holistic urban river management. The Namami Gange Programme under the Ministry of Jal Shakti has undertaken a variety of projects at this scale, such as construction of STPs and Common Effluent Treatment Plants (CETPs), drain bioremediation, river surface cleaning, rural sanitation, river front development, construction of ghats and crematoria, afforestation & biodiversity conservation, etc.

3.1.3 River management at city scale through river-sensitive urban planning

As mentioned above, river management at a city scale is a relatively unaddressed area. This essentially requires river-sensitive planning within the city's administrative boundaries, that treats the river as an asset and ensures that the developmental activities within the city are not detrimental to the river health. River-sensitive planning takes cognizance of the river and its interaction with the city. It recognizes the strong connect between a city and the river and mainstreams this aspect in the planning philosophy of the city.

3.2 Urban Planning Framework in India

As highlighted in the previous chapter, it is important for cities to integrate river thinking into their long-term planning process in order to ensure a harmonious relationship between the river and the city. River-sensitive urban planning is, therefore, very much the need of the hour in our cities.

The contemporary and formal approach to urban planning in India can be traced back to the mid-1900s. In 1960, the Town and Country Planning Organisation (TCPO) formulated the 'Model Town and Country Planning Law', which was revised in 1985 and renamed as 'Model Regional and Town Planning and Development Law' to enact a comprehensive urban and regional planning legislation in all the states and union territories. This law led to the creation of dedicated Planning and Development Authorities, tasked with preparing long-term plans for cities and monitoring their implementation. To provide a common reference for these Development Authorities across the country, the first national level planning guidelines were framed in 1996 by the Institute of Town Planners, in consonance with the provisions of 74th Constitution Amendment Act. These 'Urban Development Plans Formulation and Implementation' guidelines emerged as an outcome of the recommendations from a 'National Workshop on Master Plan Approach: Its Efficacy and Alternatives' that was held in 1995, which examined the entire process of urban development planning and implementation. With changing times, cities became more dynamic in nature, and regional implications of planning started becoming prominent. To address these, as well as to cater to the emerging concepts of inclusive planning, sustainable development, disaster management and others, the revised 'Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines[2] were conceptualised and framed by TCPO in 2014.

At the national level, the mandate for developing policies and regulations for urban planning lies with the Ministry of Housing and Urban Affairs (MoHUA) through its organizations such as TCPO and external affiliates like the Institute of Town Planners India (ITPI). At the state and city level, the Town Planning Departments are responsible for preparation and implementation of the long-term plans.

3.3 Hierarchy of Plans

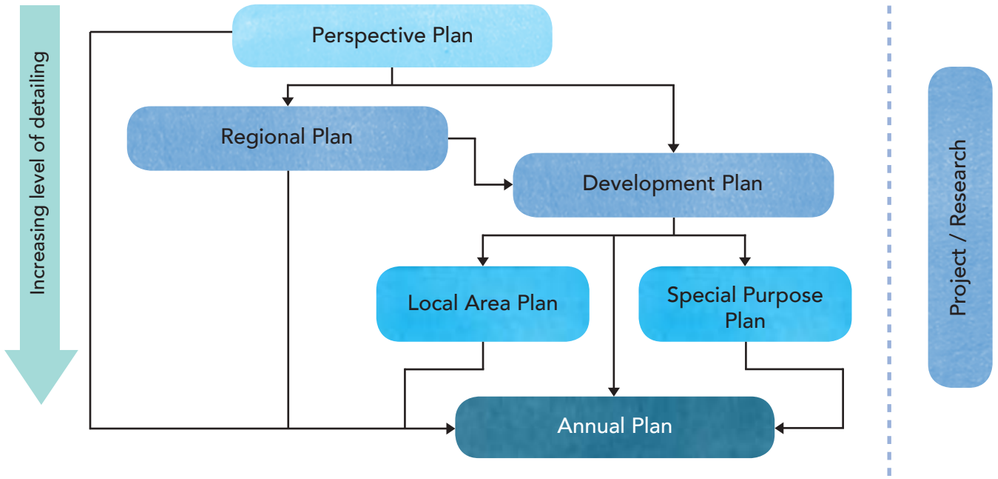
As per the URDPFI Guidelines 2014, the urban and regional planning framework is divided into two broad components: Core Area Planning, and Specific and Investment Planning. The Core Area Planning comprises of plans at four different scales with independent objectives. These include a long-term Perspective Plan with a vision and policy directions at a state level; a long-term Regional Plan for optimization of resources shared at a regional level for development; a long-term comprehensive Development Plan specific to development within urban and peri-urban limits; and a short-term Local Area Plan within the framework of Development Plan.

Likewise, the Specific and Investment Planning component is categorized into three short-term plans: a Special Purpose Plan for special areas with specific development requirements within the framework of Development Plan; an Annual Plan for physical/ fiscal resource mapping and performance indicators of Development/ Local Area Plan; and Project/ Research to focus on execution and implementation.

Figure 7 presents a schematic of the interactions of the above referred plans. A brief description of each of these plans is provided hereafter.

2 Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines 2015, Town & Country Planning Organisation

Figure 7: Relationship of urban planning systems in India



Source: URDPFI Guidelines, 2014, TCPO

3.3.1 Perspective Plan

(typically prepared for a 20-30 year horizon)
This is usually developed at the state level and focuses on the spatio-economic policies, strategies, and programmes for the development of the State. The plan is based on mapping, assessing, and analysing existing potential resources of the State. The scope of this plan covers the social, economic, and environmental development goals; policies; and priorities related to the activities that have spatial and financial implications.

3.3.2 Regional Plan

(typically prepared for a 20 year horizon)
Regional Plans are developed to ensure consistent and seamless treatment of the planning philosophy for a region, whose specific areas may be under the jurisdiction/ purview of different planning Acts/ Statutes. These include Town and Country Planning Act, Municipal Laws, Urban/ Metropolitan Planning/ Development Act, Improvement Trust Act, Industrial Development Act, Cantonment Board Act, Major Ports Act, etc. Often these laws are mutually exclusive, which may lead to planning conflicts and sub-utilization of land. The Regional Plan helps to avoid such issues.

3.3.3 Development Plan/ Master Plan

(typically prepared for a 20-30 year horizon)
Development Plan is a statutory plan prepared (under relevant Act) within the framework of an approved Perspective Plan. The approved Development Plan allows the local authority to implement development of the land area specified under the plan with the help of local area plans and projects. The term Development Plan is used differently in States. Some states call it a Master Plan. Here, both Development Plans and Master Plans have the same function and impose similar controls.

3.3.4 Local Area Plan

(typically prepared for a 5-20 year horizon)
The purpose of Local Area Plans is to facilitate micro-planning, to help decentralization and improve implementation of Development Plans/ Master Plans. These are essentially bottom up approaches to planning.

3.3.5 Special Purpose Plan

(typically prepared for a 5-20 year horizon):
Special Purpose Plans are prepared for specific development sectors depending on their economic and environmental importance. These plans need to be within the framework of the Regional Plan, Development/ Master Plan or Local Area Plan in the jurisdiction of the local authority.

3.3.6 Annual Plan

(1 year horizon)
An Annual Plan contains the details of the new and ongoing projects that the local authority intends to implement during each financial year. This plan is prepared by the local authority, where new projects are identified in line with the priorities, policies and proposals contained in the approved Regional Plan, Development Plan or Local Area Plan.

3.3.7 Projects/Research

(typically prepared for a 5-20 year horizon)
Conceived within the framework of the Perspective Plan, Development/ Master Plan or any of the plans in the planning system, projects are the working layouts with all supporting infrastructure and documents including cost, source of fund and recovery providing all necessary details for execution including finance, development, administration and management.

3.4 Relevance of Master Plan for Urban River Management

Among the various scales and hierarchy of plans in the Indian system, river-sensitive approach to urban planning is most relevant for the Master Plans for a number of reasons, as listed below.

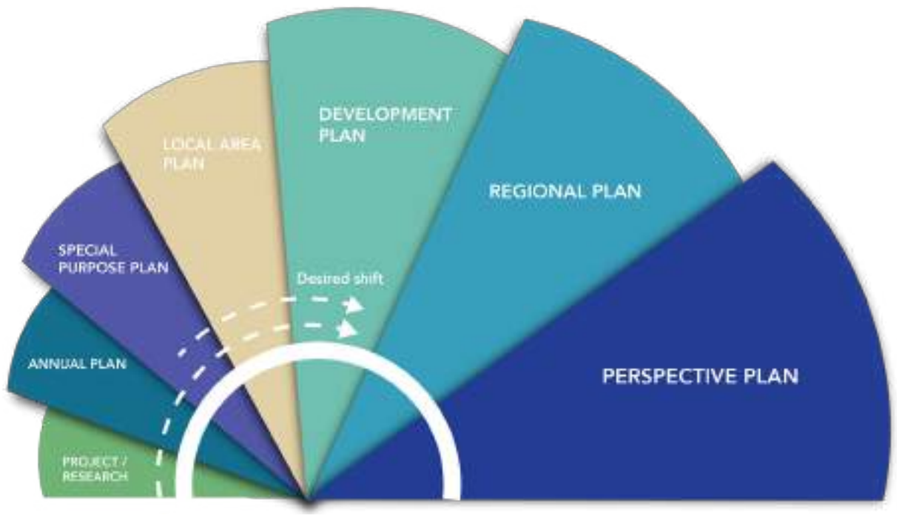
- Much of the undesirable state of rivers is due to disruptive anthropogenic activities that are more prevalent in cities. Hence, the nature of actions taken in cities are vital for the rejuvenation and protection of rivers. Master Plans are developed for cities, and cities are the operational units at which action on the ground can be taken. Hence, incorporating river thinking into Master Plans creates the ground for direct implementation of actionable items.
- Restoring degraded rivers takes time, and requires sustained effort over a long period. A Master Plan is typically prepared for a 20-30 year period, which makes it an ideal avenue for integrating long-term actionable items

related to river management.

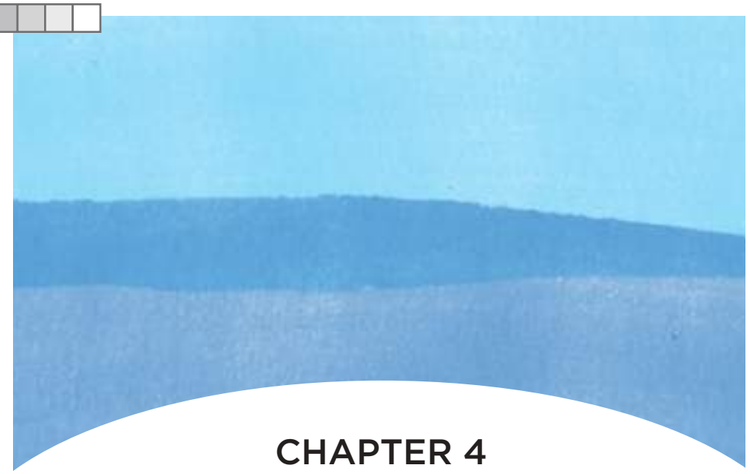
- Holistic river management requires concerted and coordinated efforts from multiple stakeholders, which usually operate in silos. A Master Plan is developed for the entire city, encompassing different planning sectors. It has the authority to create structures and mechanisms for different agencies to work together for a common vision.
- Master Plans are expected to be made with citizen engagement and support. The citizens, therefore, have a voice in the making of the Plan. This creates a unique opportunity to make river protection and rejuvenation a people's mandate.
- Master Plans are legally binding statutory documents. River-related interventions included in Master Plans will, therefore, have a legal backing, making them easier to implement.
- Master Plans are prepared by organizations reporting to the State, and water is a State subject. Thus, urban river management has a natural complementarity with the Master Plans of cities.

Currently, river management in many cities is mostly taken up in isolation as a special project, with an associated plan (Special Purpose Plan). In order to ensure holistic and comprehensive management of the river, there is a need to escalate it in the planning hierarchy, as presented in *Figure 8*.

Figure 8: Desired transition of river management considerations in the planning hierarchy



Source: Developed by the authors



CHAPTER 4

MASTER PLAN TOOLS AND INSTRUMENTS FOR RIVER MANAGEMENT

4.1 Background and Context

Traditionally, Master Plans of cities have been solely concerned with land-use planning, making the connection between built and open spaces, social settings, and their surrounding environments. However, in recent years Master Plans have begun to shed their tag of being a purely land-use based plan and emerged as a strategic enabler to influence the direction which a city will take to make it more vibrant, livable and productive. For example, the Los Angeles' General Plan (2035)[3] has marked 'Significant Ecological Areas' to conserve genetic and physical diversity within LA County by designating biological resource areas that are capable of sustaining themselves in the future. Likewise, the Andhra Pradesh Capital Region Perspective Plan (2050) talks about a shift towards renewable energy, green certifications for buildings, and zero waste philosophies, among the other conventional content. From these examples, it is quite clear that the far-reaching implications of land use are finally being recognized, making it necessary to expand the role of a traditional, narrowly focused tool to encompass biodiversity, energy use, climate change, human health, food security and water security.

A city prepares its Master Plan once in 20-30 years, typically through an inclusive process. This Plan defines the development trajectory of the city, and includes those elements and features that are of most importance to the city. Given the significance of the river for a city, it is imperative that this is acknowledged in the Master Plan, and is supported by strategies to integrate this significance in the overall development landscape. There are a number of planning instruments and tools within a Master Plan that can be used for this purpose. This section highlights these tools, along with practical examples of how these have been used in different cities.

3 https://planning.lacity.org/plans-policies/general-plan-overview

3.2 Creating a Supporting Environment for River Consideration in Master Plans

A precursor to integrating river consideration into a Master Plan is creating the required supporting environment through two aspects. The first is to clarify the ambition of the city in this regard, by setting out a broad vision of how the city views its connect with the river, within the plan period. The second is to create a robust knowledge and information baseline of the river and its interaction with the city, which will help inform river-specific strategies. After creating this supporting environment, the Master Plan instruments and tools can be used to mainstream sustainable river health management into the city's larger long-term vision. *Figure 9* presents an overview of these tools for river-sensitive planning.

Figure 9: Instruments and tools for making river-sensitive plans

Source: Developed by the authors

4.2.1 Master Plan Vision for the River

The first step in developing river-sensitive Master Plans for the city is to define and clarify its vision for the river, and how it perceives the river in its development landscape. This will help in creating a value for the river in the Plan. As the adage goes, *"What we value, we take care of."* Hence, creating a value for the river sets the stage for river-specific considerations in the Plan, which can include aspects such as management of water quality, provision of public access to the river to strengthen citizen-river connect, protection of cultural values associated with the river, sustainable utilisation of the river-tourism potential, management of risks associated with natural hazards, as well as conservation of the natural ecosystem.

From experiences around the world, an ideal visioning exercise is thoroughly inclusive, reflecting the needs and aspirations of different stakeholders, particularly including those that have traditionally been side-lined and marginalized. This helps in making river management a 'people's mandate' and helps build collective ownership around river-related initiatives.

Some examples of river-sensitive visions and objectives developed by progressive cities are provided in Box 1 and 2.

BOX 1: MASTER PLAN, NEW ORLEANS, 2030

Vision Statement

1. LIVABILITY – Enhanced quality of life for everyone that preserves the city's character
2. OPPORTUNITY – Expanding opportunity and ensuring equitable chance to share benefits
3. SUSTAINABILITY – A more resilient city

By 2030, New Orleans can become a city that celebrates its relationship with water and uses water-management strategies to provide amenities to neighbourhoods wherever possible

Source: https://www.planetizen.com/files/plans/New%20Orleans%20Plan%20Vol%202%20Implementation.pdf

BOX 2: LOS ANGELES RIVER MASTER PLAN 2020 (DRAFT)

Vision Statement

The Reimagined River - Fifty-one miles of connected open space that includes clean water, native habitat, parks, multiuse trails, art, and cultural resources to improve health, equity, access, mobility, and economic opportunity for the diverse communities of LA County, while providing flood risk management.

Goals

- Reduce flood risk and improve resilience.
- Provide equitable, inclusive, and safe parks, open space, and trails.
- Support healthy, connected ecosystems.
- Enhance opportunities for equitable access to the river corridor.
- Embrace and enhance opportunities for local arts and culture.
- Address potential adverse impacts to housing affordability and people experiencing homelessness (along the river).
- Foster opportunities for continued community engagement, development and education.
- Improve local water supply reliability.
- Promote healthy, safe, clean water.

Source: http://www.larivermasterplan.org/

4.2.2 Developing the River Baseline

Developing a baseline for the river essentially involves ascertaining the 'status quo' of the condition of the river, its interaction with the city, and its contextual setting within the region. The objective is to have a sound understanding of the ground reality - including the issues and challenges - which will then help devising specific strategies to address the shortcomings. The regional context is particularly important because rivers do not follow administrative boundaries. Hence, a city which is located downstream may suffer from impacts caused by upstream cities. As part of the baseline preparation, such aspects that will help in identifying the relevant planning interventions need to be investigated thoroughly.

In addition to the regional context, it is also important to study the various urban sectors that have an impact on the river. These include sectors such as agriculture, industry, tourism, transport, water supply and wastewater management, and solid waste management, among others. This will help in understanding the interactions of the river with these sectors, and highlight those aspects that would need to be addressed through the Master Plan.

Ideally, the contents of the river baseline should include (but not limited to) the following aspects:

- Regional context: upstream implications for the river
- Physical features: length and direction of the river course (both current and historic); existing land cover adjacent to the river (ideally in 1 km on each side); width and depth of river, groundwater depth, soil type and condition; etc.
- Topography: contours; gradients; river zone delineation; floodplain delineation; drainage pattern in the city; etc.
- Demography: spatially disaggregated population density; location of unauthorized/ slum settlements; demographic profile of the city; etc.
- Physical infrastructure: locations of sewerage infrastructure, drainage network, sewered and non-sewered areas, on-site sanitation systems, community/public toilets, solid waste collection centres, water supply systems, sewage outfall, solid waste dumping sites; etc.
- Spatial planning: planning zones; ward boundaries; land use; use zones/use premise; etc.
- Stakeholder mapping: agencies involved with river management; functions and responsibilities of these agencies; ownership of land in the river zone
- Environmental assets: area and location of water bodies, forests, wetlands, parks, protected areas/eco-sensitive zones, flora and fauna, etc.
- Social aspects: religious and cultural establishments, especially along the river; crematoria; dhobi ghats; boating locations; river-front access locations; other recreational areas; etc.
- Economy: details of water use sectors; river-related economy; etc.

In line with contemporary needs, it is best to develop the baseline on a GIS platform to ensure that the baseline can be updated periodically, and be made widely available on a digital platform to a wide range of stakeholders.

An example of a river baseline is provided in Box 3.

BOX 3: BASELINE ELEMENTS FOR THE RIVER SOUTH GREENWAY MASTER PLAN, SOUTH PLATTE RIVER, DENVER, US

Existing Condition Maps – Current Assessment

Identification and analysis of existing conditions resulted in an understanding of issues, challenges and specific planning recommendations within the River South Greenway Master Plan study area. For analysis purposes, existing conditions were organized into sixteen maps including:

1. General Types of Property Ownership
2. Generalized Existing Land Use
3. Existing Zoning
4. Flood Hazard Areas
5. Blueprint Denver
6. Neighborhood Features
7. Mobility
8. Recreation Features
9. Existing In-River Recreation Features
10. Aquatic Habitats
11. Vegetation Habitat
12. Sanitary Sewer Infrastructure
13. Storm Sewer Infrastructure
14. Notable Channel Features
15. Barriers
16. Landfills

Opportunity Maps

Analysis of existing conditions leads to the identification of opportunities. Opportunity maps for access, land, land use – water/ recreation and habitat were completed and provided a valuable tool when developing the Vision Plan Map and determining planning proposals.

For analysis purposes, existing conditions were organised into four opportunity maps including:

1. Access Opportunities
2. Land Opportunities
3. Land Use Opportunities
4. Water Recreation and Habitat Opportunities

Source: https://www.thegreenwayfoundation.org/uploads/3/9/1/5/39157543/riso.pdf

4.3. Planning Tools for River Management

The purpose of the comprehensive visioning and baseline exercise described in the previous section is to provide a city with the required directions on river-specific aspects that need to be considered, to ensure harmonious co-existence of the river and the city. Some of these directions may require short-term interventions in the form of projects and direct actions. The others will require systematic long-term policy and regulatory interventions, which can be anchored in a city's Master Plan through various tools and instruments. This section elaborates on seven such tools and instruments that can be used to ensure river-sensitive development within a city. Presented hereafter are the details of each of these instruments, along with case examples showing how they have been successfully adopted in different river cities, wherever applicable.

4.3.1 Localising National Policies and Initiatives

Policies set the framework for directing development, in-line with the overall vision and objectives of the planning document. Strong planning policies ensure controlled development that is carefully designed without deteriorating the existing landscape, while ensuring that the local needs are well addressed. The policies in-turn lead to specific strategies and projects for different areas.

Several national and state policies in India have direct implications on river management aspects. Some of these allied policies/ supporting policies are the National Policy on Faecal Sludge and Septage Management, 2017 (for sanitation waste management); Swachh Bharat Abhiyaan, 2014 (for toilets and solid waste management); Jal Shakti Abhiyaan, 2019 (for water bodies rejuvenation, water conservation, afforestation, and groundwater recharge); Draft National Forest Policy, 2018 (for forest management); Draft National Water Policy, 2012 (which has considerable river-related clauses); National Water Mission, 2011 (for climate-change related implications); Street Vendors Act, 2014 (for riverfront markets); Draft National River Policy 2011; National Biodiversity Action Plan, 2019; National Plan for Conservation of Aquatic Eco-systems (NPCA); National River Conservation Plan (NRCP); among others. The state level interventions include the River Regulation Zone (RRZ) policy by states, state Water Policies and the Inter-State River Water Disputes (Amendment) Bill (2019), among others. Box 4 presents the river-related directions of the Draft National Water Policy.

The Master Plan should devise specific localized strategies for customized implementation of these policies at a city scale, wherever possible. Furthermore, there are several guidance documents created at the national level that the Master Plan can refer to, or recommend, to help translate policies into tangible actions. These include the *CPHEEO Manual on Sewerage and Sewage Treatment Systems (2013); Guidelines for Decentralized Wastewater Management (2012) by IIT Madras; CPCB Guidelines for Restoration of Waterbodies (2019); CGWB's Manual on Artificial Recharge of Ground Water (2007); NMCG's Guidance Note for Urban Riverfront Development; State Guidelines on Rain Water Harvesting; Model Bill for Flood Plain Zoning (1975); TCPO's Urban Green Guidelines (2014)*; etc.

BOX 4: RIVER-RELATED CONSIDERATIONS IN THE NATIONAL WATER POLICY (2012), MINISTRY OF WATER RESOURCES, GOI

Conservation of River Corridors, Water Bodies and Infrastructure

- Conservation of rivers, river corridors, water bodies and infrastructure should be undertaken in a scientifically planned manner through community participation. The storage capacities of water bodies and water courses and/or associated wetlands, the flood plains, ecological buffer and areas required for specific aesthetic recreational and/or social needs may be managed to the extent possible in an integrated manner to balance the flooding, environment and social issues as per prevalent laws through planned development of urban areas, in particular.
- Encroachments and diversion of water bodies (like rivers, lakes, tanks, ponds, etc.) and drainage channels (irrigated area as well as urban area drainage) must not be allowed, and wherever it has taken place, it should be restored to the extent feasible and maintained properly.
- Urban settlements, encroachments and any developmental activities in the protected upstream areas of reservoirs/water bodies, key aquifer recharge areas that pose a potential threat of contamination, pollution, reduced recharge and those endanger wild and human life should be strictly regulated.
- Environmental needs of Himalayan regions, aquatic eco-system, wet lands and embanked flood plains need to be recognized and taken into consideration while planning.
- Sources of water and water bodies should not be allowed to get polluted. System of third party periodic inspection should be evolved and stringent punitive actions be taken against the persons responsible for pollution.
- Quality conservation and improvements are even more important for ground waters, since cleaning up is very difficult. It needs to be ensured that industrial effluents, local cess pools, residues of fertilizers and chemicals, etc., do not reach the ground water.
- The water resources infrastructure should be maintained properly to continue to get the intended benefits. A suitable percentage of the costs of infrastructure development may be set aside along with collected water charges, for repair and maintenance. Contract for construction of projects should have inbuilt provision for longer periods of proper maintenance and handing over back the infrastructure in good condition.
- Legally empowered dam safety services need to be ensured in the States as well as at the Centre. Appropriate safety measures, including downstream flood management, for each dam should be undertaken on top priority.

Source: http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf

4.3.2. Town-Specific Sectoral Strategies

In addition to localizing national/state policies, cities may also consider developing their own policies/strategies that are not necessarily covered under other policy instruments. In such cases, a city has all the flexibility to decide on the nature, scope and extent of these strategies in line with its indigenous requirements. Examples of such strategies include citizen engagement strategy, blue-green continuum strategy, strategy for urban forestry, etc. A specific strategy for development of a riparian stretch all along the river (wherever possible) may form a part of the Master Plan as well.

Some specific examples showing town-specific strategies for water/river management in Master Plans are presented in Box 5 and 6.

BOX 5: EXTRACT FROM THE STRUCTURE PLAN FOR BANGALORE METROPOLITAN REGION (BMR), 2041

Strategies for Water Resource Management

- Effective protection and rejuvenation of surface water bodies - All water features like rivers, reservoirs, lakes, seasonal stream beds and wetlands should be protected, maintained and enhanced in capacity. This is critical from the long-term ecological well-being of the region and also to address the infrastructural needs for development. All lakes and tanks in the BMR should be actively rejuvenated. This should include existing lakes as well as ones that have been degraded / lost due to bad management in the past.
- Regulation of groundwater use - Strict control on groundwater extraction to be enforced. There should be strict monitoring and control on groundwater extraction. Individual drilling, extraction and use should be stopped and community extraction and supply should be regulated.
- Encouraging integrated watershed management - Physical planning at the local area should necessarily integrate watershed management so as to address both development and environmental issues in a balanced manner.

Strategies for Environmentally Sensitive Areas

- Protection framework for Environmentally Sensitive Areas to be enhanced - Developments of any nature should be strictly monitored and controlled in and around designated environmentally sensitive areas such that further deterioration of the areas is arrested.

Source: http://bmrda.karnataka.gov.in/Documents/Revised%20Structure%20Plan%20Report-ilovepdf-compressed.pdf

BOX 6: EXTRACT FROM THE NEW YORK CITY COMPREHENSIVE WATERFRONT PLAN – VISION 2020

Department of City Planning, Vision 2020, presents strategies for implementing many of the long-term goals of PlaNYC, plan for a greener, greater New York City; to improve water quality and ensure that each neighbourhood has access to recreational space.

Citywide Strategies
The City's recommendations for waterfront and waterways spring from eight broad goals

GOAL 1: Expand public access to the waterfront and waterways on public and private property for all New Yorkers and visitors alike.
Strategy 1 - Create new publicly accessible waterfront spaces
Strategy 2 - Create a more connected waterfront
Strategy 3 - Ensure public open spaces are of high quality, support diverse uses, and are well-funded

GOAL 2: Enliven the waterfront with a range of attractive uses integrated with adjacent upland communities.
Strategy 1 - Spur reinvestment in the waterfront
Strategy 2 - Incentivise the clean-up and redevelopment of waterfront brownfield sites
Strategy 3 - Increase knowledge of historic resources on the waterfront and promote preservation and adaptive reuse

GOAL 3: Support economic development activity on the working waterfront.
Strategy 1 - Maintain robust activity in the Port of New York and New Jersey and at the Brooklyn and Staten Island marine terminal facilities
Strategy 2 - Promote the region's marine highways to move domestic and international goods within the city and throughout the region
Strategy 3 - Pursue a long-term dredged material management strategy to make New York City's waterways navigable for all forms of transport
Strategy 4 - Analyse and promote policies to strengthen maritime support services and spur reinvestment in waterfront industrial areas
Strategy 5 - Promote environmentally sustainable practices, which will enhance not only waterfront industrial businesses but adjacent residential communities as well

GOAL 4: Improve water quality through measures that benefit natural habitats, support public recreation, and enhance waterfront and upland communities
Strategy 1 - Build new cost-effective grey infrastructure and optimize existing systems to meet goals for water quality throughout the city
Strategy 2 - Maximise the use of green infrastructure and other source controls to capture rainfall on impervious surfaces, helping reduce combined sewer overflows and other discharges
Strategy 3 - Restore natural systems to improve ecological productivity, reduce pollution, and provide habitat, recreation, and climate-adaptation services
Strategy 4 - Improve monitoring and public awareness of water quality

GOAL 5: Restore degraded natural waterfront areas, and protect wetlands and shorefront habitats.
Strategy 1 - Acquire and augment protection of wetland and other shoreline habitat
Strategy 2 - Increase scientific understanding, public awareness, and stewardship of the natural waterfront
Strategy 3 - Promote ecological restoration that enhances the robustness and resilience of local and regional ecosystems

GOAL 6: Enhance the public experience of the waterways that surround New York.
Strategy 1 - Promote water recreation in suitable locations with access points, docks, and on-shore facilities
Strategy 2 - Clarify and enhance regulatory and organisational mechanisms to ensure safety of water recreation and reduce potential conflicts among various users of the waterways
Strategy 3 - Increase waterborne public transportation
Strategy 4 - Increase New York City's preparedness for waterborne emergency evacuation
Strategy 5 - Increase public knowledge and awareness of the waterfront and waterways
Strategy 6 - Explore renewable energy opportunities on our waterfront and in our waterways

GOAL 7: Improve governmental regulation, coordination, and oversight of the waterfront and waterways.
Strategy 1 - Improve predictability and efficiency of the permitting process for in-water construction
Strategy 2 - With input from stakeholders, establish design guidelines for in-water

infrastructure, such as piers, docks, and bulkheads
Strategy 3 - Ensure that the City adequately maintains City-owned waterfront infrastructure
Strategy 4 - Pursue regional coordination and partnerships on issues of regional significance

GOAL 8: Identify and pursue strategies to increase the city's resilience to climate change and sea level rise.
Strategy 1 - Conduct a citywide strategic planning process for climate resilience
Strategy 2 - Develop a better understanding of the city's vulnerability to flooding and storm surge and examine a range of physical strategies to increase the city's resilience
Strategy 3 - Explore regulatory and policy changes to improve resilience of new and existing buildings to coastal flooding and storm surges
Strategy 4 - Work with the Federal Emergency Management Agency (FEMA) and the insurance industry to encourage the consideration of more accurate data on current and future risks of flooding and storm surges
Strategy 5 - Assist with local resiliency planning
Strategy 6 - Integrate climate change projections into NYC's emergency planning and preparedness efforts

Source: https://www1.nyc.gov/assets/planning/download/pdf/plans-studies/vision-2020-cwp/vision2020/vision2020_nyc_cwp.pdf

4.3.3. Land Use Assignment

Land use planning has traditionally been the core function of the Master Plan. With improvement in knowledge about the tangible and intangible benefits that the environmental assets of a city can provide, it is important that the land use planning also reflects this. For example, the (Draft) National Land Utilization Policy, 2013 states that "land is required for development of essential infrastructure and for urbanization, while at the same time there is also a need to protect land under environmentally sensitive zones and land which provides ecosystem services. When it comes to river cities, spatial planning of the waterfront can directly help protect the ecological, amenity, economic and cultural values.

In almost all states of India, a Master Plan is a statutory land use plan, approved and adopted by the local authority, with precise and definite proposals notifying the manner in which land parcels are affected. These Plans have enough control over land through various associated techniques like land acquisition, land pooling, land reservations, Transferable Development Rights (TDRs), guided land developments, etc. These can direct the physical development of a city by ensuring the best possible use of each land parcel. For all river cities, the land use planning within the river's zone of influence, without disturbing the natural ecology of the area, is of utmost importance.

Land use planning involves allocating different land use types within the city to allow for systematic urban development. Each land use category can be further sub-divided into land use zones. The land use zone can be further divided into land use premises. Land use premises can be permitted across different land use zones. Finally, for each use premise there are a certain use activities that can be permitted.

For proper management of the land adjacent to the river, a complete exercise of delineation of the river influence zone has to be undertaken. Appropriate land uses and use zones have to be assigned for this delineated area within the Master Plan, with a focus on maintaining the natural sanctity of the area. Specific eco-sensitive areas can be earmarked for conservation. A clear identification of permissible and restricted activities is also required, for regulating controlled use of the river space without disturbing its natural character. In addition, the definitions and parameters for delineation of the river space, as well as allocation of various use zones with use restrictions (permitted, conditionally permitted or prohibited) have to also be clearly specified within the planning document. Box 7 presents an extract from the proposed notification for River Regulation Zone in India, Box 8 documents a research that helped in developing the above mentioned notification, and Box 9 summarizes the relevant features of the Draft River Conservation Rules.

Given the space constraints within cities, it will be quite critical to explore the immense potential for better appreciation and integration of the river with the city. One such opportunity is the temporal nature of changing functions along the river. Seasonal or day specific activities need to find a place. These may include natural/ ecological uses such as seasonal cultivation of flood plains to ritualistic functions such as melas or other cultural/ religious celebrations.

NOTE: More details about the criteria for delineation of river zone, permissible/ prohibited activities and specific development controls applicable to the river zone, are available in the draft publication on 'River Centric Master Planning and Urban River Management and Planning Guidelines, 2020' being developed by the Town and Country Planning Organisation (TCPO) in consultation with NIUA, Ministry of Housing and Urban Affairs, GoI. This publication is under preparation and is likely to be announced soon.

BOX 7: DRAFT NOTIFICATION ON RIVER REGULATION ZONE (RRZ), 2016

Vision Statement

For Flood Plain rivers: Rivers flowing at less than 300 m elevation until the formation of Delta close to sea level

a. Prohibited Activities Zone (RCZ-PA) Extend from river bank upto 500m from HFL without embankments. Extend from river bank upto 100m from HFL with embankments Entire area available on both sides of the river banks for ecologically sensitive area, National parks, Wild life Sanctuary etc.
b. Restricted Activities Zone (RCZ-RAI) Extend upto one kilometre from outer limits of RCZ-PA. (1.5 km from HFL) without embankments. Extend upto 1.1 kms from existing embankment.(1.1 km from HFL) with embankments.
c. Regulated Activities Zone (RCZ-RAII) Extend upto three kilometres from outer limits of RCZ-RAI.

For Mountain rivers and hill streams: Rivers flowing at elevation between 1000 m and 300 m

a. Prohibited Activities Zone (RCZ-PA)
- If slope of hill towards the river exceeds 30 degrees, RCZ-PA shall extend upto a distance of 5 m from HFL.
- If slope of hill towards the river is more than 10 but less than 30, RCZ-PA shall extend upto a distance of 15 m from HFL.
- If slope of hill towards the river is less than 10 degrees, RCZ-PA shall extend upto a distance of 50m from HFL.

b. Restricted Activities Zone (RCZ-RAI)
- Extend upto a distance of 100 m or the crest of hill, whichever is less, beyond the boundary of RCZ-PA.

Permitted Activities

RCZ-PA
- Traditional organic farming
- Traditional capture fisheries
- Traditional grazing
- Groundwater withdrawal by hand pumps for local use
- Discharge of domestic wastewaters from cities or towns only after treatment
- Purely temporary structure

Prohibited Activities

RCZ-PA
- Permanent constructions
- Construction of new embankments
- Land reclamation
- Dumping of solid wastes/creation of landfills
- Withdrawal/diversion of water

RCZ-RAI and RCZ-RAII
- Hazardous waste producing industries and chemical industries

Mountain rivers and hill streams
- Permanent constructions
- Dumping of solid waste

Restricted and Regulated Activities

RCZ-PA
- Construction of strategic importance
- Construction of sewage or effluent treatment plants (<5MLD)
- Temporary constructions in case of emergency
- Repair and maintenance of existing road/bridges

RCZ-RAI
- Construction of residential/ institutional/commercial buildings; schools, dispensaries, recreational facilities, public toilets

RCZ-RAII
- All kinds of industries discharging wastewater with toxic pollutants and heavy metals

Source: http://moef.gov.in/wp-content/uploads/2018/03/Impact-Assessment-River-Valley.pdf

BOX 8: REGULATION OF HUMAN ACTIVITIES ALONG RIVERS AND LAKES - *A BACKGROUND DOCUMENT FOR THE PROPOSED NOTIFICATION ON RIVER REGULATION ZONE, NATIONAL INSTITUTE OF ECOLOGY, 2002*

The report has been prepared for the National River Conservation Directorate, Ministry of Environment and Forests, Government of India to develop a criteria for zoning of rivers and their floodplains, and also regulate activities within those zones.

The report identifies the following criteria for recognising different river zones:

- Climatic, Geomorphic and Hydrological Criteria
- Urbanisation/Human use
- Potential for Restoration
- State of Degradation
- Ecological Criteria
- Socio-cultural Criteria

Delineation of River Regulation Zone

The criteria described above will lead to an elaborate system of zones for the numerous large, medium and small rivers in India. Four River Regulation Zones have been proposed with the following major features:

- **RRZ I** – River channels and their floodplains in ecologically sensitive and fragile watershed areas; areas mostly in foothills (medium elevations); areas of pristine/outstanding beauty, heritage sites; areas rich in genetic diversity or important for biodiversity, particularly rare/ endangered species
- **RRZ II** – River channels and their floodplains in the hills (>300 m altitude); generally low human population density; high flow velocity; river regulation relatively low
- **RRZ III** – River channels and their floodplains at lower elevation (<300 m altitude); within municipal limits (high population densities) where floodplain has already been heavily reduced and infrastructure facilities are well developed (e.g., temples, ghats, road, various residential, commercial or recreational buildings, boat jetties, fish landing facility, etc.); river stretches generally heavily regulated or channelized; water quality much degraded and restoration most difficult (low potential)
- **RRZ IV** – River channels and their floodplains at lower elevation (<300 m altitude) in suburban and rural areas where infrastructure development has not occurred or is only moderate, and where land is primarily under agriculture and grazing; areas with low degradation but high potential for restoration.

Use Activities/ Permissibility

Unless exempted (as listed below), the following activities shall be regulated to the extent indicated in each of the four Zones identified earlier for the purpose.

RRZ I

- Total prohibition of all polluting activities including permanent or temporary construction (Residential, Commercial, Religious, Recreational),
- Total prohibition of agrochemical-based cultivation,
- Total prohibition of disposal of all kinds of solid wastes (including religious offerings and idol immersion)

RRZ II

- Total prohibition on permanent/ temporary construction on floodplain/ slope facing river
- Total prohibition on mining/quarrying on hills
- Total prohibition on use of fertilizers and pesticides for agriculture
- Total prohibition on solid waste disposal
- Regulation of forage removal/grazing on hill slopes
- Regulation of gravel/sand mining

RRZ III

- No further extension of any infrastructure that may necessitate reduction in the remaining floodplain or affect the course of the river channel
- Total prohibition of disposal of all kinds of solid wastes
- Total prohibition of groundwater extraction within 500m of the river channel and limited (regulated) extraction beyond that area

RRZ IV

- Total prohibition of all polluting activities including permanent or temporary construction (Residential, Commercial, Religious, Recreational)
- Total prohibition of agrochemical-based cultivation
- Total prohibition of disposal of all kinds of solid wastes
- Total prohibition of groundwater extraction within 500m of the river channel
- Total ban on drainage and reclamation of existing wetlands
- Regulation of gravel and sand mining – stretches & amounts to be identified and notified
- Regulation of grazing and forage removal

The proposed notification also specifies the zoning to be regulated within a distance of 500 m from floodplain boundary

Since RRZ has not yet been notified, the influence zone delineation is an unresolved concern.

Source: https://cdn.downtoearth.org.in/dte/userfiles/images/RRZ-Background-Report-Dec2002.pdf

BOX 9: DRAFT RIVER CONSERVATION ZONE (REGULATION OF HARMFUL ACTIVITIES) RULES, 2012

Floodplain zoning

The following lateral zonation of river banks has been defined:

- **No Development Zone (NDZ)** - The competent authority shall determine a NDZ on either bank for each river which shall not be less than the "Active Flood Plain" of the river.

Active floodplain is defined as an area on either side of a stream/river which is regularly flooded on a periodic basis. A typical hydrological criterion to designate an active floodplain in a given reach is the 2.33-year return period of the flood

- **High and Medium Impact Zones (HIZ and MIZ)** - The competent authority shall identify and designate suitable distance/s, from the NDZ, on either bank keeping local topographical conditions in mind, to be called as HIZ and MIZ. In plains where river topography is relatively flat, these distances shall not be less than 1 and 3 km respectively from the NDZ.

Note: "Active Flood Plain" as defined by High Flood Line (HFL) which in entrenched /embanked stretches of a river stretch shall be the available space (including the river channel/s) in the valley of entrenched stretch or between two embankments or between existing roads on either side along a river acting as an embankment.

In other stretches of the river HFL / active flood plain shall be the 100 year flood line.

Source: https://cdn.downtoearth.org.in/dte/userfiles/images/river-rules-2012.pdf

4.3.4. Development Control Regulations (DCRs)

DCRs are intended to limit the type and extent of development in a given area. Regulations like height restrictions, Floor Area Ratio (FAR), minimum setbacks, ground coverage, etc. are a part of the Master Plans in the form of building bye-laws or architectural controls. For river cities, once the river zone or floodplain is demarcated, specific development controls should be identified for the sub-zones falling within this eco-sensitive area. There can be different considerations for restrictions within that particular zone. For example, in an area liable to flooding, there can be regulations on minimum plinth levels, prohibition for construction of basements, and minimum levels of approach roads, among others. Likewise, in the belt adjacent to the river, there can be regulations on FAR and ground coverage so as to ensure that the visual corridor to the river is maintained.

Box 10 to 12 provide examples of developmental regulations imposed within the river zones in different cities.

BOX 10: EXTRACT FROM THE DRAFT BIHAR BUILDING BYE-LAWS, 2013

Construction near river front

- No construction or re-construction of any building, within the distance of 200 meters, or such other higher distance as prescribed from time to time by the State Government, from the outer boundary of the riverfront of Ganges shall be permitted except for repair and renovation work of heritage buildings.
- No construction or re-construction of any building shall be allowed, within a distance of 100 meters, or such distances as prescribed by the State Government, from the outer boundary of the riverfront of any river other than the Ganges river. The State Government shall notify a list of such rivers.
- Notwithstanding the above provisions, any Planning Authority or Government Body shall be able to undertake development and beautification work of riverfront, ghats or any other planned development on reclaimed lands with the approval of the Government.

Source: http://www.bshb.in/download/Bihar_State_Urban_Bye_laws.pdf

BOX 11: EXTRACT FROM THE DRAFT DEVELOPMENT CONTROL AND PROMOTION REGULATIONS 2015, FOR PUNE MUNICIPAL CORPORATION

Construction within flood line of river

- Area between the river bank and blue flood line (corresponding to 1 in 25 year flood) shall be prohibited zone for any construction except parking, open vegetable market, garden, lawns, open space, cremation and burial ground, or like uses, provided the land is feasible for utilization.
- The construction in the area between blue flood line and red flood line (corresponding to 1 in 100 year flood) may be permitted above the red flood line level.
- If the area between the river bank and blue flood line or red flood line forms the part of the entire plot in developable zone i.e. residential, commercial, public-semi-public, industrial, then, FSI of this part of land may be allowed to be utilized on remaining land.
- The blue and red flood line shall be as marked by the Irrigation Department or any other Government institutions dealing with the subject.

Source: https://pmc.gov.in/Draft_Plan_Old_Village/28(4)/DCPR%20PUNE%20-%202015%20-%20vol%20-%201.pdf

BOX 12: EXTRACT FROM THE DEVELOPMENT CONTROL AND PROMOTION REGULATIONS 2015, FOR NASHIK MUNICIPAL CORPORATION

Construction within flood line of river Godavari, Waghadi, Nasardi and Waldevi

- Area between the river bank and blue flood line (corresponding to 1 in 25 year flood) shall be prohibited zone for any construction except parking, open vegetable market with otta type construction, garden, open space, cremation and burial ground, public toilet or like uses, provided the land is feasible for utilization.
- Provided further that development and redevelopment of the existing properties within river bank and blue flood line, in core area, marked on development plan, may be permitted at a height of 0.45 m. above red flood line level (corresponding to 1 in 100 year flood)
- Provided further that development of property falling within the river bank and blue flood line, in non-core area, shall be allowed to be developed subject to flood protection measures to be undertaken by the owner to the satisfaction of Municipal Commissioner in consultation with Irrigation Department.
- Area between blue flood line and red flood line shall be restrictive zone for the purposes of construction. The construction within this area may be permitted at a height of 0.45 m. above the red flood line level.
- If the area between the river bank and blue flood line or red flood line forms the part of the entire plot in developable zone i.e. residential, commercial, public-semi-public, industrial, future urbanizable zone, then, FSI of this part of land may be allowed to be utilised on remaining land

Source: http://nashikcorporation.in/public/upload/download/SDCR_under_section_26.pdf

4.3.5. Norms and Standards

Norms are used as a tool to ensure consistency in planning. Norms for standardised development within the river zone can help facilitate restricted and regulated growth within the area. For example, there are norms for minimum buffers within river zones, minimum required environmental flows, permissible extent of channelization, etc.

Standards, from a river point of view, are tools to ensure the quality of the riverine resources do not suffer because of urban development activities. Standards could be quantitative or qualitative values. For example, there are standards for river water quality, groundwater quality, richness of riparian biodiversity, among others.

Box 13 and 14 present examples of river related norms and standards, which can be mandated through Master Plans.

BOX 13: ENVIRONMENTAL FLOW (E-FLOW) IN RIVER YAMUNA

E- Flow Standards

- The Hon'ble Supreme Court had in W.P. (C) 537 of 1992 directed on 14 May 1999, that *"a minimum flow of 10 cumecs (353 cusec) must be allowed to flow throughout the river Yamuna."*
- In view of the above it has been estimated that the E-Flow in river Yamuna downstream of the barrage at Hathnikund should be no less than 2500 cusec (around 70% of the average minimum virgin flow of 3500 cusec reported at Hathnikund barrage during the leanest month of January). And the corresponding flow downstream of the barrage at Okhla in Delhi should be no less than 1500 cusec. These may be designated as the lower 'river safety' thresholds at the respective barrages.

Source: https://yamuna-revival.nic.in/wp-content/uploads/2019/02/E-flow-PrincipalCommittee.pdf

BOX 14: GUIDELINES FOR PREPARATION OF PROJECT REPORTS UNDER NATIONAL RIVER CONSERVATION PLAN AND NATIONAL GANGA RIVER BASIN AUTHORITY

Water Quality Standards for Rivers

- Water Quality Standards for rivers as per CPCB classification of Designated Best Use criteria of rivers for bathing are as given below:

Water Quality Standards for bathing in rivers	
Parameters	Standards
pH	6.5 to 8.5
BOD	3 (mg/l) or less
DO	5 mg/l or more
Faecal coliform	
Desirable	500 (MPN/100 ml)
Max. permissible	2500 (MPN/100 ml)

Effluent Standards

- Effluent standards have been made more stringent, for critical stretches of River Ganga, by the Ministry of Environment, Government of India

Effluent standards prescribed by NRCD, Ministry of Environment, GOI

Parameters	Units	Effluent Standards for discharge into waterbodies		Effluent Standards for discharge on land
		Existing Standards	Standards revised on 3.2.10 (Annexure 3)	
pH	6.5 to 8.5	5.5-9.0		
BOD	3 (mg/l) or less	30	*20	100
TSS	5 mg/l or more	50	*30	200
Fecal coliforms	MPN/100ml	Desirable - 1,000 Permissable - 10,000		Desirable - 1,000 Permissable - 10,000

*or lower depending on the assimilative capacity of the effluent receiving waterbody

Source: https://nrcd.nic.in/writereaddata/FileUpload/Guidelines_for_Report_Preparation_under_NRCP_NGR_A_Dec%202010.pdf

4.3.6. Recommendations and Directions

The Master Plan is also very well placed to make recommendations on current and emerging aspects that need to be addressed. It has the authority to provide tangible directions to various agencies to take action in this regard. For example, climate change is likely to alter river flows, thereby disturbing the ecology that depends on it. Similarly, in view of depleting rivers and groundwater, it is becoming increasingly evident that water demand management is the only way forward for large urban areas to meet their water demand. In river cities, specific recommendations for the floodplains should be framed, with a focus on conservation of the natural river environment.

Box 15 highlights examples of such river-related recommendations.

BOX 15: EXTRACT FROM THE LOS ANGELES RIVER REVITALIZATION MASTER PLAN (2007)

Goal: Enhance Flood Storage

Recommendation 1 - Identify opportunities for peak flood storage outside the channel to reduce flow velocities in the River to sub-critical (less than 12 feet per second) levels. This will support the maintenance and re-establishment of vegetation.

Recommendation 2 - Identify opportunities for selective acquisition of additional rights-of-way to expand the River's floodplain.

Goal: Enhance Water Quality

Recommendation 1 - Emphasise multiple-benefit landscape treatments and "green infrastructure" improvements.

Recommendation 2 - Implement water quality treatment at multiple scales to maximise efficiency.

Recommendation 3 - Create landscape-based water quality treatment at major confluences of the river to treat pollutants carried by tributaries.

Recommendation 4 - Create landscape-based "green strips" at the top of riverbanks and in adjacent linear parkland and streets to treat stormwater runoff from streets.

Goal: Enable Safe Public Access

Recommendation 1 - Provide opportunities for safe access to the water, ensure that people can quickly exit the channel, and establish a flood warning system in the event of high flow conditions.

Recommendation 2 - Provide opportunities for temporary pools and lakes for water-based recreation by installing inflatable rubber dams.

Recommendation 3 - Create a variety of public spaces, including small pocket parks, natural areas, and urban plazas and civic spaces in "reclaimed" areas of the channel.

Recommendation 4 - Ensure public safety by using alternate "greening" techniques in areas where the concrete remains necessary for flood damage prevention.

Recommendation 5 - Continue development of non-motorized transportation and recreation elements including bike and pedestrian paths and multiuse trails in the river and tributary rights-of-way

Goal: Restore a Functional Riparian Ecosystem

Recommendation 1 - Create a continuous functional riparian corridor that provides habitat for birds, mammals, amphibians, reptiles, invertebrates, and fish within the channel bottom.

Recommendation 2 - Connect this corridor to other significant habitat and migration routes along the tributaries and into the mountains.

Recommendation 3 - Improve water quality and provide fish passages, ladders, and riffle pools that would support desirable fish species, including steelhead trout if feasible.

Recommendation 4 - Bio-engineer the river's edge where feasible to create and restore wildlife habitat along the upper reaches of the river.

Source: https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/05Chapter4-RevitalizetheRiver42407.pdf

4.3.7. Special Projects

Master Plans have the authority to propose special projects that have high impact and are necessary for the city. For such projects, it will be important to detail out modalities related to the implementation, administration, management, and funding.

Special projects related to the river include ghat development, clean-up projects, development of eco-recreational sites, installing eco-tourism infrastructure, flood protection measures, artificial recharge structures, among others. Such projects can be identified within the Master Plans, along with an action plan for implementation, while directing particular agency/agencies for developing the Detailed Project Report (DPR).

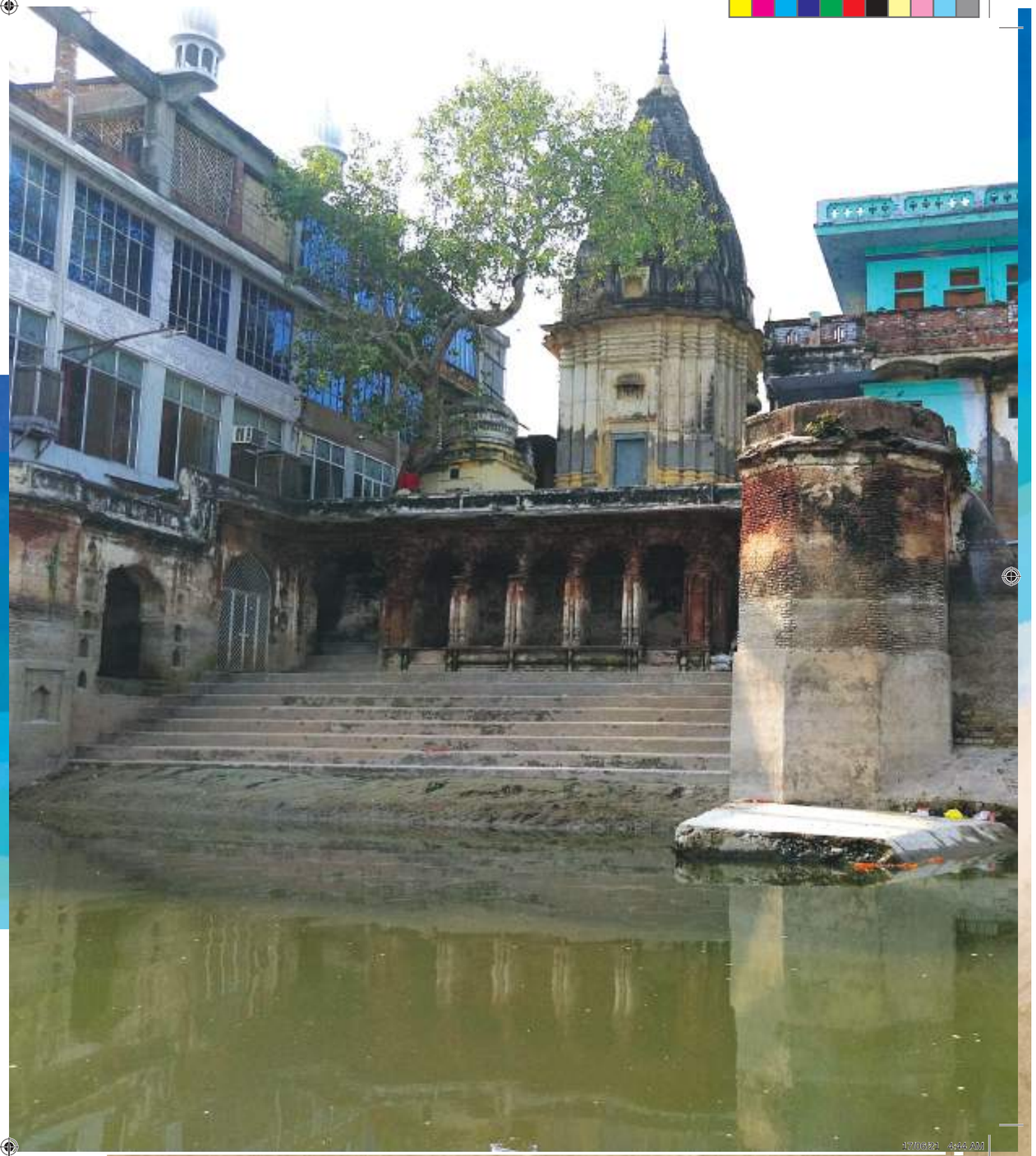
Box 16 presents an example of a project proposed for river development.

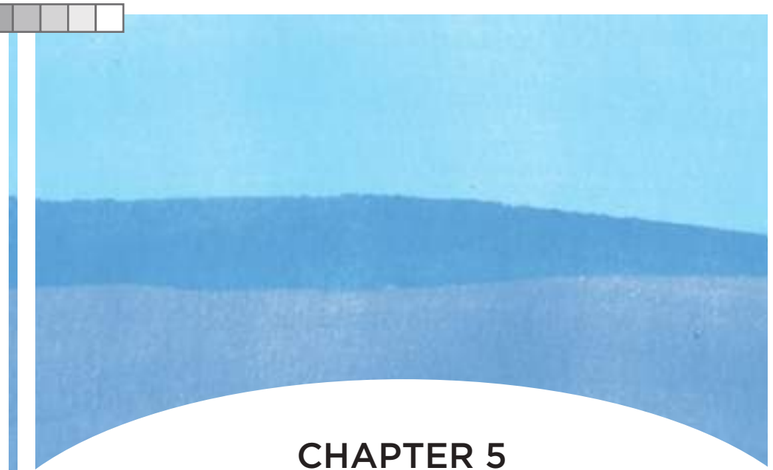
BOX 16: EXTRACT FROM THE DEVELOPMENT CONTROL AND PROMOTION REGULATIONS 2015, FOR NASHIK MUNICIPAL CORPORATION

Development of Cycle Track Along River & Nalla

- A cycle track shall be developed in green belt areas earmarked on Development Plan along the rivers.
- A distance of 6 m from the edge of minor water course (nalla) is to be left as marginal distance for construction of any building. A 3m strip of land from the edge of such water course out of this 6 m distance to be left, shall be available for use as cycle track for general public. The compound wall shall be constructed excluding this distance of 3 m strip for cycle track.
- The owner shall be entitled for FSI of this strip of land for cycle track, in-situ.
- This 3 m wide strip shall be handed over to Municipal Corporation, for which the owner shall be entitled for TDR or in-situ FSI equivalent to 35% of the area of 3 m wide strip.
- This regulation shall be applicable for development of land along nallas. Where development has already taken place and it is not possible to make provision for such 3 m wide cycle track, the Municipal Commissioner shall be empowered to decide not to apply this regulation for particular stretch of nalla. In such cases, normal marginal distances under these regulations shall apply.

Source: http://nashikcorporation.in/public/upload/download/SDCR_under_section_26.pdf





CHAPTER 5

PLANNING FOR URBAN WATERBODIES AND WETLANDS

5.1 Background and Context

Wetlands are defined as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters" (Ramsar, 2018). They are among the most productive ecosystems, providing cities with various social, ecological and economic benefits. These include flood regulation, water supply, recreational access, ground water recharge, improvement in micro-climate and air quality, livelihood generation, and biodiversity conservation, among others.

Rapid urbanization has caused a significant decrease in both the area and quality of wetlands in cities. Sadly, in many cities today, wetlands are being drained, encroached upon, polluted or degraded to the extent of disturbing the entire ecosystem. Current Master Plans do not adequately address the need for conservation and management of water bodies/ wetland systems. Hence, the development has generally been undertaken at the cost of risking the loss of these vital ecosystems. There are several studies suggesting that water-sensitive urban planning is an effective approach to reduce the impact of development on the natural water cycle, thus protecting the urban water bodies and wetland systems.

The Master Plan, therefore, has a vital role to play in the rejuvenation, conservation, and management of water bodies and wetlands in the city. The planning instruments and tools mentioned in the previous chapter can also be used for this purpose, as elaborated hereafter.

5.2 Creating a Supporting Environment for Consideration of Waterbodies and Wetlands in Master Plans

5.2.1. Developing the Baseline

This essentially involves understanding the existing state of water bodies, lakes and wetlands within the city. It will act as a starting point to establish the need, scope, and nature of rejuvenation activities required for the wetlands and water bodies. In line with contemporary needs, it is best to develop the baseline on a GIS platform to ensure that the baseline can be updated periodically, and be made widely available on a digital platform to all stakeholders who may need it.

Typically the baseline would provide information about the following challenges, among others.

- Reduction in area and depth
- Encroachment
- Algal blooms and aquatic weeds
- Decline in ecosystem services
- Pollution (including solid waste)
- Loss of biodiversity

Table below presents the data to be collected for developing a comprehensive baseline.

Table: Data required for developing the baseline for urban wetlands and water bodies

PARAMETERS	PARTICULARS
Physical	• Name of the water body (if assigned) • Classification – Natural or artificial – Perennial or seasonal – Connected or stand-alone • Satellite Image (last ten years at least) • Catchment area • Mapping (GIS platform) – Delineation of boundary – Dimensions (perimeter, water body depth and area) – Location (latitude and longitude) • Local contour map (0.5 m interval or based on water body size)
Biological	• Riparian Flora – List of native plant species – List of invasive plant species • Fauna – List of avifauna species spotted around the water body – List of aquatic species spotted in the water body • Algal bloom in the water body
Chemical	• Water quality – BOD – DO – pH – TSS – Turbidity – Faecal coliform – Nutrient value (nitrogen/ phosphorous) • Water temperature and temperature variation
Hydrogeological	• Ground water level • Soil characteristics • Water flow – inflow & outflow
Planning	• Land use parameters – Designated land use – Permissible activities – Development Control Regulations • Existing status of water body – Encroached/ Dried/ Polluted (domestic or industrial discharge, solid waste dumping, flow of silt load) • Existing status of buffer – Open space/ built-up/ vegetation • Land ownership • Water body function - recreation/ agriculture/ fishing/ tourism/ other livelihood activities • Land value • Existing waterfront development features

5.3 Planning Tools for Water body and Wetland Management

5.3.1. Localising National Policies and Initiatives

Several national and state level policies and programmes have direct implications on rejuvenation and management of water bodies and wetlands. Some of these allied policies and initiatives are the Jal Jeevan Mission (Urban) 2021; Jal Shakti Abhiyaan, 2019, and Wetlands (Conservation and Management) Rules (2017), with a strong priority focus on wetland and water body rejuvenation and conservation.

Some of the Acts which have mentioned wetland conservation include the Forest Act, 1927; the Forest (Conservation) Act, 1980; the Wildlife (Protection) Act, 1972; the Water (Prevention and Control of Pollution) Act, 1974, the Water (Prevention and Control of Pollution) Cess Act, 1977 and the umbrella provisions of the Environment (Protection) Act, 1986. The Environment (Protection) Act also specifies protection of ecologically fragile areas under which a number of wetland ecosystems in the country are being notified. Furthermore, economic valuation of wetlands has been identified as a priority area under the wetland programme.

There are several other national level guidance documents such as CPCB Guidelines for Restoration of Waterbodies (2019); TCPO's Urban Green Guidelines (2014) etc. that can be used as a reference while developing the Master Plan. Box 1 presents the related directions of the Guidelines for implementing Wetlands (Conservation and Management) Rules.

BOX 1: EXTRACT FROM THE *GUIDELINES FOR IMPLEMENTING WETLANDS (CONSERVATION AND MANAGEMENT) RULES, 2017, MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE, GOVERNMENT OF INDIA*

Purpose and Scope

The Ministry of Environment, Forest and Climate Change (MoEF&CC) has notified the Wetlands (Conservation and Management) Rules, 2017 under the provisions of the Environment (Protection) Act, 1986 as regulatory framework for conservation and management of wetlands in India. These guidelines have been drafted to support the State Governments / Union Territory (UT) Administrations in the implementation of the Rules by providing guidance on:

a. Preparing a list of wetlands in the State / UT
b. Identifying wetlands for notification under Wetlands (Conservation and Management) Rules, 2017
c. Delineating wetlands, wetlands complexes and zone of influence
d. Preparation of Brief Document
e. Determining 'wise use' and ecological character
f. Developing a list of activities to be regulated and permitted
g. Developing an Integrated Management Plan
h. Constitution and operational matters of the Wetlands Authorities
i. Overlapping provisions

Source: http://moef.gov.in/wp-content/uploads/2020/01/final-version-and-printed-wetland-guidelines-rules-2017-03.01.20.pdf

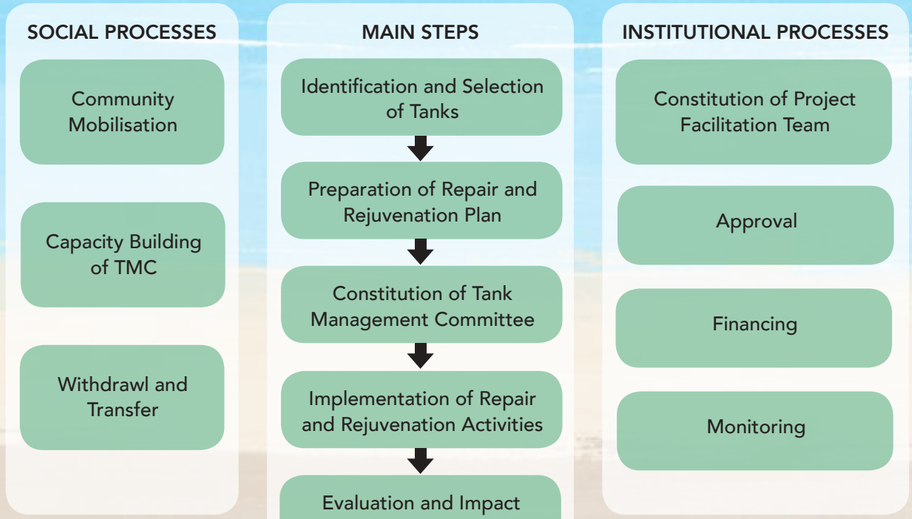
5.3.2. Town-Specific Sectoral Strategies

Some city-specific strategies related to management of water bodies and wetlands include citizen engagement strategy, blue-green continuum strategy, bio-remediation strategy, riparian plantation/ afforestation strategy, etc. Most of these strategies are generic, encompassing multiple aspects. Wetland and water bodies management can form a sub-set in the overall strategy.

An example showing a specific strategy for rejuvenating water bodies is presented in Box 2.

BOX 2: EXTRACT FROM THE *STRATEGY FOR REPAIR AND REJUVENATION OF TRADITIONAL WATER BODIES IN BUNDELKHAND REGION OF MADHYA PRADESH*

The strategy requires both social processes and institutional processes to proceed in tandem. Overall, the strategy involves identification of the water bodies to be rejuvenated based on a baseline exercise, developing a plan for the rejuvenation of the water bodies, implementing the plan, and monitoring the outcomes. A brief schematic of the whole process is presented below.



Source: http://aiggpa.mp.gov.in/uploads/project/RandR_of_WB-_Report.pdf

5.3.3. Land Use Assignment

Appropriate land uses and use zones need to be assigned to both the water bodies/ wetlands and their buffers within the Master Plan, with a focus on maintaining the natural sanctity of the area. Based on its inherent nature and the core function served by the water body/wetland, clear directions for permissible and restricted activities should be provided in order to ensure regulated use of the area. For example, an ecologically sensitive wetland area can be earmarked for conservation with limited permissible human interaction. Likewise, a water body with economic potential may be permitted for water-front development. The allocation of various use zones with use restrictions (permitted, conditionally permitted or prohibited) should also be clearly specified in the planning document. Boxes 3 and 4 provide examples of directions of permissible and prohibited uses in such areas.

BOX 3: EXTRACT FROM THE *GUIDELINES FOR IMPLEMENTING WETLANDS (CONSERVATION AND MANAGEMENT) RULES, 2017, MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE, GOVERNMENT OF INDIA*

Prohibited activities in a notified wetland

a. Conversion for non-wetland uses including encroachment of any kind;
b. Setting up of any industry and expansion of existing industries;
c. Manufacture or handling or storage or disposal of construction and demolition waste covered under the Construction and Demolition Waste Management Rules, 2016; hazardous substances covered under the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 or the Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/ Genetically Engineered Organisms or cells, 1989 or the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008; electronic waste covered under the E-Waste (Management) Rules, 2016;
d. Solid waste dumping;
e. Discharge of untreated wastes and effluents from industries, cities, towns, villages and other human settlements;
f. Any construction of a permanent nature except for boat jetties within fifty meters from the mean high flood level observed in the past ten years calculated from the date of commencement of these rules; and,
g. Poaching.

Activities permitted in a notified wetland

Activities aligned with the 'wise use' of wetland may be permitted within the wetland (wetlands complex) or its zone of influence. The following activities are likely to be aligned with the 'wise use' approach:

a. Ecological rehabilitation and rewilding of nature ;
b. Wetlands inventory, assessment and monitoring;
c. Research;
d. Communication, environmental education and participation activities;
e. Management planning;
f. Habitat management and conservation of wetland-dependent species;
g. Community-based ecotourism (with minimum construction activities);
h. Harvesting of wetlands products within regenerative capacity; and,
i. Integrating wetlands as nature-based solutions for climate change mitigation and adaptation.

Source: http://moef.gov.in/wp-content/uploads/2020/01/final-version-and-printed-wetland-guidelines-rules-2017-03.01.20.pdf

BOX 4: EXTRACT FROM THE METROPOLITAN DEVELOPMENT PLAN-2031, FOR HYDERABAD METROPOLITAN REGION

Open Space Buffer Use Zone (Around Foreshore of Waterbodies)

No construction is permitted in the Open Space Buffer (buffer belt of minimum 30 meters around the Full Tank Level of existing water bodies), except for fishing, boating, and picnics along the banks provided that only construction allowed is open to sky jetties for boating, platforms for fishing.

Source: https://www.hmda.gov.in/pdf/G.O.Ms.No.33,dt.24.1.2013%20(DMDP-2031).pdf

5.3.4. Development Control Regulations

Specific development controls should be notified for the wetlands/ water bodies and their buffer areas. There can be different considerations for restrictions within such areas. These restrictions can be over the extent of construction activity, Floor Area Ratio and Ground Coverage of buildings in the buffer areas, etc.

Box 5 provides an example of developmental regulations imposed in the Master Plan for Hyderabad.

BOX 5: EXTRACT FROM THE METROPOLITAN DEVELOPMENT PLAN-2031 FOR HYDERABAD METROPOLITAN REGION

Water Bodies (Rivers, Nalas, Reservoirs and Kuntas)

a. In water body zone no construction is permitted.
b. No building/ development activity shall be allowed in the bed of water bodies like river, or nala, and in the Full Tank Level (FTL) of any lake, pond, cheruvu or kunta / shikam lands.
c. The above water bodies and courses shall be maintained as recreational/Green buffer zone, and no building activity other than recreational use shall be carried out within:
i. 30 meters from the boundary of Lakes of area 10 Ha and above;
ii. 9 meters from the boundary of lakes of area less than 10 Ha / kuntas / shikam lands
iii. 9 meters from the boundaries of Canal, Vagu, etc.
iv. 2 meters from the defined boundary of Nala

The above shall be in addition to the mandatory setbacks unless and otherwise stated, the area and the Full Tank Level (FTL) of a lake / kunta shall be reckoned as measured or given in the Survey of India topographical maps/Irrigation Dept/Revenue records.

Note: Cheruvu and Kunta are synonyms for ponds. Shikam is a synonym for tank. Vagu is a synonym for stream.

Source: https://www.hmda.gov.in/pdf/G.O.Ms.No.33,dt.24.1.2013%20(DMDP-2031).pdf

5.3.5. Norms and Standards

Norms for standardised development of the areas adjacent to water bodies and wetlands can help facilitate restricted and regulated growth. For example, there are norms for minimum buffers around water bodies/ wetlands, permissible extent of concretisation, etc.

Standards will ensure that the quality of waterbodies and wetlands does not suffer because of urban development activities. For example, there are standards for surface water quality, groundwater quality, richness of riparian biodiversity, among others.

Boxes 6 and 7 present examples of relevant norms and standards, which have been mandated through different Plans.

BOX 6: EXTRACT FROM THE REVISED MASTER PLAN 2015, BANGALORE, ZONING OF LAND USE AND REGULATIONS

In case of water bodies a 30.0 m buffer of 'no development zone' is to be maintained around the lake (as per revenue records) with exception of activities associated with lake and this buffer may be taken into account for reservation of park while sanctioning plans.

Source: https://bbmp.gov.in/PDF/townplanning/Zoning_Regulations_RMP2015f%20(1).pdf

BOX 7: EXTRACT FROM THE INDICATIVE ACTION PLAN FOR RESTORATION OF WATER BODIES (LAKES, PONDS AND RIVERS IN TRIPURA)

Buffer Zone

- Buffer Zone around a lake or pond (at least 50 to 100 m periphery) should be maintained as green belt zone or no activity zone and no activity is allowed within the buffer zone by the concerned Departments in the State/UT. Any activity presently existing within the buffer zone (50 to 100 m), such as residential or commercial or industrial activity should take necessary measures to prevent discharge of any wastes into the water body.
- Within the buffer zone, no impervious cover is allowed and mainly plantation with a dense population of deeply rooted plants, trees, shrubs and grasses should be created so as to absorb nutrients (which promotes aquatic plant growth and a shift in the water quality) that comes directly from the anthropogenic activities.

Source: https://dste.tripura.gov.in/pdfs/indicativeactionplan.pdf

5.3.6. Recommendations and Directions

The Master Plan can make recommendations for the city's water demand management, developing blue-green linkages in a city, making bio-diversity channels across the city, rejuvenating specific water bodies, etc. Box 8 highlights examples of such recommendation that can be included in the Master Plan.

BOX 8: EXTRACT FROM THE GUIDELINES FOR URBAN WATER CONSERVATION, JAL SHAKTI ABHIYAN, 2019

Recommendations and directions to rejuvenate the water bodies

a. Water body should be cleaned through bio-remediation measures, de-silting, aeration, removal of floating and other invasive aquatic plant-species or any other technology suiting local conditions.
b. Shore-line of the water bodies should be properly fenced to protect them from encroachment. Inlet and outlet of the water body should be strengthened.
c. Inflow of domestic sewage/ industrial effluents into the water body should be arrested and only treated effluent adhering to standards prescribed by CPCB may be allowed into the water body.
d. Catchment area treatment via afforestation, storm water drainage management, silt traps, etc. may be undertaken.
e. Water front development around the water body may be taken up, keeping in view the ecosystem based approach for the aquatic body, conforming to prevalent environmental legislation and maintaining social and cultural sanctity of the place. Creation of public spaces may be taken up to ensure public eye and vigilance to protect from encroachment or throwing garbage.
f. Street vendor zones may be developed close to the water body, in convergence with National Urban Livelihood Mission (DAY-NULM).
g. Public toilets may be provided in convergence with SBM-Urban.
h. Participation of private sector, community-based organizations, philanthropic foundations may be encouraged in rejuvenation and maintenance of water bodies. - ULBs should monitor quality of water in the selected body on weekly basis and undertake appropriate action to improve wherever necessary.
i. Each water body may be geo tagged with photographs.

Source: http://mohua.gov.in/cms/jalshaktiabhiyan.php

5.3.7. Special Projects

Special projects within a city for management of its wetlands and water bodies could include rejuvenation of an iconic water body, development of a passive recreational space, constructed wetland development, among others. Such projects can be identified within the Master Plans, along with an action plan for implementation, while directing a particular agency/agencies for developing the Detailed Project Report (DPR). Box 9 presents an example of one such proposed project.

BOX 9: EXTRACT FROM THE THE RAJOKRI WATER BODY REVITALISATION PROJECT, 2020

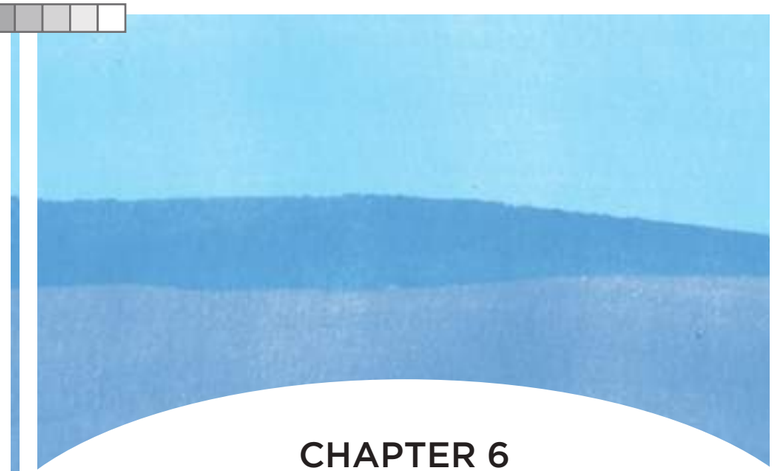
Features of the new water body include

- Central waterbody with purified water and 2 Million Gallon capacity;
- Amphitheatre that doubles up as Chhath Ghat (an ancient Hindu Vedic festival historically native to the Indian subcontinent) for public gatherings;
- Green play areas with open gym and swings;
- Gravel based walking pathways that also double up as rainwater harvesting channels;
- Constructed wetland.

Source: https://www.c40.org/case_studies/rajokri-water-body

NOTE: For more details about developing specific projects for rejuvenation, revival and management of urban wetlands and water bodies, please refer to the publication Urban Wetland/ Water Bodies Management Guidelines, A toolkit for local stakeholders, January 2021, developed by the School of Planning and Architecture, New Delhi in association with the National Mission for Clean Ganga, Ministry of Jal Shakti, GoI.

https://nmcg.nic.in/writereaddata/fileupload/40_Urban%20Wetlandwater%20bodiesmanagement%20guidelines.pdf



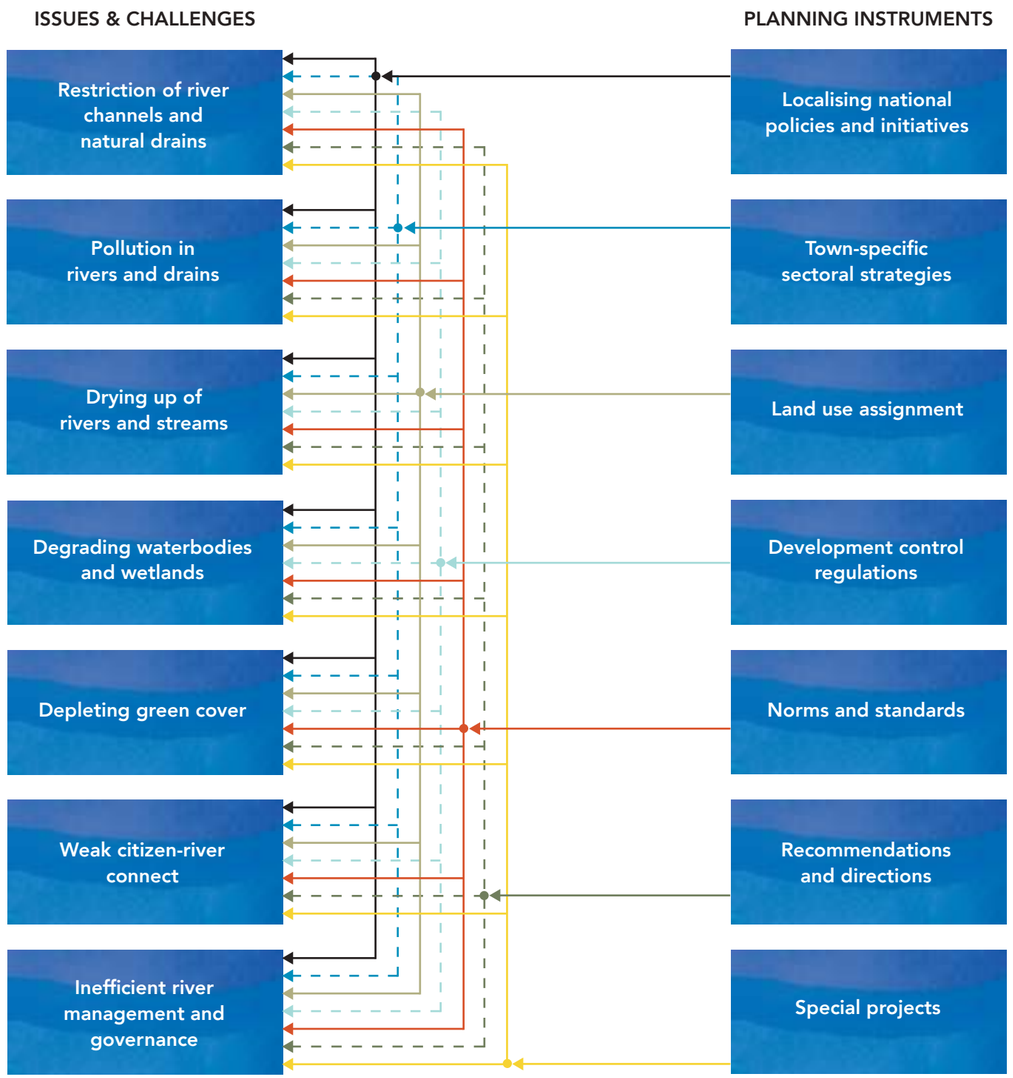
CHAPTER 6

ADDRESSING DIVERSE RIVER-RELATED ASPECTS THROUGH PLANNING

6.1 Background and Context

Chapters 3 and 4 introduced a suite of planning tools and instruments that can be used for effective and sustainable management of the rivers, wetlands and water bodies within a city. This chapter delves comprehensively into how these tools can be used for specific river-related issues that are found in most of the river cities in India. *Figure 10* presents the approach of the chapter.

Figure 10: Urban river management issues and planning instruments to address the issues



Source: Developed by the authors

6.2. Issue 1: Restriction of river channels and natural drains

What needs to be addressed?

- To prevent encroachment on river banks and along city drains
- To remove obstructions from the drainage network of the city

What can the Master Plan do about it?

Localising National Policies and Initiatives

Extracts from the relevant national policies and initiatives are presented in the adjacent column. Planners can use these as a reference and starting point for developing river-sensitive Master Plans. Keyword/ sentences have been underlined.

National Water Policy[4] *, Ministry of Water Resources, 2012*

The directions of the Policy relevant in this context are:

- The storage capacities of water bodies and water courses and/or associated wetlands, the flood plains, ecological buffer and areas required for specific aesthetic recreational and/or social needs may be managed to the extent possible in an integrated manner to balance the flooding, environment and social issues as per prevalent laws through planned development of urban areas, in particular.
- Encroachments and diversion of water bodies (like rivers, lakes, tanks, ponds, etc.) and drainage channels (irrigated area as well as urban area drainage) must not be allowed, and wherever it has taken place, it should be restored to the extent feasible and maintained properly.
- Urban settlements, encroachments and any developmental activities in the protected upstream areas of reservoirs/water bodies, key aquifer recharge areas that pose a potential threat of contamination, pollution, reduced recharge and those endanger wild and human life should be strictly regulated.

Corresponding State Water Policies (wherever developed) may also be referred.

4 http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf

The Indian Forest Act[5] *, 1927*

The directions of the Policy relevant in this context are:

- Prohibit the closing up or obstructing of the channel or banks of any river used for the transit of timber or other forest-produce, and the throwing of grass, brushwood, branches or leaves into any such river or any act which may cause such river to be closed or obstructed
- Provide for the prevention or removal of any obstruction of the channel or banks of any such river, and for recovering the cost of such prevention or removal from the person whose acts or negligence necessitated the same

URDPFI Guidelines, Vol 1[6]*, Ministry of Urban Development, 2015*

The directions of the guidelines relevant in this context are:

- The basic concept of flood plain zoning is to regulate land use in the flood plains to restrict the damage caused by floods. Flood plain can be identified based on last 50 or 100 year flooded area of water bodies or river. There can be different considerations for regulations. For example, the area likely to be affected by floods up to a 10-year frequency should be kept reserved only for gardens, parks, playgrounds, etc. Residential or public buildings, or any commercial buildings, industries, and public utilities should be prohibited in this zone.

National Disaster Management Guidelines: Management of Floods[7]*, 2008, NDMA*

The directions of the guidelines relevant in this context are:

- Flood plain zoning regulations should be developed to mitigate the flood risk
- Encroachments on drains and in floodplains will be removed by providing alternative accommodation to the poor people.

5 http://nbaindia.org/uploaded/Biodiversityindia/Legal/3.%20Indian%20forest%20act.pdf
6 http://tcpo.gov.in/sites/default/files/TCPO/schemes/URDPFI.pdf
7 https://ndma.gov.in/sites/default/files/PDF/Guidelines/flood.pdf

Town Specific Sectoral Strategies

The adjacent column provides a list of potential dedicated strategies and related actions for planners to consider

Relocating existing encroachments, and redeveloping the river zone with low density development. Typically, such a strategy would involve the following elements (among others)

- Creating a legal premise for the eviction; arranging an alternate locality for encroachers with opportunities for livelihood generation
- Engagement with the encroachers (especially slum settlements) to facilitate smooth transition; establishing the eviction protocol
- Restoring encroached area to near pristine conditions; timelines and budgets; accountability for actions
- Protecting the river zone from further encroachment.
- Timelines and responsible agencies

Enhancing the riparian green buffer along all rivers and drains (to prevent encroachment). Such a strategy will broadly involve the following:

- Establishing the width of the riparian buffer based on ground conditions
- Designing the riparian profile in terms of sub-zones and types of plant species
- Detailing out the timelines for afforestation along with agencies responsible
- Making the adequate budgetary provision
- Establishing a robust monitoring system.

If not already available, developing a baseline to map the river floodplain and catchment of drains (as a first step to understand how much room the river and drains need for their natural functioning). This is typically done through a hydrologic and hydrodynamic modelling exercise for a 1 in 100-year flood (major rivers). However, in some cases, floodplains are demarcated on the basis of 1 in 25-year flood.

Land Use Assignment

The adjacent column provides recommendations under three sub-heads (a) land allocation, (b) land use and use zone, and (c) use activities

LAND ALLOCATION

Earmarking a dedicated 'River Zone' within the floodplain. Ideally, the river zone would be the entire floodplain. If there are constraints, a part of the floodplain may be delineated as the river zone depending upon the site situation, with the condition that when the area is redeveloped the full floodplain extent will be earmarked for the river zone.

LAND USE AND USE ZONE

Assigning dedicated land use categories and use zones for:

- Rivers and Streams
- Drains

E.g. the draft Master Plan for Delhi (2041) has proposed a dedicated land use category for the river and the flood plain.

USE ACTIVITIES

Restricting activities in the river zone to prevent encroachment by detailing out

- Prohibited activities
- Permissible activities
- Regulated activities

Indicative list of activity regulations in the river zone

Prohibited activities

- Permanent or temporary construction for high-intensity residential, commercial, or industrial activities

Permissible activities

- Developing artificial water bodies, constructed wetlands, aqua culture ponds, reservoirs, detention and retention basins, bio-swales.
- Afforestation and riparian landscaped areas;
- Nature based recreational activities like nature trails, biodiversity parks, walkways, bikeways

Regulated activities

- River front development like ghats/ temples, water front tourism activities, jetties, navigation
- Recreational facilities like play grounds, gardens, parks, boating, picnic huts, camping sites, special training camps, yoga parks, sports centers/ sport clubs
- Livelihood support activities like fisheries, agriculture/ grazing/ cattle wading, horticulture, pisciculture, washing/ bathing ghats
- Cultural and educational facilities like archaeological parks, art galleries, sculpture complexes, convention centers, amphitheaters, open air museums, exhibition spaces
- Infrastructure like sewage treatment plants, water treatment plants, embankments for flood protection, ground and surface water extraction structures
- Visitor facilities, public toilets, permeable parking, food courts, kiosks, restaurants
- Burial/cemeteries and crematoria

Development Control Regulations (DCRs)

Prescribing min setback distances from the rivers and drains, for any built-up
E.g. The National Green Tribunal has stipulated a no-development zone of 100 m from the edge of the Ganga river between Haridwar and Unnao[8].

Prescribing minimum buffer width required along drains
Suggestive buffer standards -
Buffer width should be identified based on an analysis of the drainage basins. In the interim, the following buffers could be used (measured from the centre of the drain) respectively on either side.

- Primary drains – 50m
- Secondary drains – 35m
- Tertiary drains – 25m

The buffer can be developed as greenbelt with indigenous tree species, and activity regulations as per the land use category.

Adopting revised building bye-laws for the River Zone, including built-up details and typologies

- Minimum plinth level for buildings
- Basement permissions
- Maximum building height

Any construction that may be permitted within the River Zone, should have specific stipulations:

- Basements and other underground construction shall be prohibited
- No new/ extension of existing buildings without appropriate permissions and clearances
- Limiting within permissible FAR, Ground Coverage, maximum permissible height, minimum height of stilt, maximum structure length/ area, open space requirements, minimum distance from water channel, etc.

Assigning appropriate FAR, ground coverage, and height restriction for permissible activities within the buffers of the drains.

8 http://www.indiaenvironmentportal.org.in/files/NGT%20judgement_Ganga_13%20July%202017.pdf

Norms and Standards	Prohibiting covering of drains and buffers
Recommendations and Directions	The Plan may provide directions, and assign departmental responsibilities, for the following: • Setting up a dedicated committee for phased removal of encroachment in a sensitive and empathetic manner. • Delineating the floodplain (if not done already)
Special Projects	Such projects may include - • Construction of embankments/ bunds, • Development of biodiversity parks, constructed wetlands or riverfront parks to keep the river zone free from encroachment

6.3. Issue 2: Pollution in rivers and drains

What needs to be addressed?

- To prevent discharge of untreated wastewater (domestic/ industrial/ agricultural) in the water channels
- To restrict disposal of solid waste (domestic/ industrial/ bio-medical/ hazardous/ social or religious) in the water channels

What can the Master Plan do about it?

Localising National Policies and Initiatives

National Water Policy[9] *, Ministry of Water Resources, 2012*

The directions of the Policy relevant in this context are:

- Sources of water and water bodies should not be allowed to get polluted. System of third party periodic inspection should be evolved and stringent punitive actions be taken against the persons responsible for pollution.

9 http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf
10 http://amrut.gov.in/upload/newsrelease/5a5dc55188eb0FSSM_Policy_Report_23Feb.pdf

Extracts from the relevant national policies and initiatives are presented in the adjacent column. Planners can use these as a reference and starting point for developing river-sensitive Master Plans. Keyword/sentences have been underlined.

- Quality conservation and improvements are even more important for ground waters, since cleaning up is very difficult. It needs to be ensured that industrial effluents, local cess pools, residues of fertilizers and chemicals, etc., do not reach the ground water.

Corresponding State Water Policies (wherever developed) may also be referred

National Policy on Faecal Sludge and Septage Management[10] *(FSSM), 2017*

The entire policy is relevant in this context. The overall objective of the FSSM Policy is to set the context, priorities, and direction for, and to facilitate, nationwide implementation of FSSM services in all ULBs such that safe and sustainable sanitation becomes a reality for all in each and every household, street, town and city (which ultimately will reduce the pollution in rivers)

National Urban Sanitation Policy[11]*, 2018*

The entire policy is relevant in this context. A key goal of the policy is "integrated city-wide sanitation" that involves:

- Mainstreaming thinking, planning and implementing measures related to sanitation in all sectors and departmental domains as a cross-cutting issue, especially in all urban management endeavors.
- Strengthening national, state, city and local institutions (public, private and community) to accord priority to sanitation provision, including planning, implementation and O&M management
- Extending access to proper sanitation facilities for poor communities and other unserved settlements;
- Safe disposal of 100% of human excreta and liquid wastes from all sanitation facilities including toilets.
- Promoting proper usage, regular upkeep and maintenance of household, community and public sanitation facilities
- Strengthening ULBs to provide or cause to provide, sustainable sanitation services delivery

The Water (Prevention and Control of Pollution) Act, 1974[12]

The entire Act is relevant in this context. The Act provides directions for:

- Prohibition on use of stream or well for disposal of polluting matter, etc
- Restrictions on new outlets for discharge of wastewater
- Provision regarding existing discharge of sewage or trade effluent

11 http://mohua.gov.in/upload/uploadfiles/files/NUSP_0.pdf
12 https://legislative.gov.in/sites/default/files/A1974-6.pdf

Municipal Solid Wastes (Management and Handling) Rules[13]*, 2000*

The directions of these Rules relevant in this context are:

- The landfill site shall be away from habitation clusters, forest areas, waterbodies, monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.
- Prevention of run-off from landfill area entering any stream, river, lake or pond.

National Mission for Clean Ganga[14]

One of the objectives of NMCG programme is to
"ensure effective abatement of pollution and rejuvenation of the river Ganga by adopting a river basin approach to promote inter-sectoral co-ordination for comprehensive planning and management".

Swachh Bharat Mission (Urban)[15]

The mission objectives relevant in this context include:

- Elimination of open defecation
- Modern and scientific municipal solid waste management
- Effect behavioural change regarding healthy sanitation
- Generate awareness about sanitation and its linkages with public health

Atal Mission for Rejuvenation and Urban Transformation (AMRUT)[16]

The mission elements relevant in this context include:

- Developing decentralized, networked underground sewerage systems, including augmentation of existing sewerage systems and sewage treatment plants.
- Rehabilitating old sewerage system and treatment plants.
- Recycling of water for beneficial purposes and reuse of wastewater.

13 https://www.mpcb.gov.in/sites/default/files/solid-waste/MSWrules200002032020.pdf
14 https://nmcg.nic.in/aims_obj.aspx
15 http://swachhbharaturban.gov.in/
16 http://amrut.gov.in/content/innerpage/the-mission.php

Town Specific Sectoral Strategies

The adjacent column provides a list of potential dedicated strategies and related actions for planners to consider

Dedicated wastewater management strategy that should cover the following aspects:

- GIS-based mapping of sewered and non-sewered areas
- Expanding the piped sewerage system wherever feasible and viable.
- Adopting decentralized waste water solutions (DEWATS), like FSSM, for areas where a centralized sewerage system is not feasible.
- Connecting all the industries to CETP for treatment of industrial effluents before discharge
- Introducing incentives and disincentives for compliance and non-compliance.
- Community engagement
- Agencies responsible
- Timelines and budgets

Promoting organic agriculture within the floodplains, primarily through incentives for chemical free produce.

Effective solid waste management, especially in the river zone.

Land Use Assignment

The adjacent column provides recommendations under three sub-heads (a) land allocation, (b) land use and use zone, and (c) use activities

LAND ALLOCATION

Earmarking dedicated sites for:

- Disposal and treatment facilities, like
  - sewage treatment plant
  - decentralized wastewater treatment plants
  - common effluent treatment plant
  - solid waste (wet) processing centers
  - solid waste (dry) collection and recycling/ reuse centers
- Non-point source pollution generating activities like agriculture

LAND USE AND USE ZONE

Assigning specific land use categories and use zones for (solid/ liquid) waste disposal and treatment facilities

USE ACTIVITIES

Restricting activities in the river zone to prevent encroachment by detailing out:

- Prohibited activities
- Permissible activities
- Regulated activities

Indicative list of activity regulations in the river zone in addition to those mentioned in section 5.2

Prohibited activities

- Red and Orange category industries causing water pollution
- Landfills

Permissible activities

- Organic farming

Regulated activities

- Tourism
- Navigation

Development Control Regulations (DCRs)

As per the Manual on Municipal Solid Waste Management[17] *2016,*
Minimum siting distance of the sanitary landfill should be:

- 100 m from the floodplain of rivers
- 30 m from non-meandering water channels (canal, drainage etc.)
- 200 m from ponds, lakes, waterbodies

Sanitary landfill site is not permitted within areas under coastal regulation, critical habitat areas, sensitive eco-fragile areas and 100-year floodplains.

Prescribing minimum setback distances from the rivers and drains, for any built-up as per Section 5.2

Prescribing minimum buffer width required along drains, as per Section 5.2. Assigning appropriate FAR, ground coverage, and height restriction for permissible activities within the buffers.

Norms and Standards

Following are the relevant norms and standards applicable in this context that planners should be cognizant of

Effluent discharge standards for Sewage Treatment Plant as per CPCB Directions, 2015

Sewage/Effluent Discharge Standards for Sewage Treatment Plant		
S. No.	**Parameters**	**Parameters Limit**
1	pH	5.5-9.0
2	BOD (mg/l)	10
3	COD (mg/l)	50
4	TSS (mg/l)	20
5	Total Nitrogen (mg/l)	10
6	Total Phosphorus (for discharge into Ponds, Lakes) (mg/l)	1
7	Faecal Colliform (MPN/100 ml)	Less than 100

17 http://cpheeo.gov.in/cms/manual-on-solid-waste-management.php

Effluent discharge standards for Common Effluent Treatment Plants (CETP) as per MoEF&CC, 2017

Sewage/Effluent Discharge Standards for Sewage Treatment Plant				
S. No.	**Parameters**	**Max permissible values (mg/L)**		
		Into inland surface water	**On land for irrigation**	**Into sea**
1	pH[18]	6-9	6-9	6-9
2	BOD, 27°C	30	100	100
3	COD	250	250	250[19]
4	TSS	100	100	100
5	Oil and Grease	10	10	10
6	Nitrate-Nitrogen	10	Not specified	50
7	Phosphates	5	Not specified	Not specified
8	Chlorides	1000	1000	Not specified
9	Sulphates	2	2	15

18 No unit
19 Refer page-5 in http://moef.gov.in/wp-content/uploads/2017/08/CETP-Gazette.pdf

Designated best use water quality criteria as per CPCB

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wildlife and Fisheries	D	pH between 6.5 and 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5 Electrical conductivity at 25°C micro mhos/com Maximum 2250 Sodium absorption ratio Maximum 26 Boron Maximum 2mg/l

Red, Orange and Green Category industries as per waste water generation, CPCB, 2016

RED	• Airports and Commercial Air Strips having waste water generation 100 KLD and above • Health-care Establishment (as defined in BMW Rules) having incinerator irrespective of waste generation (or) having total waste water generation 100 KLD and above • Hotels having overall waste water generation @ 100 KLD and more (or) having rooms 100 and above • Railway locomotive workshop/Integrated road transport workshop/Authorized service centers having waste water generation 100 KLD and above

RED	• Synthetic detergents and soaps (excluding formulation) having waste water generation 100 KLD and above. • Automobile servicing, repairing and painting (excluding only fuel dispensing) having waste water generation 100 KLD and above. • Building and construction projects more than 20,000 sq. m built up area and having waste water generation 100 KLD and above. • Fermentation industry including manufacture of yeast, beer, distillation of alcohol (Extra Neutral Alcohol) having waste water generation 100 KLD and above. • Non-alcoholic beverages (soft drink) & bottling of alcohol/nonalcoholic products having waste water generation 100 KLD and above. • Vegetable oil manufacturing including solvent extraction and refinery /hydrogenated oils having waste water generation 100 KLD and above. • Common treatment and disposal facilities-CETP for Red category Industries
ORANGE	• Synthetic detergents and soaps (excluding formulation) having waste water generation < 100 KLD • Automobile servicing, repairing and painting (excluding only fuel dispensing) having waste water generation less than 100 KLD • Building and construction project more than 20,000 sq. m built up area and having waste water generation less than 100 KLD • Fermentation industry including manufacture of yeast, beer, distillation of alcohol (Extra Neutral Alcohol) having waste water generation less than 100 KLD • Hotels (< 3 star) or hotels having > 20 rooms and less than 100 rooms or having waste water generation > 10 KLD and less than 100 KLD and having a coal/oil fired boiler • Vegetable oil manufacturing including solvent extraction and refinery /hydrogenated oils having waste water generation < 100 KLD • Parboiled Rice Mills having waste water generation < 100 KLD and fuel consumption less than 12 MTD • Airports and Commercial Air Strips having waste water generation < 100 KLD • Health-care Establishment (as defined in BMW Rules) without incinerator and having total waste water generation less than 100 KLD
ORANGE	• Common treatment and disposal facilities (CETP for Orange category industries) • Railway locomotive work shop/Integrated road transport workshop/Authorized service centers having waste water generation < 100 KLD
GREEN	• Hotels (up to 20 rooms and without boilers) and having waste water generation < 10 KLD and no hazardous waste generation

Adopting revised building bye-laws for incorporating guidelines on household sewer connections

Following provisions may be incorporated:

- Sewer connection mandatory for households wherever public sewerage is provided
- Connection to septic tanks in unsewered areas

Recommendations and Directions

Directing concerned agencies to implement 'Polluter Pays Principle' to restrict polluting activities

Creating an enabling environment for nudging civic behaviour (by empowering NGOs, RWAs, educational institutes, etc.) for a pollution-free city

Directing concerned agencies to

- Design and implement IEC programmes for pollution management
- Conduct capacity building of relevant officials in technology and other solutions for pollution management

Special Projects

Such projects may include -

- Developing a constructed wetland
- Developing a community composting center
- Rejuvenation of an iconic/historic drain

6.4. Issue 3: Drying up of rivers and streams (because of over abstraction of water)

What needs to be addressed?

- To ensure regulated extraction of water from surface and ground water sources
- To promote reuse and recycle of water for limiting potable water requirement
- To promote ground water recharge for augmenting water extraction

What can the Master Plan do about it?

Localising National Policies and Initiatives

Extracts from the relevant national policies and initiatives are presented in the adjacent column. Planners can use these as a reference and starting point for developing river-sensitive Master Plans. Keyword/sentences have been underlined.

National Water Policy[20] *, Ministry of Water Resources, 2012*

The directions of the Policy relevant in this context are:

- Ecological needs of the river should be determined, through scientific study, recognizing that the natural river flows are characterized by low or no flows, small floods (freshets), large floods, etc., and should accommodate developmental needs. A portion of river flows should be kept aside to meet ecological needs ensuring that the low and high flow releases are proportional to the natural flow regime, including base flow contribution in the low flow season through regulated ground water use.
- There is a need to map the aquifers to know the quantum and quality of ground water resources (replenishable as well as non-replenishable) in the country. This process should be fully participatory involving local communities. This may be periodically updated.
- Declining ground water levels in over-exploited areas need to be arrested by introducing improved technologies of water use, incentivizing efficient water use and encouraging community-based management of aquifers. In addition, where necessary, artificial recharging projects should be undertaken so that extraction is less than the recharge. This would allow the aquifers to provide base flows to the surface system, and maintain ecology.

Corresponding State Water Policies (wherever developed) may also be referred.

20 http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf

Model Bill for the Conservation, Protection, Regulation and Management of Groundwater[21]*, 2016*

The directions of the Bill relevant in the urban context are:

Demarcation of Groundwater Protection Zones:

- The State Groundwater Agency in consultation with the appropriate government and local communities shall demarcate groundwater protection zones, in order to
  – Protect the appropriate areas (especially recharge zones) of the aquifer from threats such as physical deterioration, including loss of exposed surface area, change in land-use pattern and causation of chemical and other pollution;
  – Protect the natural identity of the aquifer and the needs of groundwater dependent ecosystems;
  – Protect vulnerable areas that require special attention and regulation, including areas affected by contaminants, and especially those with presence of arsenic and fluoride in groundwater and areas where groundwater has suffered saline water ingress;
  – Provide for sufficient quantity and safe quality water required to meet the water for life needs according to the status of groundwater resources under periodic dynamic resources assessments; and
  – Provide for groundwater for livelihoods
- Groundwater protection zones will be based on the latest dynamic resources assessments conducted by the Central Ground Water Board (CGWB) and state governments.
- The demarcation of groundwater protection zones shall take into account all the following factors:
  – Existing uses and users of the aquifer;
  – Existing groundwater uses and users in the recharge area(s);
  – Availability and quality of groundwater in the aquifer;
  – Social, environmental and economic implications of the demarcation;
  – The need for the demarcation of such recharge areas into groundwater protection zones in terms of their capacity or need to solve groundwater depletion and/or contamination;
  – Availability or existence of other options or alternative measures

21 http://mowr.gov.in/sites/default/files/Model_Bill_Groundwater_May_2016_0.pdf

Regulation of Groundwater Protection Zones –

- The appropriate government shall take all possible measures to conserve and protect groundwater protection zones, in particular in the context of groundwater security plans.
- The notification of Groundwater Protection Zones will be decided by the State Groundwater Agency, based on inputs of the Regional Directorates of the CGWB.
- Wherever an area has been notified as a Groundwater Protection Zone, appropriate measures regarding regulation on the extraction and use of groundwater, rules regarding afforestation and deforestation, prohibition of waste disposal, regulation of mining leases will be adopted and if necessary, enforced.

Groundwater Protection Zones may also include more specific measures, as may be appropriate, such as distance (from structures created or activities taken up to augment and/or protect recharge, including percolation tanks, recharge ponds, and social fencing of natural recharge areas) to new wells, pumping regulation for existing wells as well as other regulatory protocols, depending upon hydrogeological and socio-economic conditions.

Guidelines to regulate and control ground water extraction in India[22]*, 2020, Ministry of Jal Shakti, GoI*

The directions of the Guidelines relevant in the urban context are:

- Projects falling within 500 m. from the periphery of demarcated wetland areas shall mandatorily submit a detailed proposal indicating that any ground water abstraction by the project proponent does not affect the protected wetland areas. Before seeking permission from CGWA, the projects shall take consent/approval from the appropriate Wetland Authorities to establish their projects in the area.
- Water management plans shall be prepared by all the State Ground Water Authorities/ Organizations for all Over-exploited, Critical and Semi-critical assessment units starting with Over-exploited units. Water management plans shall be reviewed and updated periodically.
- All new/existing industries, industries seeking expansion, infrastructure projects and mining projects abstracting ground water, unless specifically exempted, will be required to seek No Objection Certificate from Central Ground Water Authority or, the concerned State/ UT Ground Water Authority as the case may be.

22 http://cgwa-noc.gov.in/LandingPage/Guidlines/NewGuidelinesNotified250920.pdf#ZOOM=100

Town Specific Sectoral Strategies

The adjacent column provides a list of potential dedicated strategies and related actions for planners to consider

National Water Mission[23] *under National Action Plan on Climate Change*

The directions of the Mission relevant in this context are:

- Mandating water harvesting and artificial recharge in relevant urban areas
- Enhancing recharge of the sources and recharge zones of deeper groundwater aquifers
- Preparation of state-wise implementation plan for rain water harvesting and artificial recharge based on Master Plan of CGWB both for rural and urban areas and monitoring mechanism
- Implementation of rain water harvesting and artificial recharge in over exploited assessment units, critical and semi-critical areas and their impact assessment
- Identify and evaluate incentives for adopting and sustaining roof top rain water harvesting systems.
- Active community participation in ground water monitoring, regulation and management

Dedicated strategies may be developed in the Master Plan for the following:

Phased augmentation of groundwater levels (if the situation is critical). Such a strategy should cover the following:

- Scientific mapping of groundwater levels
- Identifying potential recharge zones
- Protecting the recharge zones by putting them under "Natural Conservation Zones" or "Eco-sensitive locations" category
- Actions for groundwater recharge
- Responsibility matrix
- Timelines and budgets

City-wide wastewater reuse strategy. Such a strategy must touch upon the following (among others):

- Potential uses of treated wastewater based on a scientific study
- Quality of treated effluent
- Transporting wastewater from the STPs to the intended area of use
- Creating a market for treated wastewater
- Responsibility matrix
- Timelines and budgets

23 http://nwm.gov.in/

Land Use Assignment

The adjacent column provides recommendations under three sub-heads (a) land allocation, (b) land use and use zone, and (c) use activities

LAND ALLOCATION

Earmarking areas for groundwater recharge based on a land suitability analysis.

LAND USE AND USE ZONE

Assigning specific land use categories and use zones for ground water recharge sites. For example, they be marked as "Natural Conservation Zones" (as recommended by MoEF&CC).

USE ACTIVITIES

Permitting only eco-sensitive activities in areas designated for groundwater recharge, by enlisting:

- Permissible activities
- Regulated activities
- Prohibited activities

All activities involving construction of impervious surfaces shall be strictly prohibited.

Development Control Regulations (DCRs)

Prescribing maximum permissible ground coverage, for existing areas that are conducive to groundwater recharge.

For example, the Gujarat General Development Control Regulations, (2017)[24] requires that *"Maximum of 50% of the total open space including marginal open spaces and common plot of a building-unit shall be paved. The remaining shall be permeable for rain water percolation."*

Protecting groundwater resources

A pertinent example of this can be found in the Mumbai Metropolitan Regional Plan (2036)[25]. The plan stipulates that *"construction of basements may be allowed subject to the condition that no objection certificate is obtained from the State Ground Water Authority to the effect that such construction will not adversely affect free flow of groundwater in that area."*

24 http://www.auda.org.in/uploads/Assets/rdp/finalcomprehensi11012017111757857.pdf
25 https://mmrda.maharashtra.gov.in/documents/10180/8037279/1.+Draft+M-MR+Plan+Report%2C%202016-36+Colour/d107b724-c039-4ea1-840f-58a92bb9daf2

Using Transferable Development Rights (TDR) to incentivize private property owners to handover critical groundwater recharge areas on their properties to the city.

Norms and Standards

Establishing norms for minimum lot size that should mandatorily install a rainwater harvesting system

For example, the Development Plan for Surat (2035)[26] has made it mandatory for private plots larger than 4000 sq. m. and high-rise buildings to install rainwater harvesting units for recharging the groundwater.

Establishing street guidelines for incorporating recharge stretches along all major street sections

Recommendations and Directions

Directing the concerned agencies for preparing Water Management Plans, especially for all Over-exploited, Critical and Semi-critical areas, which will be reviewed and updated periodically.

The major actions under such plan should include (among others):

- Minimising the potable component of water demand by reduction of water demand, shifting from fresh water sources to reused/ recycled water, etc.
- Minimising non-revenue water losses from leakage, theft, etc.
- Use of treated wastewater for groundwater recharge
- Nudging civic behaviour to conserve water

Directing concerned agencies to design and implement IEC programmes for water conservation

Directing agencies to impose strict penalties and disincentives for unauthorised groundwater extraction

26 https://www.sudaonline.org/wp-content/uploads/2017/03/SUDA-DP-2035-report-final-22.02.2017.pdf

Directing agencies to consider incentivising:
- Reuse of treated wastewater
- Use of water efficient fixtures

Special Projects

Such projects may include -
- Large-scale stormwater capture reservoirs for groundwater augmentation
- Construction of special parks in areas suitable for groundwater recharge

6.5. Issue 4: Degrading water bodies and wetlands

What needs to be addressed?

- To rejuvenate water bodies and wetlands
- To ensure sustainable and efficient management of water bodies and wetlands

What can the Master Plan do about it?

Localising National Policies and Initiatives

Extracts from the relevant national policies and initiatives are presented in the adjacent column. Planners can use these as a reference and starting point for developing river-sensitive Master Plans. Keyword/sentences have been underlined.

National Water Policy[27] *, Ministry of Water Resources, 2012*

The directions of the Policy relevant in this context are:
- Conservation of rivers, river corridors, waterbodies and infrastructure should be undertaken in a scientifically planned manner through community participation.
- Encroachments and diversion of waterbodies (like rivers, lakes, tanks, ponds, etc.) and drainage channels (irrigated area as well as urban area drainage) must not be allowed, and wherever it has taken place, it should be restored to the extent feasible and maintained properly.
- Sources of water and waterbodies should not be allowed to get polluted. System of third-party periodic inspection should be evolved and stringent punitive actions be taken against the persons responsible for pollution.

Corresponding State Water Policies (wherever developed) may also be referred.

National Environment Policy, Ministry of Environment and Forests, 2006[28]

The directions of the Policy relevant in this context are:
- Formulate conservation and prudent use strategies for each significant catalogued wetland, with participation of local communities, and other relevant stakeholders.
- Formulate and implement eco-tourism strategies for identified wetlands through multi stakeholder partnerships involving public agencies, local communities, and investors.

27 http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf
28 https://www.indiawaterportal.org/sites/default/files/iwp2/National_Environment_Policy__MoEF_2006.pdf

- Take explicit account of impacts on wetlands of significant development projects during the environmental appraisal of such projects; in particular, the reduction in economic value of wetland environmental services should be explicitly factored into cost-benefit analyses.
- Consider particular unique wetlands as entities with "Incomparable Values", in developing strategies for their protection.
- Promote traditional techniques and practices for conserving village ponds.

Wetlands (Conservation and Management) Rules, 2017, MOEF&CC, GoI
The entire document is relevant in this context. Presented below are the sections covered in the document. Refer to the full document[29] for details.

- Identifying wetlands for notification under Wetlands (Conservation and Management) Rules, 2017
- Delineating wetlands, wetlands complexes and zone of influence
- Determining 'wise use' and ecological character of the wetland
- Developing a list of activities to be regulated and permitted
- Developing an Integrated Management Plan for the wetland
- Constitution and operational matters of the Wetlands Authorities
- Overlapping provisions

Town Specific Sectoral Strategies

The adjacent column provides a list of potential dedicated strategies and related actions for planners to consider

Strategy for rejuvenation and conservation of water bodies and wetlands.

As suggested in the *"Urban Wetland/ Water Bodies Management Guidelines, A toolkit for local stakeholders by SPA Delhi and NMCG, 2021[30]"*, the strategy should include the following:

- Mapping urban wetlands and water bodies
- Identification of ecosystem services of the wetlands and water bodies
- Groundwater assessment
- Land suitability for groundwater recharge
- Remediation of deteriorated wetlands and water bodies
- Measures for conserving rejuvenated wetlands and water bodies
- Agencies responsible
- Timelines and budgetary allocation

29 http://moef.gov.in/wp-content/uploads/2020/01/final-version-and-printed-wet-land-guidelines-rules-2017-03.01.20.pdf
30 https://nmcg.nic.in/writereaddata/fileupload/40_Urban%20Wetlandwater%20bod-iesmanagement%20guidelines.pdf

Land Use Assignment

The adjacent column provides recommendations under three sub-heads (a) land allocation, (b) land use and use zone, and (c) use activities

The following additional guidance documents can be referred for developing these strategies:

- Indicative Guidelines for Restoration of Water Bodies, 2019, CPCB[31]
- Advisory on Conservation and Restoration of Water Bodies in Urban Areas, 2013, CPHEEO[32]

Maintaining a blue-green continuum in the city by

- Planning for phased revival of water bodies
- Enhancing the riparian green buffer along all water bodies
- Linking the water bodies and green areas, wherever possible

LAND ALLOCATION

Earmarking land for:

- Artificial water bodies, reservoirs or constructed wetlands
- Riparian buffers around water bodies

LAND USE AND USE ZONE

Assigning specific land use categories and use zones for

- Wetlands and water bodies (e.g., the Metropolitan Development Plan for Hyderabad 2031[33] has a separate land use category assigned for water bodies)
- Riparian buffers

USE ACTIVITIES

Permitting only eco-sensitive activities in areas designated for water bodies/ wetlands and their buffers.

Suggestive list of permissible/regulated activities
Wetlands and marshes for water-based ecologies, groundwater recharge points, active public use in the form of parks, spaces for yoga, active sports (without formal seating), cycling and walking facilities, arboretums,

31 https://cpcb.nic.in/NGTMC/Ind-Guidelines-RestWaterBodies-10062019.pdf
32 http://mohua.gov.in/upload/uploadfiles/files/Advisory%20on%20Urban%20Water%20Bodies.pdf
33 https://www.hmda.gov.in/pdf/G.O.Ms.No.33,dt.24.1.2013%20(DMDP-2031).pdf

greenhouses, gardening clubs, exhibitions, museums and information centres, open air theatres, community vegetable gardens, boating, plant nurseries, restaurants.

Development Control Regulations (DCRs)

Specifications for restricted activities around water bodies and wetlands
E.g. In the Metropolitan Development Plan for Hyderabad 2031, "waterbodies must be maintained as a recreational/green buffer zone, and no building activity other than recreational use shall be carried out within

- 30 meters from the boundary of lakes of area 10 Ha and above;
- 9 meters from the boundary of lakes of area less than 10 Ha
- 9 meters from the boundaries of a Canal
- 2 meters from the defined boundary of drains"

Using Transferable Development Rights (TDR) to incentivize private property owners to handover eco-sensitive areas on their properties to the city.

Assigning appropriate FAR, ground coverage, and height restriction for permissible activities within the buffers.

Norms and Standards

Prescribing standards for water quality in water bodies (e.g. Dissolved Oxygen; Biochemical Oxygen Demand; E-Coli, Total Suspended Solids, Eutrophication, etc.)

Refer to the standards presented in Section 5.3.

Recommendations and Directions

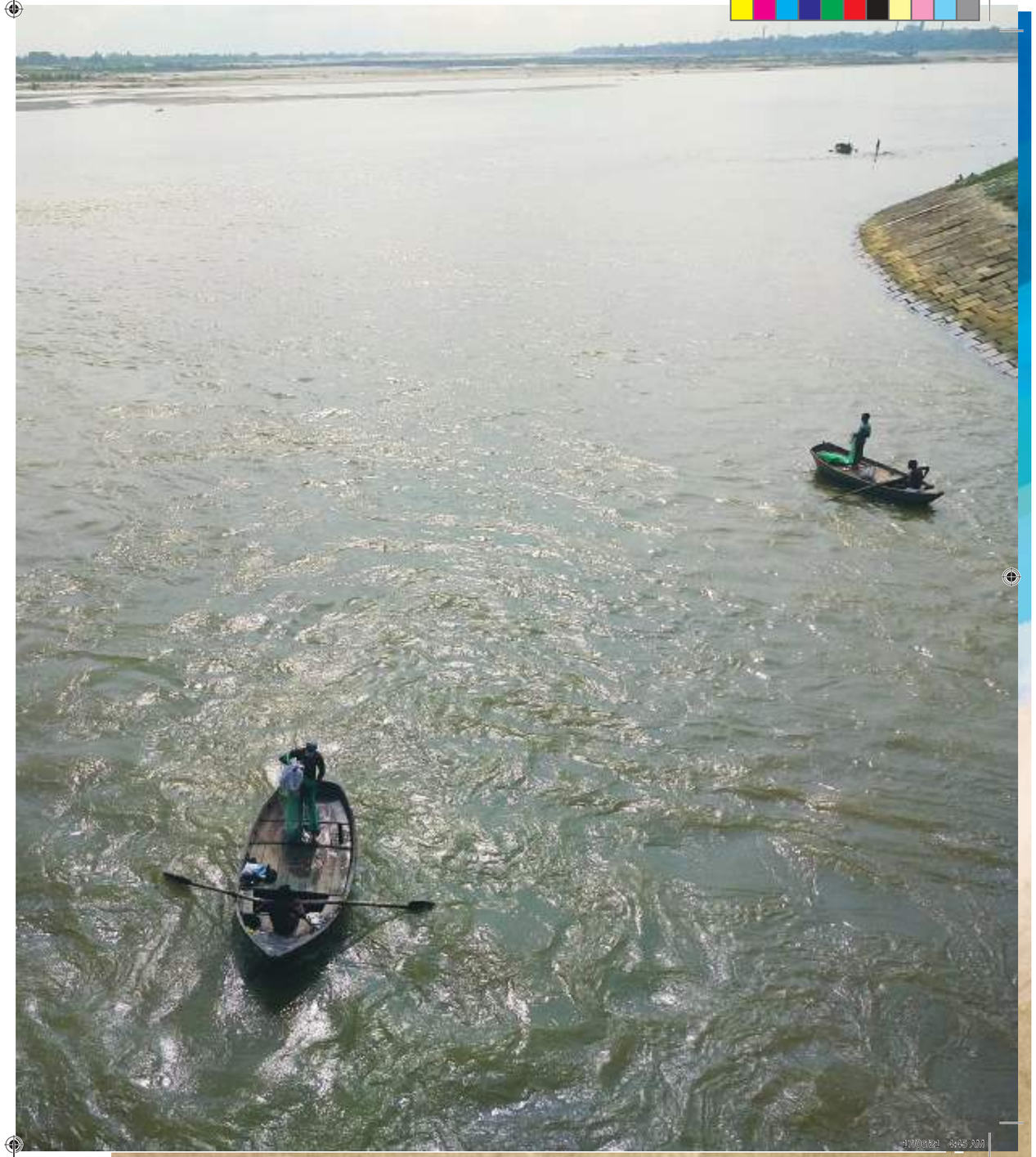
Enhancing the economic potential of water bodies and wetlands

Reviving lost heritage values associated with water bodies

Special Projects

Such projects may include -

- Setting up a comprehensive GIS-based database for water bodies and wetlands
- Rejuvenating an iconic/ historic water body
- Developing a constructed wetland
- Lake-front development



6.6. Issue 5: Depleting green cover

What needs to be addressed?

- To create a riparian zone with native species along the water channel for pollution and erosion control
- To maintain adequate forest/ tree cover across the city for ground water recharge

What can the Master Plan do about it?

Localising National Policies and Initiatives

Extracts from the relevant national policies and initiatives are presented in the adjacent column. Planners can use these as a reference and starting point for developing river-sensitive Master Plans. Keyword/sentences have been underlined.

Draft National Forest Policy, 2018[34]

The entire Policy is relevant in this context. The urban-specific elements of the Policy include:

- Managing and expanding green spaces in urban and peri-urban areas to enhance citizens' wellbeing
- Promotion of trees outside forests and urban greens be taken up on a mission mode for attaining the national goal of bringing one third of the area under Forests & trees cover and also for achieving the Nationally Determined Contribution (NDC's) targets of the country.
- Urban greens include woodlands, wetlands, parks, wood in institutional areas, gardens, avenue plantations, block plantations etc in such areas. These green patches bring many aesthetic, recreational, environmental and economic benefits to cities and their dwellers. They need to be managed as urban forest ecosystems to enhance optimal urban forest cover and to nurture and sustain urban health, clean air and related benefits. Management plans should be prepared and implemented in consonance with the development plan of cities.

34 http://www.indiaenvironmentportal.org.in/files/file/Draft%20National%20Forest%20Policy,%202018.pdf

Urban Greening Guidelines, 2014, Ministry of Urban Development[35]

Green spaces around flood plains need to be protected and it is to be ensured that they are not unnecessarily encroached upon, by means of the following actions –

- Declaring the environmental sensitive zone as no construction/ development zone. This has to be ensured in the proposed/ existing landuse plan of the city.
- While framing zoning regulations, it has to be ensured that only those activities are to be allowed which may not have any adverse impact on environment, and should not lead to addition of built up space.

National Mission for a Green India[36]*, Ministry of Environment & Forest, 2008*

The entire Mission is relevant in this context. The urban-specific elements of the Mission include *"bringing 0.2 Million Hectares of urban/ peri-urban lands under forest and tree cover."*

The strategy of the Mission for enhancing tree cover in the peri-urban and urban area involves:

- Identifying and marking boundaries coupled with zoning of such areas is of utmost importance
- Setting up of local users' or citizens' groups to oversee maintenance
- Linking green spaces, including urban wetlands, and environment education programs by development of outreach initiatives, nature trails and interpretation activities wherever possible
- Making development of additional green spaces an essential and integral component of programs and schemes aimed at urban renewal and redevelopment
- Increasing manpower for watch and ward, setting up of mobile forces and legal services to combat encroachments, waste dumping, land grab and other threats

In urban areas, the ward level committees /RWAs linked to Municipality/ Municipal Corporations will facilitate planning and implementation under the Mission.

35 http://mohua.gov.in/upload/uploadfiles/files/G%20G%202014(2).pdf
36 http://www.jkforest.gov.in/pdf/gim/GIM_Mission-Document-1.pdf

Town Specific Sectoral Strategies

The adjacent column provides a list of potential dedicated strategies and related actions for planners to consider

Phased increase of green cover in the city. The Urban Greening Guidelines[37], 2014 by MoUD can serve as a useful reference in developing the strategy. The strategy should focus on:

- Developing greenways or green corridors, as eco-friendly recreational developments, along the major water channels.
- Enhancing the riparian green buffer along all water bodies
- Developing strategic afforestation plans, especially in the river zone with native riparian species
- Developing & maintaining a blue-green continuum
- Implementing compensatory afforestation in available open areas
- Planning for greens in redevelopment areas
- Using the large open sites available within the city for afforestation or compensatory plantation

Land Use Assignment

The adjacent column provides recommendations under three sub-heads (a) land allocation, (b) land use and use zone, and (c) use activities

LAND ALLOCATION

Earmarking land for afforestation, especially for:

- Compensatory afforestation
- Riparian buffers
- Greenways/ green corridors

LAND USE AND USE ZONE

Assigning specific land use categories and use zones for

- Forests (Reserved/ Protected/ Restricted)
- Biodiversity parks
- Recreational parks and playgrounds
- Green buffers
- Green belts
- Greenways/ green corridors

Some of these may be marked as eco-sensitive areas on the plan.

37 http://mohua.gov.in/upload/uploadfiles/files/G%20G%202014(2).pdf

USE ACTIVITIES

Permitting only eco-sensitive activities in areas designated for different categories of greens, by enlisting

- Permissible activities
- Regulated activities
- Prohibited activities

The Forest (Conservation) Act, 1980[38] and Forest Conservation Rules, 2003[39] may be referred to for detailing out these activities.

Development Control Regulations (DCRs)

Using FAR as an incentive to augment green cover on private property in the form of street trees, green roofs, green walls, and rain gardens so as to increase the amount of green space within developments.

Assigning appropriate FAR, ground coverage, and height restriction for permissible activities within different categories of greens.

Norms and Standards

Mandating a minimum per capita tree cover for the city

The City may recommend a per capita green cover of at least 9 sq m (as recommended by WHO for urban areas).

Also, provision may be made for a total of 10-12 sqm per person of open spaces, including recreational spaces, organised green and other common open spaces such as vacant lands/ flood plains/ forest cover, etc. (as recommended by the URDPFI).

38 https://www.prsindia.org/uploads/media/Compensatory%20Afforestation/bill185_20080723185_Forest__Conservation__Act__1980.pdf
39 https://mpforest.gov.in/img/files/Handbook_FC_Act_2019.pdf

Providing population-based norms for the number of parks required in the city.

The following norms may be recommended for requirement of organized greens in plain areas (as recommended by the URDPFI)

S. No.	Category	Population served per unit	Area requirement (ha)
1	Housing Area Park	5000	0.50
2	Neighbourhood Park	15000	1.00
3	Community Park	1 lakh	5.00
4	District Park	5 lakh	25.00
5	Sub city Park	10 lakh	100.00

Recommendations and Directions

Directing concerned agencies for engaging communities and citizens in afforestation and tree conservation drives.

Creating an enabling environment for CSR activities towards afforestation.

Special Projects

Such projects may include developing -
- Biodiversity parks
- Miyawaki forests

6.7. Issue 6: Weak citizen-river connect

What needs to be addressed?

- To design and develop a riverfront catering to the needs of the citizens in a sustainable manner
- To make the riverfront accessible to the public
- To create a stronger economic value for the river

What can the Master Plan do about it?

Localising National Policies and Initiatives

Extracts from the relevant national policies and initiatives are presented in the adjacent column. Planners can use these as a reference and starting point for developing river-sensitive Master Plans. Keyword/sentences have been underlined.

National Water Policy[40] *, Ministry of Water Resources, 2012*

The directions of the Policy relevant in this context are:
- Rivers and other water bodies should be considered for development for navigation as far as possible and all multipurpose projects over water bodies should keep navigation in mind right from the planning stage.

Corresponding State Water Policies (wherever developed) may also be referred.

National Tourism Policy, 2002[41]*, Ministry of Tourism and Culture, GoI*

The directions of the Policy relevant in this context are:
- The potential for river cruises in India needs to be developed for the North-Eastern States, (Brahmaputra and Ganges) and Kerala. To capitalize on the potential of the several navigable rivers that have high tourism significance, strategic actions are required to harness the potential as a means of transport as well as unique tourism products.
- White water and more sedate great river rafting offer a unique tourism product, while regulations and certification for adventure tourism operators should be introduced so that they meet minimum safety standards.
- Eco-tourism should be made a priority tourism product with focal points located in the Himalayas, North-Eastern States, Western Ghat, Jharkhand, Andaman and Nicobar Islands, and the Lakshadweep Islands.
- Business travel is also a form of tourism and typically occurs in urban environment. Urban quality along the lines specified for regional and site

40 http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf
41 https://tourism.gov.in/sites/default/files/2019-11/National_tourism_Policy_2002.pdf

master plans, including tourism interests and requirements in the urban planning processes should be improved.
- A series of themed cultural attractions should be developed based on outstanding site planning and design.

Town Specific Sectoral Strategies

The adjacent column provides a list of potential dedicated strategies and related actions for planners to consider

Enhancing the potential of sustainable river-related tourism (sensitive to the carrying capacity of the river). Such a strategy would typically touch upon the following.

- Thrust sectors for tourism based on a ground study (e.g. water sports; river cruise; floating markets; navigation; spiritual riverfronts; etc.)
- Creating an enabling environment for the tourism to flourish (e.g. policies, infrastructure,
- Marketing, advertising, infrastructure and governance mechanism
- Enhancing livelihood opportunities
- Minimising environmental impacts
- Timelines and budgetary considerations

Assigning Land Use Categories

The adjacent column provides recommendations under three sub-heads (a) land allocation, (b) land use and use zone, and (c) use activities

LAND ALLOCATION

Earmarking a dedicated 'Interactive sub-Zone' within the 'River Zone' for:
- Eco-sensitive religious activities (designated ghat areas)
- Tourism activities (water sports)
- Navigation activities (dock stations, jetties)
- Public recreation activities

LAND USE AND USE ZONE

Assigning specific land use categories and use zones for religious, tourism, navigation, recreational and other areas in the River Zone.

USE ACTIVITIES

Permitting only eco-sensitive activities by enlisting
- Permissible activities
- Regulated activities
- Prohibited activities

Refer to Section 5.2 for indicative examples for each of these activities.

Development Control Regulations (DCRs)

Adopting revised building bye-laws for the Interactive Zone, including specific provisions based on footfall
- Ground coverage and percentage of built-up
- FAR and height restrictions
- Material usage
- Accessibility
- Parking provision
- Public facilities (toilets, lighting, signages, security)

Norms and Standards

Recommending and regulating the permissible footfall for the River Zone

An assessment of the carrying capacity of different ecologically sensitive sites within the River Zone may be used to establish the footfall limit for each area (especially the areas earmarked under Interactive Zone)

Special Projects

Such projects may include -
- Eco-parks along river banks
- Tourism and religious infrastructure
- Urban Riverfront Development

Urban Riverfront Development can be proposed with nature-based elements such as,
- Riparian landscaping
- Bio-remediation practices
- Landscape features along the riverbank, in a manner sensitive to and respectful of the existing natural habitat

Riverfront Development may also have facilities like public plazas, seating spaces, lighting, toilet, parking etc.

6.8. Issue 7: Inefficient river management and governance

What needs to be addressed?

- To establish a wholesome multi-disciplinary and inter-sectoral framework for river management in a city
- To scale up citizen involvement in river management activities
- To identify resources for project implementation, management and funding

What can the Master Plan do about it?

Localising National Policies and Initiatives

Extracts from the relevant national policies and initiatives are presented in the adjacent column. Planners can use these as a reference and starting point for developing river-sensitive Master Plans. Keyword/sentences have been underlined.

National Water Policy[42] *, Ministry of Water Resources, 2012*

The directions of the Policy relevant in this context are:

- Integrated Water Resources Management (IWRM) taking river basin or sub-basin as a unit should be the main principle for planning, development and management of water resources.
- Being inter-disciplinary in nature, water projects should be planned considering social and environmental aspects also in addition to techno-economic considerations in consultation with project affected and beneficiary families.
- Project financing should be structured to incentivize efficient & economic use of water and facilitate early completion of ongoing projects.
- All components of water resources projects should be planned and executed in a pari-passu manner so that intended benefits start accruing immediately and there is no gap between potential created and potential utilized.
- Pricing of water should ensure its efficient use and reward conservation.
- To meet the need of the skilled manpower in the water sector, regular training and academic courses in water management should be promoted.

Corresponding State Water Policies (wherever developed) may also be referred.

42 http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf

Town Specific Sectoral Strategies

The adjacent column provides a list of potential dedicated strategies and related actions for planners to consider

Promoting holistic management of activities in the flood plains, using a systematic approach. The governance strategy should touch upon the following:

- Formation of a composite body, for single-point management and earmarking the responsibilities of various agencies
- Monitoring and management at regular intervals, i.e. every five years
- Engaging citizens in river management activities
- Developing an online portal or a dashboard, for single point availability of data (related to water/ river management) from multiple sources

Norms and Standards

Establishing a city's contribution to the environmental flow of the river based on a scientific study

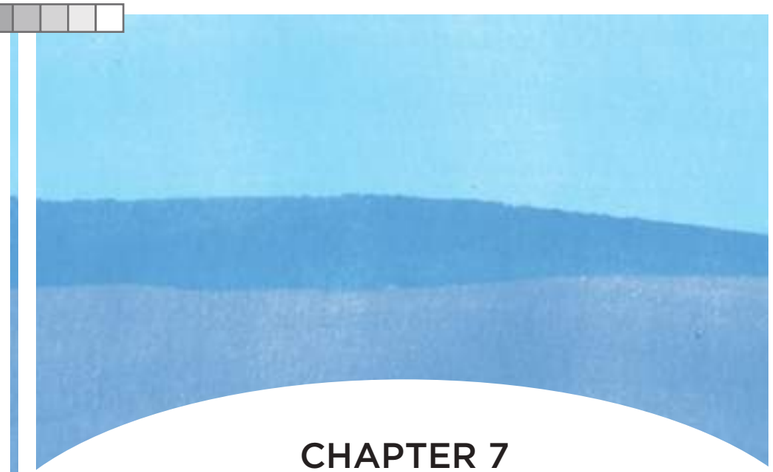
Recommendations and Directions

Engaging citizens in river management activities (e.g. citizen science; river health monitoring; river clean-up activities; celebrating river day)

Special Projects

Such projects may include -

- Creating an integrated database for river/water management
- Creating a public dashboard for disseminating relevant data/information to general citizens



CHAPTER 7

PRACTICAL IMPLICATIONS FOR MAKING RIVER-SENSITIVE MASTER PLANS

7.1. Practical Considerations

The contents of this guidance document have been developed to provide planners with insights, references, and ideas for developing river-sensitive Master Plans. It has introduced a set of seven planning tools that can be used for this purpose. It has also demonstrated how different river-related challenges can be addressed with these planning tools and instruments.

However, planners should also be aware of the practical aspects that need to considered in making robust river-sensitive Master Plans. This Chapter focuses on some of these.

Handling informal encroachment sensitively

Informal encroachment in floodplain, especially on river banks, is typically in the form of slum settlements who have no access to housing elsewhere. Very often, the inhabitants of these slum settlements depend on the river for their livelihoods. Given that these settlements do not have proper sanitation and solid waste disposal facilities, their presence in the floodplain is bound to have a detrimental effect on the river. However, evicting them will only result in transferring the problem to another location, which ultimately may impact the river indirectly. Hence, there is a need for a systematic rehabilitation plan for such encroaching entities that emphasizes on alternative livelihood options in addition to a relocation strategy. Planners should make every attempt to engage with such entities during the preparation of the Master Plan in order to develop empathetic and humane solutions.

Ascertaining land ownership

A significant aspect of conserving and protecting river and riverine resources requires naturalization of the immediate vicinity. This may include creating green buffers, soft scaping, de-concretizing, leveraging on green infrastructure, etc. Implementing such solutions will require restrictions on FAR, ground coverage and height restrictions on buildings. Ascertaining the land ownership in these areas is, therefore, important to avoid legal complications while the Plan is being implemented.

Developing a framework for implementation

A framework for implementation will help in the smooth translation of the Master Plan on the ground. Such a framework should clearly highlight the various actions to be taken, agencies responsible for action, key performance indicators, and a stock-taking mechanism. The framework for implementation should ideally form part of the Master Plan so that it receives an official sanctity after the Plan is notified.

Allowing for course correction

The implementation of the Master Plan does not always proceed as per the directions provided in the Plan. Many times, improvisations need to be done in order to acknowledge and respond to ground realities. The Master Plan needs to account for these by allowing for course correction at periodic intervals. Most Master Plans are reviewed every five years, which can offer an ideal avenue for these course corrections to be adopted.

Leveraging on technological advances

While the Master Plan should be technologically agnostic to ensure that it does not favour any particular technology provider, it can create an environment for facilitating the use of state-of-the-art technologies (without naming the providers) for river management. Already aspects such as satellite-based monitoring of water quality; artificial intelligence for riverine biodiversity mapping; big data and citizen science for river health monitoring; unmanned aerial vehicles for floodplain mapping, etc. are being used across the world successfully. Going forward, the nature and type of technologies are expected to become more sophisticated and effective. The city must, therefore, be ready to embrace these seamlessly.

Climate change implications for river management

Climate change is one of the biggest global challenges today. Water is the primary medium through which the effects of climate change are manifested. Rivers are, therefore, quite susceptible to climate change impacts in terms of variability of flow, sediment load, and biotic quality. Planners will need to account for these anticipated changes, and provide appropriate planning responses.

7.2. Plan Development

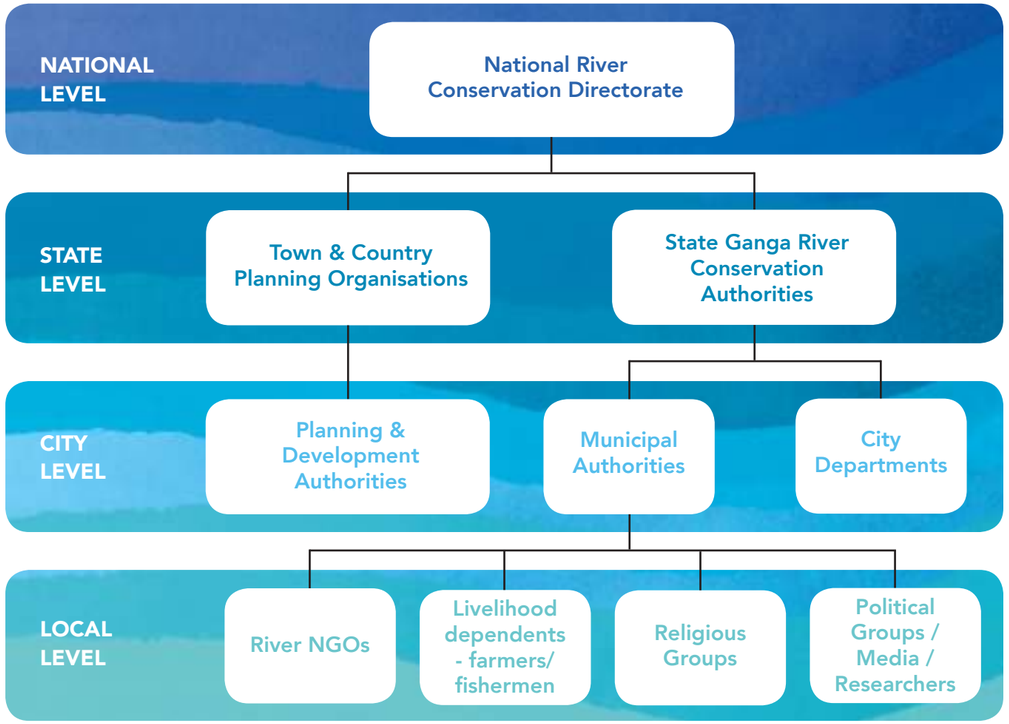
As a way forward, all river cities that are preparing their new Master Plans are expected to ensure that the directions provided in this document are incorporated within their Plans, with a view to address context specific river needs. For the cities with an ongoing Master Plan tenure, it will be useful to conduct an immediate analysis of the extent to which these directions have been considered. This will help in incorporating the appropriate revisions when the current Plan is reviewed.

If feasible, the state town and country planning organisations should identify the river cities which need to adopt these guidelines. Accordingly, the Planning and Development Authorities of these cities should initiate the process of preparing a river-centric Master Plan using this guidance note as a reference. During the preparation of the Plan, all concerned agencies must be consulted, which will help in establishing the implementation pathways of the Plan.

Finally, river being a public entity has a social connect with the communities, making it important to consider the local river needs. The planning exercise shall thus also involve citizen consultation, for incorporating strategies that improve the citizen connect with the rivers.

Figure 11 explains the role of different stakeholders engaged in the process of river-sensitive planning and development. However, cities may adopt their own framework for regulating development and management of their rivers.

Figure 11: Role of different stakeholders in the process of river-sensitive planning



Source: Developed by the authors

ANNEXURES

Annexure 1

Ganga Basin Towns

List of towns on the main stem of Ganga River

STATES	NO. OF TOWNS
Uttarakhand	16
Uttar Pradesh	21
Bihar	18
Jharkhand	2
West Bengal	40
Total Basin Towns	**97**

UTTARAKHAND	
1	Haridwar
2	Rishikesh
3	Muni Ki Reti - Dhalwala
4	Tapovan
5	Chamoli - Gopeshwar
6	Srinagar
7	Uttarkashi (Budkot)
8	Joshimath
9	Rudraprayag
10	Gauchar
11	Karnaprayag
12	Devprayag
13	Nandprayag
14	Kirtinagar
15	Badrinath
16	Gangotri Dham

JHARKHAND	
1	Sahibganj
2	Rajmahal

UTTARAKHAND	
1	Prayagraj (Allahabad)
2	Anoopsahar
3	Babrala
4	Ballia
5	Bijnor
6	Bithoor
7	Chunar
8	Farrukhabad
9	Garhmukteshwar
10	Ghazipur
11	Hastinapur
12	Jhunsi
13	Kannauj
14	Kanpur
15	Mirzapur
16	Pt. Deen Dayal Upadha-yaya (Mughal Sarai)
17	Narora
18	Ramnagar
19	Saidpur
20	Shuklaganj/ Gangaghat
21	Varanasi

BIHAR	
1	Patna
2	Bhagalpur
3	Begusarai
4	Munger
5	Chapra
6	Danapur
7	Hajipur
8	Buxar
9	Jamalpur
10	Barauni
11	Barh
12	Mokameh
13	Sultanganj
14	Fatuah
15	Bakhtiyarpur
16	Barahiya
17	Sonepur
18	Kahalgaon

WEST BENGAL	
1	Baidyabati
2	Bally
3	Bansberia
4	Baranagar
5	Barrackpore
6	Berhampore
7	Bhadreshwar
8	Bhatpara
9	Budge Budge
10	Chakdah
11	Champdani
12	Chandannagar
13	Dhulian
14	Diamond Harbour
15	Garulia
16	Gayeshpur
17	Haldia
18	Halisahar
19	Jamtara Nagar Panchayat
20	Adityapur Municipal Corporation
21	Jangipur
22	Jiaganj-Azimganj
23	Kalyani
24	Kamarhati
25	Kanchrapara
26	Katwa
27	Khardah
28	Kolkata
29	Konnagar
30	Maheshtala
31	Murshidabad
32	Nabadwip
33	Naihati
34	Panihati
35	Rishra
36	Santipur
37	Serampore
38	Titagarh
39	Uluberia
40	Uttarpara

Annexure 2

List of towns having Master Plans/ Development Plans, as per the Ganga basin's state's Town and Country Planning websites

UTTARAKHAND	
1	Doonghati
2	Dehradun
3	Haridwar
4	Chameli-Gopeshwar
5	Gauchar
6	New Tehri
7	Srinagar
8	Rishikesh
9	Badrinath
10	Paudi
11	Bageshwar
12	Rudrapur
13	Kashipur
14	Bajpur
15	Kichcha
16	Ramnagar
17	Kausani Lwesal
18	Nainital
19	Bhimtal
20	Roorkee
21	Gairsend

UTTAR PRADESH	
1	Kanpur
2	Bithoor
3	Akbarpur-Mati
4	Lucknow Development Area
5	Unnao-Shuklaganj Development Area
6	Raebareli Development Area
7	Varanasi
8	Varanasi Part -B {Ramnagar-Mughalsarai / Pt. Deendayal Upadhyaya}
9	Agra
10	Fatehpur -Sikri
11	Mathura-Vrindavan (Ka)
12	Mathura-Vrindavan (Kha) {Kosikala, Nandgaon, Chata, Chaumuha}
13	Mathura-Vrindavan (Ga) {Govardhan-Radhakund}
14	Firozabad-Shikohabad Development Area
15	Aligarh Development Area
16	Allahabad Development Area
17	Bareilly Development Area
18	Meerut Development Area

UTTAR PRADESH	
19	Baghpat-Baraut-Khekada Development Area
20	Ghaziabad
21	Loni
22	Muradnagar
23	Modinagar
24	Bulandhsahar
25	Sikandarabad
26	New Sikandarabad
27	Jahangirabad
28	Khurja Development Area
29	Hapur
30	Garhmukteshwar-Brijghat
31	Pilkhuwa
32	Moradabad Development Area
33	Rampur Development Area
34	Jhansi Development Area
35	Orai Development Area
36	Ayodhya-Faizabad Development Area
37	Gorakhpur Development Area
38	Azamgarh Development Area

UTTAR PRADESH	
39	Saharanpur Development Area
40	Muzaffarnagar
41	Khatauli
42	Banda Development Area
43	Basti Development Area

JHARKHAND	
1	Basukinath Nagar Panchayat
2	Bishrampur Nagar Parishad
3	Bundu Nagar Panchayat
4	Chaibasa Nagar Parishad
5	Chakradharpur Nagar Parishad
6	Chakulia Nagar Panchayat
7	Chatra Nagar Parishad
8	Dumka Nagar Parishad
9	Garhwa Nagar Parishad
10	Giridih Nagar Parishad
11	Godda Nagar Panchayat
12	Gumla Nagar Parishad
13	Hazaribagh Municipal Corporation
14	Hussainabad Nagar Panchayat
15	Chas Municipal Corporation
16	Chhatarpur Nagar Panchayat
17	Chirkunda Nagar Parishad
18	Deoghar Nagar Nigam

JHARKHAND	
19	Jamtara Nagar Panchayat
20	Adityapur Municipal Corporation
21	Jamshedpur NAC
22	Jhumritilaiya Nagar Parishad
23	Khunti Nagar Panchayat
24	Koderma Nagar Panchayat
25	Latehar Nagar Panchayat
26	Lohardaga Nagar Parishad
27	Madhupur Nagar Parishad
28	Manjhiaon Nagar Panchayat
29	Medininagar Nagar Parishad
30	Pakur Nagar Parishad
31	Rajmahal Nagar Panchayat
32	Sahibganj Nagar Parishad
33	Saraikela Nagar Panchayat
34	Simdega Nagar Parishad
35	Kapali Nagar Parishad
36	Mihijam Nagar Parishad
37	Nagar Uttari Nagar Panchayat
38	Phusro Nagar Parishad
39	Ramgarh Nagar Parishad
40	Jugsalai Municipality
41	Mango NAC
42	Ranchi Municipal Corporation
43	Dhanbad Municipal Corporation

WEST BENGAL	
1	Kolkata
2	Siliguri
3	Jalpaiguri
4	Naxalbari
5	Haldia
6	Asansol
7	Durgapur
8	Srinikatan Santiniketan Planning Area
9	Burdwan
10	Digha-Shankarpur Planning Area
11	Midnapur-Kharagpur Planning Area
12	Gangasagar-Bakkhali Planning Area
13	Jaigaon
14	Tarapith-Rampurhat
15	Furfura Sharif
16	Bakreswar
17	Patharchapuri
18	Mukutmanipur

ISSUES OF URBAN RIVERS	RESTRICTION OF RIVER CHANNELS & NATURAL DRAINS	POLLUTION IN RIVERS & DRAINS	DRYING UP OF RIVER & STREAMS	DEGRADING WATERBODIES & WETLANDS	DEPLETING GREEN COVER	WEAK CITIZEN-RIVER CONNECT	INEFFICIENT RIVER MANAGEMENT & GOVERNANCE
							
OBJECTIVES	PROTECTION OF CATCHMENT	PROHIBITING UNTREATED DISCHARGE	REGULATED EXTRACTION, RECHARGE	ADEQUATE QUANTITY & QUALITY	ADEQUATE FOREST & TREE COVER	STRONGER IDENTITY FOR THE RIVER	EFFECTIVE FRAMEWORK FOR MANAGEMENT
PLANNING TOOLS							
Localising National Policies & Initiatives	National Water Policy, Ministry of Water Resources, 2012 **URDPFI Guidelines, Vol 1, Ministry of Urban Development, 2015** National Disaster Management Guidelines: Management of Floods, 2008, NDMA	National Water Policy, Ministry of Water Resources, 2012 **National Policy on Faecal Sludge and Septage Management, 2017** National Urban Sanitation Policy, 2018 **The Water (Prevention and Control of Pollution) Act, 1974** Municipal Solid Wastes (Management and Handling) Rules, 2000 **National Mission for Clean Ganga** Swachh Bharat Mission (Urban) **Atal Mission for Rejuvenation and Urban Transformation (AMRUT)**	Model Bill for the Conservation, Protection, Regulation and Management of Groundwater, 2016 **Guidelines to regulate and control ground water extraction in India, 2020), Ministry of Jal Shakti, GoI** National Water Mission under National Action Plan on Climate Change	National Water Policy, Ministry of Water Resources, 2012 **National Environment Policy, Ministry of Environment and Forests, 2006** Wetlands (Conservation and Management) Rules, 2017, MOEF&CC, GoI	Draft National Forest Policy, 2018 **Urban Greening Guidelines, 2014, Ministry of Urban Development** National Mission for a Green India, Ministry of Environment & Forests, 2008 **Compensatory Afforestation Fund Rules, 2018**	National Water Policy, Ministry of Water Resources, 2012 **National Tourism Policy, 2002, Ministry of Tourism and Culture, GoI**	National Water Policy, Ministry of Water Resources, 2012
Town-Specific Sectoral Strategies	Relocating existing encroachments **Low density redevelopment in the river zone** Enhancing the riparian green buffer **Strategies for promoting Green-Infrastructure & Bio-drainage to prevent urban flooding**	Dedicated wastewater management strategy **Promoting organic agriculture within the floodplains** Effective solid waste management	Phased augmentation of groundwater levels **City-wide wastewater reuse strategy**	Strategy for rejuvenation and conservation of water bodies and wetlands **Maintaining a blue-green continuum in the city** Relocating existing encroachments	Phased increase of green cover **Enhancing the riparian plantation**	Enhancing the potential of sustainable river-related tourism	Promoting holistic management of activities in the flood plains by formation of a composite body for single-point management; monitoring and management at regular intervals; engaging citizens in river management activities; developing an online portal or a dashboard; and promoting transparency in governance
Land use Assignment	Delineating a 'River Zone' within the floodplain **Assigning dedicated land use categories and use zones** Restricting activities in the river zone	Earmarking dedicated sites and assigning specific land use for disposal & treatment facilities, and non-point source pollution generating activities **Restricting activities in the river zone to prevent pollution**	Earmarking areas and assigning specific land use for groundwater recharge sites **Permitting only eco-sensitive activities**	Earmarking land and assigning specific land use for artificial water bodies/ reservoirs or constructed wetlands, and riparian buffers **Permitting only eco-sensitive activities**	Earmarking land for afforestation, especially for compensatory afforestation, riparian buffers, greenways/ green corridors **Assigning specific land use categories and use zones for different greens** Permitting only eco-sensitive activities	Earmarking dedicated 'Interactive sub-zone' within the 'River Zone', and assigning specific land use & use zones **Permitting only eco-sensitive activities**	
Development Control Regulations	Prescribing min setback distances from the rivers and streams, for any built-up **Prescribing minimum buffer width required along drains** Adopting revised building bye-laws (appropriate FAR, ground coverage, and height restrictions) for the River Zone	Prescribing min siting distance of sanitary landfill sites from eco-sensitive areas like rivers and water bodies **Adopting revised building bye-laws for incorporating guidelines on household sewer connections**	Prescribing maximum permissible ground coverage, for existing areas that are conducive to groundwater recharge **Using Transferable Development Rights (TDR) to incentivize private property owners to handover critical groundwater recharge areas on their properties**	Specifications for min buffer around water bodies and wetlands **Assigning appropriate FAR, ground coverage, and height restriction for permissible activities within the buffers** Using Transferable Development Rights (TDR) to incentivise private property owners to handover water body sites on their properties	Assigning appropriate FAR, ground coverage and height restriction for permissible activities within different categories of greens **Using FAR as an incentive to augment green cover on private property**	Adopting revised building bye-laws for the Interactive Zone	
Norms & Standards		Fixing effluent discharge standards from STP and CETP	Establishing min plot size that should mandatorily install a rainwater harvesting system Street guidelines for incorporating recharge stretches along all major street sections Establishing per capita water demand and fixing supply for the city	Prescribing water quality in water bodies (DO, BOD, TSS, E-Coli, etc.)	Mandating a minimum per capita tree cover for the city Providing population-based norms for the number of parks required in the city	Regulating the permissible footfall for the River Zone	Establishing city's contribution required to the environmental flow of the river
Recommendations & Directions	Setting up a dedicated committee for phased removal of encroachment **Prohibiting covering of drains and buffers**	Implementing 'Polluter Pays Principle' **Nudging civic behavior for a pollution-free city** Designing and implementing IEC programmes and conduct capacity building for pollution management	Preparing Water Management Plans, especially for all Over-exploited, Critical and Semi-critical areas **Designing and implementing IEC programmes for water conservation** Imposing strict penalties for unauthorised groundwater extraction **Incentivising reuse of treated wastewater and use of water efficient fixtures**	Enhancing the economic potential of water bodies and wetlands **Reviving lost heritage values associated with waterbodies**	Engaging communities and citizens in afforestation and tree conservation drives **Creating an enabling environment for CSR activities towards afforestation**	Hazard prevention	Engaging citizens in river management activities (like citizen science, river health monitoring, river clean-up activities, celebrating river day)
Special Projects	Construction of embankments/ bunds **Development of biodiversity parks, constructed wetlands or riverfront parks to keep the river zone free from encroachment**	Developing a constructed wetland **Developing a community composting centre** Rejuvenation of an iconic/historic drain	Large-scale stormwater capture reservoirs **Construction of special parks in areas suitable for groundwater recharge**	Setting up a comprehensive GIS-based database for water bodies and wetlands **Rejuvenating an iconic/ historic waterbody** Developing a constructed wetland **Lake-front development**	Biodiversity parks **Miyawaki forests** Riparian plantation in any stretch along the river	Eco-parks along river banks **Tourism and religious infrastructure** Urban Riverfront Development	Creating an integrated database for river/water management **Creating a public dashboard for disseminating relevant data/information to general citizens**

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National Institute of Urban Affairs (NIUA)
Google Photos

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