



Draft Urban River Management Plan– Bhagalpur

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Deliverable 3: Preparation of Urban River Management Plan for Bhagalpur city, Bihar

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on Clean
Ganga



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Bhagalpur
Nagar
Nigam

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This report is a collaborative effort of NMCG and NIUA along with Bhagalpur Nagar Nigam for preparation of Urban River Management Plan for cities in Bihar.

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Disclaimer: The interventions proposed in this Draft URMP document (Version1) are prepared in consultation with the city stakeholders, NIUA and NMCG as project concepts. For its implementation, a Detailed Project Report (DPR) needs to be prepared.



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GLOSSARY

Abbreviation	Full Form
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BOD	Biochemical Oxygen Demand
BSDMA	Bihar State Disaster Management Authority
BSPCB	Bihar State Pollution Control Board
BUIDCO	Bihar Urban Infrastructure Development Company
CGWB	Central Ground Water Board
COD	Chemical Oxygen Demand
CPHEEO	Central Public Health and Environmental Engineering Organization
CPCB	Central Pollution Control Board
DGCs	District Ganga Committee
DEP	District Environment Plan
DO	Dissolved Oxygen
DPR	Detailed Project Report
FPZ	Flood Plain Zoning
MoEF&CC	Ministry of Environment, Forest & Climate Change
MoHUA	Ministry of Housing and Urban Affairs
MSWG	Multi-Stakeholder Working Group
NDVI	Normal Difference Vegetation Index
NGT	National Green Tribunal
NIC	National Informatics Centre
NIUA	National Institute of Urban Affairs
NMCG	National Mission on Clean Ganga
NWIC	National Water Informatics Centre
OHT	Over Head Tank
PHED	Public Health and Engineering Department
RCD	Road and Construction Department
SBM	Swachh Bharat Mission
STP	Sewage Treatment Plant
UDHD	Urban Development and Housing Department
ULB	Urban Local Bodies
UWD	Urban Water Diagnostics
URMI	Urban River Management Index
URMP	Urban River Management Plan
WRD	Water Resource Department





EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

Urban rivers, once vital to culture and ecology, now face severe degradation, threatening livelihoods, public health, and biodiversity. The National Mission for Clean Ganga (NMCG) is integrating river protection into urban planning through initiatives like the River Cities Alliance and Urban River Management Plans (URMPs). Under NMCG's guidance, the National Institute of Urban Affairs (NIUA) is preparing URMPs for 60 cities, including six in **Bihar; Bhagalpur, Buxar, Chapra, Gayaji, Munger, and Muzaffarpur** to restore river health, enhance resilience, and promote water-sensitive development. The Bihar URMPs will address challenges such as flooding and loss of natural drainage through governance reforms, community engagement, sustainable infrastructure, and financial integration. Aligned with national and state missions, the plans propose phased interventions: short-term actions for waste and pollution control and medium-term measures for structural improvements like wastewater treatment, floodplain zoning, and riverfront revitalization ultimately institutionalizing integrated urban river governance and long-term resilience.

Bhagalpur city occupies a strategically significant position along the southern bank of the Ganga River in eastern Bihar. Historically known as Champa Nagari and celebrated today as the "Silk City" of India, Bhagalpur is one of Bihar's oldest urban centres and its third most populous city. The urban area extends over approximately 25.96 sq. km and supports a population of about 4 lakh as of 2011. The city's hydrology is shaped by two rivers, the Ganga, wide and seasonally dynamic with its braided channel, sandbars, and riverine islands (*dias*), and the Champa River, a smaller and significantly more polluted tributary running along the city's western edge. Together, these rivers define Bhagalpur's ecological character, socio-economic dynamics, its vulnerability to flooding and bank erosion, and its centuries-old cultural identity.

Functionally, Bhagalpur serves as a major regional centre for trade, education, administration, and artisanal industry. The city is well-connected through National Highway 31 linking it to Patna and the northeast, National Highway 80 towards Munger and Buxar, and its growing role as a logistics node on National Waterway-1. Tilak Manjhi Bhagalpur University and the Indian Institute of Information Technology (IIIT) anchor its identity as an educational hub in eastern Bihar. Its renowned *Tussar* and *Mulberry* silk industry, with strong export linkages to national and international markets, sets Bhagalpur apart as a centre of traditional craftsmanship and industrial heritage.

Bhagalpur's riverscape is inseparable from its spiritual and cultural life. The city hosts the Vikramshila Gangetic Dolphin Sanctuary, the only legally protected river stretch in India and a critical habitat for the endangered Gangetic dolphin (*Platanista Gangetica*), freshwater turtles, and the endangered Greater Adjutant Stork locally known as Garuda. The ghats of Bhagalpur, draw pilgrims annually for Chhath Puja, Kartik Purnima Mela, Dussehra, and the Shravani Mela. The sacred *kawar* pilgrimage route running from Sultanganj to Deogarh passes directly through the city. Bhagalpur's institutional standing, its ecological anchor, and the economic strength of its silk industries present significant opportunities for river-sensitive urban development. National Waterway-1 connectivity opens avenues for river-based trade and eco-tourism, while existing waterbodies and floodplain wetlands offer potential for groundwater recharge and urban greening.

However, the city's river health faces mounting challenges: the Ganga's shifting course drives recurring floodplain encroachment, while the Champa River suffers from industrial effluents, particularly from silk processing units in Nathnagar. The Champa River is inadequately treated and has degraded to a secondary waterbody rather than a river, making a case for dedicated management of this water resource. The absence of a statutory master plan and formal floodplain



zoning, low wastewater network coverage, gaps in solid waste and faecal sludge management, and weak institutionalisation of citizen engagement further constrain integrated river management.

The Urban River Management Plan (URMP) for Bhagalpur provides a structured, evidence-based framework to address these issues through integrated planning, floodplain zoning, waterbody rejuvenation, riparian restoration, wastewater reuse, and community engagement. By embedding these strategies into the city's master plan, URMP offers a pathway to improve river health, enhance resilience, and leverage cultural assets for sustainable development.

Summary of key interventions proposed in the Bhagalpur URMP

Following is the key summary of interventions prepared based on a detailed baseline assessment, identification of issues and challenges and aligning with the objectives of URMP framework and city's vision.

1 REGULATING FLOODPLAIN ACTIVITIES + Objective 1: Regulation of Activities in the Floodplain				
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
1.1	Floodplain Zoning Integration into the Master Plan	Nagar Parishad Buxar (Lead), WRD, Town & Country Planning Dept	State Planning Funds, NMCG technical assistance	NA
1.2	Ecological Floodplain, Wetland, Sandbar & River Zoning and Conservation Strategy (Champa-Ganga Corridor)	WRD and Town & Country Planning Directorate (Zoning & Master Plan Delineation), BUIDCO (Execution), and BMC (Local Enforcement & O&M)	NMCG, CAMPA Funds, State Flood Management Fund	will be project to project basis
2 POLLUTION FREE RIVER + Objective 2: Pollution Free River				
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
2.1	FSTP for Bhagalpur city– addressing the exiting infrastructure gap. (Phase 1– 50 KLD)	Bhagalpur Municipal Corporation (BMC), BUIDCO	SBM/ AMRUT 2.0	INR 7.5 Cr (Capex– Phase 1) OnM – 12.5 Lakh/ year
2.2	Interception, Diversion, and Centralized Treatment for the Champa River– CETP	BUIDCO (Execution/Tendering), BSPCB (Regulation/Standards), and Bhagalpur Municipal Corporation (Long-term operation/Municipal reuse)	NMCG/AMRUT 2.0	To be determined based on a more detailed study and DPR
2.3	Champa River Eco-Hydrological Restoration, Stork Habitat Conservation, and Cultural Corridor Project (INTEGRATED WITH OBJ 8 AND 9 PROPOSAL)	Bhagalpur Municipal Corporation (BMC) (Lead on sanitation, solid waste traps, and Zone 2 center management) in close	NMCG/AMRUT2.0	12 – 13 Cr



		coordination with the State Forest Department / VGDS Division (Lead on Stork Focus Area) and BUIDCO (Technical execution of edge works)		
3 REJUVENATE WATERBODIES AND WETLANDS Objective 3: Rejuvenation of inland water bodies				
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
3.1	Project Pokhar Rakshak: Silt Core Dredging and Native Bio-Fencing Initiative	Bhagalpur Municipal Corporation (BMC)	NMCG, AMRUT 2.0, Jal Jeevan Haryali Mission	Cost will vary depending upon the talab size
3.2	Central Library Pond Eco-Restoration Project	Bhagalpur Municipal Corporation (BMC)	NMCG/AMRUT 2.0	INR 4,065,410
3.3	GIS-Based Waterbody Inventory and Eco-Hydrological Diagnostic System (Integrated with NIUA's Urban Water Body Diagnostic Tool)	Bhagalpur Municipal Corporation (BMC) and BSPCB	Bhagalpur Municipal Corporation (BMC), AMRUT 2.0	INR 26,40,000
4 ENHANCE RIPARIAN BUFFER Objective 4: Enhancing Riparian Buffer				
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
4.1	Integration of Riparian Buffer Regulations into the Master Plan including Ecological Enhancement through Native and Zoned Planting	WRD and Town & Country Planning Directorate, BMC	State Planning Funds, NMCG technical assistance	N/A
4.2	Continuous Green Corridor along the proposed Eco-friendly riverfront Development Zone	Water Resources Department (WRD) as lead, with BMC	CAMPA Funds	Integrated with Intervention 6.1
5 INCREASED REUSE OF TREATED WASTEWATER 6 MAXIMUM GOOD QUALITY RETURN FLOW Objective 5: Increased Reuse of Treated Wastewater Objective 6: Maximum Good quality return flow				
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
5.1	Circular Water Reuse & Clean Return Flow Management Program	Bhagalpur Municipal Corporation (BMC) (O&M, SOP enforcement, and distribution) with technical support from BUIDCO and regulatory licensing from the BSPCB.	NMCG policy component or AMRUT 2.0 city action plans	N/A



7 ECO-FRIENDLY RIVERFRONTS PROJECTS	8 LEVERAGING ECONOMIC POTENTIAL OF THE RIVER	Objective 7: Eco-friendly Riverfront Projects Objective 8: Leveraging Economic Potential of the River		
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
7.1	Eco-Sensitive Riverfront Zonation, Bioengineered Edge Stabilization, and Outfall Phytoremediation Project	Water Resources Department (WRD) (Lead on edge treatments and floating structures), Bhagalpur Municipal Corporation (BMC) (O&M, solid waste management, and kiosk regulation), and Forest Dept / VGDSM (Sanctuary boundary enforcement).	NMCG/AMRUT 2.0	INR 95,048,900
9 CITIZEN AWARENESS ON RIVER SENSITIVE BEHAVIOUR	10 ENGAGE CITIZENS IN RIVER MANAGEMENT ACTIVITIES	Objective 9: River Sensitive Behaviour among Citizens Objective 10: Citizen engagement in river management		
	Intervention	Responsible agency	Potential Funding Source	Estimated budget
8.1	Institutionalizing and Scaling “Dolphin Mitra” Programme	Bhagalpur Nagar Nigam	Dolphin Sactuary Development Budget/NMCG	10–15 Lakhs
8.2	Community Awareness and Stewardship Programme for Aquatic Ecosystem Conservation	VGDS & Bhagalpur Nagar Nigam	NMCG	5–10 Lakh
8.3	Citizen–Science Portal for Socio–Ecological Data Collection, Reporting, and Knowledge Sharing	Vikram Shila Gangetic Dolphin Sanctuary, BMC	NMCG	~10 Lakhs





INTRODUCTION



1. INTRODUCING URBAN RIVER MANAGEMENT PLAN FOR BHAGALPUR

1.1. Concept, Vision and Pillars of URMP

The core concept of the URMP is to integrate river-sensitive thinking into mainstream urban planning and governance. Rather than treating the river as a residual drain or a standalone beautification project, the URMP positions the river as a living ecological system and a shared urban asset that supports biodiversity, livelihoods, cultural practices, and city resilience. The framework promotes a shift from fragmented, project-based interventions to a holistic, basin-aware, and outcome-oriented approach that aligns with existing statutory plans such as the Master Plan, City Sanitation Plan, and City Development Plan. Importantly, the URMP is designed as a living document, allowing cities to monitor progress, learn from implementation, and recalibrate actions over time.

The Urban River Management Plan (URMP) for Bhagalpur city has been prepared with an intent to manage the Ganga River and the other associated water systems within the city, in a sustainable manner. The URMP framework prepared by the National Institute of Urban Affairs (NIUA) and the National Mission for Clean Ganga (NMCG), has been followed for preparing the URMP Bhagalpur.

The URMP is anchored in the three pillars of sustainable development: Environmental, Economic, and Social. These pillars collectively guide the vision, objectives, and interventions proposed under the plan.

Figure 1 : Elements of the URMP Framework

ENVIRONMENT PILLAR

.....Responsible



Focuses on restoring river health by reducing pollution, protecting floodplains and riparian buffers, rejuvenating water bodies, and maintaining ecological flows to support biodiversity and resilience.

ECONOMIC PILLAR

.....Beneficial



Aims to harness the river's ecosystem services for sustainable livelihoods and local economic growth through eco-friendly riverfronts, tourism, navigation, and allied activities without compromising river health.

SOCIAL PILLAR

.....Inclusive



Seeks to reconnect citizens with the river by promoting river-sensitive behavior, cultural engagement, and active public participation in river conservation and management.

The Urban River Management Plan envisions a future where urban rivers function as healthy ecological systems, support sustainable economic activities, and are valued and celebrated by citizens. The vision emphasizes river-sensitive urban development that enhances environmental resilience, urban liveability, and socio-economic productivity while maintaining the ecological integrity of the river.

The URMP operationalizes this vision through ten objectives covering environmental, economic, and social dimensions. The URMP's vision shall be achieved through a set of ten objectives, six of



which are environmental, and two each for the economic and social visions. Each objective is unique and addresses a niche aspect of urban river management.

It is important to note that the URMP is a living document that shall evolve over time as more knowledge and resources become available. The URMP also indicates a phase-wise (short term, medium term, long term) implementation plan for these interventions.

Figure 2 : Objectives across the 3 elements of the URMP Framework

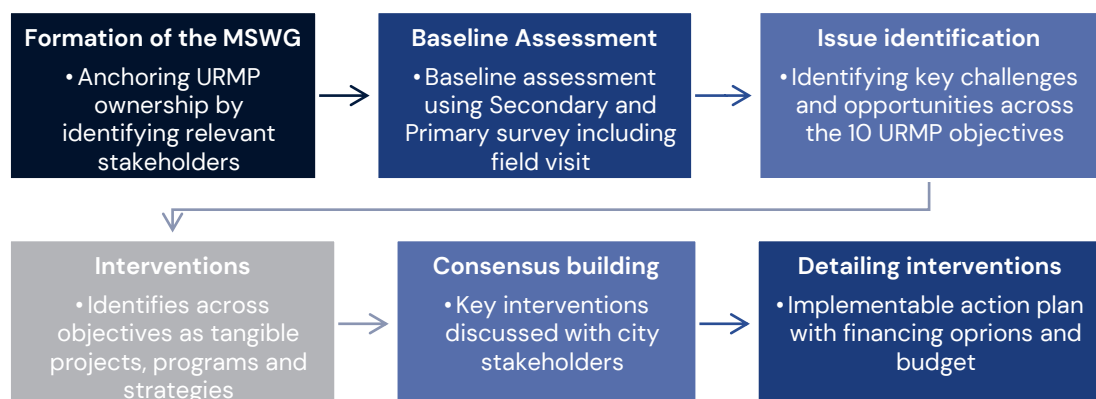


1.2. Process for preparation of URMP Bhagalpur

Following process was followed for the preparation of URMP Bhagalpur:

- **Step 1** –Setting up a core working group of relevant stakeholders to anchor the ownership of the URMP
- **Step 2** – Conducting a thorough baseline assessment of the relevant parameters to establish current status and the baseline score
- **Step 3** – Identifying key challenges and issues and preparing SWOT
- **Step 4** – Identifying tangible interventions for each objective of the URMP framework
- **Step 5** – Consensus building on the interventions via stakeholder workshops with City officials
- **Step 6** – Preparation of detailed plan for prioritised implementation of the interventions, and linking each intervention to probable institutional and financing option, along with a monitoring framework

Figure 3 : Steps for preparation of URMP Bhagalpur



1.3. URMP Bhagalpur– Working Group

The preparation of the Urban River Management Plan (URMP) for Bhagalpur was spearheaded by the Mayor and Municipal Commissioner, with active support from BUIDCO, PHED, and other relevant line departments. The process was guided by the National Mission for Clean Ganga (NMCG) and National Institute of Urban Affairs (NIUA).

Figure 4: First MSWG Meeting held on 14th July 2025



Discussions during the first MSWG meeting helped shape the vision for the Bhagalpur URMP, which serves as the foundation for evaluating related challenges and identifying opportunities across thematic areas. Bhagalpur is envisioned to evolve as an environmentally sustainable urban center that conserves biodiversity, strengthens the local economy, and promotes its cultural and religious heritage through low-impact tourism. The city's development is expected to build upon its ecological assets, cultural identity, and strategic location, while enhancing overall quality of life as a central objective of the URMP.

VISION

Conserve biodiversity, Strengthen city's economy
and
Promote culture through low impact tourism

This was followed by **baseline assessment** phase that involved intensive on-ground data collection, stakeholder consultation and review of available project reports on various initiatives related to managing the river and urban water bodies health, including key issues and potential.



Key Observations made and Challenges Identified:

- **Pollution Sources Identified:** Untreated sewage from septic tanks, solid waste dumping at Mayaganj which is on the flood plain of river Ganga, Kankaithi landfill, and effluent discharge from the silk industry (notably in Nathnagar) were identified as primary contributors to river pollution. A 45 MLD STP with nine IPS units has been constructed under BUIDCO, though several IPS remain stalled pending forest clearance.
- **Hydrology and Riverfront Challenges:** The Ganga's shifting course has rendered several ghats underutilised and caused severe erosion along the floodplain. The Municipal Commissioner highlighted the need for a scientific assessment of proposals like the Bhakityarpur Canal to redirect flow closer to Bhagalpur.
- **Water Supply and Drainage Gaps:** The city depends on the Champa River WTP and deep borewells, which are declining in yield due to falling groundwater levels. There is no dedicated stormwater drainage system, leading to frequent waterlogging and siltation.
- **Biodiversity and Ecological Significance:** Bhagalpur hosts the Vikramshila Gangetic Dolphin Sanctuary—one of the most stable dolphin habitats in the basin—and breeding sites for the endangered Greater Adjutant stork ("Garuda"). The Forest Department emphasised integrating biodiversity conservation, organic farming, and water reuse in the URMP.
- **Institutional Coordination and Data Sharing:** Departments such as Forest, Minor Irrigation, and Town Planning agreed to share spatial, biodiversity, and project data (STP DPRs, forest management plan, dolphin surveys, etc.) to aid URMP preparation.
- **Solid Waste and Faecal Sludge Management:** Door-to-door collection is operational but lacks segregation. Legacy waste clearance is under tendering, and the workforce is being doubled. Unregulated desludging practices by private operators remain a key concern; guidelines and monitoring mechanisms were proposed.
- **Urban Planning and Land Management:** Bhagalpur lacks a statutory Master Plan. Current development is governed by building control regulations based on road width, with no formal river edge demarcation. Encroachments and the absence of river buffer zoning were noted.
- **Proposed Theme for Bhagalpur URMP:** *"Bringing the Ganga Closer to the City"* – emphasising ecological restoration, biodiversity protection, and re-establishing cultural and economic linkages between Bhagalpur and its rivers (Ganga and Champa).

Based on the baseline assessment and key issues identified, interventions were developed across the 10 objectives aligning with the URMP framework in close consultation with NIUA.





BHAGALPUR URMP - BACKGROUND



2. Bhagalpur URMP– BACKGROUND

2.1. City Profile



Bhagalpur is the district headquarters of Bhagalpur district in eastern Bihar and is situated on the southern bank of the Ganga River, occupying approximately 66 km of the Gangetic stretch within the mid-Gangetic alluvial plain. The Chandan and Badua rivers, along with smaller seasonal channels, contribute to the district's hydrological character, supporting agriculture and local ecosystems while also bringing recurring flood risk during the monsoon. The river system at Bhagalpur is ecologically distinctive. The 50 km Ganga stretch between Sultanganj and Kahalgaon hosts the Vikramshila Gangetic Dolphin Sanctuary, the only dedicated sanctuary in Asia for the conservation of the Gangetic River Dolphin. This riverine setting has historically underpinned the city's fertility, trade, and cultural identity, while also exposing it to significant seasonal inundation, active bank erosion, sandbar formation, and the gradual northward drift of the main channel, which periodically disrupts water supply and navigation.

Bhagalpur is the third largest city in Bihar by population and serves as the headquarters of Bhagalpur district, Bhagalpur division, and the Eastern Range of the Bihar Police. Its name is believed to be derived from *Bhagdatpuram*, meaning City of Good Luck. Historically, the city was known as Champa Nagari and served as the capital of the ancient kingdom of Anga, one of the sixteen *mahajanapadas* referenced in early Buddhist and Jain texts. Its most celebrated institutional legacy is Vikramashila Mahavihara, a major Buddhist monastic university founded by King Dharmapala between the late eighth and early ninth century CE, which ranked alongside Nalanda and Odantapuri as one of the three most important centres of Buddhist learning in medieval India. The city subsequently featured in Mughal administrative networks and colonial trade systems and remains a significant cultural and educational hub in the Anga region.

Bhagalpur stands at approximately 43 metres (about 141 feet) above mean sea level and is located at 25°15'N latitude and 87°0'E longitude, approximately 220 km east of Patna and 410 km northwest of Kolkata. The Ganga forms the northern edge of the urban area, with the city's built fabric extending southward into the fertile alluvial plains. The soil profile varies across the district — reddish alluvium in the south formed by Ganga floodwaters, light-red adhesive soil in the central areas suited to brick manufacturing and dense habitation, and sandy river-deposited soils in the north and west subject to annual flood deposition. The Bhagalpur Municipal Corporation, established as a Nagarpalika in 1864 and elevated to a full Municipal Corporation in April 1981, currently comprises 51 wards. Bhagalpur is also one of the cities selected for development under the Government of India's Smart Cities Mission.



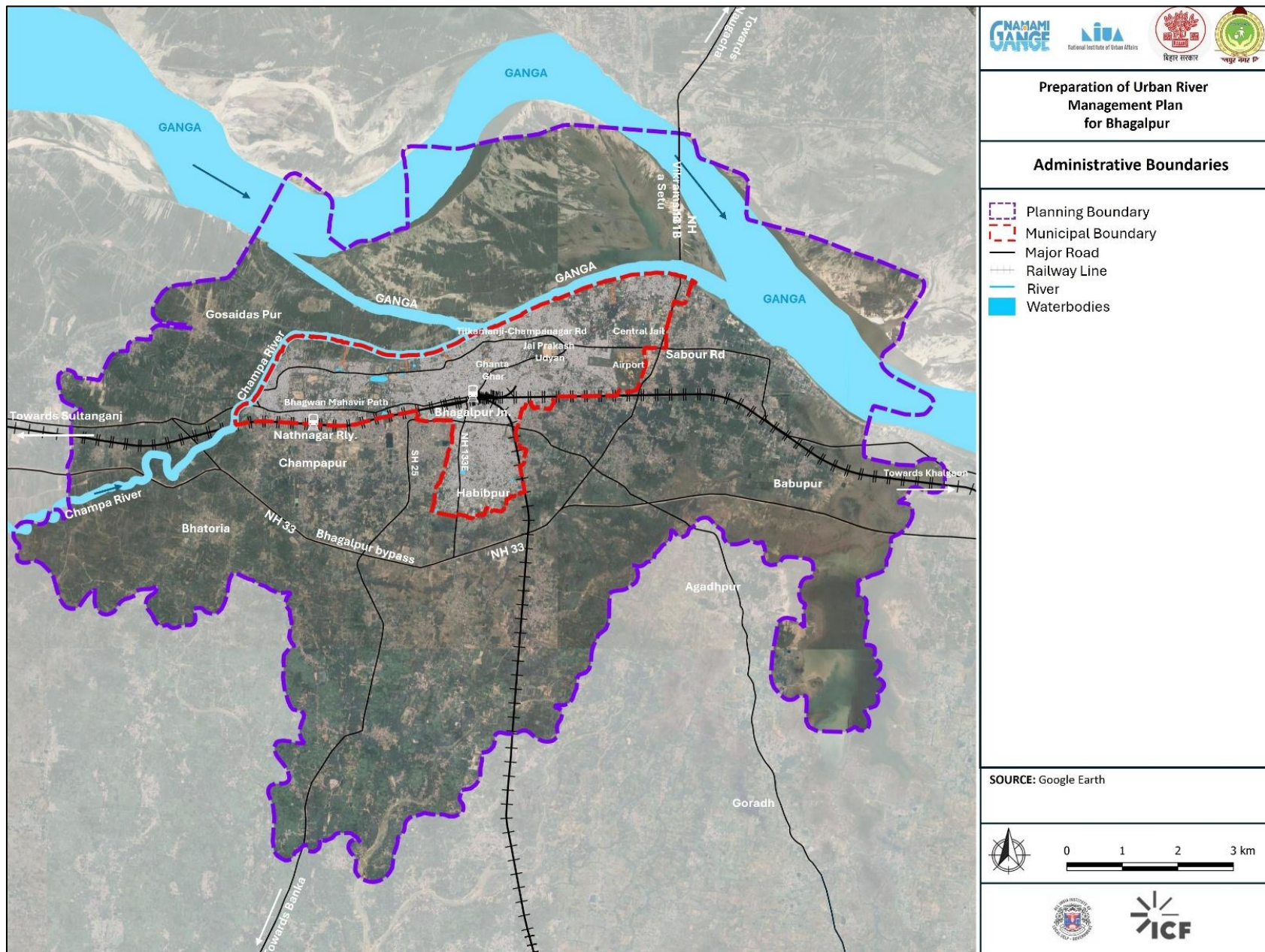
The city is well connected through road and rail networks. NH-80 runs through the city and connects it with Patna, while SH-19 and SH-25 serve as the main arterial roads. The Vikramshila Setu, a 4.7 km bridge across the Ganga near Bhagalpur, links NH-80 on the south bank with NH-31 on the north, connecting the city to Naugachia, Purnia, and Katihar and substantially reducing travel distances across the river. The city is also served by the Bhagalpur Railway Junction, with the Vikramshila Express providing direct connectivity to Patna and Anand Vihar Terminal in Delhi. The Bhagalpur stretch of the Ganga falls along National Waterway No. 1, and ongoing investments in inland waterway infrastructure are expected to enhance freight movement and regional logistics in the coming years.

Bhagalpur has been associated with the silk industry for hundreds of years and ranks second after Karnataka in silk fabric production and exports nationally. The GI-tagged Bhagalpuri Tussar silk, woven primarily in the Nathnagar area, sustains a large artisanal and weaving workforce and represents the city's most distinctive economic identity. Beyond silk, the economy is broadly reliant on agriculture, with rice, wheat, maize, barley, and oilseeds as the main crops, alongside the NTPC Kahalgaon Super Thermal Power Plant as a major industrial anchor in the district.

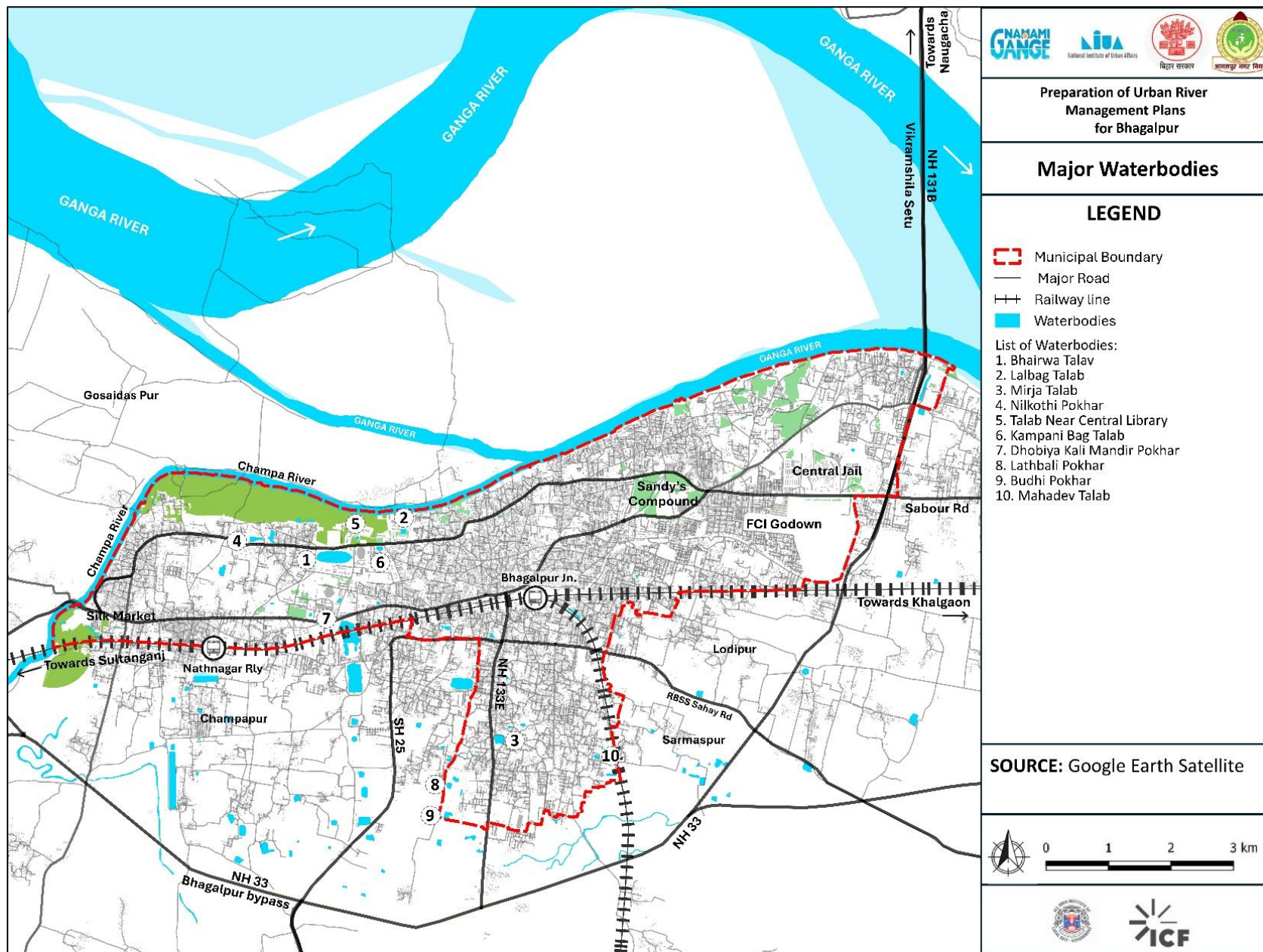
The Ganga ghats in Bhagalpur nearly 46 prominent and minor ghats in the city alone form the social and ritual spine of the riverfront, serving as sites for daily Hindu observances, cremation rites, and major seasonal festivals. Many of these ghats are closely associated with ancient temples, local legends, and regional folklore, and have existed for centuries. Events such as Chhath Puja, the Kanwar Yatra originating at Sultanganj, and Kali Puja draw large seasonal influxes of pilgrims and worshippers, reinforcing Bhagalpur's deep socio-cultural identity as an Anga heritage city while placing significant seasonal pressure on riverbank infrastructure, sanitation systems, and water quality management along the Ganga frontage.



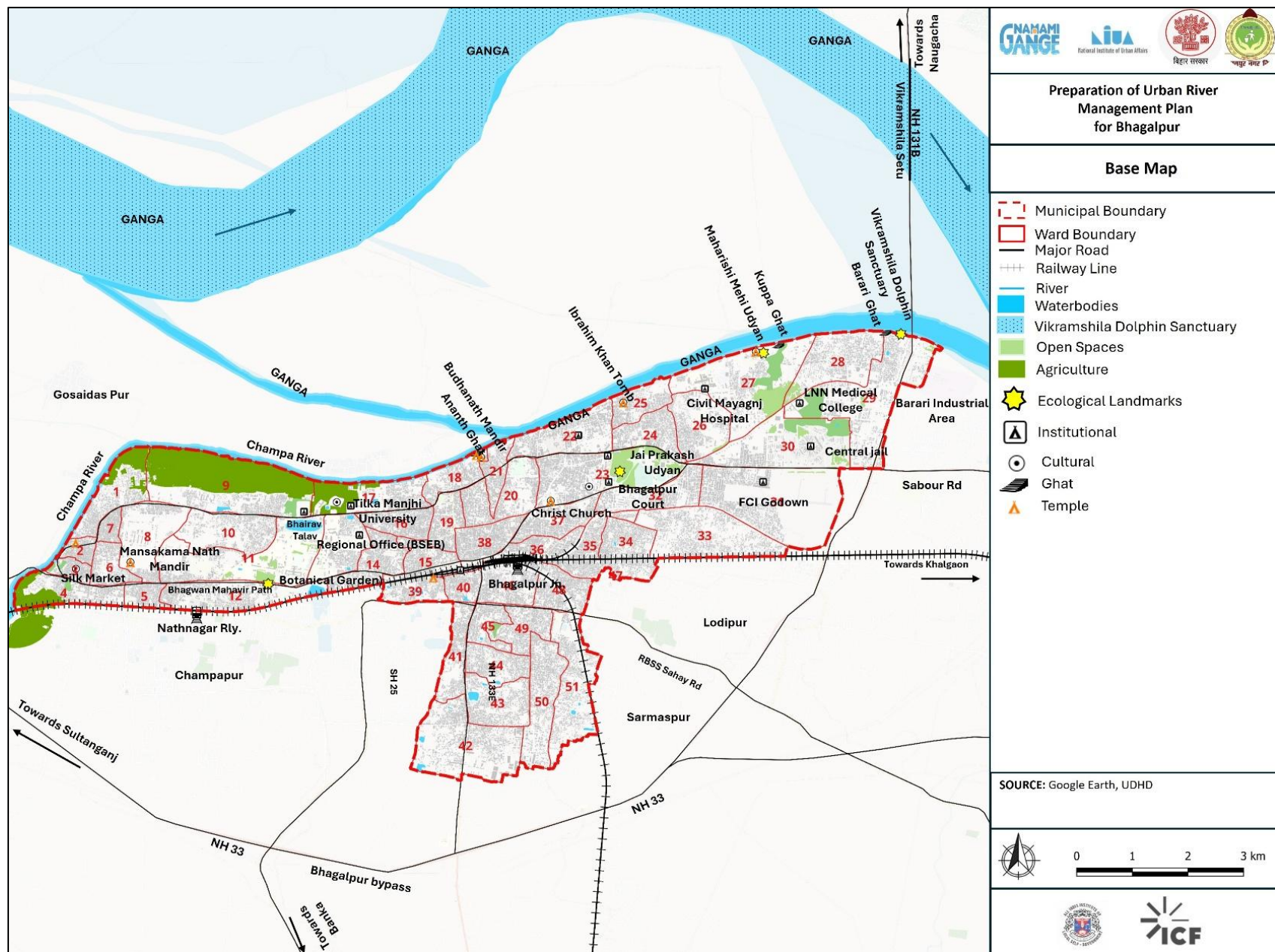
Map 1 Administrative Boundary- Bhagalpur municipal corporation and Planning area



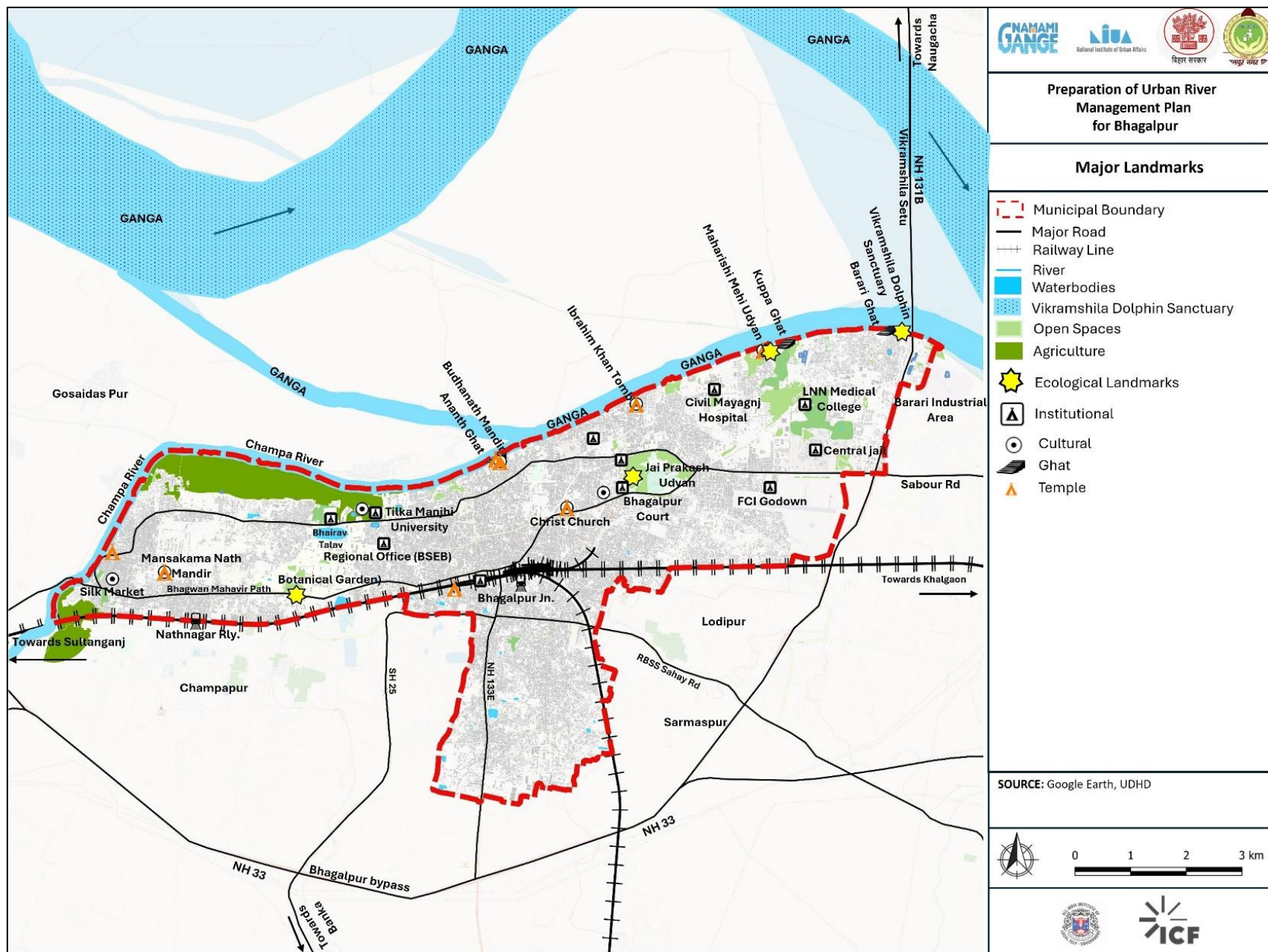
Map 2 Bhagalpur Water Bodies and River



Map 3 Administrative ward boundary-Bhagalpur city



Map 4 Major Landmarks



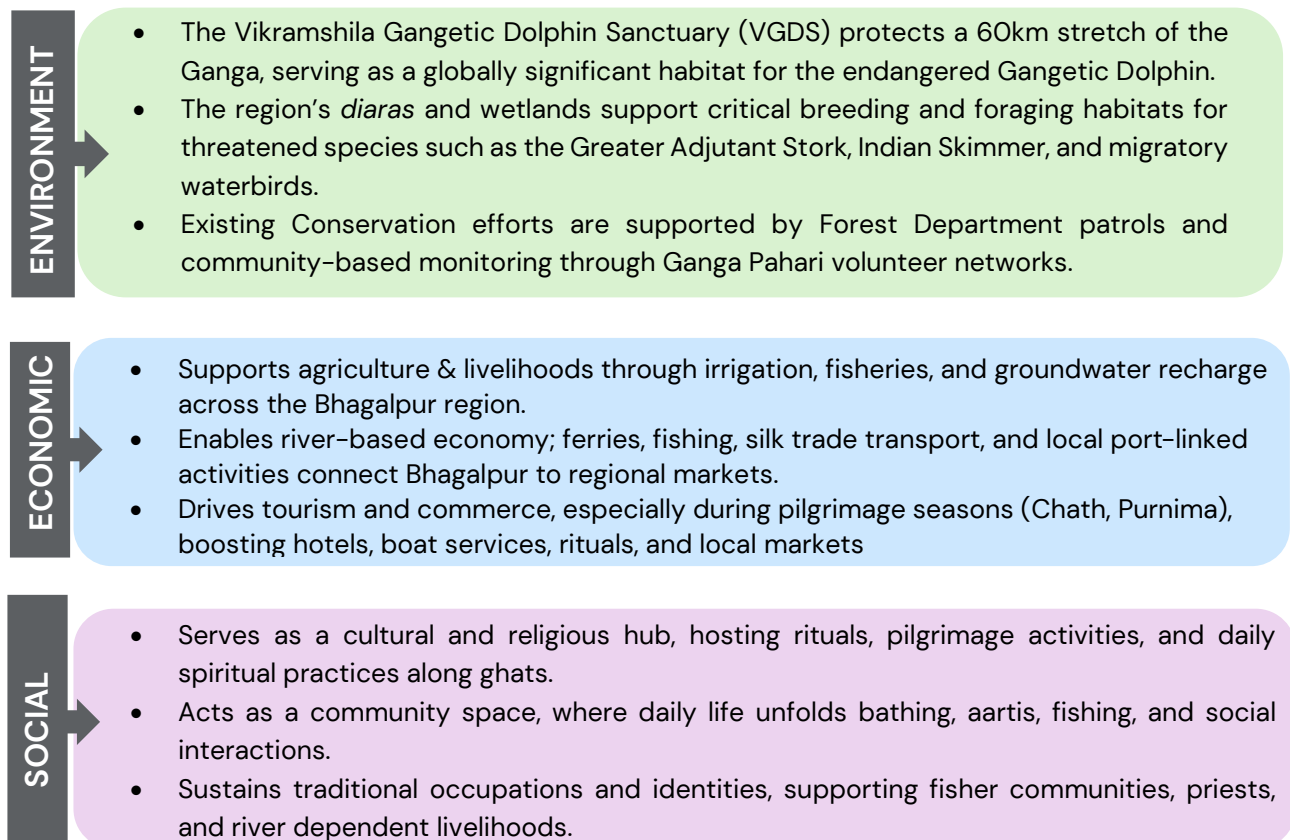
2.2. Bhagalpur and its relationship with Ganga and Champa

The Ganga River, coursing through the historic city of Bhagalpur, is far more than a geographical feature—it holds profound spiritual, cultural, and ecological significance, deeply woven into India’s heritage. The river is revered in Hindu tradition not only as a physical landmark but as a goddess, a purifier, and a symbol of salvation and sustenance. Bhagalpur, celebrated as the “Silk City” of India, has long been shaped by the Ganga’s flow, with its ghats, temples, and markets testifying to a centuries-old bond between river and civilisation. Major festivals such as Chhath Puja and Kartik Purnima Mela are celebrated with grandeur on its banks, where lakhs of devotees gather to worship and offer prayers.

The name “Ganga” is embedded in Vedic and Puranic literature as the celestial river, born from the matted locks of Lord Shiva, sanctifying the earth with her descent. Described as *Tripathaga*—the river flowing through heaven, earth, and the underworld—the Ganga embodies purity, fertility, and liberation. In Bhagalpur, her wide, meandering course transforms into a sacred landscape where spiritual beliefs meet livelihoods. Yet, like at many stretches, the river’s flow is capricious eroding one bank while nourishing another, shaping lives with both generosity and unpredictability.

At Bhagalpur, the Ganga is joined by tributaries like the Chandan and Ghaghara, and her vast channel can stretch over several kilometres wide during the monsoon. The riverbed here is braided, interspersed with sandbars locally called *diaras*, which are seasonally cultivated with maize, pulses, and oilseeds by farming communities. In contrast, the lean summer months expose sandy shoals where fishing nets, ferryboats, and sand miners dominate the horizon.

Figure 6 The Environmental, Economic and Social outcome of Bhagalpur URMP



VIKRAMSHILA GANGETIC DOLPHIN SANCTUARY WITH ECO SENSITIVE ZONE

The Vikramshila Gangetic Dolphin Sanctuary (VGDS) is India's only designated dolphin sanctuary, covering a 60 km stretch of the Ganga River from Sultanganj to Kahalgaon in Bhagalpur district, Bihar, notified in 1991 under the Wildlife (Protection) Act, 1972.

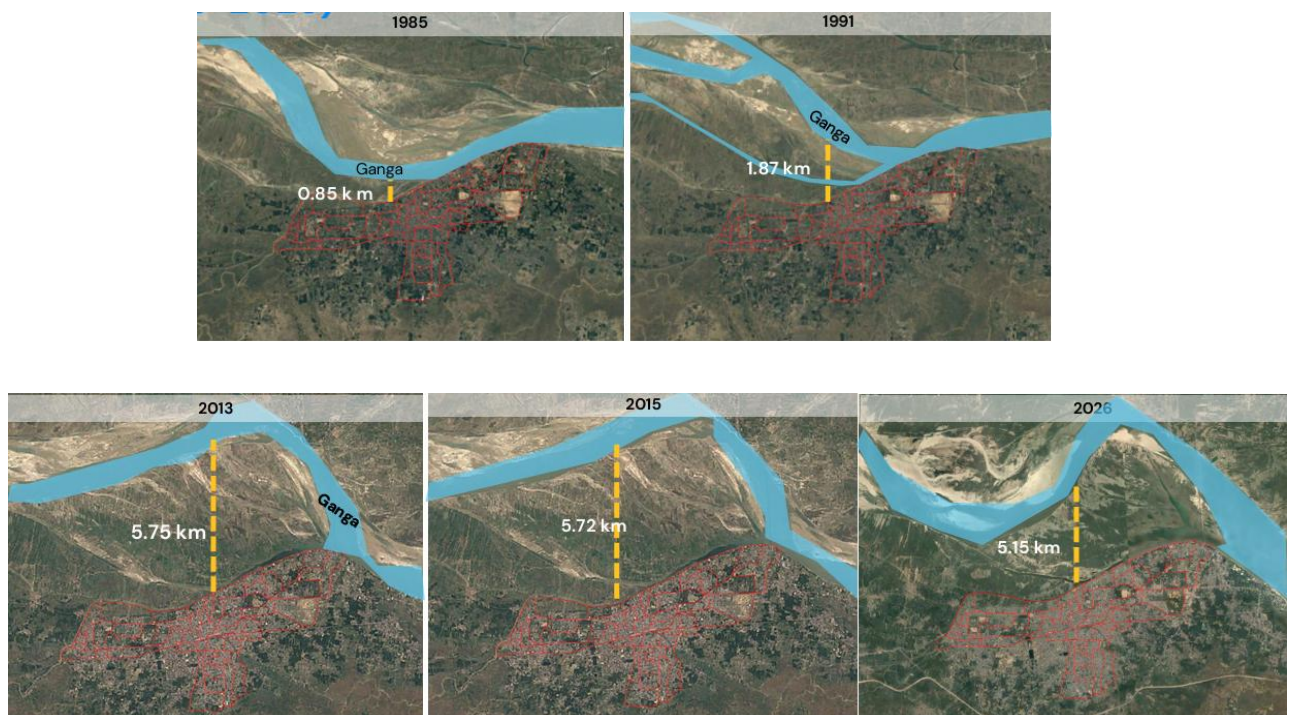
The ecological importance of this zone is recognized under Final Notification S.O. 3030(E) dated 9 November 2015 issued by the Ministry of Environment, Forest and Climate Change (MoEFCC), concerning the Eco-Sensitive Zone (ESZ) of the VGDS. According to the notification, extraction of surface and groundwater is restricted solely to bona fide agricultural use and domestic consumption by land occupiers. It also stipulates that no new construction of any kind shall be permitted within one kilometer from the boundary of the Protected Area.



Figure 7 River morphology and bird breeding hotspot area

River Morphology

Figure 8 River Morphology (1985–2026)



Seasonal morphological transformation in the river system around Bhagalpur reflects the strong influence of the monsoonal climate on channel patterns, sediment movement, and floodplain dynamics, particularly in the Ganga River.

During the monsoon phase, the river undergoes a dramatic expansion due to intense rainfall and upstream discharge. Channels that remain separate during drier months often merge into a broad, continuous flow. The floodplain becomes extensively submerged, sometimes extending several kilometers beyond the usual banks. In this stage, the river behaves as a high-energy system, actively eroding its banks, transporting large amounts of sediment, and constantly reshaping its course. Villages, agricultural lands, and existing landforms may be temporarily or permanently altered during this period.

In the post-monsoon and winter seasons, water levels gradually recede, leading to a more stable river system. Channels begin to reorganize and become more clearly defined. Sediments carried during the monsoon are deposited, resulting in the formation of sandbars and temporary islands, locally known as “chars.” These features are especially prominent near Bhagalpur and play an important role in influencing local agriculture and settlement patterns, although they remain highly dynamic and prone to change. They are also essential in terms of that they become major breeding grounds for fishes and habitat areas for birds.

During the summer season, the river reaches its lowest discharge levels. The flow becomes fragmented into smaller, isolated channels, with large portions of the riverbed exposed. These exposed areas reveal accumulated sediments and create a stark contrast to the monsoon’s expansive flow. This cyclical transformation highlights the constantly evolving nature of the river system in Bhagalpur.

2.3. Socio-Cultural and Religious Importance

Bhagalpur holds a deep historical and cultural significance, closely tied to the Ganga and the spiritual traditions of the region. In ancient texts, the area is associated with Anga, one of the sixteen Mahajan padas, with Bhagalpur serving as an important settlement along historic trade and pilgrimage routes.¹ The region is also linked to the Tapovan tradition, where ascetics and scholars are believed to have undertaken penance and study. The nearby Vikramshila site, established under the Pala dynasty, emerged as one of the most prominent centres of Buddhist learning in the subcontinent, second only to Nalanda.² Along the river, Barari Ghat and surrounding stretches continue to function as key ritual and spiritual spaces, reinforcing the city’s long-standing relationship with sacred landscapes and religious practice.⁴

¹ *Gazetteer of Bhagalpur District*, Government of Bihar, Department of Revenue & Land Reforms, Revised Edition.

² Department of Ancient Indian History & Archaeology, Tilka Manjhi Bhagalpur University, *Anga in Ancient India: Historical Context and Cultural Geography*, University Working Paper Series.

³ Archaeological Survey of India (ASI), Excavation Report: Vikramshila Mahavihara, Publication Series (1972–1995).

⁴ Bihar State Tourism Development Corporation (BSTDC), Tourism Profile: Bhagalpur District, Government of Bihar.



Figure 9 Major Ghats and Religious places

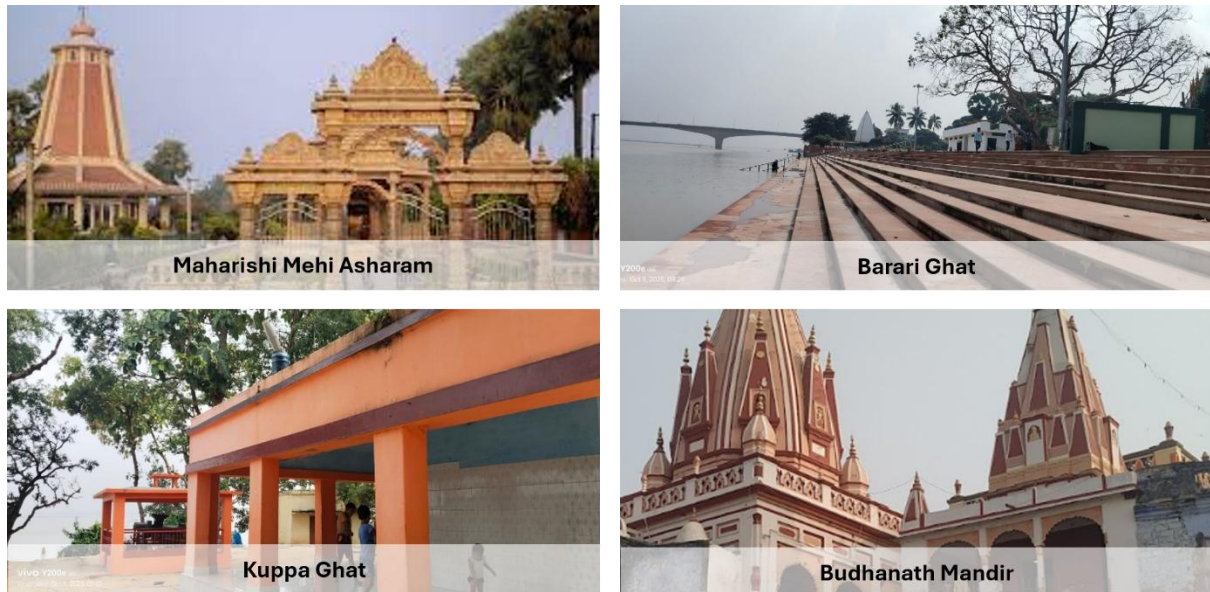


Figure 10 Major Festivals



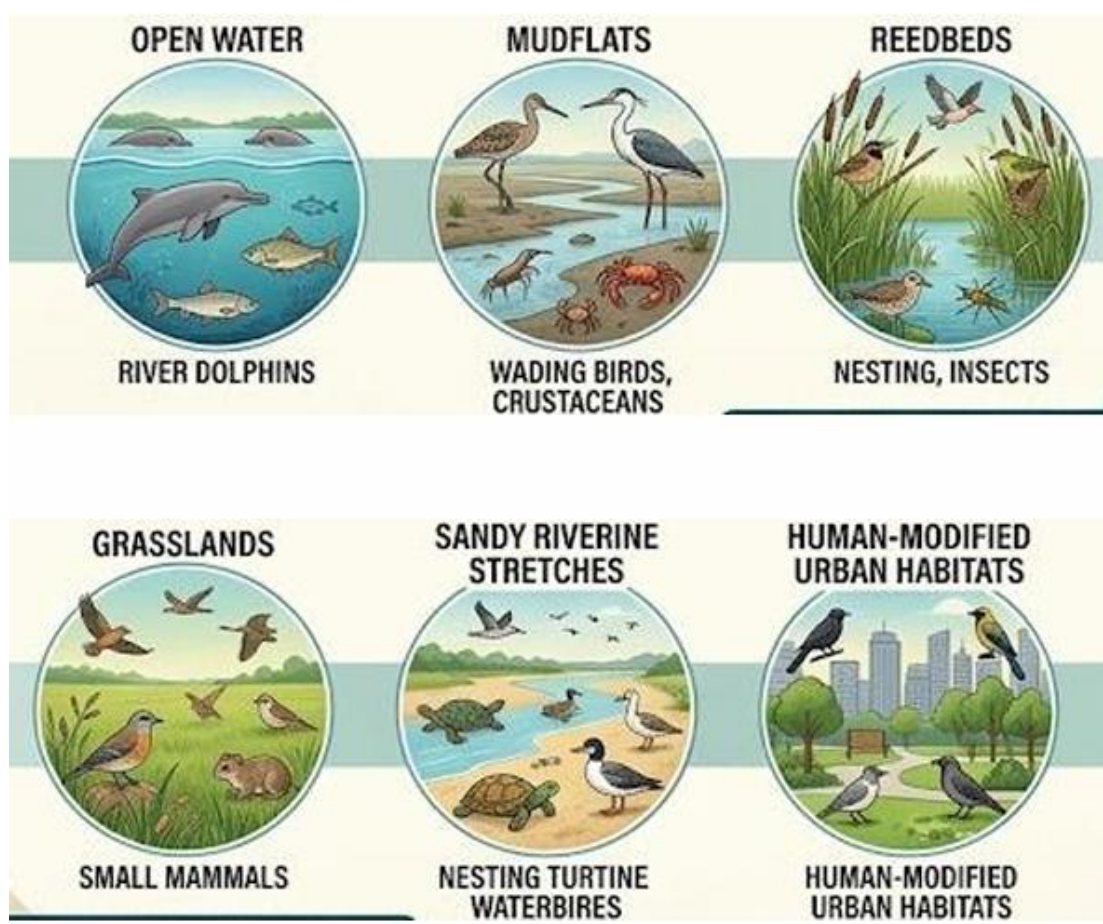
These sacred riverfront sites and temples attract large numbers of devotees throughout the year, with particularly high footfall during Chhath Puja (October–November), Kartik Purnima (November), Ganga Dussehra (May–June), and Kali Puja (October–November). Major congregations occur at Barari Ghat, Manik Sarkar Ghat, Kuppa Ghat, Sabour Ghat, and other ritual nodes, where collective bathing, worship, and immersion activities reinforce Bhagalpur’s cultural and spiritual identity.



2.4. Biodiversity Status

1. **Flora:** Native riparian vegetation includes *Dalbergia sissoo* (Indian rosewood), *Acacia catechu*, *Ficus religiosa*, and *Saccharum spontaneum*. However, invasive species like *Prosopis juliflora* and *Eichhornia crassipes* dominate disturbed stretches and floodplain ponds.
2. **Aquatic Fauna:** Fisheries in the Bhagalpur stretch of the Ganga River support diverse native fish species, including Indian Major Carps (IMCs) like Catla and Rohu, catfishes such as *Mystus* spp. and *Wallago*, and small indigenous fishes (SIFs). The region has a history of significant fishing activity, but resources have declined due to factors like overfishing, siltation, and pollution, impacting the livelihood of local fishing communities. The degradation of spawning grounds on sandbars and rising pollution are key stressors
3. **Terrestrial Biodiversity:** Open spaces and temple groves within the city provide pockets of biodiversity but are disconnected. Urban expansion into agricultural edges has reduced ecological corridors linking the river to hinterland ecosystems

Figure 11 Biodiversity–Ecological System Structure



Source: Consultant

Biodiversity in Bhagalpur is structured as a layered and interconnected ecosystem, where diverse habitats collectively support a wide range of species. Open water, mudflats, reedbeds, grasslands, sandy riverine stretches, and human-modified urban environments all contribute to species distribution and ecological balance.



These habitats can be broadly categorized into three main types:

Ganga Main Channel: Characterized by deep pools and braided channels, this habitat supports river dolphins, diverse fish species, and other aquatic fauna.

Floodplains and Diara (sandbars): Seasonal sandbars serve as critical nesting and breeding grounds for various species, especially birds and reptiles.

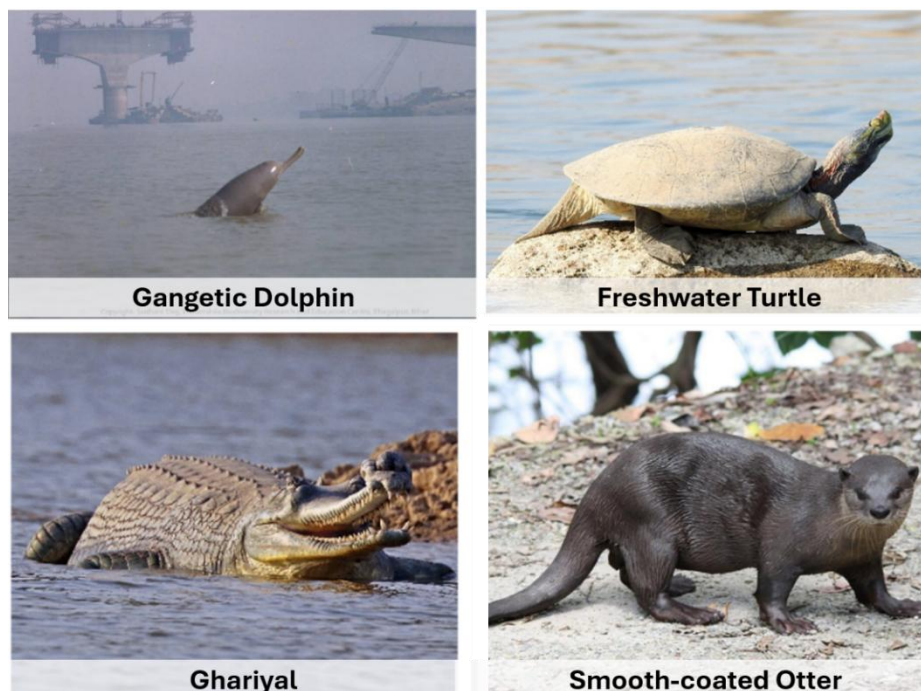
Urban Water Bodies, Streams, and Wetlands: These localized habitats play an essential role in maintaining hydrological stability and supporting urban biodiversity. Bhagalpur has approximately 605 wetlands, covering a total area of 24,171 hectares.

Importantly, these habitats function as interconnected systems. Any disruption in one component can have cascading effects on the others. Therefore, conservation efforts must focus on preserving ecological connectivity rather than protecting isolated sites, ensuring the long-term sustainability of the region's biodiversity.

Aquatic Fauna Profile

The river ecosystem is sustained by a set of key fish species that form its primary trophic base, including Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), and Wallago (*Wallago attu*). These species play a foundational role in maintaining the aquatic food web and supporting higher trophic levels. Among the flagship species, the Gangetic Dolphin, which is classified as Vulnerable, serves as an important indicator of river health and flow conditions. The ecosystem also supports several threatened species, such as the Gharial (Critically Endangered), Narrow-headed Softshell Turtle (Endangered), Smooth-coated Otter (Vulnerable), Indian Flapshell Turtle (Vulnerable), and Checkered Keelback Snake (Vulnerable). The entire aquatic and semi-aquatic fauna is intricately dependent on adequate river flow and good water quality. Any decline in fish populations directly disrupts this balance, adversely affecting dolphins and other higher trophic organisms. Therefore, all proposed Urban River Management Plan (URMP) interventions must treat pollution control and the maintenance of environmental flow as non-negotiable priorities to ensure the long-term sustainability of the river ecosystem.

Figure 12 Aquatic Fauna Profile





BASELINE ASSESSMENT- SUMMARY



3. BASELINE ASSESSMENT–SUMMARY

3.1. Baseline score and interpretation

Table 1: URM Baseline assessment score– Ganga in Bhagalpur

	URMP Objective	Score Achieved	Current Status
ENVIRONMENTAL	Regulation of activities in Floodplain • Flood plain management score	2	
	Pollution Free River– • Net Dissolved Oxygen score	3	
	Rejuvenation of Waterbodies • Waterbody revival score	1	
	Enhancing Riparian Buffer • Riparian Buffer score	4	
	Increased Reuse of Treated Used Water • Wastewater re-use score	1	
ECONOMICAL	Ecofriendly Riverfront Projects • Ecofriendly riverfront score	3	
	Leveraging Economic Potential of River • River economy score	5	
SOCIAL	River Sensitive Behaviour Among Citizens • Citizen sensitization score	3	
	Engage Citizens in River Management • Citizen Management score	1	
	TOTAL	23	

Note: *Score for Objective 6– Good quality return flow, is not valid in the case for Bhagalpur

$$\text{URM Index} = (2+3+1+4+1+X+3+5+3+1) / 9^* = 23/9 = 2.56$$

URM Index for Bhagalpur city = 2.56

Average level urban river management

Basic actions required to ensure urban river management are evident. However, there are still major gaps and serious concerns with regards to almost all dimensions of urban river management.

3.2. SWOT analysis

Based on the baseline assessment and consultations with city stakeholders, the following SWOT analysis has been prepared for the Ganga and its associated water bodies in Bhagalpur. This provides a diagnostic basis for identifying intervention areas under the URMP across the three pillars–Environmental, Economic and Social. The SWOT will position Bhagalpur–URMPs approach to align with the vision as well as provide a forward-looking strategy for interventions.



ENVIRONMENTAL

Treatment of wastewater, groundwater, trunk infrastructure, flood plain management, pollution, rejuvenation of inland water bodies and drains

STRENGTH

- Legally Protected Dolphin Sanctuary
- Rich riparian biodiversity

WEAKNESS

- Untreated Sewage
- Silk-Industry Effluent
- Unregulated Sand Mining

OPPORTUNITY

- Floodplain-based green-blue infrastructure
- Riparian buffer restoration

THREAT

- Recurrent Flooding
- Bank Erosion



Encroachment along the riverbank



Ganga Riverfront Project



Solid waste Dumping



Under Construction STP

ECONOMIC

Leveraging the economic potential of the riverfront and other economic activities

STRENGTH

- Renowned silk industry
- River-linked agriculture
- Fisheries
- Religious Tourism

WEAKNESS

- Unregulated river-linked livelihood
- No formalized Household industrial area

OPPORTUNITY

- Eco-tourism
- Religious Tourism
- Silk value-addition
- Riverfront Development

THREAT

- Pollution from silk industries
- Extremely flood prone



Tussar Silk



Greater Adjutant Stork



Manjusha Painting – GI Tagged



Baudhnath Temple



SOCIAL

Citizen sensitization and awareness on the importance of the river and mobilisation of community led efforts in managing river's health

STRENGTH	• Cultural & Spiritual attachment to Ganga • Strong Community Engagement	 Champapur Digambar Jain Mandir	 Maharishi Mehi Ashram, Kuppaghat
WEAKNESS	• Slum proliferation • Sewage & Solid Waste Dumping	 Ghats	 Ganga Prahri Programme
OPPORTUNITY	• School Participation • River Stewardship committee		
THREAT	• Flood and Pollution driven health risk		





INTERVENTIONS



4. INTERVENTIONS

4.1. Objective 1: Regulation Of Activities in Floodplains

Rationale: Objective 1 focuses on regulating activities within the river floodplain to safeguard riverine ecology, reduce flood risk, and align urban growth with river-sensitive planning principles. While Buxar's floodplain continues to perform essential ecological and hydrological functions, it does so in the absence of a coherent regulatory framework at the city or state level.

4.1.1. Existing Situation

Floodplain characteristics and land use dynamics

The floodplain of the Ganga River in Bhagalpur comprises of a critical ecological buffer that supports hydrological regulation, sediment deposition, and biodiversity maintenance, while simultaneously functioning as a zone of diverse economic activities. The interaction between its physical setting, evolving land-use configurations, and patterns of encroachment reveals a persistent tension between regulatory frameworks and the socio-economic activities shaping the urban riverfront. These dynamics highlight the complex relationship between environmental governance and the lived realities of river-dependent communities, underscoring the need for an integrated approach to floodplain management that reconciles ecological sustainability with local livelihoods.

Embankments, flood plain and river buffer analysis

In Bhagalpur, the Ganga River flows along the entire length of the city, shaping both its physical setting and cultural identity. However, the Water Resources Department (WRD) has not delineated any official embankment lines or floodplain boundaries along this stretch. There are no ground markers or defined limits to indicate the extent of the floodplain, and protective embankments are largely absent. The city's riverfront development features a stone masonry intermittently in some stretches, designed primarily for access and aesthetics rather than flood protection.

Across most of the urban stretch, residential and commercial constructions extend right up to the riverbank, leaving little to no riparian buffer. The natural floodplain has gradually been converted into built-up areas, with very limited open or vegetated space along the water's edge. This unregulated interface between the city and the river has led to continuous encroachment pressures and a loss of the river's natural resilience as seen in Figure 13 . The absence of a defined buffer zone or floodplain management measures makes the riverfront highly vulnerable to seasonal inundation and ecological degradation.



Figure 13 Ongoing encroachments within the floodplains

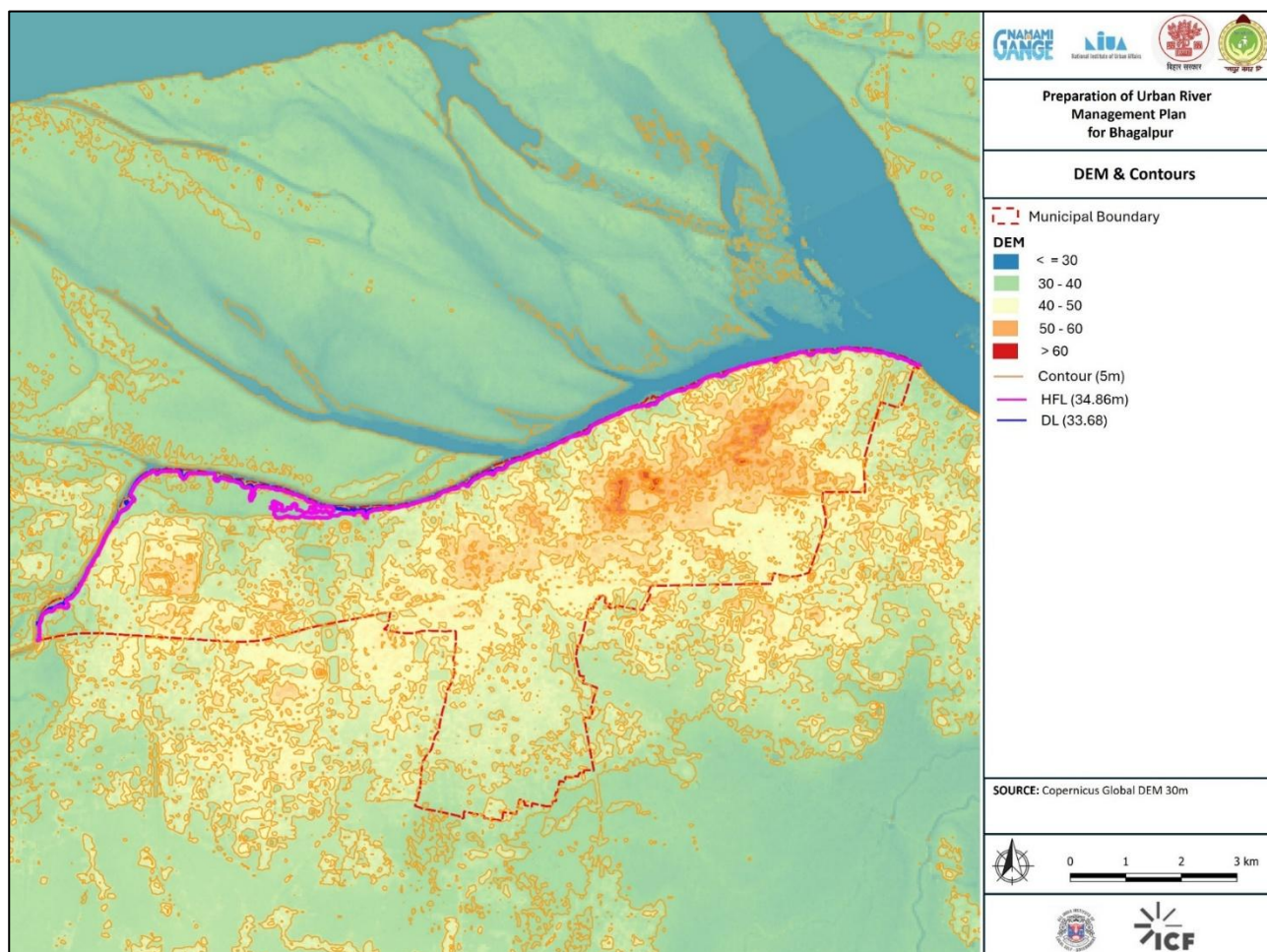


As per data from the Water Resources Department, Government of Bihar, the Danger Level (DL) of the Ganga River at Bhagalpur is 33.68 metres, while the Highest Flood Level (HFL) recorded at the Bhagalpur gauging station is 34.86 metres.

The Danger Level (DL) and Highest Flood Level (HFL) recorded at river gauging stations indicate the elevation of the river water surface relative to a standard survey datum, not the ground or embankment level at the site. At Bhagalpur, the Ganga River has a Danger Level of 33.68 m and a Highest Flood Level of 34.86 m (Water Resources Department, Government of Bihar). The HFL is therefore 1.18 m above the declared danger threshold, signalling the river's peak known flood stage



Map 5 DEM & Contours



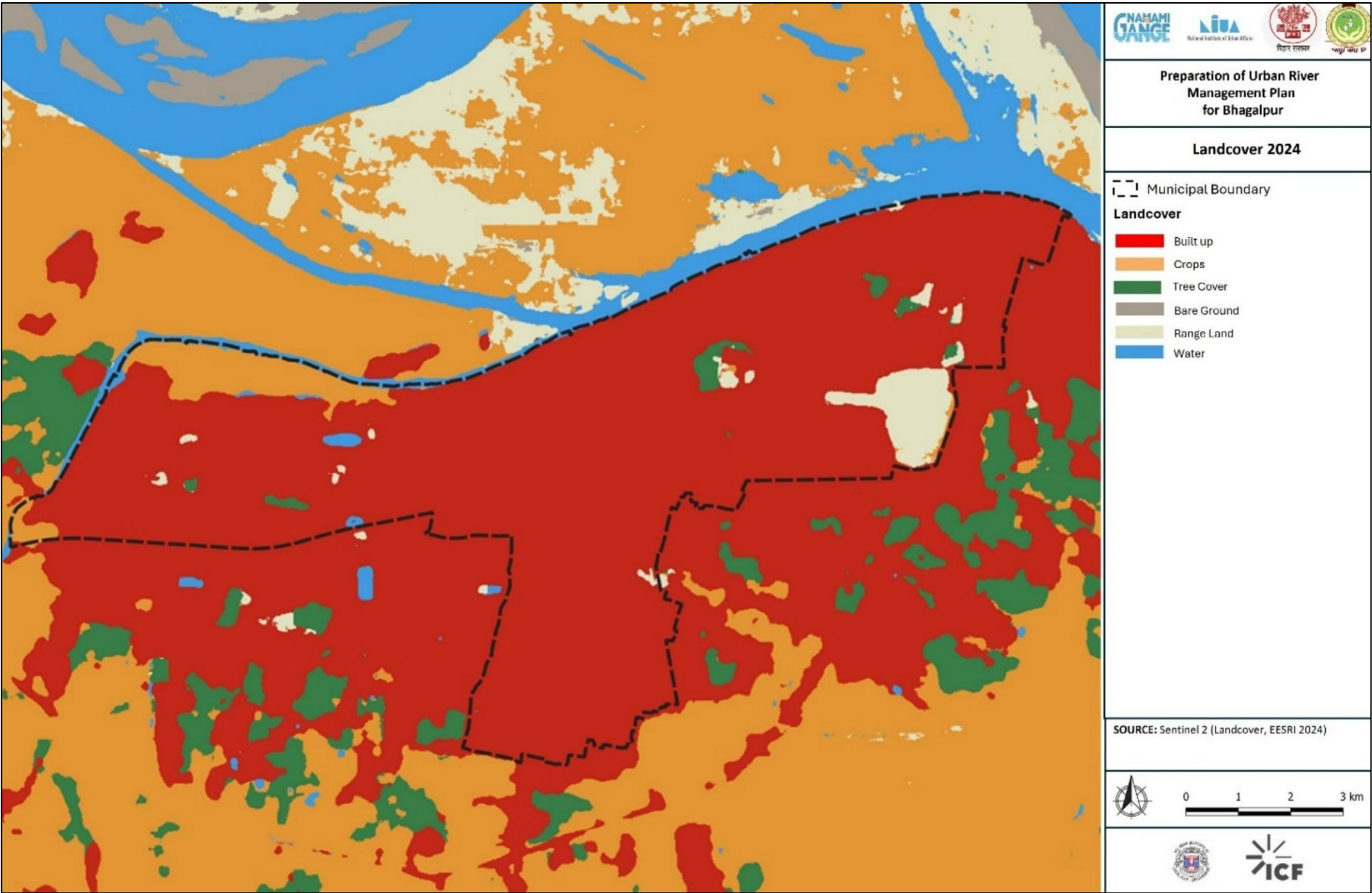
Land Use and Land Cover Analysis in the River Buffer Area

The land cover map illustrates the spatial distribution of major surface features within the ULB boundary for 2024. Built-up areas dominate the central and southern portions of the city, indicating significant urban expansion. Agricultural croplands and patches of rangeland are primarily located around the urban periphery, while clusters of tree cover appear in scattered pockets. Water bodies, including river channels and ponds, are visible mostly along the northern boundary near the Ganga and in small depressions within the city. The presence of extensive built-up areas suggests increasing land-use pressure, highlighting the need for integrated planning to balance urban growth with green and open spaces.

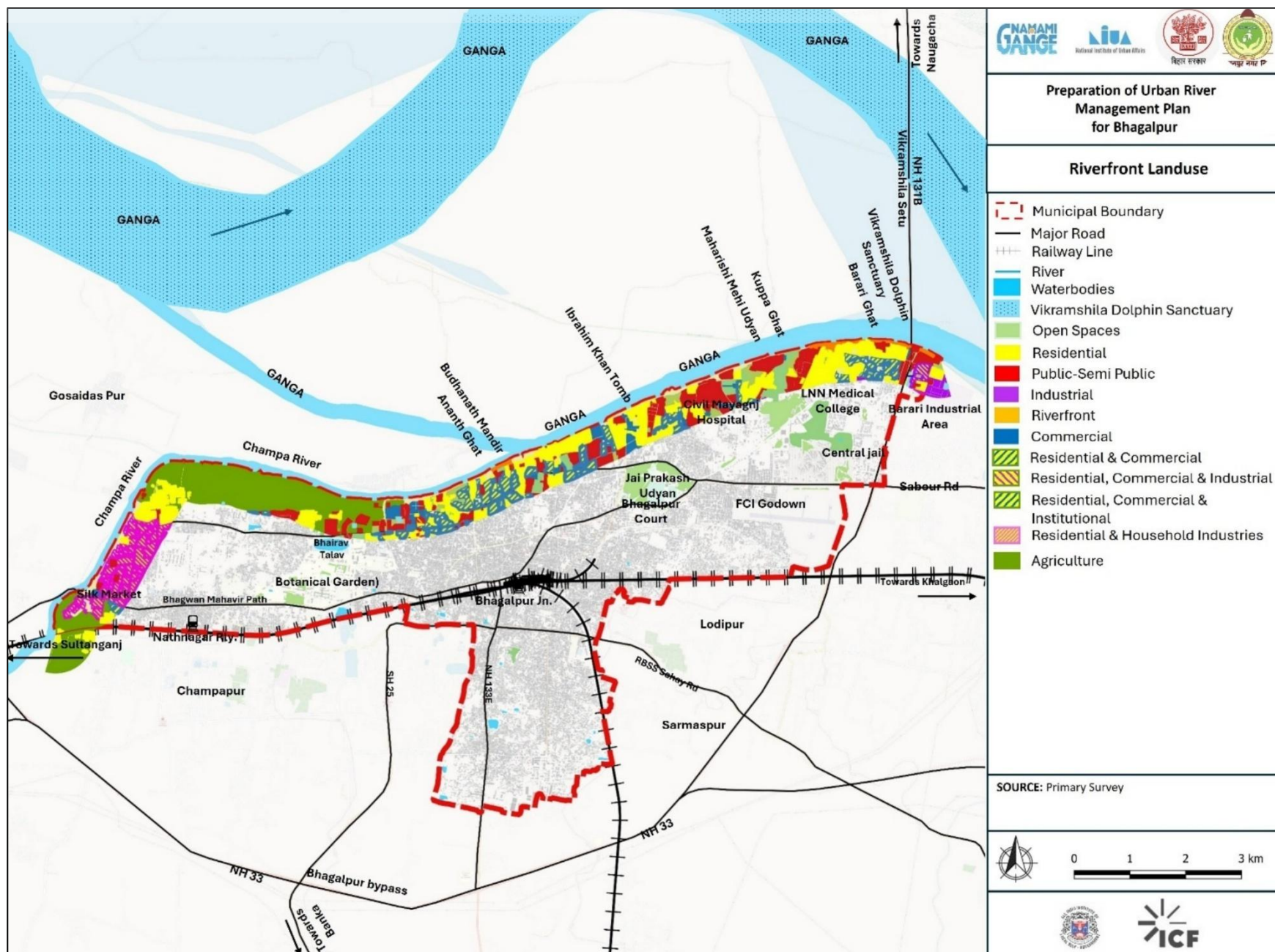
Figure 14 Riverbank Ganga River



Map 7 Landuse-Landcover 2024



Map 8 Riverfront Landuse

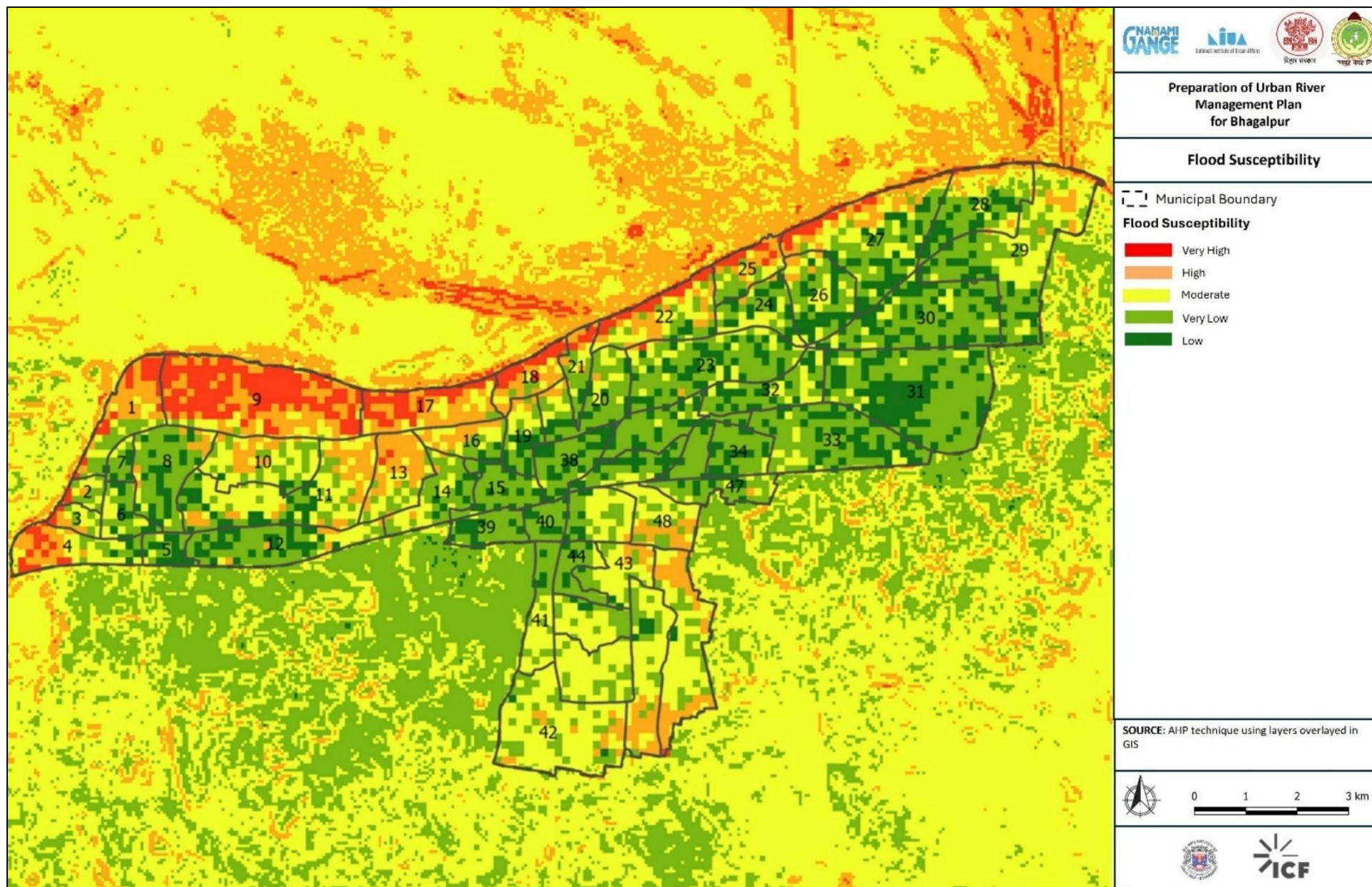


Flood Susceptibility

Bhagalpur faces severe and worsening flood risk because the city sits almost entirely on low-lying alluvial floodplain of the Ganga, with the river's Danger Level of 33.68 m and HFL of 34.86 m leaving little margin during the monsoon and cyclone season (July–September); this was starkly illustrated in August 2025, when the Ganga rose roughly 94 cm above the danger level, submerging parts of the *diara* belt and flooding institutions like Tilka Manjhi Bhagalpur university and Bhagalpur Engineering College, while at Kahalgaon water levels were the highest in past 16 years. The risk is compounded largely by unregulated urban growth into the floodplain (no formal embankment or buffer-line demarcation by the Water Resource Department), encroachment and informal housing along nalas and drains that reduce drainage capacity, and the loss of natural floodplain absorption as farmland and open spaces give way to built-up areas, this leads to a recurring pattern where low-lying northern wards and riverside settlements bear the brunt of waterlogging, infrastructure damage, and displacement each flood season.



Map 9 Flood Susceptibility Map



4.1.2. URMP Score

Flood Management Score

The floodplain management assessment indicates weak overall performance and implementation of regulated activities in the floodplain, with **only 2 out of 100 points achieved**, placing the city in the lowest category under URMP criteria.

Flood plain management points <30 translates to 1 score as per URMP framework

4.1.3. Interventions

The interventions focus on transitioning Bhagalpur from **embankment-led flood control** to **regulation-led floodplain management**, aligned with national guidelines and NGT directives.

4.1.3.1. Intervention 1-1: Floodplain Zoning Integration into the Master Plan

This intervention recommends the systematic integration of floodplain zoning and river-sensitive planning provisions into the statutory Master Plan and Development Control Regulations (DCRs) of Bhagalpur, with the objective of converting currently fragmented controls into coherent and enforceable planning guidance. The intent is to translate existing national and state-level floodplain guidelines and judicial directions into enforceable planning controls at the city level.

Figure 15 Process for Floodplain Zoning Integration into the Master Plan



Key Planning Components:

Step 1: Delineate and Zone the Floodplain

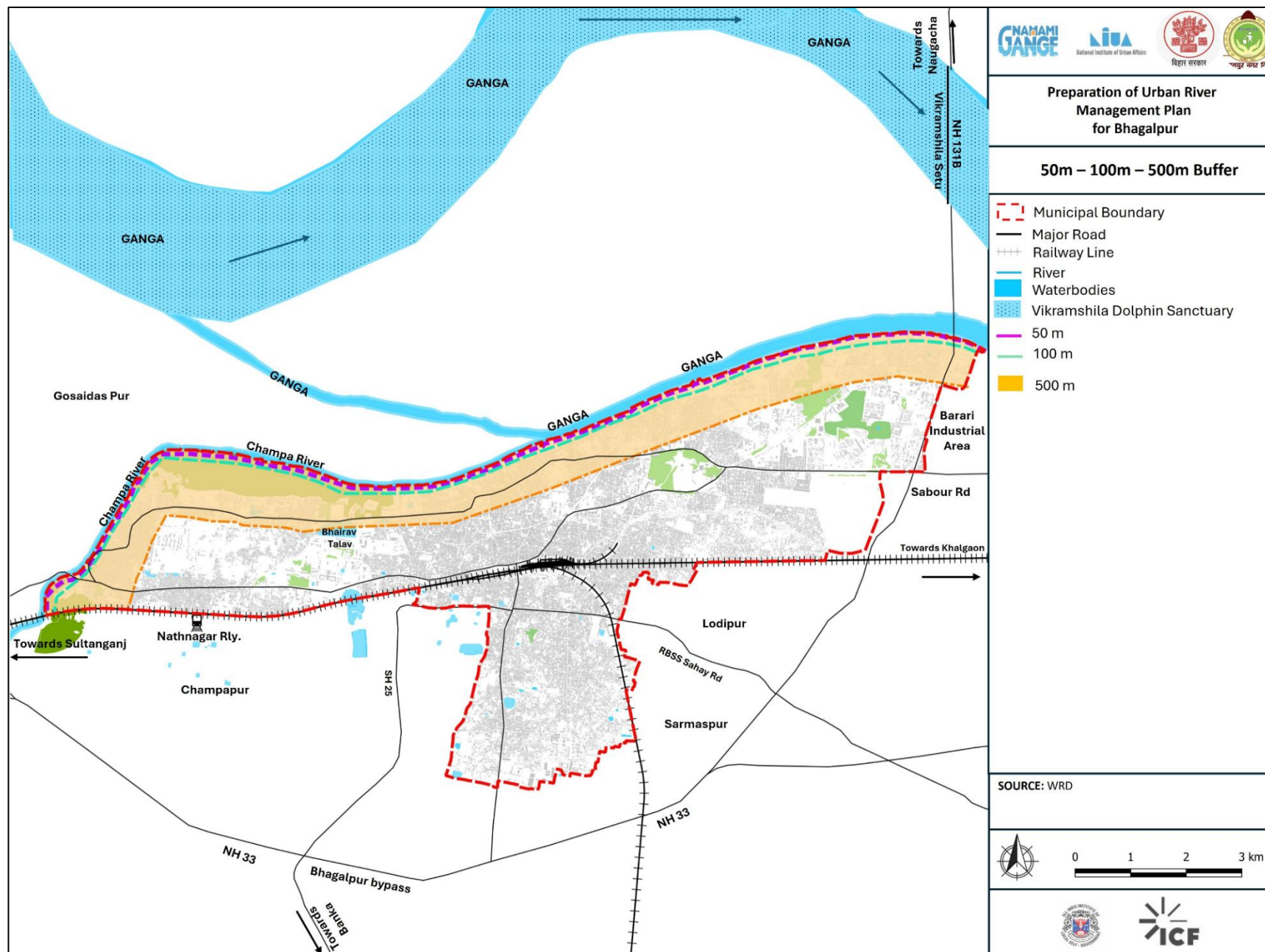
Approach:

- Adoption of the WRD-notified floodplain extent (including the 500m Prohibited Zone with permissible activities, on the non-embanked side) as the base planning layer.
- Application of a 100 m no-development buffer from the river edge as an interim regulatory safeguard, guided by NGT directions.
- Progressive refinement through delineation of 10-, 25-, 50-, and 100-year flood lines using hydrological data, observed high-flood levels, embankment alignments, and topographic analysis. This would eventually be done through the statistical model for floodplains under development by the state.
- Integration of floodplain layers with cadastral and planning base maps to guide land-use zoning and development **permissions**.

Flood Zone	Flood Frequency	Planning Intent
No Development Zone (NDZ)	100 m river buffer	Preserve active floodplain; prohibit permanent construction
Regulated Development Zone (RDZ)	500 m river buffer	Permit limited, flood-resilient uses with conditions



Map 10 NDZs and RDZs Buffer



Step 2: Modify relevant Development Control Regulations (DCRs)

The DCRs accompanying the Master Plan should clearly articulate land-use controls within each floodplain zone. A list of suggested activities for each zone is given below. They are derived from applicable national and state policy frameworks on floodplain management and river-sensitive planning. These include the Model Bill for Flood Plain Zoning (CWC, 1975); relevant NGT orders, including the order dated 13.07.2017 in *M.C. Mehta vs Union of India*, which mandates no-development buffers and prohibits waste dumping and large-scale construction in floodplains; the Draft River Regulation Zone Notification, MoEF&CC (2016); the Technical Guidelines on Flood Plain Zoning issued by CWC (2025); and the Flood Plain Zoning Notification of the Water Resources Department, Government of Bihar (March 2025). A detailed summary of these orders is given in Annexure 1.

Table 2 Suggested Permissible Activities in the NDZ and RDZ

Activity Type	No Development Zone	Regulated Development Zone
Permanent residential housing	✗ Prohibited	✗ Prohibited
Agriculture (organic / natural)	✓ Permitted	✓ Permitted
Chemical-intensive farming	✗ Prohibited	△ Strongly discouraged
Grazing / pasture	✓ Permitted	✓ Permitted
Religious activities (Chhath, rituals)	✓ Permitted (temporary, non-monsoon)	✓ Permitted
Permanent religious structures	✗ Prohibited/ △ Regulated	✗ Prohibited
Ghats (eco-sensitive design)	✓ Permitted	✓ Permitted
Cremation grounds	✓ Permitted	✓ Permitted
Parks, open spaces, playgrounds	✓ Permitted	✓ Permitted
Commercial / industrial activity	✗ Prohibited	✗ Prohibited
Solid waste dumping / landfills	✗ Prohibited	✗ Prohibited
STPs / river conservation works	✗ Prohibited	△ Strongly discouraged

Legend:

✓ Permitted △ Regulated / Conditional ✗ Prohibited



The following **should be permitted across zones**, subject to safeguards:

- Bridges, embankment repairs, flood protection works
- Water supply pipelines, power transmission lines
- Outfalls, river conservation works under NMCG

Step 3: Physically Demarcate the floodplain Boundaries

Once the floodplains are demarcated, they should be physically demarcated, as done in the case of the Bandh road, to improve on-ground enforceability. This can be done via:

- Installation of boundary pillars, signage, and visual markers along NDZ and RDZ edges.
- Use of embankment crests as reference lines where embankments exist, supplemented by signage clarifying regulatory status.
- Periodic verification of demarcation using GIS and field surveys.

Step 4: Riparian Buffer Integration and Ecological Design

The Master Plan should incorporate a continuous riparian buffer of approximately 7.5–15 metres, as suggested under the URMP guidelines, along the river edge, to be notified as an ecological buffer zone. Design recommendations for this buffer are given in Intervention 4-2 and a list of approved native species, and commonly found flora and fauna is given in Annexure 2.

Institutional Responsibilities and Coordination

The implementation of this intervention should, ideally, be led by the Nagar Nigam Bhagalpur, with technical and regulatory coordination from the Town and Country Planning Department and the Water Resources Department.

Intervention	Responsible Agency	Intervention type
Floodplain Zoning Integration into the Master Plan	Nagar Parishad Buxar (Lead), WRD, Town & Country Planning Dept.	Policy & Regulatory
Estimated Budget	Potential Funding Sources	Timeline
N/A	State Planning Funds, NMCG technical assistance	Short-term (1–2 years)

4.1.3.2. Intervention 1-2: Ecological Floodplain, Wetland, Sandbar & River Zoning and Conservation Strategy

Bhagalpur's riverine landscape encompassing the Ganga's active floodplain, seasonal *diara* sandbars, riparian wetlands, and the Champa Nala corridor, this represents both the city's most ecologically significant asset and its most vulnerable terrain. The zones which are not protected under the Floodplain protection strategy (Intervention 1-1) and Vikramshila Gangetic Dolphin Sanctuary.

Decades of incremental encroachment, unregulated sand extraction, agricultural intensification on *diara* lands, and the absence of a notified floodplain zoning framework have collectively eroded the natural functions that this landscape once performed: flood attenuation, groundwater recharge, biodiversity support, and erosion control.



While the Vikramshila Gangetic Dolphin Sanctuary lends Bhagalpur a degree of protected status and ecological recognition, regulatory coverage has not translated into on-ground conservation of the floodplain and its associated habitats. This intervention establishes an **integrated ecological conservation strategy for the floodplain, wetlands, sandbars, and river margins combining spatial zoning, habitat protection, bioengineering-based stabilization, and tributary restoration** to form the ecological foundation upon which all subsequent river management objectives are built.

1. Wetland and Sandbar Conservation

Bhagalpur's stretch of the Ganga is characterized by a multi-threaded channel morphology with seasonally dynamic mid-channel bars and *diara* floodplains. These sandbars are not merely geomorphological features they constitute critical ecological habitats supporting nesting and breeding grounds for riverine birds including the Indian Skimmer, Black-bellied Tern, and Greater Adjutant Stork, all of which are classified as Endangered or Vulnerable under IUCN criteria. The *diaras* also provide spawning substrates for fish species within the Vikramshila Gangetic Dolphin Sanctuary. Unregulated sand mining, encroachment for seasonal cultivation, and disturbance during peak nesting periods represent the primary threats to these habitats.

Steps and Components:

- **Ecological mapping and seasonal demarcation** of active sandbars within the urban and peri-urban river reach, with differentiation between ecologically sensitive nesting zones and areas permitting limited seasonal agriculture
- **Biodiversity mapping** by conducting regular ecological surveys across the diara network to map and monitor threatened riparian birds and semi-aquatic species. The surveys should identify key breeding sites, turtle basking areas, and nesting colonies of priority species creating a GIS-based baseline of their spatial distribution.
- **Notification of sandbar conservation zones** in alignment with the VGDS Management Plan (2018–2028) zoning framework, restricting mechanized sand mining, motorized vessel access, and any form of permanent construction
- **Seasonal habitat protection protocols** during nesting periods (typically February–June), including temporary fencing or marker buoy delineation at critical nesting stretches, in coordination with the Forest Department and VBREC
- **Regulation of *diara* cultivation** through documented land-use agreements with farming communities, establishing buffer strips between agricultural activity and active nesting areas
- **Citizen science monitoring** integrating Ganga Prahari volunteers and VBREC field teams to record nesting activity, species presence, and disturbance incidents at key sandbar locations on a seasonal basis
- **Sand mining governance reform** through coordination with the District Mining Office to enforce existing restrictions within the wildlife sanctuary stretch and establish a no-mining corridor between Barari and Kahalgaon

2. Riparian Buffers Restoration

Riparian buffer restoration forms a foundational layer of this intervention. The detailed ecological design, species selection, planting strategies, and restoration targets for riparian buffers are addressed comprehensively under **Objective 4: Enhancing the Riparian Buffer, & Objective 5** which outlines the full implementation framework for these components.



3. Champa River Restoration

The Champa Nala, originating from the southern uplands and flowing northward through the heart of Bhagalpur before discharging into the Ganga, is the city's most significant urban waterway after the Ganga itself.

In its current state Champa is severely degraded; the channel carries untreated sewerage; riparian buffer along the urban core stretch has been entirely encroached upon and during the monsoon, backflow from the Ganga inundates adjacent low-lying residential areas including Champa Nagar, Nath Nagar, and Medini Nagar. The channel is largely dry outside monsoon months, reducing the Champa to an intermittent sewage-laden drain rather than a functioning system.

This has been detailed in objective 2, intervention 2b further.

4. Nature-based River Stabilization

Bhagalpur's riverbanks are subject to active erosion pressures, particularly along the Kahalgaon and Sultanganj stretches and in areas where the channel narrows and current velocities intensify during peak monsoon flow. Hardscape measures such as concrete retaining walls and heavy concrete embankments disturb the ecological character and habitat of the river, therefore the strategy is to move towards different array of bioengineering techniques:

- High tensile vegetated embankments to bind alluvial soil sheets.
- Flexible, rock-filled gabion stabilization cages to absorb velocity surges.
- Soft, organic erosion-control measures like coir geotextile mats and live willow fascines.

Intervention	Responsible Agency	Intervention type
Ecological Floodplain, Wetland, Sandbar & River Zoning and Conservation Strategy (Champa-Ganga Corridor)	WRD and Town & Country Planning Directorate (Zoning & Master Plan Delineation), BUIDCO (Execution), and BMC (Local Enforcement & O&M)	Policy and Regulatory
Estimated Budget	Potential Funding Sources	Timeline
<i>Will be project to project basis</i>	NMCG, CAMPA, State Flood Management Fund	Medium term



4.2. Objective 2: Pollution Free River

Rationale: Objective 2 aims to assess and address the sources of pollution affecting the Ganga within Buxar's municipal limits by examining the city's liquid and solid waste management systems in an integrated manner. The central premise of this objective is that, at a minimum, the quality of river water exiting the city should not be inferior to that entering it.

4.2.1. Existing Situation

A review of infrastructure systems in the city in baseline report highlights the following gaps.

Key infrastructure and Gaps

- **Liquid waste:** about 90% of the city still relies on non-compliant on-site sanitation systems often directly linked to open drains; the 45 MLD STP is functional (treating ~10 MLD) but there is no dedicated Fecal Sludge Treatment Plant, and industrial effluent will only be partly covered by a small 1 MLD proposed ETP at Barari. The current STP functions at only one third of its capacity. Even at full capacity there would be a gap of 15 MLD which is not being provide for.

Table 3 Projected Demand

Year	Population (In Lakhs) * Calculated by CAGR method	Water Supply (MLD)	Sewage Generation (MLD)	Gap in Sewage Generation (MLD)
2011	4.10	55	44	4
2025	5.12	69	55	15
2035	6.10	81	65	25
2045	7.05	95	76	36

A second STP on the eastern side of Bhagalpur is needed to address the existing and future wastewater treatment gap. The city with its current infrastructure still has a gap of 15 MLD, sewage generation is projected to increase to 76 MLD by 2045. This recommended eastern STP would meet growing demand, reduce pressure on the existing facility, improve service coverage in expanding urban areas, and prevent untreated wastewater from entering the Ganga.

- **Drainage:** major nalas like Hathiya Nala, Koyla Ghat Drain, and Champa Nala-1 and 2 carry highly polluted flows (BOD 90–145 mg/L) straight into the Ganga, since the city's 15 major outfall drains were never fully intercepted, and monsoon backflow regularly mixes sewage with floodwater in low-lying wards.
- **Water supply:** the city delivers just ~37.35 MLD against demand, covering under a fifth of needs at only 33 litres per capita per day for about seven hours of supply, with just 4 of 7 overhead tanks functional; a planned 90 MLD treatment plant (ADB/WABAG-backed) aims to fix this by 2030 but isn't operational yet.



The city faces growing groundwater challenge due to limited piped water supply coverage, which serves less than 20% of the city's demand. As a result, most residents rely on groundwater extraction through private borewells, while declining monsoon rainfall and failing recharge rates are putting additional pressure on aquifers.

- **Solid Waste:** The city generates around 225 tons of municipal solid waste (MSW) daily, of which about 87% is collected through the municipal collection system. While the city has a Material Recovery facility (MRF) for dry waste, source segregation remains below 20%, and there are no functional composting or waste processing facilities. Most collected waste is disposed of at the Kankaithi dumpsite, which lacks scientific landfill systems.

4.2.1.1. Liquid Waste Management

Before the introduction of limited trunk sewer lines, nearly 90 per cent of Bhagalpur's population relied exclusively on **on-site sanitation systems**. Field visits and investigations reveal that many septic tank outlets were directly linked to open drains, allowing untreated effluent to enter the stormwater system and ultimately discharge into the Ganga. This problem was especially acute in settlements along riverbanks, floodplains, and low-lying areas, where poorly constructed containment systems and direct connections contribute disproportionately to microbial and organic pollution. Most existing systems do not conform to CPHEEO or BIS standards; common defects include undersized chambers, unlined walls, absence of vent pipes or baffles, and lack of desludging access. Older installations often have sealed or inaccessible covers, making mechanical cleaning impossible and leading to overflow or seepage into adjacent soils.^{5 6}

Faecal Sludge and Septage Management (FSSM) Practices

Bhagalpur has adopted a **city-level FSSM value chain**, whereby cesspool vehicles can be called via the ULB. The vehicle (either operated by the ULB or private contractors) dumps the collected sludge in open grounds untreated.

Industrial Effluent and Non-Domestic Discharges

Beyond domestic sewage, industrial effluents from the Barari Industrial Area contribute to the localised pollution burden. A 1 MLD Effluent Treatment Plant (ETP) is proposed at Barari for industrial wastewater, but many small and medium enterprises still rely on individual pretreatment or none at all. During monsoons, these effluents often become diluted and are carried via the city's stormwater drains, eventually entering the Ganga.⁷

Trunk Infrastructure and STP Linkages

Under an ongoing Sewerage Master Plan, Bhagalpur proposed construction of trunk rising mains, interceptor sewers, and Interception & Diversion (I&D) works to capture wastewater from 15 major outfall drains discharging untreated flow into the river. The original scheme envisaged a 65 MLD STP to treat the intercepted flow. The Bid Evaluation Report was submitted to the National Mission for Clean Ganga (NMCG) with a target completion around December 2021. However, the approved and contracted project is for a 45 MLD STP. In October 2021, the concession agreement was signed between NMCG, BUIDCO, and a private consortium (Adani + Organica) under PPP/hybrid-annuity

⁵ City Development Plan (2010 – 2020) Bhagalpur, LEA Associates South Asia Pvt. Ltd., New Delhi

⁶ SFD Report Bhagalpur (13/04/2020), Centre for Science and Environment

⁷ Action Plan for Restoration and Conservation of Ganga River, Department of Environment, Forest & Climate Change, Government of Bihar



mode to design, build, and operate the 45 MLD STP and associated I&D works over a 15-year O&M period.⁸ The STP is functional and treats 10 MLD of sewage as per collected official records.

Figure 16 Hathiya Nallah



Storm Water Drainage System

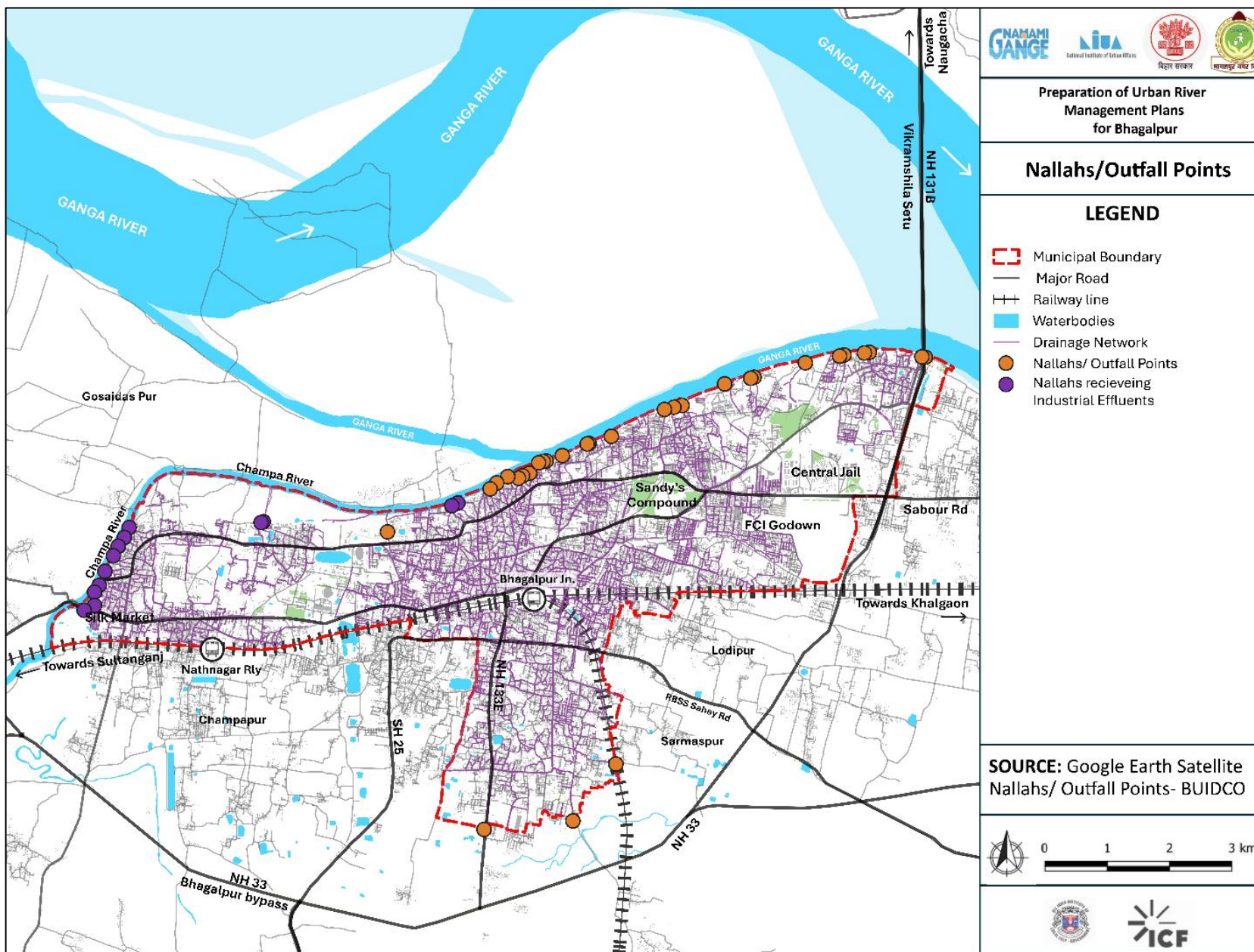
Bhagalpur's stormwater network functions largely as an extension of its sewerage system rather than as a dedicated drainage system, since a detailed survey of major drains found that every outfall carries domestic sewage.

This mixing of stormwater and sewage is worsened during the monsoon, when backflow from the Ganga causes floodwaters to combine with sewage-laden drains, spreading contamination into adjoining wetlands, floodplains, and low-lying residential areas, a problem most acute in densely populated wards near Tilka Manjhi, Nathnagar, and Barari where most households still depend on on-site sanitation systems that overflow under heavy rainfall. There is no segregated stormwater network, no formal capacity assessment of the drains relative to peak monsoon flows, and the system is further choked by solid waste and silt accumulation along nalas and the riverbank, meaning drainage performance during high-rainfall events is governed less by engineered capacity than by the extent of encroachment, siltation, and sewage loading in any given stretch.

⁸ Concession Agreement Signed for Development of STP in Bhagalpur, Bihar under NMCG, Press Information Bureau. Retrieved from [[Press Release: Press Information Bureau](#)]



Figure 17 Major Nallah & outfall points



4.2.1.2. Solid Waste Management

Bhagalpur generates an estimated 225 tonnes of municipal solid waste per day (projected to rise to 321.62 TPD by 2030), of which about 87% is collected through recently introduced door-to-door collection, mechanised transport, and road/drain sweeping. Source segregation has been rolled out citywide via twin colour-coded bins for the city's 82,167 households, supported by one hopper-tipper vehicle and two e-rickshaws per ward, but compliance remains weak and mixed waste continues to dominate. Collected waste moves through four secondary storage points (Lajpat Park, Mushari Gate, Budhanath, Sahebganj) to the Kankaithi disposal site via compactors and hook loaders, but there is only one functioning Material Recovery Facility and no composting, biomethanation, or scientific landfill in operation, so all waste is dumped on open land without leachate control or environmental safeguards. Special waste streams, ritual offerings, e-waste, and street litter, are nominally managed through twin bins, recycler tie-ups, and IEC campaigns, but a meaningful share still ends up in the river or its banks, and BUIDCO/Smart City Mission tenders for an integrated processing facility, scientific landfill, MRF/transfer station, and decentralised composting units are underway but not yet operational.

Figure 18 Solid Waste Dumping in the drains and along the river banks



Key Gaps:

- Roughly 13% of waste goes uncollected and is informally dumped; source segregation remains below 20% despite bin distribution and IEC campaigns, so mixed waste dominates the stream.
- Secondary collection points lack adequate storage and pre-treatment capacity, and transportation fleet (compactors, hook loaders, only 12 tractors, 1 JCB) is insufficient to cover the full city.
- No scientific landfill, composting, or biomethanation facility exists; all waste is dumped untreated at Kankaithi, where legacy waste causes leachate, odour, and groundwater contamination risks.



- Uncollected waste, ritual/religious offerings, and street litter routinely enter drains and riverbanks, adding directly to Ganga pollution during monsoon runoff, including within the Vikramshila Gangetic Dolphin Sanctuary stretch.
- Private operator coverage is patchy (limited wards only), and institutional manpower/equipment are inadequate for the current and projected waste load.

4.2.1.3. Pollution Hotspot Analysis

An integrated assessment of Bhagalpur's pollution hotspots reveal distinct spatial clusters where liquid and solid waste mismanagement converge to stress the Ganga River and urban water bodies. The most critical drain-based hotspots are Hathiya Nala (BOD 145 mg/l), Koyla Ghat Drain (NOD 125mg/l) and Champa Nala (BOD 95 mg/l), all of which discharge near raw domestic sewerage directly into the Ganga without any interception or treatment; other drains such as Adampur, Sahebganj, Mayabari, and the STP drain add to the cumulative load through at lower BOD intensities.

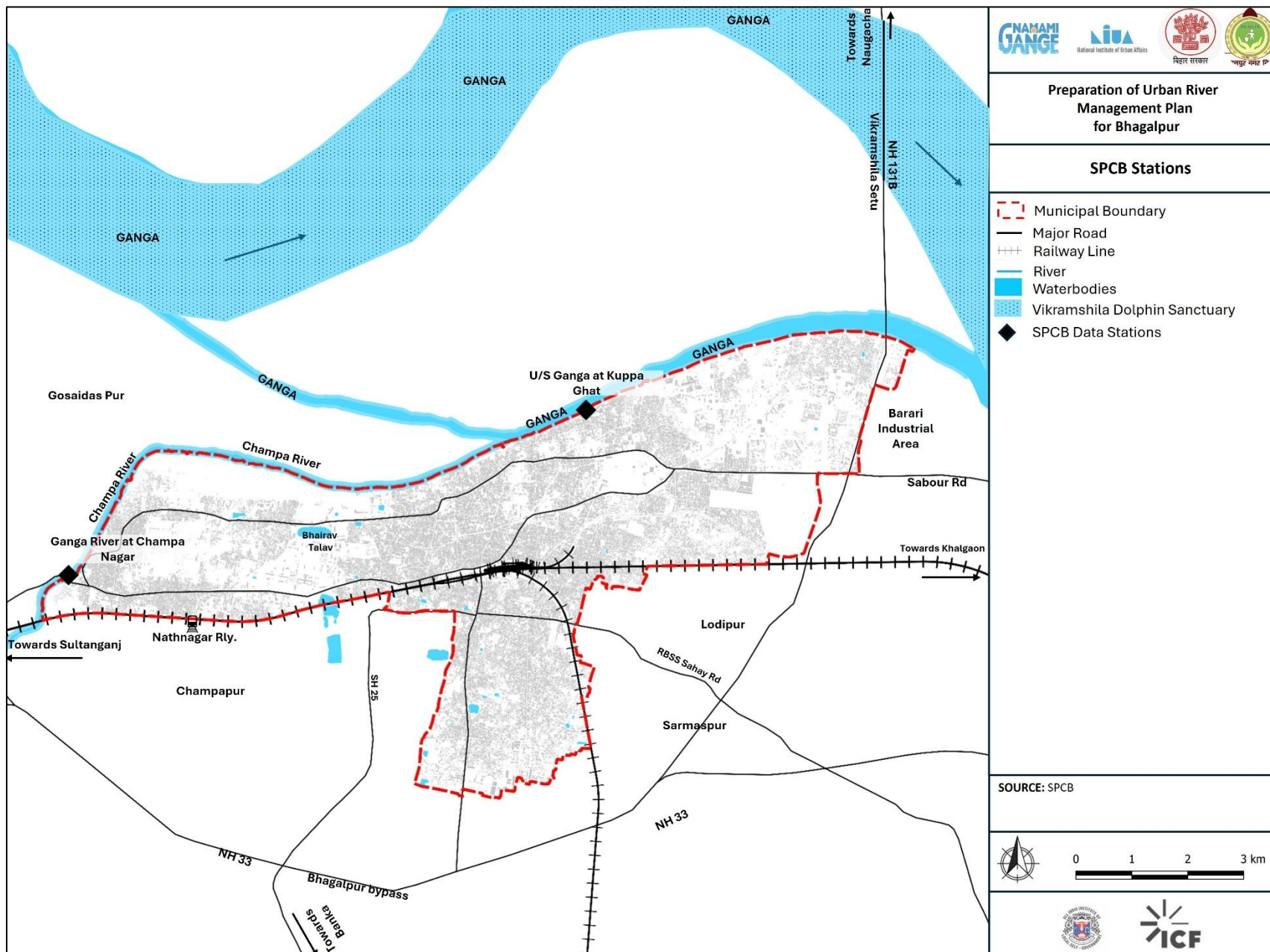
Beyond the drain network, ghat-based and settlement-based hotspots intensify the burden seasonally. Barari Ghat, a key bathing and cremation site, sees episodic discharge of ash, partially burnt organic matter, and ritual offerings, with a new crematorium under construction but not yet operational; Kuppa Ghat similarly draws a large religious gathering but has no wastewater or solid waste infrastructure. Low-Lying informal settlements near nalas and floodplains act as a third category of hotspots. During monsoons, overflowing drains and accumulated waste create stagnant pollutant pools that are flushed directly into the river as floodwaters recede, compounding both ecological damage and public health risk.

Water quality

SPCB monitoring at three stations in Bhagalpur i.e. Barari Ghat, downstream at Ganga Bridge, and at Champa Nagar reveals that Bhagalpur's stretch of the Ganga maintains moderate baseline water quality but experiences severe seasonal stress. Dissolved Oxygen (DO) frequently exceeds the CPCB minimum of 5 mg/L during post-monsoon months (often reaching 10+ mg/L due to dilution), but drops sharply to 0–3 mg/L in June–August when river flow is low and organic loading from drains is highest; BOD stays broadly within the CPCB limit of ≤ 3 mg/L for much of the year (typically 1–2.5 mg/L) but spikes to 3–4 mg/L during monsoon runoff and major festival periods such as Chhath, Ganga Dusshera, and Pitru Paksh.



Map 11 SPCB Stations

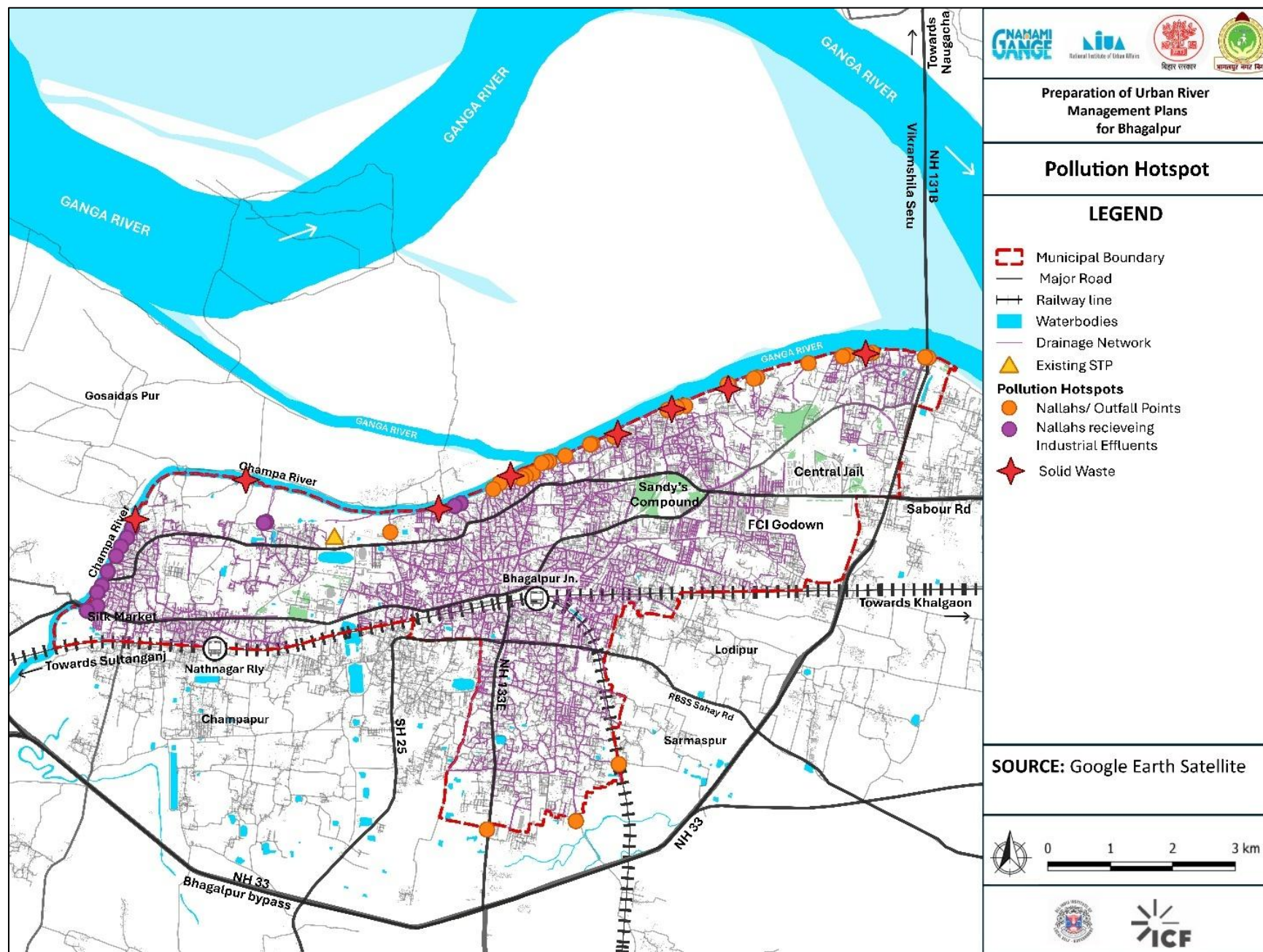


Chemical Oxygen Demand (COD) shows the sharpest variability, typically ranging from 8–18 mg/L but spiking to 25–35 mg/L during monsoon and festival months, particularly downstream near the Road Bridge, pointing to the accumulation of both organic and chemical pollutants from urban drains.

Champa Nagar is the most consistently stressed station due to its proximity to dense settlements and urban drain outfalls, while Kuppa Ghat maintains comparatively better baseline conditions but still shows festival-linked deterioration. The Net DO score, calculated using available inlet–outlet data (Champa Nagar to Barari Ghat), shows a marginal positive change of 0.25%, pointing to limited but real oxygen depletion as the river passes through the city underscoring that seasonal and event-specific pollution control, not just year-round infrastructure, is critical for restoring river health. Detailed in Annexure 4



Figure 19 Major Pollution Hotspots



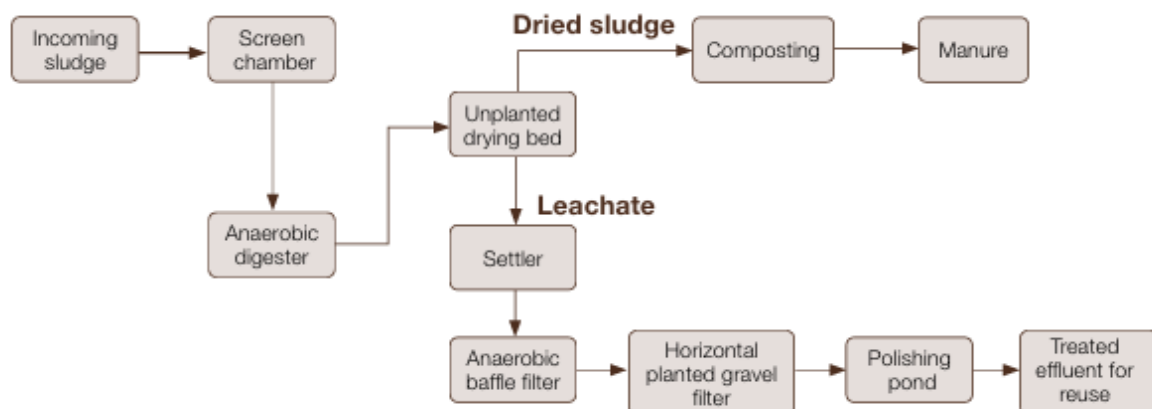
4.2.2. URMP Score

As per URMP framework to understand the pollution levels in the river the Net Dissolved Oxygen Score is measured. Since the SPCB- Bihar has published data of DOSs, there are 3 monitoring stations in Bhagalpur. For this stage, the outlet is considered as the Barari Ghat and the inlet as Champa Nagar (due to data availability). The net DO is $DO_{outlet} - DO_{inlet} / DO_{inlet} \times 100$. DO difference is -5 to 0, indicating an average score of 3. The water is highly polluted because of direct discharge of household sewerage and industrial effluents.

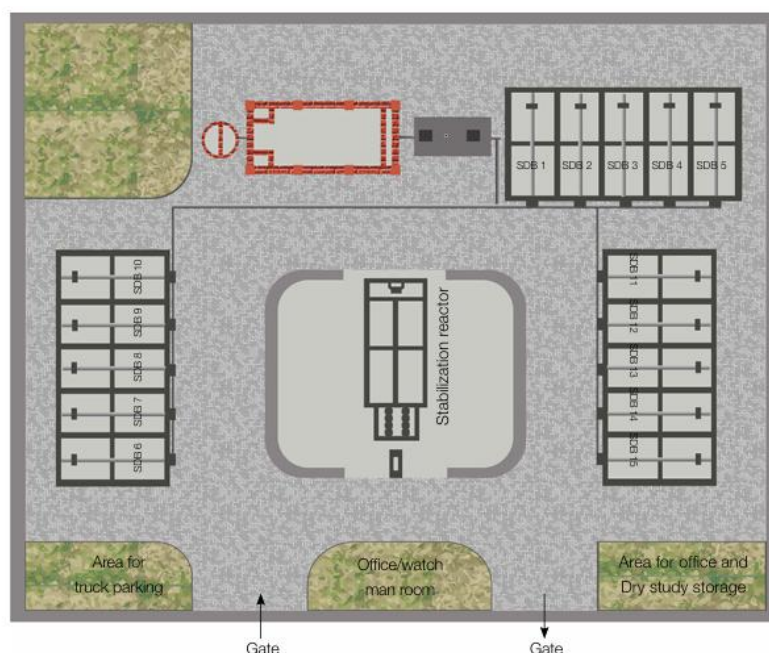
4.2.3. Interventions

4.2.3.1. Intervention 2-1: FSTP for Bhagalpur city- addressing the infrastructure gaps

To address the short-term gaps in septage management, till the time the city level sewerage treatment becomes operational, it is proposed to have a FSTP which can work later as a co treatment facility. The proposed flow diagram will be as follows:



The proposed system layout being as shown below:



The calculations for the STP is assumed with the basic data being:

Parameter	Value
City population (base year)	5,10,000
Number of households	82,167
Average household size	6.2 persons/HH
Underground sewerage coverage	15%
Population dependent on on-site sanitation (OSS)	85%
Existing desludging fleet is of 8 vehicles and 2 are assumed to be increased in near future.	10 vehicles x 2 KL capacity each

Note: the fleet capacity is assumed to be 2 KL (2,000 litres) per trip – a realistic vacuum-tanker size.

The demand side assessment of Faecal Sludge is done through two methods.

1. CPHEEO planning norm (1 litre per capita per day)

Year	OSS population	Rate	FS generation
Base year (2026)	4,33,500	1.0 LPCD	433.5 KLD
Design year (2041)	5,83,434	1.0 LPCD	583.4 KLD

2. Household desludging-trip method

This method is grounded in actual tank/pit volumes and desludging frequency and generally tracks closer to what cities actually collect. Assumptions: average septic tank/pit volume desludged = 2 m³ per trip; desludging frequency = once every 3 years.

Year	Households	Volume/trip	Cycle	FS generation
Base year (2026)	69,842	2 m ³	3 years	127.6 KLD
Design year (2041)	93,998	2 m ³	3 years	171.7 KLD

It is pertinent to note that the collection fleet capacity needs to be checked for supply side.

Parameter	Value
Fleet size	10 vehicles
Capacity per vehicle	2 KL/trip
Assumed trips/vehicle/day	2
Assumed operating days/year	300



Fleet daily throughput	40 KLD
Fleet annual volume	12,000 m ³ /year
Fleet trip capacity	6,000 trips/year
Trips required to desludge base-year OSS households on a 3-year cycle	23,281 trips/year
Current fleet coverage of base-year desludging need	26%
Fleet size needed for full base-year coverage (same duty cycle)	39 vehicles (i.e. 29 more than at present)

This clearly shows that the total capacity is constrained by the supply side fleet. Which means we can phase the system accordingly.

Phased capacity

Phase	Trigger / timeframe	Recommended capacity	Basis
Phase 1	Immediate / Year 1-3	50 KLD	Matches realistic near-term collection (current fleet ~40 KLD, plus modest augmentation), with buffer
Phase 2	Design year (~15 yrs), modular expansion	150–175 KLD	Aligned with Method B design-year estimate (~172 KLD), contingent on fleet scale-up to ~35–40 vehicle-equivalents

Civil works (land, inlet chamber, equalisation tank) should be provisioned from the outset for the full 150–175 KLD ultimate capacity, even though mechanical/electrical equipment is installed in the smaller Phase 1 module. This avoids re-acquiring land or redoing civil structures later.

Further it may be noted that is the STP and sewerage system is adopted in between we may abandon the second phase of FSTP altogether and city may put all its efforts to implement a full city sewerage system.

FSTP capital and operating cost

The cost is calculated based on data from CPHEEO/NFSSM Alliance FSSM Technology & Costing Compendium and recent Indian FSTP DPRs (hybrid mechanised systems).

Item	Phase 1 (50 KLD)
Capital cost (Rs 15 lakh/KLD)	Rs 7.5 crore
Annual O&M (Rs 25,000 /KLD/yr)	Rs 12.50 lakh/year
Land requirement (~0.2–0.25 acre/10 KLD)	1.0 – 1.25 acre

Summary

Parameter	Recommended value
Phase 1 FSTP capacity	50 KLD
Ultimate (Phase 2) capacity	150 – 175 KLD



Core technology	Screening + grit removal + equalisation + mechanical dewatering (screw press) + planted drying beds for solids
Co-treatment mechanism	Metered filtrate feed to STP inlet; solids handled and reused separately on-site
Phase 1 capital cost	Rs 7.5 crore
Phase 1 annual O&M	Rs 12.5 lakh/year
Land required (provisioned for ultimate capacity)	3.0 – 4.4 acre
Complementary investment	Fleet augmentation (~29 additional vehicles, phased) if sewerage system is not adopted.

4.2.3.2. Intervention 2-2: Interception, Diversion, and Centralized Treatment for the Champa River

To systematically eliminate the discharge of untreated industrial and mixed domestic effluents into the Champa River, this intervention outlines a coordinated collection and centralized treatment framework tailored to the urban hydrology of the area.

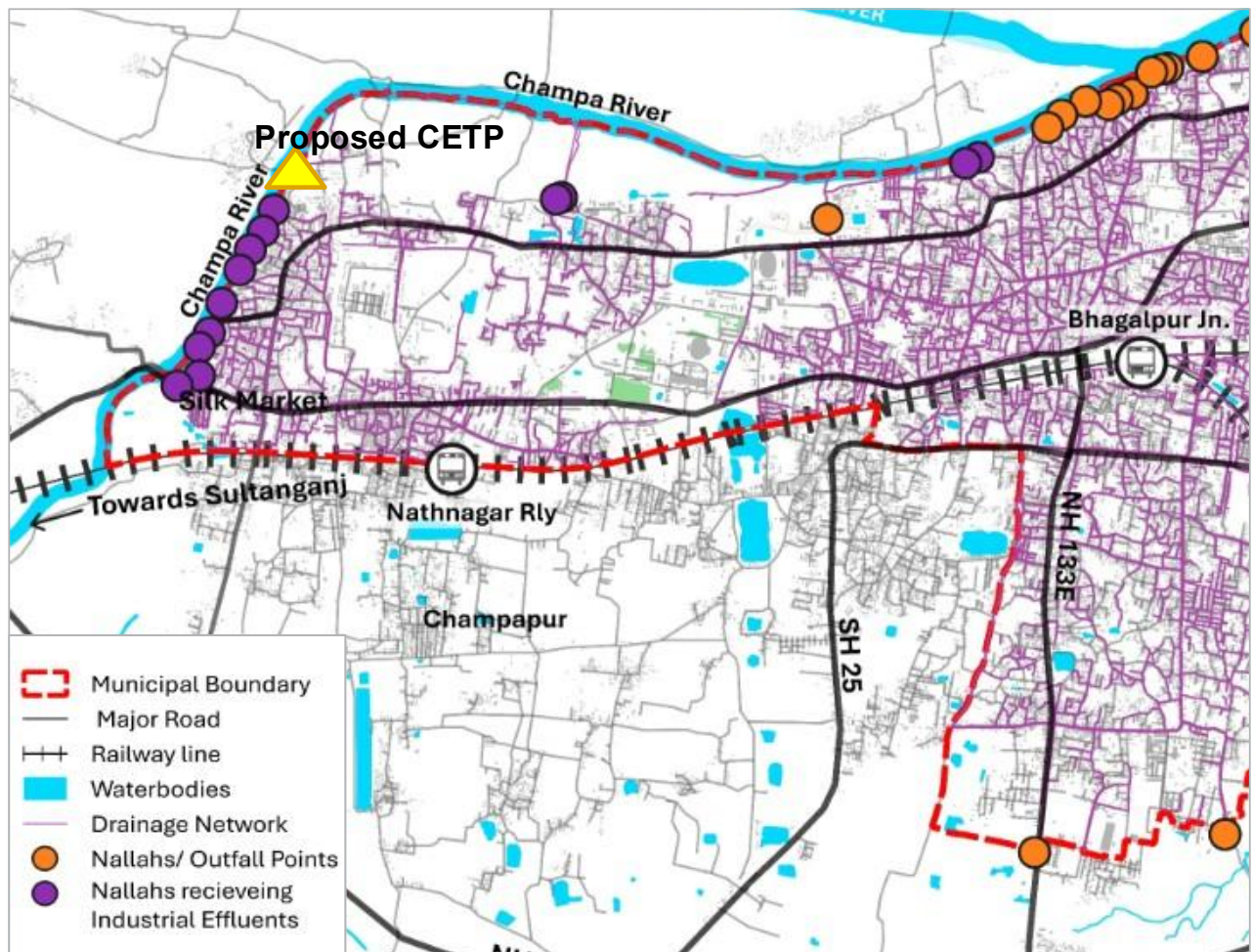
1. Underground Interceptor Drain System (Conceptual Logic & Function)

The interceptor system serves as a physical barrier between urban pollution channels and the aquatic environment, redirecting wastewater flows entirely away from the Champa River.

- **Hydraulic realignment:** Currently, channels like Champa Nala-1 and Champa Nala-2 deliver raw domestic sewage mixed with localized household industrial effluents directly to the river. The proposed underground interceptor main will run parallel to the bank of the Champa River, positioned at a deep invert level below the existing outfall points to catch gravity discharge before it leaves the bank.
- **Diversion logic:** A specialized diversion chamber featuring a drop manhole or fixed weir wall will be built at each of the 10 outfall interfaces. During dry weather periods, the system captures 100% of the wastewater flow and directs it into the interceptor main.
- **Monsoon overflow routing:** Given that seasonal rains cause high surges and waterlogging in low lying zones around Nathnagar and Champa Nagar, the diversion chamber will include high-level overflow weirs. If extreme flash floods overwhelm the system, diluted excess stormwater can bypass the interceptor to prevent backflow into dense residential and manufacturing neighborhoods.
- **Terminal transmission:** The gravity main will slope downward toward a terminal wet well located just south of the bridge, where high-efficiency pumps lift the collected effluent into the centralized plant inlet works (i.e the 45 MLD STP).

The CETP will be placed at the end of all drains falling into the Champa near the Srirampur Bridge on Champa River.





2. Centralized Effluent Treatment Plant (CETP)

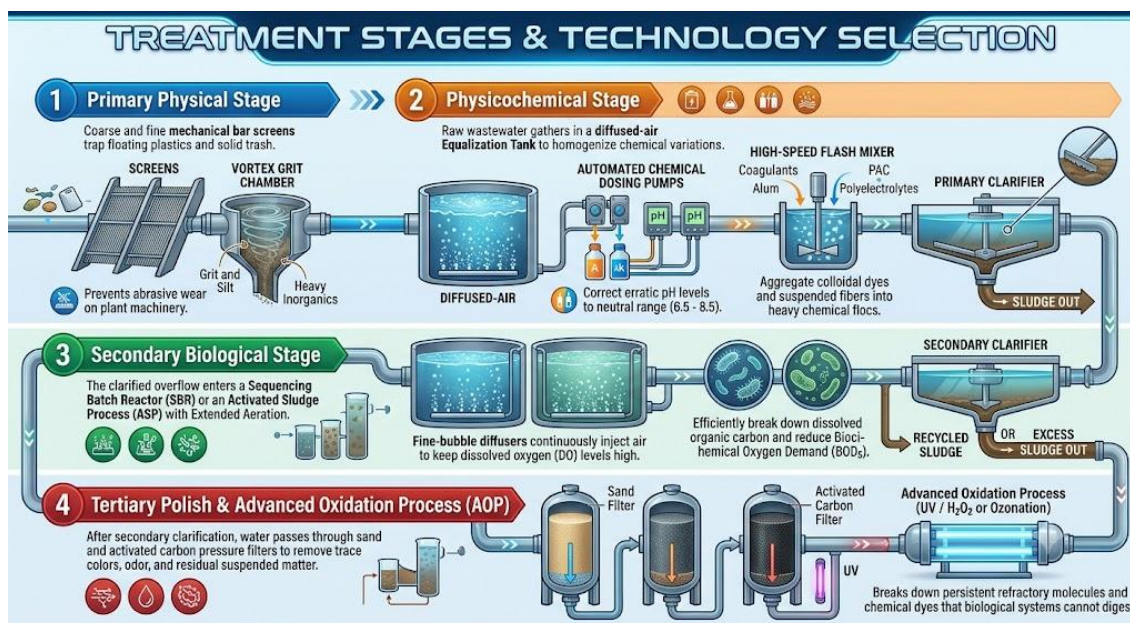
Because the effluent is a complex blend of domestic sewage and industrial wastewater from traditional Tussar silk weaving, handloom processing, and textile washing units, a robust multi-stage treatment design is required.

Treatment Stages & Technology Selection

- **Primary Physical Stage:** Coarse and fine mechanical bar screens trap floating plastics and solid trash, followed by a vortex grit chamber to filter out heavy inorganic sands and silt, preventing abrasive wear on plant machinery.
- **Physicochemical Stage (Chemical Conditioning):** The raw wastewater gathers in a diffused-air Equalization Tank to homogenize chemical variations. Automated chemical dosing pumps add acids or alkalis to correct erratic pH levels to a neutral range of **6.5 – 8.5**. Coagulants (like Alum or Polyaluminum Chloride) and organic polyelectrolytes are introduced in a high-speed flash mixer to aggregate colloidal dyes and suspended fibers into heavy chemical flocs, which settle out inside a Primary Clarifier.
- **Secondary Biological Stage:** The clarified overflow enters a Sequencing Batch Reactor (SBR) or an Activated Sludge Process (ASP) with Extended Aeration. Fine-bubble diffusers continuously inject air to keep dissolved oxygen (DO) levels high, allowing aerobic micro-organisms to efficiently break down dissolved organic carbon and reduce Biochemical Oxygen Demand (BOD).



- Tertiary Polish & Advanced Oxidation Process (AOP):** After secondary clarification, the water passes through sand and activated carbon pressure filters to remove trace colors, odor, and residual suspended matter. Finally, an Advanced Oxidation **Process (UV / H₂O₂ or Ozonation)** breaks down persistent refractory molecules and chemical dyes that biological systems cannot digest.



Two very different waste streams typically get lumped together as "silk effluent," and they need different handling:

Source,	What happens,	Effluent character,
Degumming (boiling cocoons/raw silk to remove sericin gum),	Soap/soda-ash boiling bath,	Very high BOD/COD (sericin protein is biodegradable but heavily loaded), alkaline pH 9–11, high temperature (60–100°C), low color
Dyeing (silk yarn/fabric, acid dyes mostly; reactive dyes if blended with cotton)	Dye bath + salt + acid/alkali fixing,	Very high color, high COD, high TDS (2,000–6,000 mg/L from Glauber's salt/common salt used as dyeing auxiliary), variable pH (acidic 4–6 for silk acid dyes, alkaline 10–12 if reactive dyes on cotton blends)
Washing/finishing	Rinsing, soaping-off	Lower strength, moderate BOD/COD, detergent residue



3. Targeted Effluent Discharge Standards

The treated effluent must strictly meet targeted environmental thresholds suitable for surface discharge and circular urban reuse:

Parameter	Raw Effluent Range (Typical Industrial/Sewage Mix)	Treated Target Standard (Discharge / Municipal Reuse)
pH	4.5 – 10.5	6.5 – 8.5
Biochemical Oxygen Demand (BOD)	42 – 145 mg/L	10 mg/L
Chemical Oxygen Demand (COD)	300 – 600 mg/L	50 mg/L
Total Suspended Solids (TSS)	200 – 500 mg/L	20 mg/L
Oil & Grease	20 – 80 mg/L	5 mg/L

4. Municipal Reuse and River Base Flow Allocation

Once the target parameters are met, the treated water enters a municipal distribution scheme, supporting a circular economy:

- **Municipal Non-Potable Infrastructure:** The Bhagalpur Municipal Corporation can use this reliable water supply for street cleaning, road dust control, and irrigation in urban public parks or collegiate green spaces.
- **Industrial Supply Loop:** Part of the treated water can be piped back to traditional textile and weaving units for non-critical process washing, lowering groundwater abstraction across the local aquifer.
- **Environmental Flow Return:** All surplus treated water can be discharged directly back into the Champa River channel north of the bridge. This ensures maximum high-quality return flow to maintain the river's ecological health before it joins the main channel, helping safeguard downstream aquatic ecosystems and the nearby Vikramshila Gangetic Dolphin Sanctuary.

Intervention	Responsible Agency	Intervention type
Interception, Diversion, and Centralized Treatment for the Champa River	BUIDCO (Execution/Tendering), BSPCB (Regulation/Standards), and Bhagalpur Municipal Corporation (Long-term operation/Municipal reuse)	Project
Estimated Budget	Potential Funding Sources	Timeline
To be determined based on a more detailed study and DPR	NMCG/AMRUT 2.0	3–5 years

4.2.3.3. Intervention 2–3: Champa River Restoration through ecological restoration, river-edge improvement, riparian buffers and hotspot-based pollution management

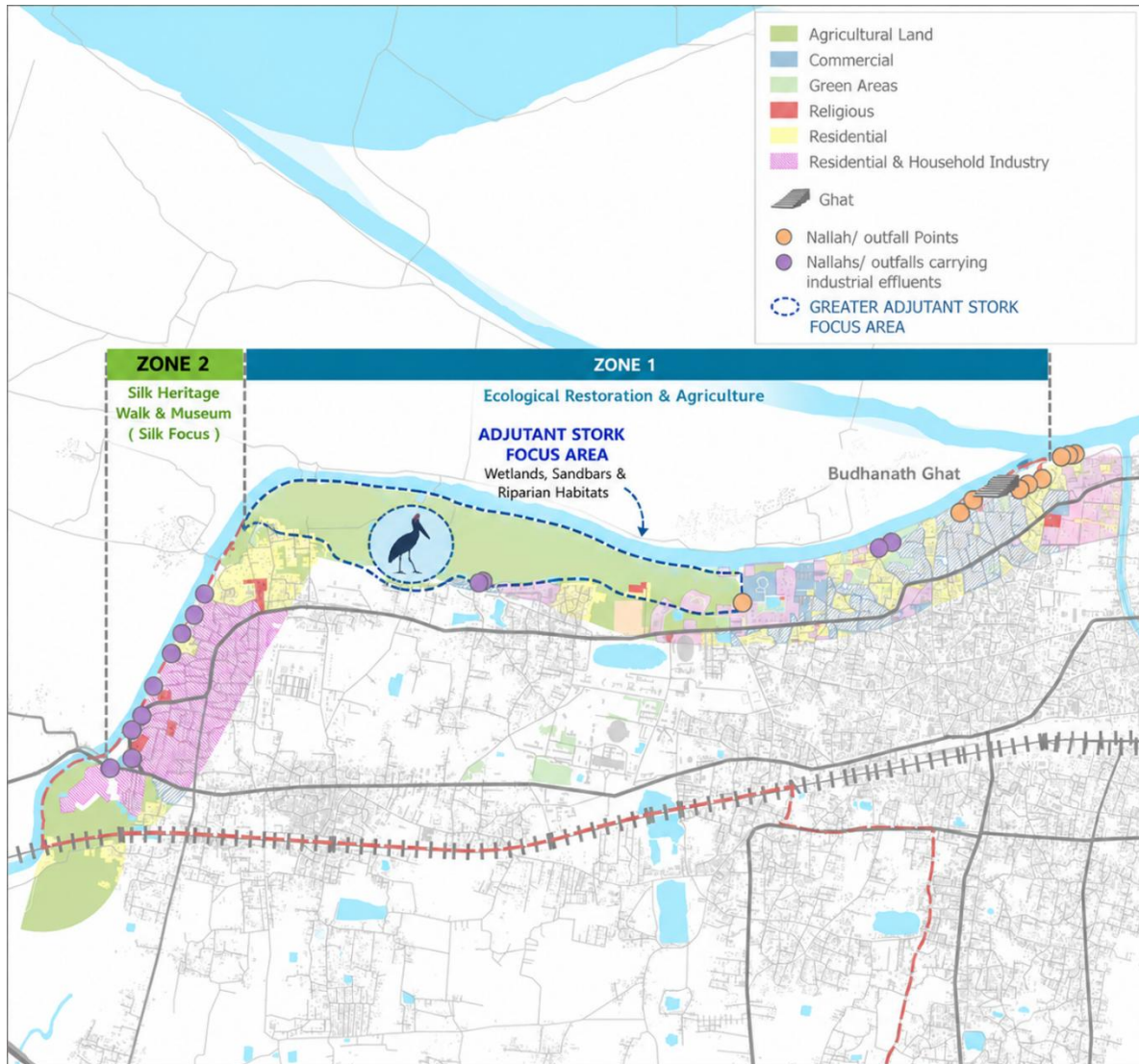
This comprehensive intervention targets the 7.5 km stretch of the Champa River that forms part of the municipal boundary. The current landscape features a mix of agricultural land, residential zones, and household industries (silk). Unregulated urban expansion has led to visible residential



encroachment toward the riverbanks, informal solid waste dumping along the water's edge, and multiple outfall points discharging untreated domestic sewage and toxic silk-dye industrial effluents directly into the river channel.

To systematically address these multi-sectoral pressures, the river corridor is split into two specialized planning zones:

Figure 20 Zoning of Champa River



1. Zone 1: Ecological Restoration, River Edge Improvement, and Pisciculture

Zone 1 leverages nature-based strategies to restore degraded ecosystems, improve bank stability, and enhance dynamic habitat spaces.

Ecological Restoration

- **Desilting & Natural Drainage:** Executes selective desilting across choked channels and restores natural drainage patterns to improve the basin's flood-retention capacity.

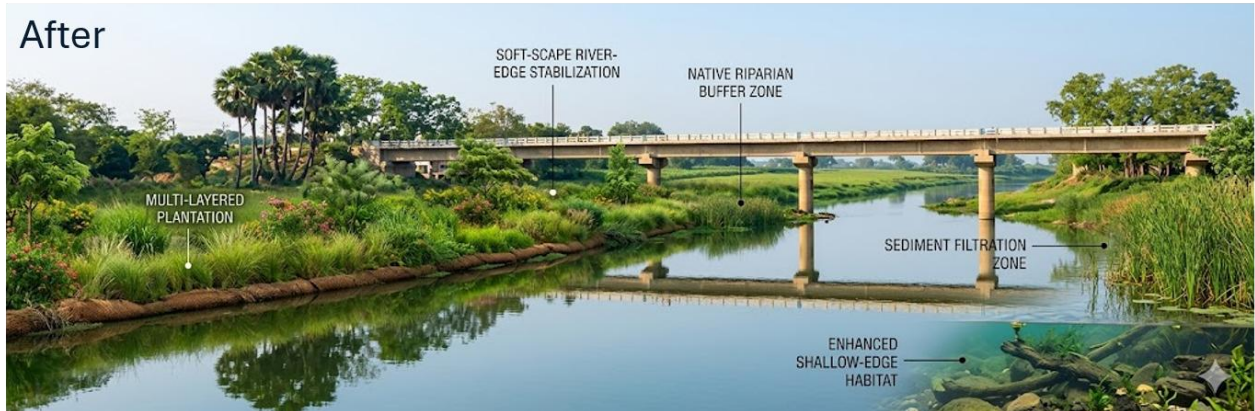


- **Flora-Based Remediation:** Restores degraded river-edge ecosystems using a robust array of native, flood-tolerant vegetation capable of withstanding sharp seasonal inundations.
- **Hardscape Restrictions:** Prohibits permanent hardscape construction and aggressive civil infrastructure along the immediate banks to shield sensitive zones from layout conversion and encroachment.
- **Shallow-edge Revitalization:** Focuses on the enhancement of shallow edge habitats to rebuild spawning pockets for aquatic biodiversity, which directly supports and stabilizes the localized pisciculture (fish-rearing) activities practiced at various spots along the river corridor.

Before



After



River-Edge Improvement

- **Softscape Bioengineering:** Replaces hard masonry river walls with softscape-based river-edge stabilization using modular bioengineering techniques (e.g., coir matting, geotextile layers, and vegetative root grids).
- **Continuous Riparian Buffers:** Develops wide, continuous native riparian buffer strips parallel to the high flood line across vulnerable suburban and residential interfaces.
- **Multi-Layered Plantations:** Deploys a dense, multi-layered plantation matrix consisting of native grasses, woody shrubs, wetland reeds, and flood-tolerant tree species to bind loose alluvial soils.



- **Runoff Filtration Zone:** Restrains agricultural runoff and filters harmful surface sediments before they hit open water by using these vegetated buffers as functional phytoremediation beds.



Before: Untreated discharge, agricultural run-off and solid waste flowing into river Ganga



After



Before



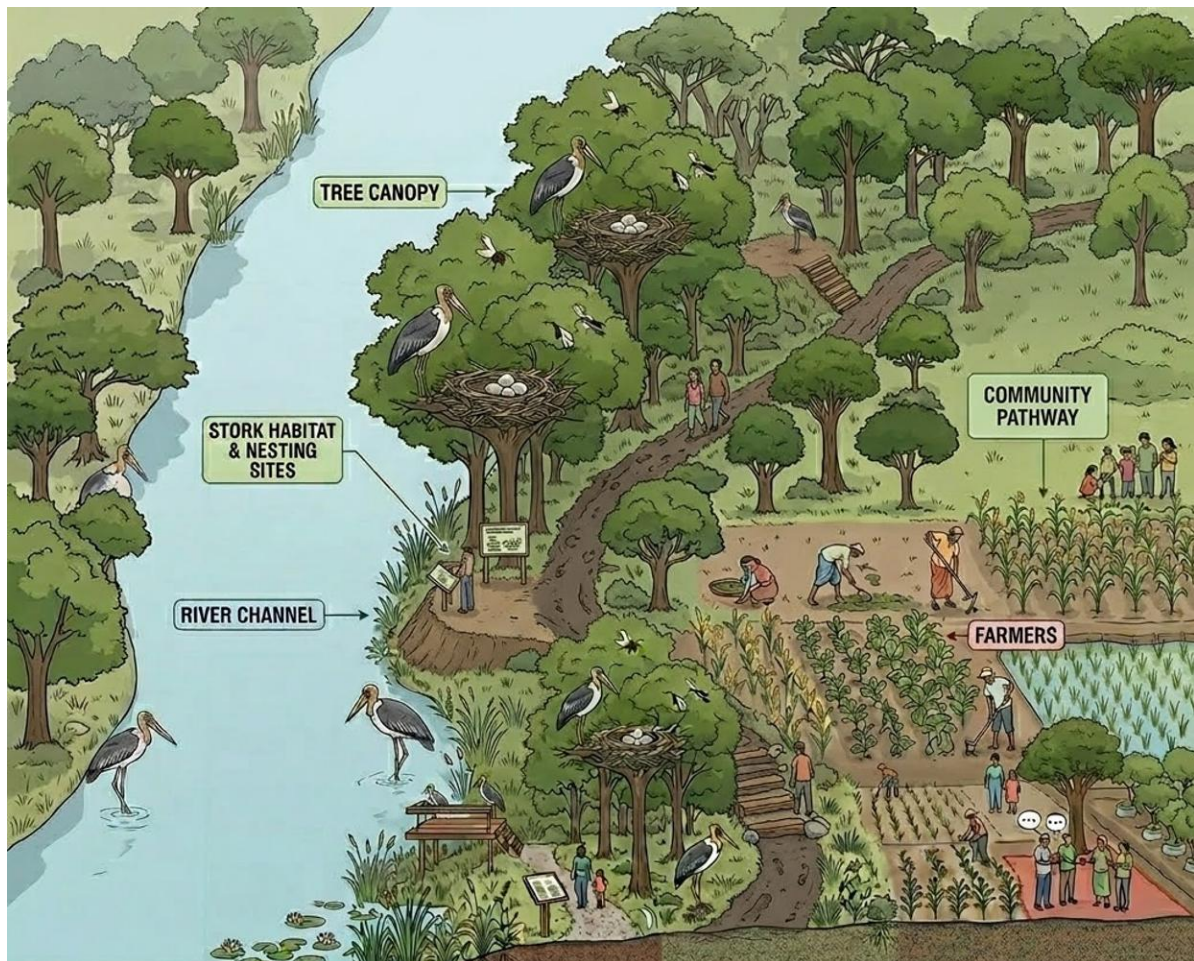
After

Guardians of the Garuda Stork Conservation

A core segment of Zone 1 wetlands and sandbars is cordoned off as a dedicated preserve to support one of the world's rarest avifaunal populations. In accordance with this focus area details the following activities:

- **Habitat Protection:** Restores delicate wetland and riparian habitats to maintain secure foraging, nesting, and safe flight movement patterns for the endangered **Greater Adjutant Stork (Garuda)**.
- **Canopy Afforestation:** Drives targeted plantation of tall, native canopy trees within the wider ecological buffer zone to expand future stork nesting choices and improve overall habitat quality.
- **Community-Led Stewardship:** Establishes the "**Guardians of the Garuda**" initiative, physically involving local residents, neighborhood schools, riparian farmers, and fishing communities in monitoring, nest protection, and regular river-edge cleanup drives.
- **Low-Impact Interface:** Installs lightweight, low-impact bird observation points and detailed environmental signage to foster educational awareness without creating structural interference.
- **Recreational Controls:** Enforces strict zoning bans on hardscape tourism expansion and high-noise recreational activities inside the mapped boundaries of this sensitive ecological pocket.





2. Zone 2: Silk Walk & Information Center

To create a sustainable economic driver that celebrates local manufacturing identity while protecting the waterfront, the southern urban edge transitions into a themed heritage zone. Zone 2 implements the following steps:

- **Silk Heritage Promenade:** Develops a low-impact, silk-focused heritage walk along the river buffer, celebrating Bhagalpur's world-renowned traditional weaving industry and localized craftsmanship.
- **Silk Interpretation Center & Museum:** Constructs a context-sensitive, lightweight eco-museum showcasing historical handloom processes, mulberry and tussar rearing cycles, and native weaving livelihoods.
- **Artisan Interaction Hubs:** Integrates small-scale silk walks featuring dedicated artisan interaction spaces, open demonstration kiosks, and fair-trade market platforms to directly uplift localized weaving households while maintaining an eco-friendly riverfront footprint.





Intervention	Responsible Agency	Intervention type
Champa River Eco-Hydrological Restoration, Stork Habitat Conservation, and Cultural Corridor Project	Bhagalpur Municipal Corporation (BMC) (Lead on sanitation, solid waste traps, and Zone 2 center management) in close coordination with the State	Project



	Forest Department / VGDS Division (Lead on Stork Focus Area) and BUIDCO (Technical execution of edge works)	
Estimated Budget	Potential Funding Sources	Timeline
INR 123,088,500 (Integrated with obj 8&9)	NMCG/AMRUT 2.0	3–5 years



4.3. Objective 3: Rejuvenation Of Waterbodies and Wetlands in The City

Rationale: Objective 3 aims to restore the ecological, hydrological, and social functions of Bhagalpur’s inland waterbodies. With the city’s high population density and extensive built-up areas, its limited waterbodies are under significant development pressure, making their protection and conservation critical. Additionally, Bhagalpur’s lacks adequate open and recreational spaces. Therefore, rejuvenating selected ponds to serve a dual purpose—enhancing environmental health while providing citizens with recreational areas—will be the core strategy for the city.

4.3.1. Existing Situation

Bhagalpur has a dense network of natural and man-made ponds within its municipal wards, collectively serving domestic, livelihood, cultural, and ecological functions. An initial inventory from the 2024 Water Body Census identified 29 inland water bodies, 10 priority ponds were selected for detailed assessments based on 1 acre area (URMP NIUA) hydrological importance and rejuvenation potential. (Detailed in Annexure 3)



Figure 21 Shortlisted Waterbodies

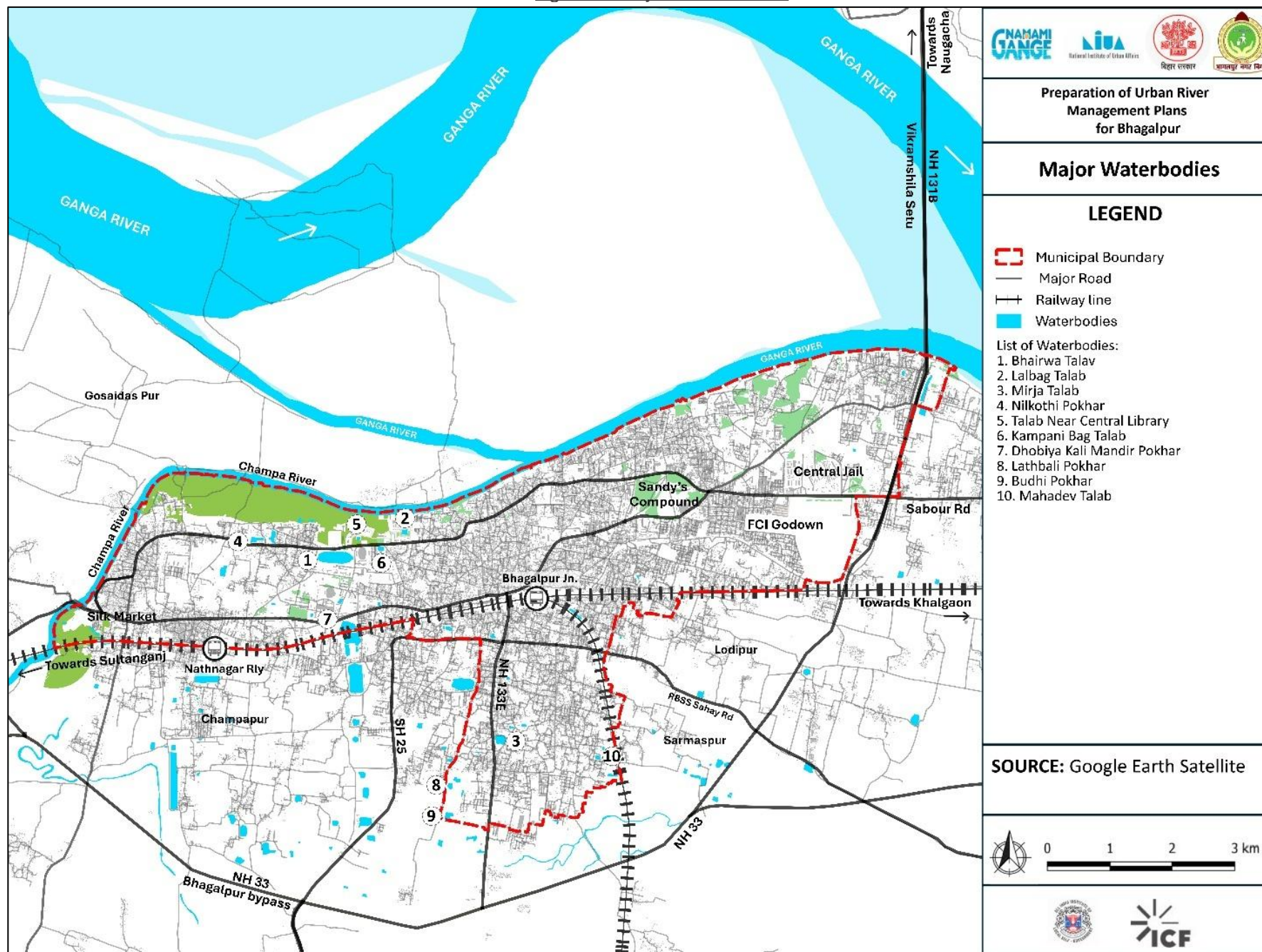
Sl. No.	Name of Water Bodies	Location (Ward No.)	Water Spread Area (acre)	Solid Waste Present	Untreated Wastewater Discharge	Boundary Protection Present	Visible Eutrophication	Minimum DO (mg/L)	Water Volume Change vs. Last Year
1.	Bhairwa Talab	11	13.60	No	No	Yes	No	≥ 4	No reduction
2.	Lalbag Talab	W No. 17 (near PG Girls Hostel, TMBU)	1.00	No	No	No	Yes	≥ 4	No reduction
3.	Mirja Talab	43	3.20	No	Yes	No	Yes	≥ 4	No reduction
4.	Nilkothi Pokhar	9	1.90	Yes	Yes	No	Yes	≥ 4	No reduction
5.	Talab near Central Library	17	1.00	No	No	No	Yes	≥ 4	No reduction
6.	Kampani Bag Talab	13	1.00	Yes	Yes	No	Yes	≥ 4	Reduced
7.	Dhobiya Kali Mandir Pokhar	12, Naya Tala	5.25	Yes	Yes	No	Yes	≥ 4	No reduction
8.	Lathbali Pokhar	42	1.50	No	Yes	No	No	≥ 4	No reduction
9.	Budhi Pokhar	42, Sailbag	2.25	Yes	Yes	No	Yes	No	Reduced
10.	Mahadev Talab	51, Kutubganj	1.00	Yes	Yes	No	No	≥ 4	No reduction

These ponds include Bhairwa Talab (13.6 acres), Dhobiya Kali Mandir Pokhar (5.25 acres), Mirja Talab, Nilkothi Pokhar and Budhi Pokhar, which serve daily uses such as bathing, washing, livestock care, and aquaculture through dhobi ghats and informal fish farming. These also become critical cultural nodes during Chhath Puja, local melas, and other festivals. Several also function as informal stormwater buffers during monsoon, helping moderate urban flooding, and contribute meaningfully to local groundwater recharge, with the census–documented ponds collectively holding an original storage capacity exceeding 12,670 m³.

Water body	Key issues observed	Supporting evidence / source
Lalbag Talab	Eutrophication; likely nutrient pollution	Visible eutrophication recorded, linked to nutrient-rich wastewater inflows and weed/algal growth.
Mirja Talab	Eutrophication; likely nutrient pollution	Visible eutrophication recorded, linked to nutrient-rich wastewater inflows and weed/algal growth.
Nilkothi Pokhar	Eutrophication; likely nutrient pollution	Visible eutrophication recorded, linked to nutrient-rich wastewater inflows and weed/algal growth.
Kampani Bag Talab	Volume reduction; poor water quality; degraded embankment condition	Volume reduction recorded; located in densely populated ward showing steep deterioration in water quality and embankment condition.
Budhi Pokhar	Siltation; reduced depth; volume reduction; poor water quality; degraded embankment condition	Depth reduced from around 6 m to 2–3 m in parts; volume reduction recorded; identified among ponds with severe deterioration in dense urban wards.
Bhairwa Talab	Severe siltation; reduced depth; reduced flood buffering and recharge function	Depth reduced from around 6 m to 2–3 m in parts, limiting flood buffering and groundwater recharge capacity.
Dhobiya Kali Mandir Pokhar	Poor water quality; degraded embankment condition	Identified among ponds in densely populated wards showing steep deterioration in water quality and embankment condition.
Several assessed ponds	Encroachment; blocked or dysfunctional inlet/outlet channels	Encroachment affects around 10–25% of original spread area of many ponds; inlet-outlet channels blocked or dysfunctional across several sites.
Majority of assessed ponds	Solid waste, untreated wastewater discharge, lack of boundary protection	Solid waste observed in 8 of 10 ponds; untreated wastewater discharge in 10 of 10 ponds; boundary protection present in only 3 of 10 .
Assessed water bodies overall	Degraded condition despite continued use	Only 5 of 10 assessed water bodies meet the URMP “acceptable condition” standard.



Figure 22 Major Waterbodies



Key Gaps

There is a complete absence of structured management, maintenance and long-term stewardship frameworks for the city's water bodies, which has resulted in largely unregulated and ad hoc use of these assets. Despite their widespread and regular use for religious practices, bathing and informal recreation there are no formal awareness or behavior change programmes to guide communities toward sustainable use.

Routine maintenance practices are almost entirely missing, with no defined or enforced schedule for desludging or desilting, leading to gradual loss of storage capacity and deterioration in water quality. Additionally, there is no regulatory oversight of polluting practices such as idol immersion, dumping of flower waste, and other ritual-related activities, which cumulatively contribute to severe water contamination.

Significant infrastructure deficiencies are observed across most ponds, further exacerbating degradation.

Existing and Planned projects for rejuvenation of waterbodies:

Several initiatives are currently underway in Bhagalpur to restore and enhance the ecological, cultural, and recreational value of local waterbodies and their surrounding public spaces.

- Construction of T.N.B. Collegiate Park under AMRUT 2.0, integrating green open space with adjacent waterbodies to strengthen community access and urban ecological networks.
- Beautification and rejuvenation of Nehru Memorial Pond, including desilting, landscaping, edge protection, and improved pedestrian circulation under AMRUT 2.0. Boundary protection and partial desilting works have been undertaken at ponds such as Kampani Bag Talab, Dhobiya Kali Mandir Pokhar, and Lathbali Pokhar, aimed at restoring water retention and preventing encroachment.
- Under previous municipal works and ward-level development funds, inlet-outlet clearing and basic embankment stabilisation have been conducted at select ponds (e.g., Bhairwa Talab and Nilkothe Pokhar) to maintain seasonal recharge.
- Future planning under BUIDCO includes pump station upgrades and nala-tapping works that will restore hydrological inflow conditions to key ponds and enhance urban stormwater detention capacity in adjoining neighbourhoods.⁹

These initiatives collectively indicate a growing institutional focus on blue-green infrastructure, with waterbodies being repositioned not only as ecological assets but also as community recreation spaces and climate resilience buffers.

⁹ Bhagalpur to Get Three New Parks and Renovated Pond, Work to Begin Soon, Patna Press, September 14th 2025, Retrieved from [<https://patnapress.com/bhagalpur-new-parks-pond-renovation-2025/>]



Figure 23 Inland Waterbodies



Key issues/concerns about waterbodies management

- Encroachment is widespread, with many ponds losing 10–25% of their original spread area, leading to a noticeable reduction in storage capacity and seasonal drying in several cases.
- Siltation is significant, especially in older ponds such as Bhairwa Talab and Budhi Pokhar, where water depth has reduced from 6 m to as low as 2–3 m in parts, restricting their flood buffering and recharge potential.
- Discharge of wastewater and solid waste dumping is observed in multiple ponds (e.g., Company Bag Talab, Budhi Pokhar), deteriorating water quality and accelerating eutrophication and weed growth.
- Infrastructure gaps persist, with damaged or absent boundary fencing and non-functional inlet–outlet channels in several ponds, increasing risks of encroachment and stormwater stagnation.
- Despite regular community use for religious activities and local recreation, there is no structured awareness or stewardship programme, leading to continued practices of idol immersion, flower waste dumping, and unregulated public access.
- Many ponds continue to serve as critical groundwater recharge assets, but their present capacity is significantly lower than their original capacity, indicating the need for systematic desilting and hydrological restoration.

4.3.2. URMP Score

Water body revival score = (Total number of water body in “acceptable” condition / Total number of water bodies) $\times$ 100 . Out of the 13 water bodies evaluated, 5 were in acceptable condition scoring 38.46 as per the parameters defined in the framework. As per URMP, if water body revival factor is <40 , then water body revival score is 1.

4.3.3. Interventions

4.3.3.1. Intervention 3–1: Project Pokhar Rakshak: Silt Core Dredging and Native Bio-Fencing Initiative

A major reason for urban flooding and waterlogging in Bhagalpur is the reduced capacity of the ponds in the city. Due to no maintenance protocol the waterbodies in the city have been silted resulting in reduced storage capacity. This intervention focuses on restoring the hydrological and ecological function of these ponds to reduce waterlogging, improve water storage, and prevent waste dumping.

1. Desilting and Restoration of Water Storage Capacity

To address years of sediment accumulation and reduced storage capacity, desilting will be carried out during dry season.

- **Silt Trap Development:** A dedicated silt-trap zone will be created at the inlets of the ponds to capture sediments before reentering the talab.
- **Pond Deepening:** Desilting will restore water depths of approximately 2.5–3 m, creating an estimated 32,000 m³ of additional storage capacity.
- **Ecological Desilting:** Desilting will retain the natural clay layer at the pond bottom to support groundwater recharge and ecological functions.



2. Nature-Based Edge Stabilization

The intervention will focus on natural solutions to reduce erosion and improve ecological value.

- **Gentle Terraced Slopes:** Pond edges will be regarded into stable terraced slopes to reduce erosion and improve accessibility.
- **Native Wetland Planting:** Native species such as Kans (*Saccharum spontaneum*) and reeds (*Phragmites karka*) will be planted along the edges to filter runoff and trap sediments.

3. Waste Management and Perimeter Protection

- **Native Green Buffer:** A belt of native trees and shrubs, including Neem, Peepal and Acacia, will be planted around the pond boundaries to discourage encroachment.
- **Trash Screens at Inlets:** Waste-trapping screens will be installed at stormwater inlets to capture floating plastics and debris before they enter the ponds.

Intervention	Responsible Agency	Intervention type
Project Pokhar Rakshak: Silt Core Dredging and Native Bio-Fencing Initiative	Bhagalpur Municipal Corporation (BMC)	Project
Estimated Budget	Potential Funding Sources	Timeline
Cost will vary per talab (For one pokhar the cost has been given in annexure INR 749010)	NMCG, AMRUT 2.0, Jal Jeevan Haryali Mission	Medium Term

4.3.3.2. Intervention 3-2: Ecological Restoration of Central Library Pond, Ward 17

As part of the baseline inventory for Bhagalpur city, the Central Library Pond in Ward 17 has been identified as a critical priority site for localized eco-restoration due to its significant urban interface and potential for biodiversity enhancement. The detailing of this specific intervention balances ecological engineering with community livelihoods, serving as a replicable model for other urban ponds.

1. Site Diagnostics, Vision, and Strategy

As outlined the project baseline establishes clear baseline features and strategic directions:

- **Total Area:** 1 Acre.
- **Primary Use:** Pisciculture (fish farming).
- **Key Issue:** Visible eutrophication.

Vision Statement: An ecologically restored wetland supporting sustainable pisciculture, biodiversity enhancement, environmental education, and habitat creation.

Broad Tactical Strategies

- Implementation of native wetland restoration protocols.
- Deployment of eco-sensitive, non-structural edge treatments.
- Targeted plantation of native and aquatic species to facilitate active habitat restoration.
- Provisioning of low-impact Nature Learning spaces and wildlife observation areas.

2. Phased Action Framework (Proposed Strategy)

To achieve the vision laid out, execution will follow a strict, low-impact five-step strategy:



1. **Boundary Protection & Demarcation:** Physically mark the pond boundaries using low-impact edge markers. Install continuous natural hedges along the perimeter with limited, designated entry points to systematically curb illegal dumping and encroachment.
2. **Desilting & Weed Eradication:** Execute mechanical and manual removal of invasive aquatic species (such as *Eichhornia crassipes*) and conduct localized desilting. This will restore the pond's original depth profile and significantly improve its water retention and localized flood-buffering capacity.
3. **Phytoremediation Staging:** Construct wetland edges and deploy Floating Treatment Wetlands (FTWs) directly within the water column. Introduce hyper-accumulating native species—including *Typha*, *Phragmites*, and *Vetiver*—to extract heavy nutrients (phosphorus and nitrogen) and combat eutrophication.
4. **Bio-Filtration Zones:** Create expansive reed beds along the vulnerable slope embankments to actively filter urban stormwater runoff before it drops into the pond basin.
5. **Community & Educational Interface:** Establish a dedicated Nature Learning space, complete with a low-impact observation area and descriptive informational signage regarding local aquatic food webs and wetland processes.

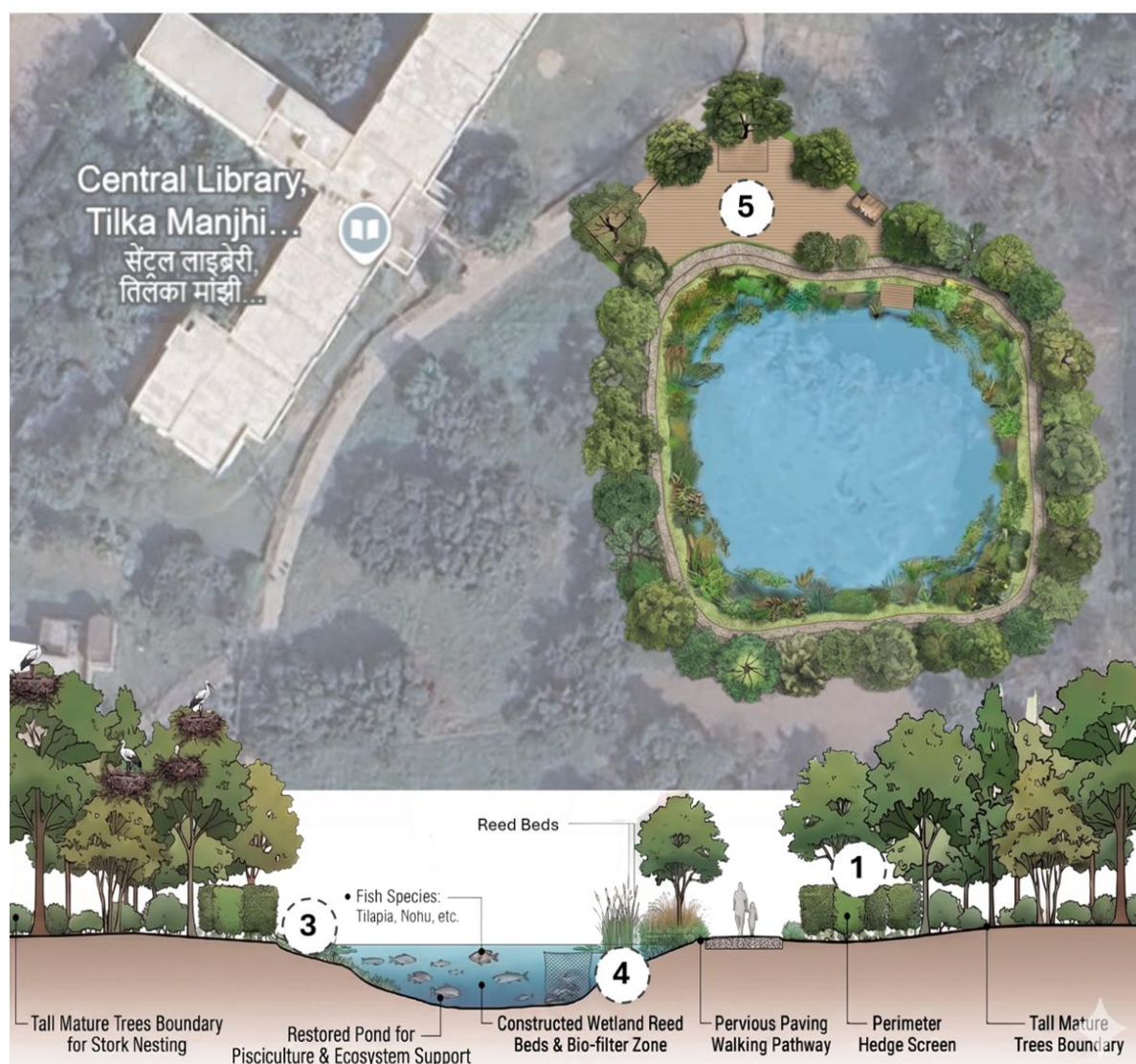
3. Cross-Sectional Design Specifications

The spatial and structural layout of the intervention—visualized in the comprehensive engineering cross-section in is broken down into highly specialized ecological zones:

1. **Restored Pond Basin:** The core 1-acre basin is sculpted to support robust fish species such as **Tilapia and Rohu**, optimizing water quality to maintain a stable, commercially viable, and ecologically balanced pisciculture loop.
2. **Constructed Wetland Reed Beds & Bio-filter Zone:** Positioned at the runoff entry interface, featuring specialized macrophyte species including ***Phragmites australis*, *Typha latifolia*, and *Phragmites karka*** rooted in engineered bio-soil mediums to provide intensive biofiltration.
3. **Pervious Paving Walking Pathway:** A low-impact pedestrian trail composed of highly porous, permeable pavers to ensure that surrounding surface rainfall continues to infiltrate into the local water table naturally rather than turning into rapid sheet runoff.
4. **Perimeter Hedge Screen:** Dense, low-height native brush buffers that act as a visual and physical barrier, protecting sensitive nesting and spawning banks from urban noise and stray domestic litter.
5. **Tall Mature Trees Boundary:** The outermost buffer zone is layered with large canopy trees to provide structural shade, lower evaporation rates, and explicitly foster **stork nesting** habitats along the western edge.



Figure 24 Rejuvenation of Central library Tilak Manjhi Pond



Intervention	Responsible Agency	Intervention type
Central Library Pond Eco-Restoration Project	Bhagalpur Municipal Corporation (BMC)	Project
Estimated Budget	Potential Funding Sources	Timeline
INR 4,065,410	NMCG, AMRUT 2.0, Saat Nischay Part-2	Medium Term (3–5 years)

4.3.3.3. Intervention 3-3: GIS-Based Waterbody Inventory and Eco-Hydrological Diagnostic System (Integrated with NIUA's Urban Water Body Diagnostic Tool)

To transition from ad-hoc interventions to a data-driven, scientific management matrix. Bhagalpur must scale up its digital oversight capabilities. As established this intervention mandates the creation of a comprehensive GIS-based inventory and water quality monitoring system for all



urban waterbodies. By fully embedding the Urban Waterbody Diagnostic tool (NIUA's UWD)¹⁰ into its core strategy, the city establishes a web-based, standardized Decision Support System (DSS). This system maps physical, chemical, biological, and management attributes to prioritize localized actions and track catchment-scale pollution hotspots in direct integration with objective 2.

1. Unified Spatial & Baseline Diagnosis

The digital platform redefines asset mapping by replacing fragmented manual listings with a standardized, web-based diagnostic profile

- **Polygon Digitization & Area Calculation:** Utilizing satellite image assistance embedded into the diagnostic tool, municipal surveyors can trace and digitize the precise geometric boundaries of each waterbody directly on the web map interface. The system automatically calculates the surface area of the digitized polygon in hectares/acres to track shrinkage over time.
- **Automated Buffer Zone Delineation:** In accordance with the NIUA scientific technical methodology, the tool dynamically projects an orange-line perimeter boundary around the waterbody to establish a strict protective buffer zone:
 - For waterbodies with a surface area under **10 hectares**, a mandatory **9-meter** ecological buffer is projected from the edge.
 - For waterbodies expanding beyond **10 hectares** (such as *Bhairwa Talaab*), a **30-meter** active buffer zone is projected.
- **Asset Attribute Census:** Each digitized node is populated with primary data points, including localized ownership parameters (Municipal Corporation ownership vs. private tenancy), current water column depth against original volumetric baselines, and registered socioeconomic uses (e.g., pisciculture, ritual bathing, or storm-surge buffering)

2. Multi-Criteria Health Indexing & Diagnostic Metrics

The status-quo evaluation transitions to an objective scoring by feeding physical, biological, and chemical indicators directly into the NIUA analytical engine:

- **Surface Biological Degradation Mapping:** Rather than relying on simple approximations, the tool allows field teams to trace areas directly on the map interface to calculate the exact percentage of the surface covered by destructive **algal blooms and invasive macrophytes** (such as water hyacinth).
- **Solid Waste Accumulation Matrix:** Solid waste density within the basin and its designated 9m/30m buffer zones is quantified by marking dump boundaries on the system interface. The registry separates domestic organic waste from heavy Construction and Demolition (C&D) waste to trigger targeted municipal collection runs.
- **Chemical Profile Logging:** Field engineers execute tri-point water sampling to determine primary chemical parameters. To satisfy tool requirements, a minimum of **three distinct spatial Dissolved Oxygen (DO) values** must be sampled and logged per waterbody to compute the baseline biological health score, tracking the threshold requirement of a minimum DO of 4mg/L.

¹⁰ <https://niua.in/urban-water-body-diagnostic-tool>



- **Buffer Zone Encroachment Audit:** The built-up footprints or illegal structural expansions pressing inside the projected orange-line buffer boundaries are systematically highlighted and assigned a density percentage range to generate rapid legal enforcement alerts.

Intervention	Responsible Agency	Intervention type
GIS-Based Waterbody Inventory and Eco-Hydrological Diagnostic System (Integrated with NIUA's Urban Water Body Diagnostic Tool)	Bhagalpur Municipal Corporation (BMC) and BSPCB	Project
Estimated Budget	Potential Funding Sources	Timeline
26,40,000	AMRUT 2.0	Medium term



4.4. Objective 4: Enhancing Riparian Buffer

Rationale: Objective 4 focuses on strengthening riparian buffers along the Ganga riverfront in Buxar as a nature-based defence against erosion, flooding, and river pollution. While Buxar already benefits from a naturally evolved vegetative cover along its river edge, the absence of formal planning controls, ecological management, and monitoring has limited the effectiveness and long-term resilience of these buffers.

4.4.1. Existing Situation

Within the Municipal limits of Bhagalpur, the river edge extends approximately 13.5 km, of which nearly 11.50 km retains some form of riparian buffer. However no formally demarcated riparian buffer zone has been established by the WRD. The buffer is highly fragmented and spatially uneven; the urban core along the Champa River features a narrow strip of 7.5 to 30 m disrupted by encroachments, while suburban stretched offer moderate widths of 30–60 m, and the rural periphery supports broad, continuous buffer exceeding 100m.

Dominant vegetation consists of grasses, reeds, and shrubs, with tree species such as Shisham, Neem, Babul, and Peepal concentrated near ghats and institutional precincts. Concretised riverfront developments, unregulated land reclamation, solid waste dumping, and the organic rather than planned evolution of buffer patches significantly limit the ecological and hydrological function these zones are expected to perform.

Existing Sectional Profiles

The **indicative sections of the riparian buffer** highlight critical ecological and urban dynamics along two major rivers—**Champa and Ganga**

Figure 25 Riparian Buffer Cross Sections

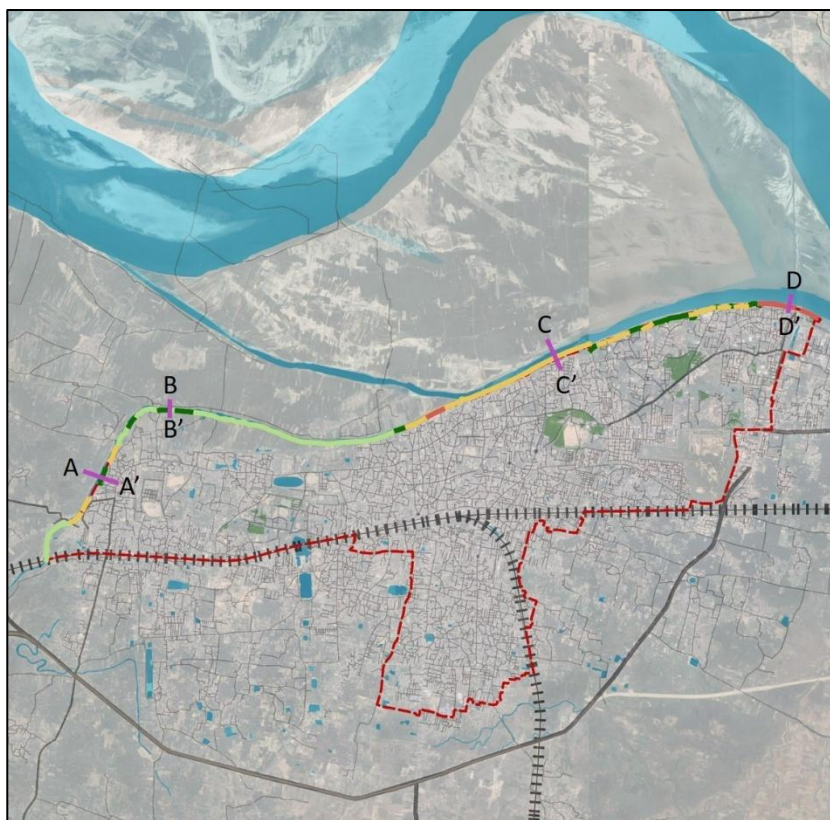
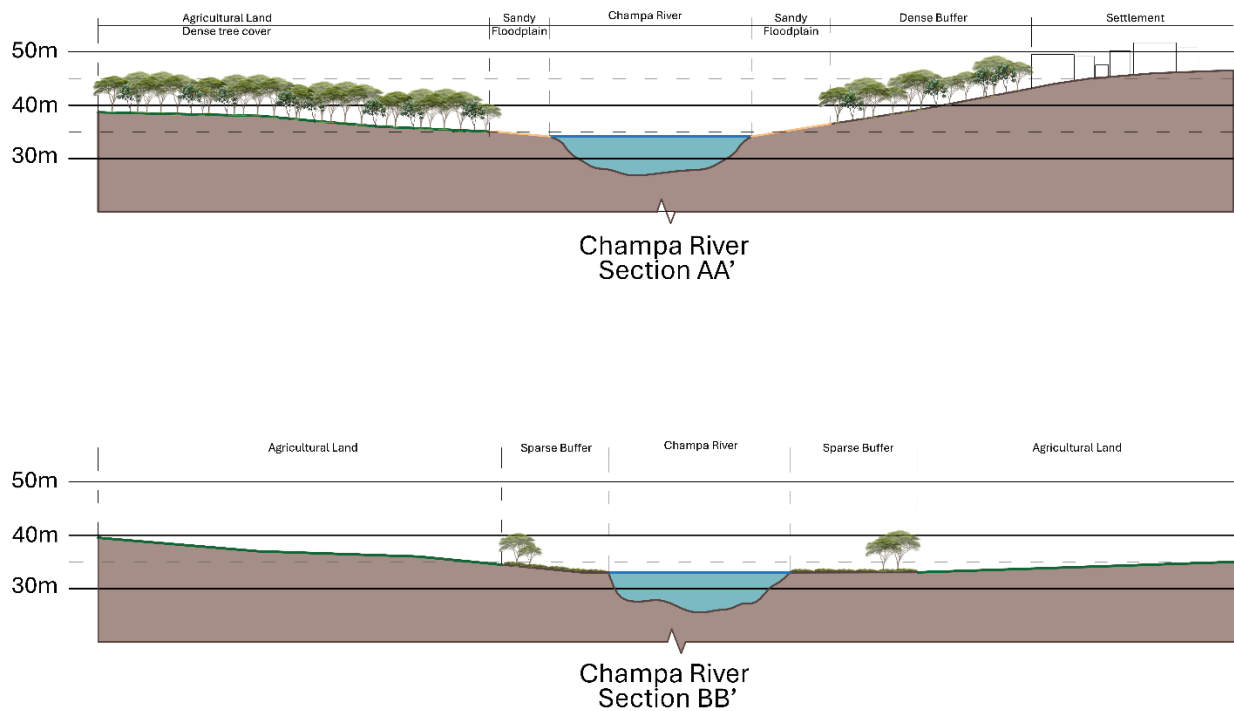


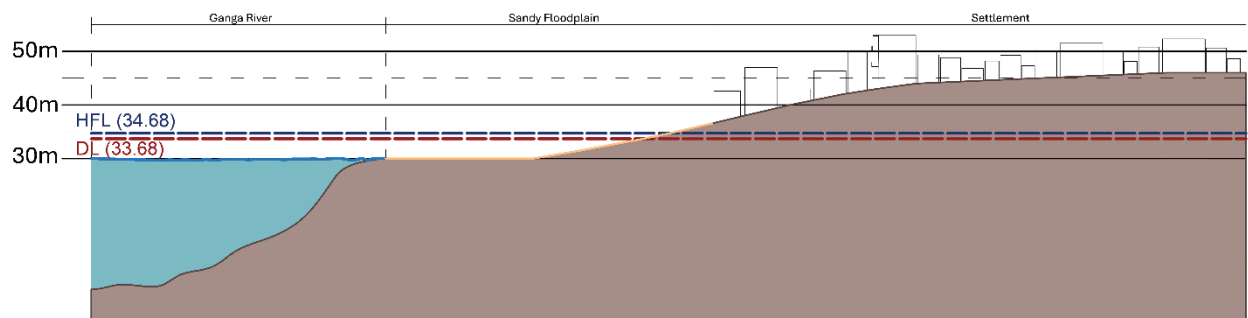
Figure 26: Illustrative sectional profile riparian buffer– Tel River



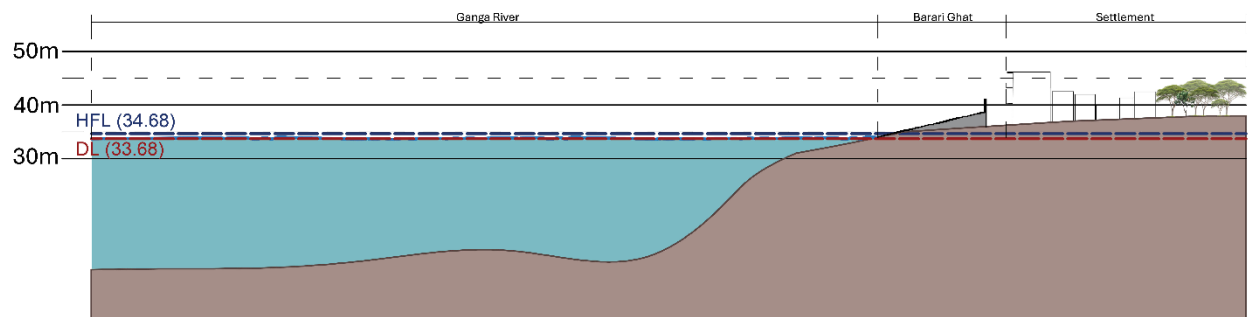
- **Sections AA (Champa River):** These segments exhibit **dense vegetation** including mature trees, shrubs, and grasses, forming a robust natural buffer. However, the presence of **sewerage outfall points** into the Champa River underscores the need for **stringent water quality management** to prevent degradation of the riparian ecosystem.
- **Sections BB (Champa River):** These segment exhibits **sparse vegetation**, without any major grasses or trees. Most of the riverbank is used for agriculture. The smooth slope also makes it highly susceptible to flooding during monsoon season.



Figure 27: Illustrative riparian buffer section- Ganga River



Ganga River
Section CC'

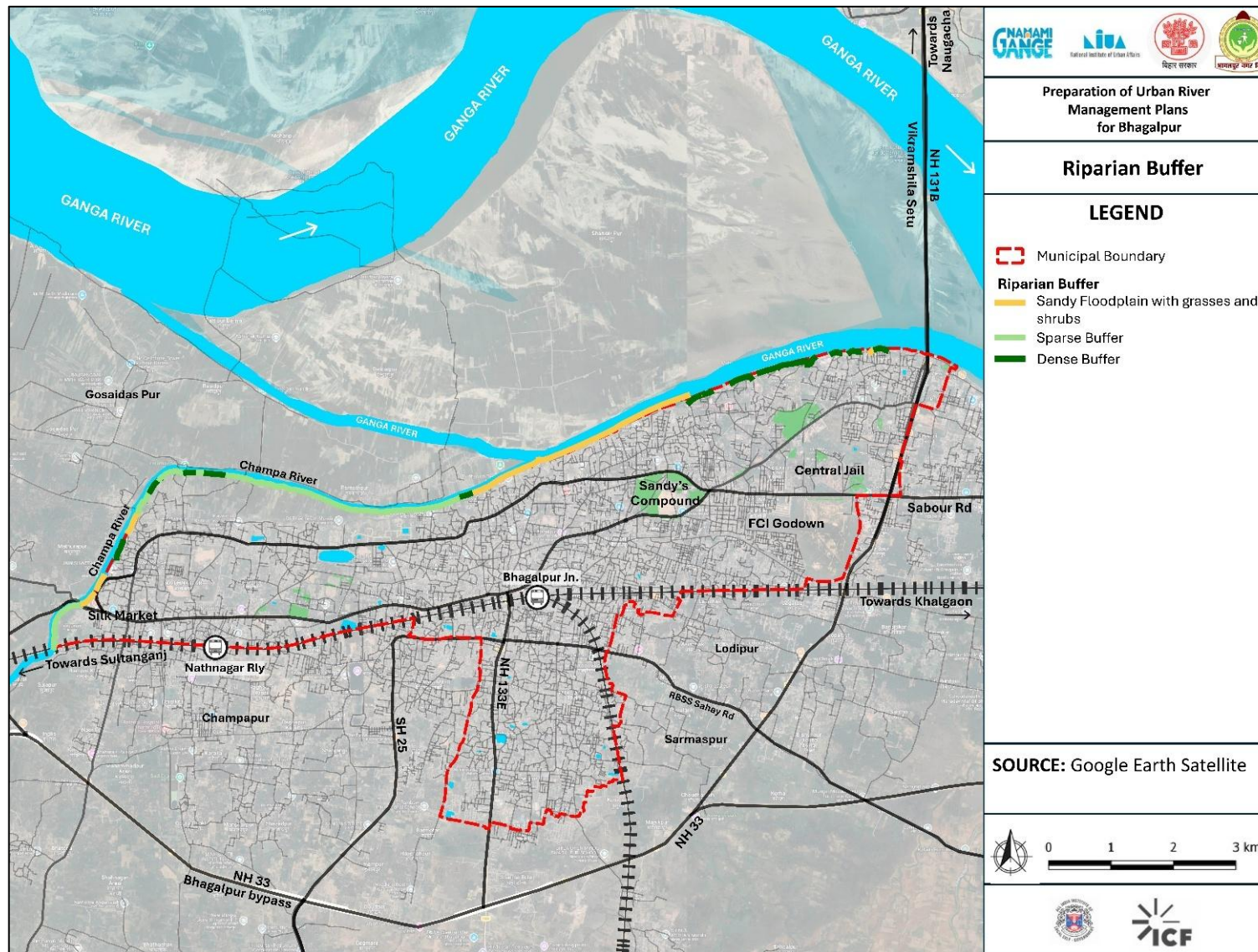


Ganga River
Section DD'

Sections CC and DD (Ganga River): In contrast, these areas are characterised by **sparse grass cover**, minimal tree density, and a **flat terrain**. The land adjacent to the river is **highly encroached** facing major flooding during the monsoon period every year.



Figure 28 Existing Riparian Buffer



NDVI Analysis

Satellite-based NDVI analysis (2017–2025) shows consistently low vegetation cover across the Bhagalpur's Municipal area. The proportion of low-vegetation cover (NDVI class 0–0.15) increased from approximately 35–38% in 2017 to 38–48% in 2025, while dense vegetation (NDVI>0.45) declined from 6–8% to 5–6% over the same period. The riverfront zone along the Ganga continues to exhibit a persistent low-NDVI band, indicative of exposed alluvial surfaces, seasonal sandbars, and the near-total absence of systematic riparian plantation.

This steady deterioration is primarily attributed to encroachment near ghats and access roads, the limited implementation of green belt or bio-shield plantation programmes, and seasonal agricultural withdrawal exposing floodplains soils to erosion and compaction.

Biodiversity Profile

The Ganga–Champa system hosts rich biodiversity, including over 61 fish species dominated by carps, catfishes, and perches, along with iconic fauna like the Gangetic Dolphin, Gharial, freshwater turtles, and more than 87 waterbird species. Its riparian zones feature grasses such as *Saccharum* and *Typha*, woody plants like *Acacia* and *Ficus*, and aquatic flora including lotus, water lilies, and submerged grasses, which stabilize banks, filter pollutants, and sustain food webs. These ecosystems act as biodiversity corridors, regulate water quality, and mitigate floods, making riparian buffers vital for urban resilience. However, in cities like Bhagalpur, these areas face threats from encroachment, pollution, and infrastructure expansion, necessitating strategies like protected zoning, buffer enforcement, and eco-sensitive design to preserve ecological integrity and reduce flood risks.

Key Gaps

A major gap lies in the absence of a continuous riparian buffer along the river corridor. The absence of any officially demarcated buffer boundary leaves the zone legally unprotected and susceptible to continued encroachment and land reclamation. No continuous vegetated strips exist immediately landward of the river edge or along drainage channels feeding into the Ganga, resulting in diminished stormwater filtration, heightened soil erosion risk, and increased surface heat exposure. The predominance of grasses and low shrubs over mature tree canopy limits the structural resilience of the buffer against high-flow monsoon events.

Institutionally, fragmented responsibilities among the Bhagalpur Nagar Nigam, Forest Department, and Water Resources Department without a unified management framework or regular satellite-based monitoring protocol further impede coordinated and sustained intervention.

4.4.2. URMP Score

The riparian buffer score evaluates the extent to which riverbanks within the city are protected by vegetated buffer zones. Only buffers with a minimum width of 7.5 meters were considered, as narrower strips provide limited ecological and hydrological benefits.

Adding the cumulative scores of the two the Riparian buffer factor is 85.18, translating to a score of 4 as per URMP framework



4.4.3. Interventions

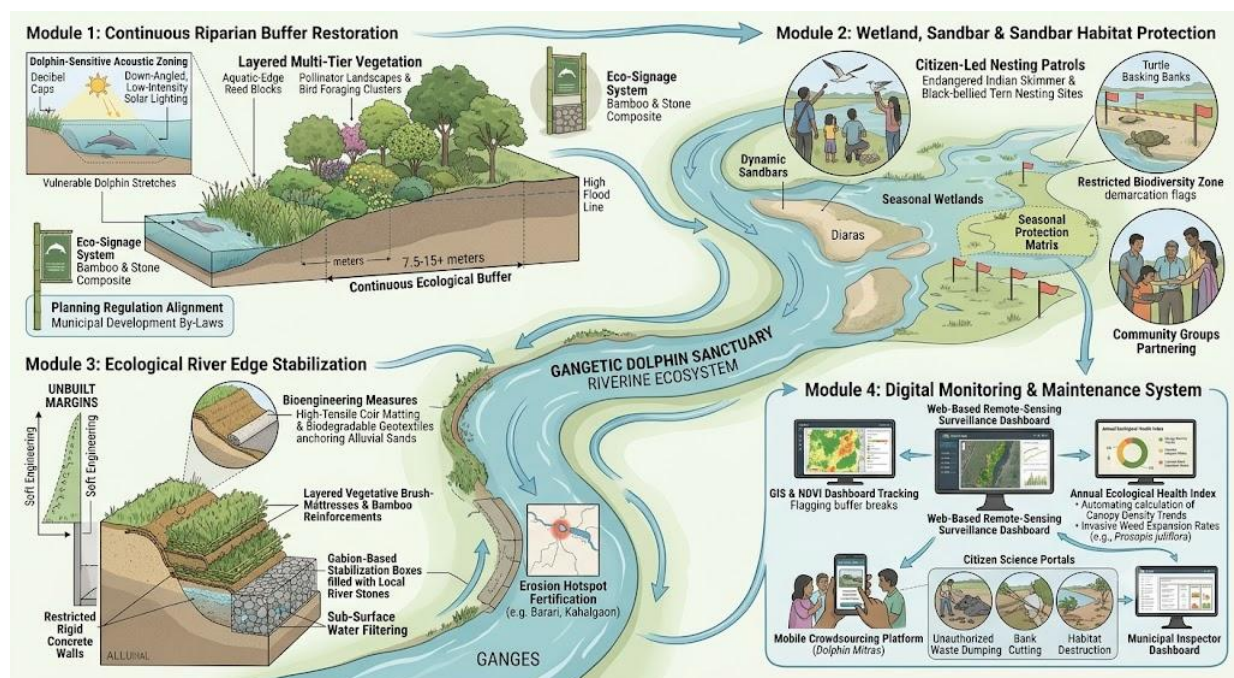
4.4.3.1. Intervention 4-1 Integration of Riparian Buffer Regulations into the Master Plan including Ecological Enhancement through Native and Zoned Planting

This strategic intervention builds directly upon the land-use baselines and administrative mandates defined in Intervention O1: Ecological Floodplain, Wetland, Sandbar & River Zoning and Conservation Strategy. This intervention establishes an adaptive engineering and landscaping framework that explicitly recognizes the Ganga River edge at Bhagalpur as:

- A critical floodplain ecosystem
- A continuous regional biodiversity corridor
- A core habitat landscape directly linked to the legally protected Vikramshila Gangetic Dolphin Sanctuary (VGDS)
- A hydrologically dynamic river edge requires adaptive, non-structural ecological management rather than conventional concrete embankments.

1. Strategy and Technical Execution

Figure 29 Strategy for Riparian Buffer restoration



The intervention combines soft bioengineering with local eco-zoning regulations, executed across four major strategic modules

➤ Module 1: Continuous Riparian Buffer Restoration

- **Planning Regulation Alignment:** The project enforces minimum ecological buffer widths ranging from **7.5 to 15+ meters** landward from the high flood line, strictly embedded within municipal development by-laws.
- **Layered Multi-Tier Vegetation:** Stretches of fragmented green cover will be transformed into continuous ecological buffers using native floral matrices. The layout introduces dedicated pollinator landscapes, bird foraging clusters, and specialized aquatic-edge reed blocks.



- **Dolphin-Sensitive Acoustic Zoning:** To shield vulnerable stretches of the adjacent Gangetic Dolphin sanctuary from intense urban stressors, the landward buffer zones will be designated as acoustic and light-limiting shields, enforcing decibel caps and down-angled, low-intensity solar lighting.
- **Eco-Signage Systems:** Low-impact informational signs crafted from local bamboo and stone composites will be integrated to raise public awareness regarding the sanctuary's indicator species.

➤ **Module 2: Wetland, Sandbar & Sandbar Habitat Protection**

- **Seasonal Protection Matrix:** Dynamic sandbars (*diaras*) and low-lying seasonal wetlands will be mapped and cordoned off as restricted biodiversity zones during post-monsoon crop cycles and lean summer dry spells.
- **Citizen-Led Nesting Patrols:** In partnership with local community groups, seasonal demarcation systems will protect bird nesting sites (such as those of the Endangered Indian Skimmer and Black-bellied Tern) and turtle basking banks from sand-mining or stray domestic cattle.

➤ **Module 3: Ecological River Edge Stabilization**

- **Bioengineering Measures:** Traditional, rigid concrete river walls will be completely restricted across unbuilt margins. Bank stabilization will exclusively utilize soft engineering methods:
 - High-tensile **coir matting** and biodegradable **geotextiles** to anchor loose alluvial sands.
 - Layered vegetative brush-mattresses and **bamboo reinforcements**.
 - Flexible, permeable **gabion-based stabilization** boxes filled with local river stones to allow natural sub-surface water filtering while resisting strong seasonal erosion currents.
- **Erosion Hotspot Fortification:** Immediate works will target highly vulnerable, unembanked sandy stretches near Barari and Kahalgaon to arrest rapid bank shifting during monsoon discharge peaks.

➤ **Module 4: Digital Monitoring & Maintenance System**

- **GIS & NDVI Dashboard Tracking:** A web-based remote-sensing surveillance protocol will track Normalized Difference Vegetation Index (NDVI) shifts to flag early structural breaks or vegetation thinning in the buffer.
- **Annual Health Assessments:** The system automates an annual ecological health index calculation, evaluating canopy density trends, invasive weed expansion rates (e.g., *Prosopis juliflora*), and soil moisture performance.
- **Citizen Science Portals:** A mobile crowdsourcing reporting platform will empower local groups ("*Dolphin Mitras*") to instantly log and upload unauthorized waste dumping, bank cutting, or habitat destruction directly to the municipal inspector dashboard.

2. Multi-Agency Institutional Governance Ecosystem

As mandated, long-term success is anchored upon a clear division of operational responsibilities across state and municipal bodies:



- **Lead Execution Agency:** The **Water Resources Department (WRD), Government of Bihar** holds primary charge. The WRD leads all structural embankment permissions, hydrological restoration modeling, and strict ecological zoning enforcement.
- **Municipal Support & O&M Partner:** The **Bhagalpur Municipal Corporation (BMC)** provides daily urban alignment. The BMC's engineering and sanitation units handle localized solid waste management, drain interception routing, ritual ghat cleaning, plantation maintenance, and community-level enforcement.
- **Technical Oversight:** The State **Department of Environment, Forest, and Climate Change (DoEFCC)** coordinates native nursery setups and enforces strict forestry compliance parameters.
- **Community Outreach Support Network:** Ground-level protective protocols, awareness drives, and participatory plantation campaigns are supported by the *Mandar Nature Club*, the Vikramshila Gangetic Dolphin Sanctuary (VGDS) field office, and specialized ecological NGOs.

Intervention	Responsible Agency	Intervention type
Integration of Riparian Buffer Regulations into the Master Plan including Ecological Enhancement through Native and Zoned Planting	BMC	Policy
Estimated Budget	Potential Funding Sources	Timeline
N/A	State Planning Funds, NMCG technical assistance	1-2 Years

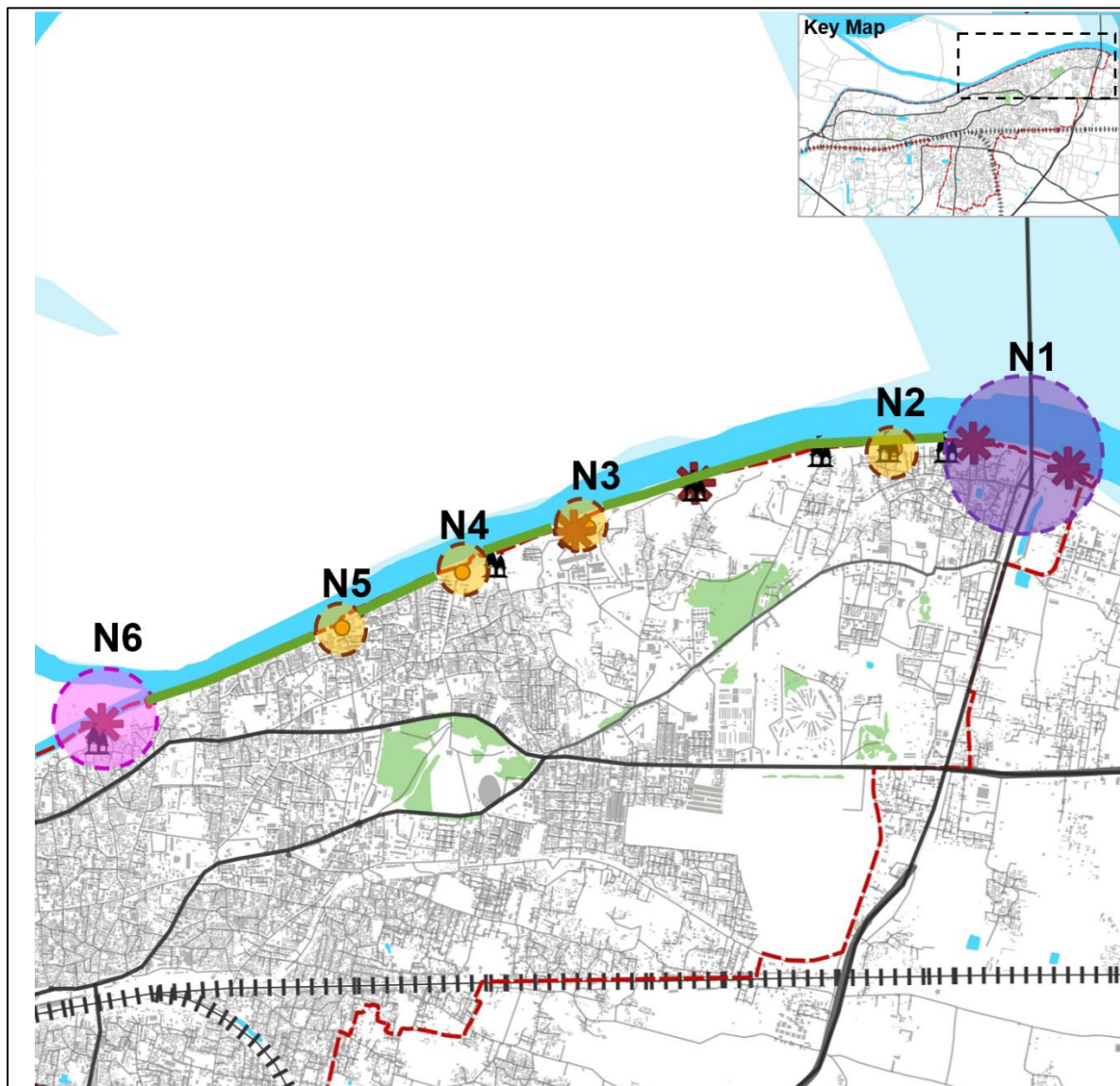
4.4.3.2. Intervention 4-2 Continuous Green Corridor along the proposed Eco-friendly riverfront Development Zone

A continuous ecological buffer should be implemented along the 14 km proposed (Objective 7&8) 14 km Ganga riverfront corridor, focusing exclusively on the unbuilt, natural gaps between the designated activity nodes (Node 1 to Node6; detailed under Intervention 8-1).

By moving away from conventional concrete embankments, this project establishes a multi-tiered, nature-based bio-shield. The corridor is designed to act as a natural sponge for flood mitigation, an acoustic filter for the adjacent Vikramshila Gangetic Dolphin Sanctuary (VGDS), and a continuous habitat corridor for regional wildlife



Figure 30 Continuous riparian buffer between nodes

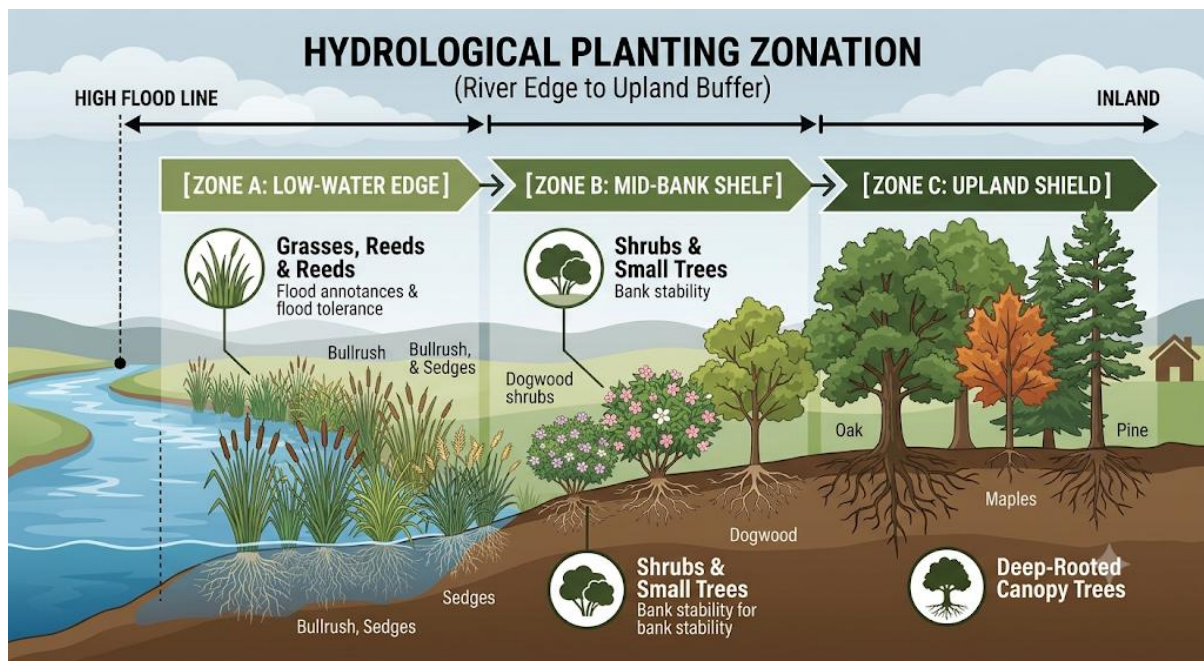


1. Planting Zoning Strategy

To enhance resilience against seasonal monsoon flooding while replicating the natural floodplain structure, the plantation design is organised into three distinct hydrological elevation zones.



Figure 31 Planting Strategy



Zone A: The low-water edge & Shallow Marginal Shelf

- **Hydrological Condition:** Subject to regular seasonal inundation, high velocity currents, and prolonged submergence during the monsoon peak.
- **Vegetation Matrix (Grasses, Reeds & Sedges):**
 - **Kans Grass (*Saccharum Spontaneum*):** A native, highly aggressive binder that forms deep, fibrous root mats. It traps incoming surface sediments, slows down runoff velocity, and stabilizes loose alluvial sands.
 - **Common Reed (*Phragmites Karka/Phragmites australis*):** Excellent for water purification and bank hold. It serves as a biological phytoremediation bed, filtering agricultural and pluvial runoff before it reaches the main stream.
 - **Vetiver Grass (*Vetiveria zizaniodes*):** Known for its massive vertical root system (up to 3–4 m deep) that acts as an underground bio-nail, mechanically holding the soil slope together.

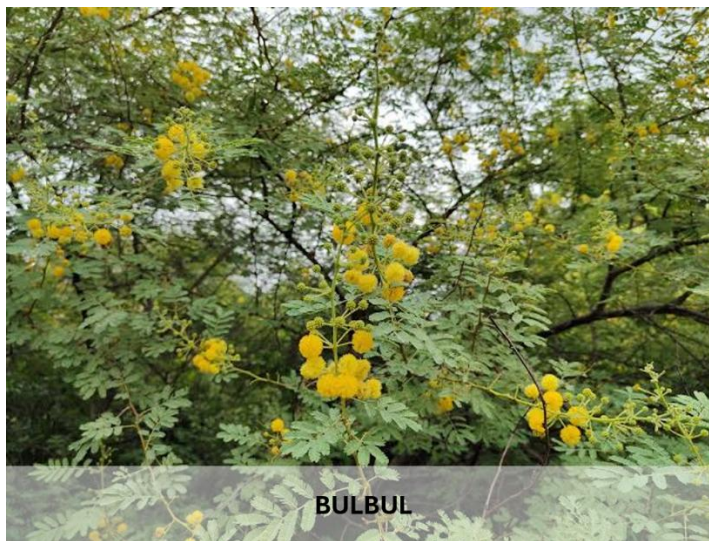
Figure 32 Native Species



Zone B: The Mid-Bank Slope & Active Floodplain Shelf

- **Hydrological Condition:** Intermittently flooded during seasonal high-water fluctuation; requires flexible, elastic vegetation that prevents soil scouring.
- **Vegetation Matrix (Shrubs & Semi-Aquatic Small Tress):**
 - **Bulbul (*Acacia nilotica*):** A hardly, flood-tolerant thorny species whose extensive root networks adapt well to alluvial bank stress and provide immediate bank stability.
 - **Tamarix (*Tamarix dioica/Jhau*):** Naturally adapted ti sandy, braided riverbeds and diara edges. It bends with flood currents without breaking, effectively anchoring dynamic shorelines.

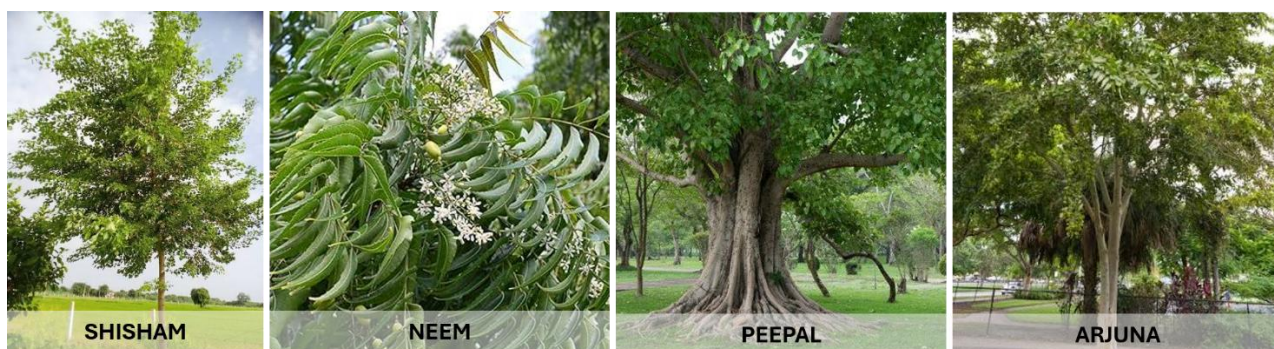
Figure 33 Native species for zone 2



Zone C: The upland Green Belt Buffer

- **Hydrological Condition:** Sits above the routine high-flood threshold; acts as a permanent terrestrial boundary shield and wildlife refuge.
- **Vegetation Matrix (Deep-Rooted Large Canopy Trees):**
 - Shisham/ Indian Rosewood (*Dalbergia sissoo*): A native keystone species of the Gangetic plain. Its expansive, deep root architecture offers long-term slope stability against massive lateral river cuts.
 - Neem (*Azadiracta indica*) : Improves soil organix health, adds structural canopy layer coverage, and enhances regional pollinator biodiversity.
 - Neem (*Azadiracta indica*) : Improves soil organic health, adds structural canopy layer coverage, and enhances regional pollinator biodiversity.
 - Peepal (*Ficus religiosa*) & Arjun (*Terminalia arjuna*): Large, water-loving canopy tress that thrive near river basins. Their extensive root matrices secure the upper topsoil while their dense branches provide critical nesting, roosting, and breeding habitats for local avifauna.





2. Implementation Strategy

Restriction of Hard Infrastructure: The entire zone between Node 1 and Node 6 (excluding existing ghat envelopes) is categorized as a strict No-Development Zone (NDZ). No concrete walling, or commercial building is permitted.

Biengineering stabilization support: Prior to planting saplings on steep, erosion-prone sections, the slopes will be lined with biodegradable coir geotextiles and jute mats. Saplings are planted through silts cut into the mats, allowing the roots to bind the soil fabric before the organic blanket naturally decomposes over 3–5 years.

Acoustic & Light Buffering: The upland tree canopy is designed as a thick, multi-layered bio-fence. This green wall acts as a barrier that minimises urban noise and stray light transmission toward the river channel, ensuring a quiet corridor for dolphin navigation and foraging.

Intervention	Responsible Agency	Intervention type
Continuous Green Corridor along the proposed Eco-friendly riverfront Development Zone	Water Resources Department (WRD) as lead, with BMC	Project
Estimated Budget	Potential Funding Sources	Timeline
Integrated with Intervention 6–1	Compensatory Afforestation Fund Management and Planning Authority (CAMPA) / Forestry Funds	Medium term (1–3 years)



4.5. Objective 5: Reuse Of Treated Wastewater

Objective 5 Rationale: Cities consume vast amounts of freshwater and release most of it back as wastewater. If untreated, this becomes a pollutant; if treated and reused, it becomes a vital resource. Reusing wastewater reduces the stress on rivers, lowers dependence on groundwater, and supports a circular water economy. It also ensures environmental flows in the river are not – sacrificed for urban consumption. Promoting reuse can bridge the gap between growing demand and finite freshwater supply

4.5.1. Existing Situation

Bhagalpur faces a significant water supply deficit, with current supply at 37.35 MLD against an estimated demand of 90 MLD, resulting in intermittent water availability of about 7 hours per day and a low per capita supply of 33lpcd. Demand is projected to rise further by 104.5 MLD in 2030 and nearly 125 MLD by 2047, while only 4 of the city's 7 overhead tanks are presently functional.

Although a new 90 MLD water treatment plan and associated distribution infrastructure are being developed by BUDICO with ADB support, additional treatment capacity will still be required in the future. Continued dependence on groundwater also remains a concern due to increasing nitrate and arsenic contamination in local aquifers.

The city has made significant progress in wastewater management through 45 MLD STP, currently treating about 35 MLD and interceptor system covering 12 major outfall drains. In the absence of a wastewater reuse framework, treated water is largely getting discharged into Ganga. As a result, opportunities to use treated wastewater for irrigation, landscaping, industrial activities, road cleaning, or maintenance of public parks and gardens remain untapped.

Without reuse planning, Bhagalpur will continue to depend heavily on groundwater and water from Ganga, while treated wastewater remains an underutilized asset.

Key Gaps

The most critical gap is the complete absence of a formalised wastewater reuse policy or institutional framework at the city level, leaving Bhagalpur unable to leverage its existing 45 MLD treatment capacity for any structured reuse purpose. No official data on wastewater reuse volumes is available with the municipal authorities, making it impossible to calculate the city's Wastewater Reuse Score.

There is no pipeline network, decentralised storage infrastructure, or distribution system to convey treated effluent to potential reuse sites such as peri-urban farms, urban green spaces, or water bodies. Social acceptance, health risk management, and technical concerns such as salinity and sodium adsorption ratios remain unaddressed.

Moreover, while national mandates (NITI Aayog, MoHUA) require 50% reuse of treated wastewater in urban areas by 2025, and Bihar's Low Carbon Action Plan (2024) prioritises agricultural and municipal reuse, Bhagalpur has yet to translate any of these policy directives into actionable local programmes or investments.

4.5.2. URMP Score

Objective 5-Water Re-use Score :

The city formally does not reuse the treated wastewater (<20%).

Hence the **water reuse score is 1** as per URMP framework.



4.6. Objective 6: Good quality return flow

Objective 6 Rationale: Objective 6 seeks to ensure that Bhagalpur contributes actively to maintaining the ecological flow and water quality of the Ganga by returning adequate volumes of treated good-quality water to the river system. Good-quality return flow is critical not only for dilution and self-purification of the river but also for sustaining aquatic ecosystems, reducing downstream pollution impacts, and maintaining resilience during lean-flow periods. In Bhagalpur, this objective is particularly important due to the city's heavy dependence on groundwater, the absence of full sewerage interception, and the presence of multiple untreated drain outfalls directly discharging into the Ganga.

4.6.1. Existing Situation

Bhagalpur's return flow profile is shaped by the current state of its sewage treatment infrastructure and the near-total absence of a structured wastewater reuse framework. The city abstracts approximately 37.35 MLD of water to serve its population, against a total demand of over 104 MLD a deficit that is expected to widen significantly through 2047. Despite this extraction burden, the mechanisms to return treated water to the Ganga in adequate volume and quality remain underdeveloped.

The city's primary treatment infrastructure consists of a 45 MLD Sewage Treatment Plant (STP) at Barari. Against its installed capacity, the STP is currently treating approximately 35 MLD a utilisation shortfall attributable to incomplete inflow infrastructure, including pumping stations and nala interception works that are still under various stages of procurement and construction. The original Sewerage Master Plan envisaged a 65 MLD STP with interceptor sewers capturing flows from 15 major outfall drains; the downscaled 45 MLD facility therefore represents both a capacity and coverage constraint. A tender for a Detailed Project Report on treated wastewater reuse was issued in March 2023, but no formalised reuse system is currently operational.

All treated effluent from the STP is discharged directly into the Ganga River through designated outfalls. No portion of this treated flow is currently reused for irrigation, urban greening, groundwater recharge, or industrial purposes. During the monsoon season, uncontrolled surface runoff enters the river through a network of natural and semi-engineered stormwater drains, compounding peak flow stress and sediment loads. Prior to the partial rollout of trunk sewers, nearly 90% of the urban population relied on on-site sanitation systems, many of which were informally connected to open drains a legacy that continues to contribute organic and microbial loading to the river.

Key Gaps

- STP operating at ~35 MLD against 45 MLD installed capacity; actual sewage generation (~68–72 MLD) far exceeds treatment coverage
- Seven major drains not yet intercepted; untreated sewage continues to discharge directly into the Ganga
- No formalised wastewater reuse policy or institutional framework in place
- Stormwater and sewage networks remain largely unseparated, causing combined overflow during monsoon
- No real-time monitoring of return flow volumes or quality against committed benchmarks
- Absence of mandated return flow standards in city water use permits or regulatory instruments
- DPR for reuse planning initiated (March 2023) but not yet operationalised
- FSTP operational but functioning below capacity with seasonal efficiency gaps



4.6.2. URMP Score

Objective 6-Return Flow Factor :

As per URMP framework, if return Flow Factor = (minus) -10 ~ (minus) - <5 , water reuse score is 3

Hence the return flow score is 3 as per URMP framework.

4.6.3. Interventions

4.6.3.1. Intervention 5-1 Circular Water Reuse & Clean Return Flow Management Program

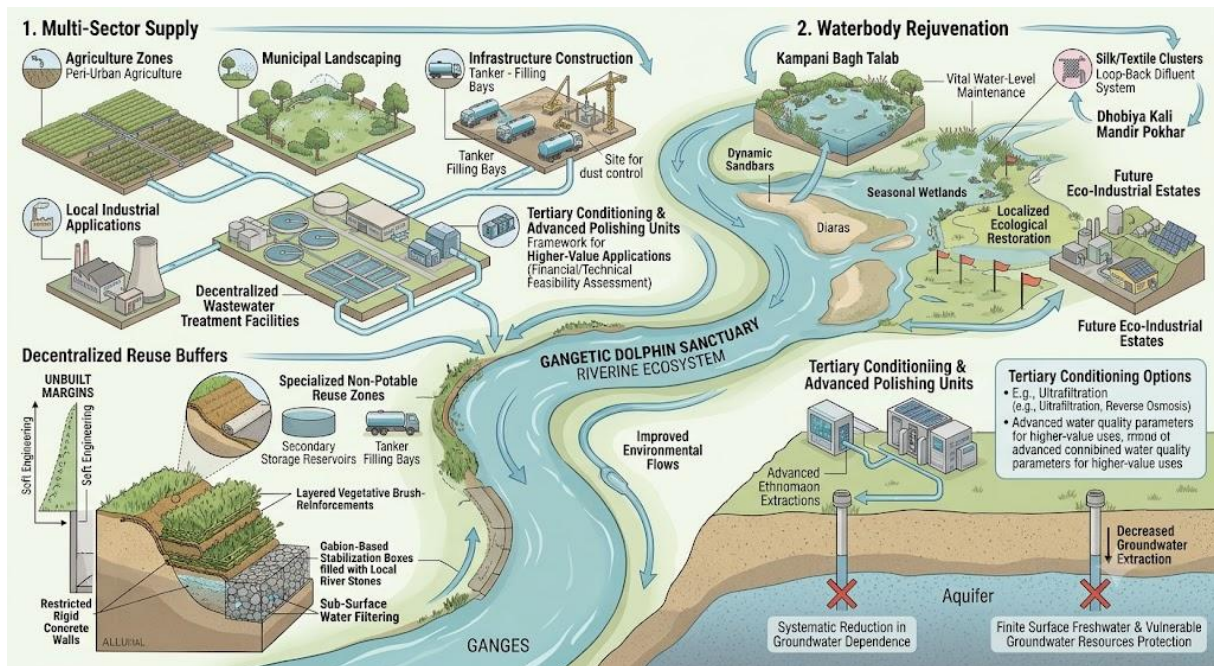
This comprehensive program integrates an Industrial Wastewater Management and Compliance Framework for the eco-estate. The strategy shifts Bhagalpur from a linear “abstract-use-discharge” model to a closed-loop circular water economy, significantly reducing urban pressure on the Ganga and Champa river systems.

1. Treated Wastewater Reuse System (Infrastructure & Channels)

To operate the macro-level vision, a multi-sector distribution network will be established to match treated effluent volumes with non-potable urban demands:

- **Multi-Sector Supply Networks:** Dedicated treated wastewater reuse networks will be developed to supply key urban sectors, including agriculture, municipal landscaping, infrastructure construction, and local industrial applications.
- **Targeted Industrial & Cluster Demand:** Loop-back distribution systems will promote reuse within peri-urban agriculture zones, the dense localized silk/textile clusters, and future Eco-Industrial Estate developments (such as the transformed Nathnagar cluster).
- **Waterbody Rejuvenation & Environmental Flows:** The system will route treated effluent directly to selected inland waterbodies specifically naming **Kampani Bagh Talab, Budhi Pokhar, and Dhobiya Kali Mandir Pokhar**: along with other suitable waterbodies. This targeted replenishment supports vital water-level maintenance, localized ecological restoration, and improved environmental flows within connected city basins.
- **Decentralized Reuse Buffers:** Specialized non-potable reuse zones, featuring secondary storage reservoirs and tanker filling bays, will be created around major wastewater treatment facilities.
- **Aquifer & Conservation Benefits:** By establishing these circular avenues, the city will systematically reduce its current heavy dependence on finite surface freshwater and vulnerable groundwater resources.
- **Tertiary Conditioning Options:** The framework will explore advanced tertiary treatment and polishing units, where financially and technically feasible, to elevate water quality parameters and enable higher-value reuse applications.





2. Industrial Wastewater Management and Compliance Framework for Eco-Estates

Industrial wastewater from the Nathnagar silk cluster and industries within the BIADA industrial area requires immediate, phased intervention to prevent untreated discharges from entering the Champa River and associated drainage networks. The implementation focuses on strengthening industrial compliance, pollution monitoring, and wastewater management through a phased approach driven by the following key activities:

- Industrial Waste Profiling & Inventory:** Establish a detailed baseline through industrial waste profiling and a comprehensive inventory of industries across Nathnagar and BIADA, explicitly documenting wastewater generation volumes, freshwater consumption metrics, and chemical discharge characteristics.
- Geospatial Mapping & Hotspot Tracking:** Execute the precise mapping of industrial discharge points, open connection drains, and localized pollution hotspots using advanced GIS-based monitoring systems linked directly to the citywide river-health reporting grid.
- Unit-Level Pre-Treatment Deployment:** Oversee the identification and structural implementation of unit-level pre-treatment measures directly at manufacturing sites, mandating on-unit settling tanks, physical filtration systems, and chemical neutralization units to mitigate aggressive pH and colloidal loads at the source.
- Enforcement & Regulatory Inspections:** Set up a rigorous field enforcement protocol featuring regular wastewater quality monitoring and unannounced compliance inspections conducted by the Bihar State Pollution Control Board (BSPCB).
- Long-Term Wastewater Planning:** Coordinate the preparation of a formal industrial wastewater management plan, incorporating a thorough assessment of cluster-level treatment options and outlining future infrastructure integration with the centralized CETP network.
- Co-Treatment Technical Evaluations:** Conduct detailed evaluations of co-treatment opportunities for pre-treated industrial wastewater within future municipal wastewater



treatment facilities, subject to strict technical feasibility modeling and formal regulatory approvals.

- **Ultimate Goal:** The intervention directly aims to reduce industrial pollutant loads entering the river system, establish a robust compliance framework, and create the solid planning foundation required for a long-term transition towards a dedicated Eco-Industrial Estate.

3. Reuse Governance & Monitoring Framework

To ensure institutional accountability, public safety, and environmental quality compliance, the program relies on the governance mandates:

- **City-Level Policy & Targets:** The Urban Local Body will develop a formal city-level wastewater reuse policy, establishing time-bound, mandatory reuse targets for institutional, commercial, and industrial consumers.
- **Quality & Stream Gauging:** Automated water-quality and environmental flow monitoring systems will be deployed at core nodes across the reclaimed distribution network.
- **Regulatory Inter-Agency Connectivity:** Terminal outfall monitoring arrays will be integrated with the online dashboards of the **Bihar State Pollution Control Board (BSPCB)** and the **National Mission for Clean Ganga (NMCG)** to prevent raw or sub-standard bypasses.
- **Compliance & Transparency Tracking:** Digital reporting and compliance mechanisms will track annual metrics, documenting actual reuse volumes against municipal water balances.
- **Standardized Operational Protocols:** The administration will prepare explicit Standard Operating Procedures (SOPs) to govern the safe transmission, quality control, and volumetric allocation of treated wastewater supplied to urban ponds, wetlands, municipal green spaces, and industrial user networks.

Intervention	Responsible Agency	Intervention type
Circular Water Reuse & Clean Return Flow Management Program	Bhagalpur Municipal Corporation (BMC) (O&M, SOP enforcement, and distribution) with technical support from BUIDCO and regulatory licensing from the BSPCB.	Policy
Estimated Budget	Potential Funding Sources	Timeline
N/A	NMCG policy component or AMRUT 2.0 city action plans	Medium Term (3-5 years)

4.7. Objective 7: Eco Friendly Riverfront Project

Rationale: Objective 7 – Eco-friendly riverfronts reconnect citizens with rivers while promoting recreation, culture, and sustainable tourism. Objective 7 encourages the development of people-centric spaces without compromising ecological integrity. The emphasis is on smaller, scalable interventions that improve aesthetics, enhance access, and stimulate local economies.



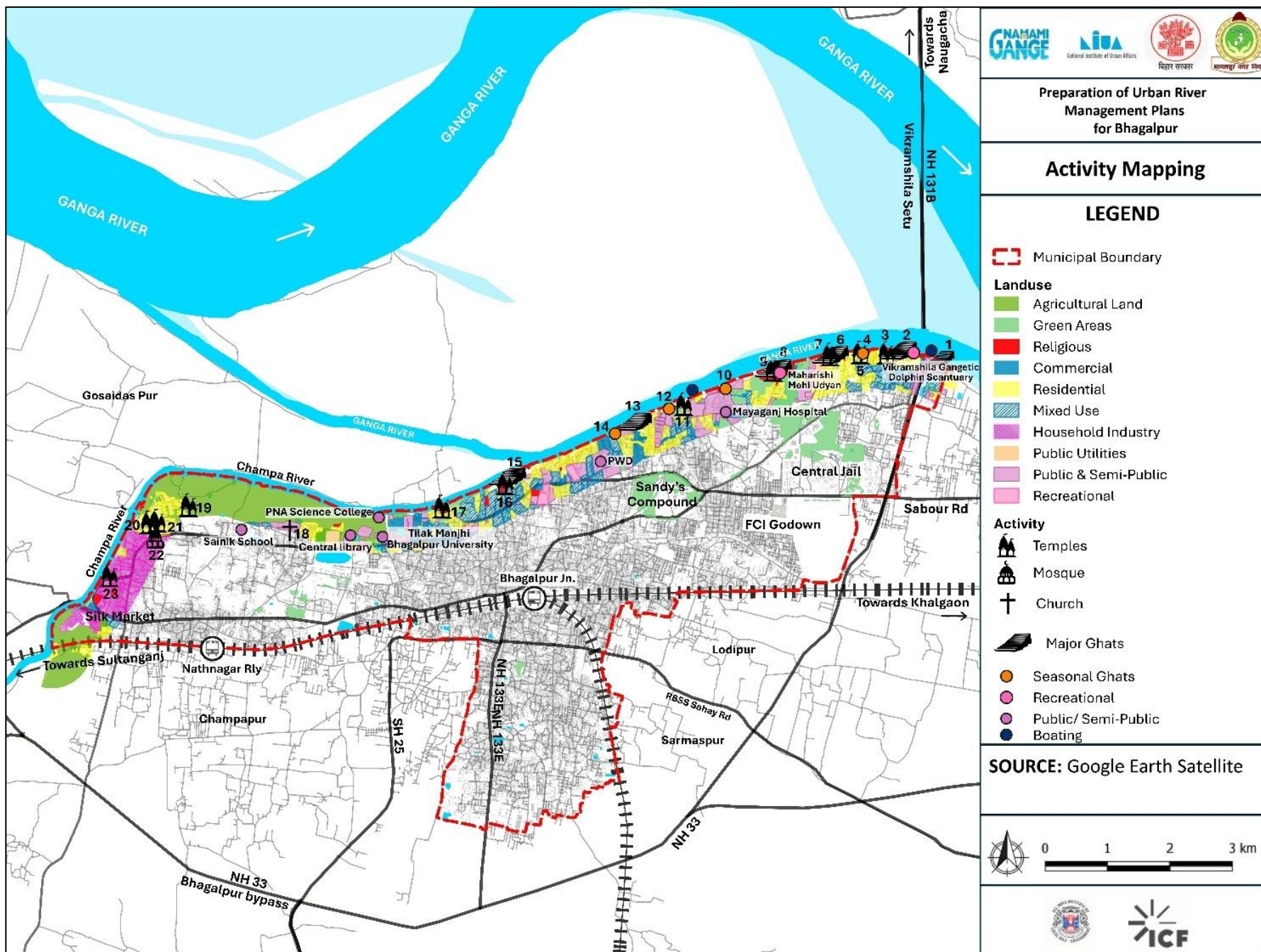
4.7.1. Existing Situation

Bhagalpur's riverfront extends approximately 14 km along the Ganga within municipal limits, anchored by a network of culturally significant ghats; Barari, Kuppa, Hanuman, and Koyla, that serve as focal points for daily ritual bathing, cremation, community gatherings, and major festivals such as Chhath and Ganga Dussehra. The Barari Ghat complex, associated with the Baba Budhanath (Adi Vishweshwar) Temple, constitutes the primary ceremonial hub, while Kuppa Ghat holds significance as a Santmat pilgrimage precinct linked to Maharshi Mehi Paramhans. Hanuman Ghat near Nathnagar supports local ritual life and seasonal fairs.

Beyond the ghats, the riverfront hosts a diversity of uses: informal boat landings, a traditional crematorium with limited infrastructure, institutional assets including the **Vikramshila Dolphin Sanctuary and the Dolphin Observatory**, and public open spaces such as Budhnath Park and Maharshi Mehi Ashram Park. The stretch falls entirely within the Vikramshila Gangetic Dolphin Sanctuary (VGDS) a nationally protected ecological corridor for the endangered Gangetic dolphin which places significant regulatory and ecological constraints on the nature and scale of permissible riverfront interventions.



Map 12 Activity Map

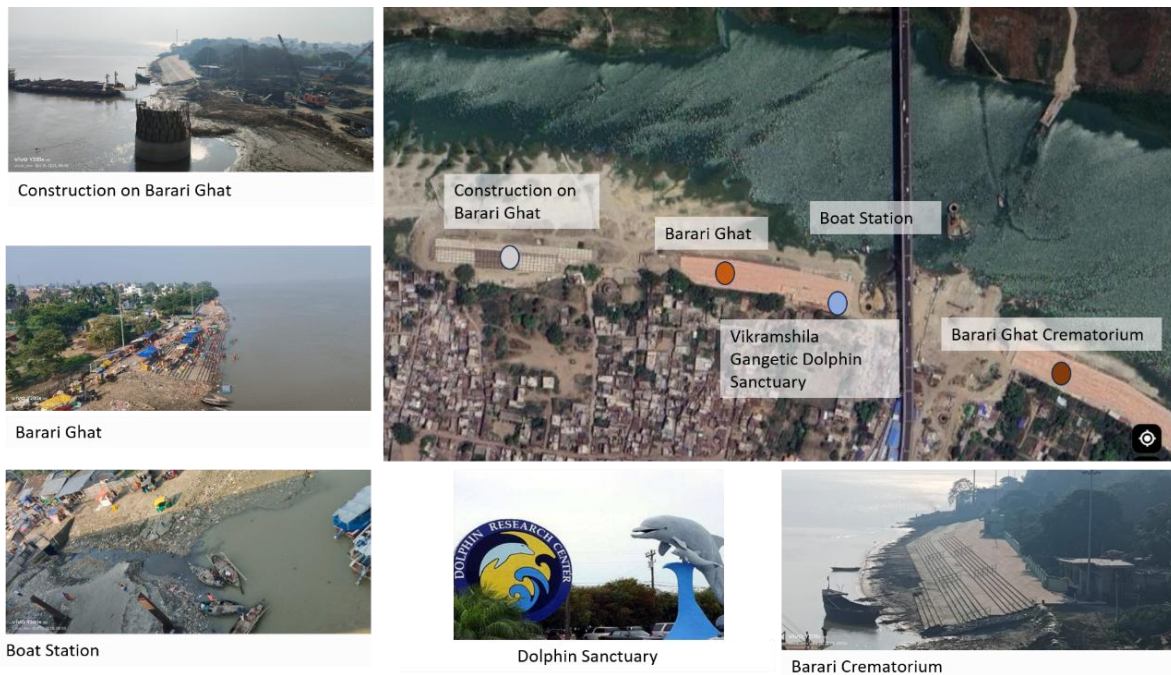


S.No	Name
1	Shamshan Ghat and Crematorium
2	Barari Ghat
3	Hanuman Mandir
4	Kothi Ghat
5	Kali Mandir
6	Hanuman Ghat
7	Shiv Mandir
8	Kuppa Ghat
9	Maharishi Mehi Ashram
10	Visarjan Ghat
11	Baba Bhuteshwar Temple
12	Khirmi Ghat
13	Seedhi Ghat
14	Koyla Ghat
15	Budhanath Ghat
16	Budhanath Temple
17	Dudhiya Mandir (Lord Shiv Temple)
18	Roman Catholic Cathedral Church
19	Shitla Sthan Mandir
20	Bhairav Mandir
21	Mahashay Deorhi Durga Mandir
22	Shahi Masjid
23	Jain Shwetambar Society

Figure 34 Activity Map of Barari Ghat



Figure 35 Activity map of Budhnath Temple stretch



Ongoing/Proposed Projects

The riverfront along the Ganga in Bhagalpur holds significant cultural and ritual value, anchored by ghats such as Barari, Kuppa Ghat, and Hanuman Ghat. In recent years, multiple improvements and infrastructure initiatives have been undertaken to enhance public access, pilgrimage amenities, environmental conditions, and overall riverfront experience. The following section summarises the key ongoing and proposed projects along this stretch.

- **Barari Ghat Beautification & Riverfront Improvement:** Upgradation works including stepped embankments, paved access, lighting, seating edges, and landscaping around Barari Ghat.¹¹
- **Barari to Hanuman Ghat Riverfront Corridor Proposal:** Proposed integrated riverfront walkway, with pedestrian pathways and river-view platforms to create a continuous public frontage along the Ganga.
- **Kuppa Ghat (Maharshi Mehi Ashram Area) Pilgrimage–Amenity Enhancements:** Improvements related to visitor movement, seating, river-edge access, and spiritual tourism facilities associated with Santmat pilgrims.
- **Hanuman Ghat Public Access & Ritual Infrastructure Strengthening:** Minor upgrades for bathing steps, seasonal fair arrangements, and local gathering areas.¹²
- **Crematorium Modernisation at Barari / Bhootnath Area:** Infrastructure modernisation initiatives for cleaner, organised ritual spaces, including movement, shelter, and service facilities.¹³

¹¹ **Times of India.** “Forest department stops Bhagalpur riverfront development work.” (1 June 2022).

¹² **Prabhat Khabar (Hindi).** Coverage of ongoing beautification and riverfront improvements at Barari and Hanuman Ghat. (2023–2024 editions).

¹³ **Bhagalpur Smart City Limited – Project Briefs & DPR Summaries** (Public presentations and municipal tender documents).



- **Pontoon Jetties Constructed in Bhagalpur District (IWAI):** Jetties at Sultanganj, Kahalgaon and Tintanga to support regulated boating and river-mobility services along the Ganga corridor.¹⁴
- **Sewage Pumping Stations & Interception Along Budhanath–Barari Stretch (Namami Gange / BUIDCO):** Works aimed at reducing direct wastewater discharge along the riverfront zone.¹⁵

Key Gaps

- No predominant use of natural or low-impact materials in riverfront development; existing works are concrete-heavy
- Absence of soft landscaping elements; existing parks such as Budhnath Park are in poor condition and require significant upgradation
- Solid waste management at ghats remains inadequate and inconsistent, with no designated ritual waste collection or composting systems
- Minimal ULB revenue generation from riverfront assets; parks and ghats are largely non-monetised
- Commercial activity at ghats is entirely informal — no formalised vendor zones, no regulated stalls
- Riverfront projects have limited visibility on tourism platforms; only the Vikramshila Dolphin Sanctuary features on government tourism listings
- Development at Barari Ghat has faced regulatory intervention due to potential impact on Gangetic dolphin habitat; no sanctuary-compliant riverfront masterplan in place
- No regulated boating framework — dolphin-spotting rides operate without standardised tariffs, safety protocols, or ecological safeguards
- Absence of sanitation infrastructure (bio-toilets, dedicated washing facilities) at most ghats
- No interpretive or eco-tourism programming linking cultural heritage with dolphin conservation

4.7.2. URMP Score

Objective 7: Eco friendly Riverfront project score

Since there are some mahor riverfront projects under Bhagalpur Municipal corporation's jurisdiction, seeing high footfalls but they are not being managed properly as per defined parameters,

Bhagalpur scores **32/100**, that translates to a score of **2**.

¹⁴ **Press Information Bureau (PIB).** "IWAI constructs pontoon jetties in Bhagalpur district (Sultanganj, Kahalgaon, Tintanga)." (25 July 2025 release).

¹⁵ Namami Gange Programme, Government of India. Sewage interception, diversion, and pumping station project status reports for Bhagalpur.



4.8. Objective 8: Leverage Economic Potential of the River

Objective 8 focuses on assessing and promoting sustainable river-linked economic activities while ensuring that interventions respect the carrying capacity of the ecosystem. It highlights the potential of rivers as economic assets that can drive inclusive urban growth.

4.8.1. Existing Situation

The Ganga in Bhagalpur represents a substantial but largely unrealised economic asset. The river flows along **the Vikramshila Gangetic Dolphin Sanctuary** one of the few protected habitats globally for the endangered Gangetic dolphin (*Platanista gangetica*) lending it rare ecological and tourism significance. The city's riverfront is marked by 12–14 functional ghats, including **Barari Ghat, Kuppa Ghat, Hanuman Ghat, and Seedhi Ghat**, which serve as daily centres for ritual bathing, cremation, and community life, and transform into major pilgrimage nodes during Chhath, Ganga Dussehra, and Makar Sankranti, drawing thousands of visitors.

Small-scale, river-dependent livelihoods exist across multiple sectors. Approximately 30–35 wooden country boats operate between Sultanganj, Barari, and Kahalgaon, serving river crossings, pilgrim movement, and informal dolphin-spotting rides during the winter tourist season. Around 70–80 vendors and kiosks along the ghats sell prasad, flowers, and seasonal goods, with earnings closely tied to festival cycles. A network of dharamshalas, ashrams, and low-cost riverfront lodges supports religious movement, particularly along the Sultanganj–Deoghar pilgrim corridor during Shraavan Mela. Agriculture and fisheries along the riverbanks further extend the Ganga's economic footprint. As per the URMP framework, Bhagalpur scores the maximum Economic Potential Score of 5, with active economic uses across navigation, fisheries, agriculture, religious-cultural tourism, and other verified activities.

Figure 36 River-Edge Activities in Bhagalpur: Seedhi Ghat, Temples, Inland Waterways and Ritual Ghats



Institutional and Governance Framework

Governance of river-based economic activity is distributed across multiple agencies the Nagar Nigam, Forest Department, Minor Irrigation Department, and Krishi Vibhag with broader coordination required from IWAI, the Fisheries and Tourism Departments, and NMCG. There are no formal state-level linkages in place, though Bihar's Tourism Policy and Fisheries Policy provide applicable frameworks.

Key Gaps

- No centralised ticketing system, visitor footfall tracking, or structured tourism management framework; revenue flows remain largely informal and unrecorded
- Boat operations unregulated no standardised tariffs, trained pilots, safety certification, or ecological safeguards for dolphin-watching activities
- No dedicated river economy cell at the ULB level; inter-agency coordination remains weak
- Absence of formal fisher cooperatives or cooperative structures for boat operators
- Weak enforcement of waste disposal norms along ghats, temple precincts, and fish landing sites
- No carrying capacity thresholds or visitor-load limits defined for the sanctuary or ghat areas
- Key sites such as Seedhi Ghat and Budhanath Ghat remain underutilised, lacking cohesive maintenance, landscaping, or interpretive infrastructure
- No linkage between river tourism and the city's heritage assets (Vikramshila ruins, Colganj rock-cut temples, Bhagalpur silk)
- Growing eco-tourism interest heritage walks, dolphin-watching, river cruises not yet supported by any regulatory or promotional framework

4.8.2. URMP Score

Objective 8: River Economy Score

Total river economy score is calculated by considering the number of economic uses that city utilizes the river for. As per URMP framework, **if the river has 5 economic use, then the score is 5**

4.8.3. Interventions

4.8.3.1. Intervention 6–1 Eco-Friendly Riverfront Development and Economic Leverage

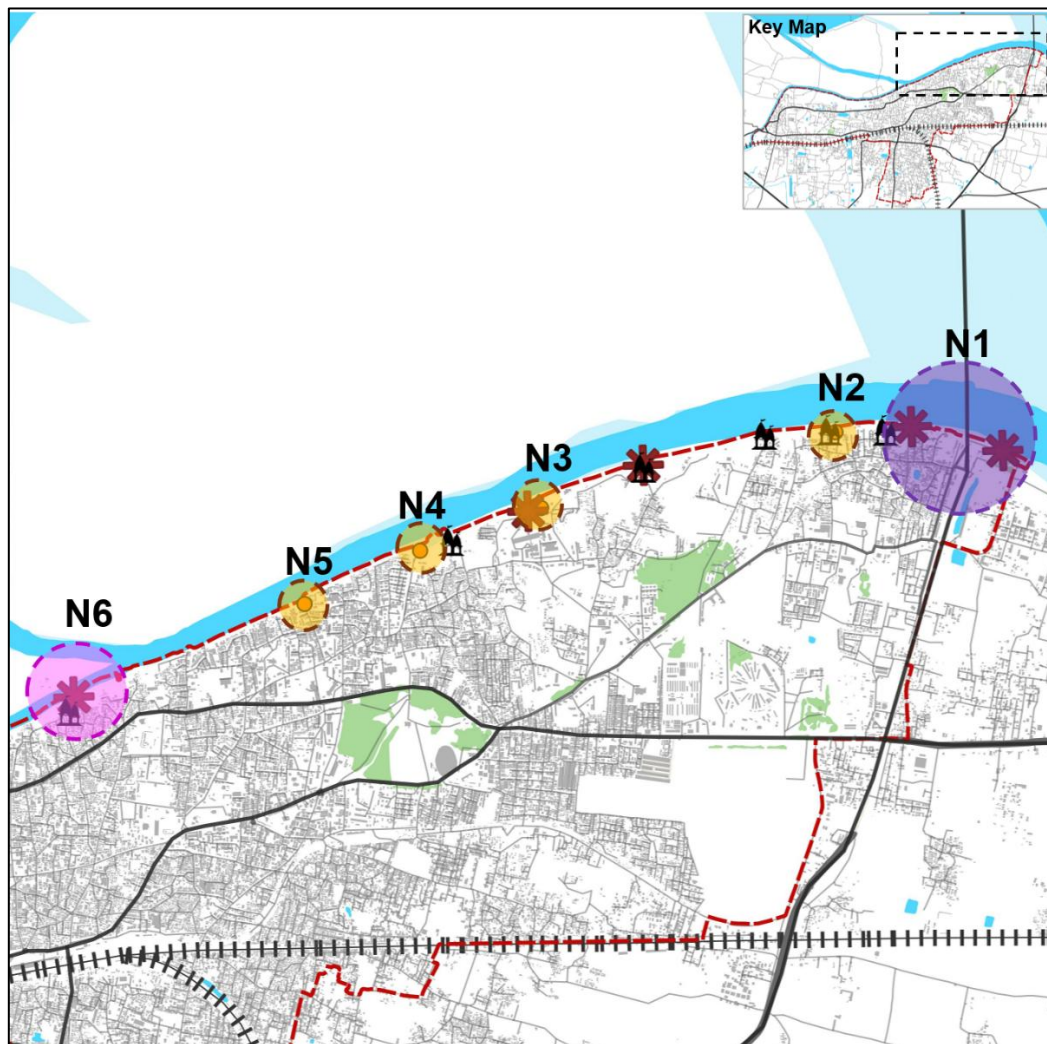
This comprehensive intervention outlines the master design for the Bhagalpur urban riverfront corridor. It integrates people-centric spaces with strict ecological zoning rules to safeguard the Vikramshila Gangetic Dolphin Sanctuary (VGDS) and optimize municipal return flows.

1. Strategy 1 Creation of Activity Nodes (Zonation and Regulations)

The strategy proposes the development of a series of thematic activity nodes along riverfront, each designed to celebrate the unique cultural, religious, and ecological significance of individual ghats while creating a cohesive and engaging public realm.



Map 13 Riverfront activity nodes



- **Node 1 (N1: Barari Ghat and Shamshan Ghat)** is planned as a *Religious and Biodiversity Node*, integrating spiritual activities with ecological restoration and nature-based experiences.
- **Nodes N2, N3, N4 and N5 (Kothi Ghat, Visarjan Ghat, Khirni Ghat, and Koyla Ghat)** are planned as *Seasonal Ritual or Softscape Ghats*, featuring landscaped spaces and flexible infrastructure that can accommodate periodic religious ceremonies, festivals and community gatherings while remaining active public spaces throughout the year.
- **Node N6 (Budhanath Ghat)** will function as a prominent *Religious Ghat*, strengthening its role as a spiritual destination through improved pilgrim amenities, congregation spaces, and enhanced visual connections to the river.

Together, these activity nodes aim to distribute visitor movement, enhance user experiences, preserve cultural traditions, and promote environmental stewardship along the riverfront corridor.

➤ **Node N1: Biodiversity & Core Ritual Node (*Barari Ghat and Shamshan Ghat*)**

This is a highly sensitive zone integrating community ritual heritage with strict wildlife protection protocols.



Figure 37 Node 1

- | | |
|---|-------------------------------------|
| 1- Cremation & Ritual Ghat | 4- Jetty for VGDS guided tours |
| 2- Constructed wetlands/ Riparian Buffer | 5- Ritual/ Festival Ghat |
| 3- Biodiversity Ghat (Vikramshila gangetic dolphin sanctuary) | 6- Continuous Pedestrian connection |



i. **Biodiversity Ghat (Vikramshila Gangetic Dolphin Sanctuary)**

- **Biodiversity focused riverfront space** designed to promote conservation, environmental education, and sustainable recreation while protecting the ecological integrity of the Vikramshila Gangetic Dolphin Sanctuary.
- **Low Impact boating** facilities featuring non-motorized wooden boats and low-speed motorboats to minimize disturbance to Gangetic dolphins and other aquatic biodiversity.
- **Temporary kiosks and interpretation centers** providing visitor information, biodiversity education, eco-tourism guidance, local handicraft sales, and awareness on dolphin conservation.
- **Constructed wetlands and riparian buffer systems** for stormwater and outfall treatment, riverbank stabilization, habitat enhancement, erosion control, and ecological restoration of the river edge.
- **Green-integrated riverfront infrastructure** incorporating permeable pathways, native plantations, shaded seating, biodiversity signage, ritual waste bins, and segregated waste collection systems to improve visitor experience while supporting sustainable riverfront management and pollution reduction.



Figure 38 Before and after of Biodiversity Ghat



ii. Boat Tour

- **Eco-tourism jetty** for regulated dolphin-viewing and river interpretation tours along the proposed **Barari Ghat → Shankarpur Diara → Barari Ghat** with controlled visitor access and wildlife friendly operating protocols.
- **Boat timings and frequency** to be regulated as per VGDSM guidelines to ensure minimal disturbance to aquatic biodiversity and dolphin habitats.
- **Low-impact boating operations** using non-motorized wooden boats and low-speed motorboats designed to reduce underwater noise and ecological disturbance.
- **Restricted operating hours:** Motorized boats shall operate only between 9:00 Am and 4:00 PM, avoiding periods critical for dolphin feeding and movement.
- **Weekly ecological rest day:** Tourist boating activities shall remain suspended for at least one day per week to provide a disturbance-free period for wildlife and support habitat conservation.
- **Speed regulations:** Boad speeds shall not exceed 5-6 km/hr upstream and 8-9 km/hr downstream to minimize wake generation, collision risks and disturbance to dolphins and other aquatic fauna.

iii. Ritual/Festive Ghat



- **Enhanced ritual bathing ghat** with improved access, shaded seating areas, and native plantation to reduce excessive hardscape and improve thermal comfort for pilgrims and visitors.
- **Dedicated ritual waste disposal infrastructure**, including floral waste bins and segregated waste collection systems, to prevent river pollution and support environmentally responsible religious practices.
- Biodiversity interpretation and informational signage highlighting the ecological significance of the Ganga, local biodiversity, and sustainable practices for visitors and pilgrims.
- Flexible temporary kiosks to support the sale of ritual materials, local handicrafts, refreshments, and visitor services, while accommodating seasonal festivals and peak pilgrimage periods.

iv. **Restrictions/Regulated activity:**

- **Regulated boating** only along designated eco-tourism routes approved by VGDSM
- **Restriction on high-speed motorboats**, loudspeakers, and noise-generating activities
- **No idol immersion, large-scale bathing**, washing, or polluting ritual activities.
- Construction of additional **hardscape ghats shall be prohibited** to minimize ecological disturbance and preserve the natural river edge.
- **Prohibition of dumping ritual waste**, plastics, sewage, and solid waste into the river
- **Controlled vending** through designated temporary kiosks and information centers only
- **Temporary kiosks** permitted only lightweight, removable structures using **eco-sensitive materials** such as bamboo, timber, cane, and tensile fabric.
- **Restriction on permanent commercial construction** and excessive hardscape development near riparian edges
- **Limited visitor access during sensitive breeding and migratory periods of aquatic fauna**
- **Prohibition** of fishing, sand mining, and **extractive activities**
- **Controlled lighting and sound levels** to minimize ecological disturbance.

➤ **Nodes N2, N3, N4 & N5: Seasonal Softscape Ritual Nodes (Kothi Ghat, Visarjan Ghat, Khirni Ghat, Koyla Ghat)**

These zones feature natural bank profiles that experience seasonal monsoon flooding. The intervention upgrades these spaces using lightweight, flexible infrastructure:

- **Removable Floating Platforms:** Deploys modular, floating pontoon steps designed for seasonal bathing and festival activities without breaking or modifying the earthen riverbanks.
- **Bamboo fenced immersion zones:** Temporary bamboo framing paired with sub-surface protective net catchments during major festivals (such as Chath Puja and Durga Puja). This design improves the user safety and catches flowers, clay, and debris before they can float into the main channel.
- **Integrated Waste Separation:** Provides color-coded twin bins directly at access heads to segregate biodegradable offerings from plastic ones.



Figure 39 Before and after for N2-N5



➤ **Node N6: Heritage and Religious Node (Budhnath Ghat)**

The development strategy for N6 shifts from heavy commercialization to preserve its traditional and ecological character through these direct activities:



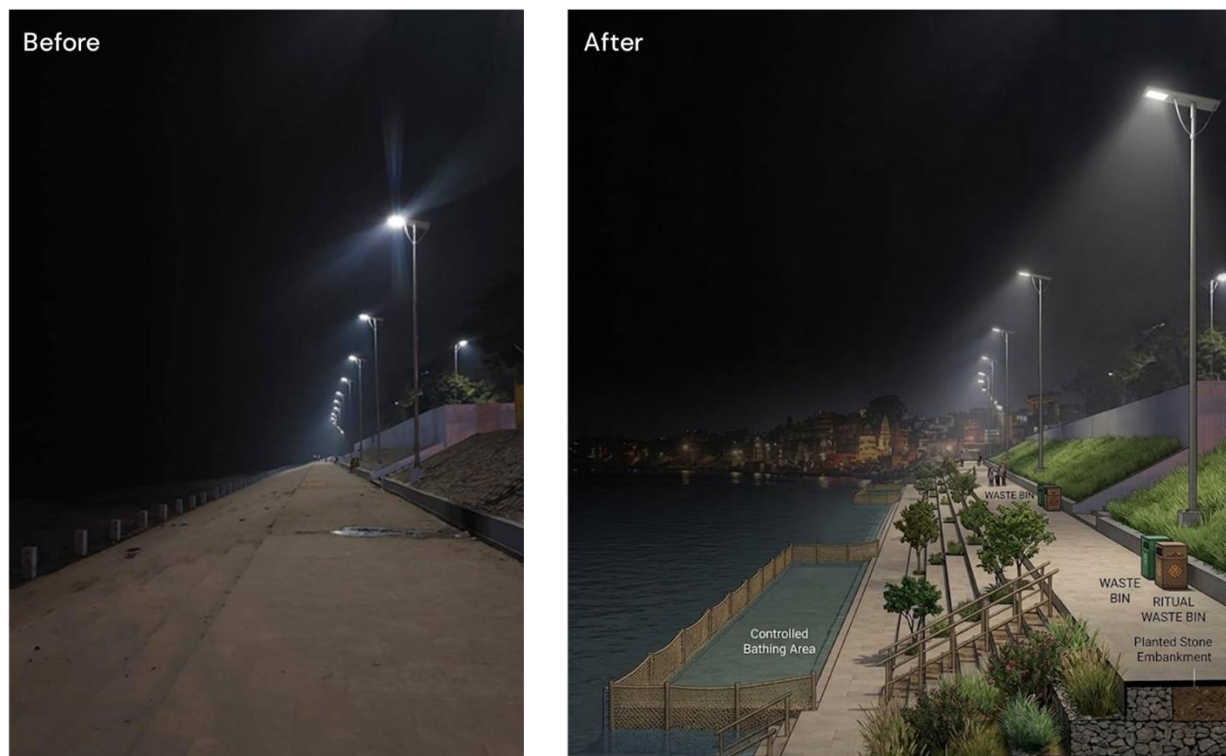
Figure 40 Zoning of Node 6



- **Retention of Religious Character:** Retain the traditional religious character of the ghat with minimal structural intervention and enforce a strict ban on any major hardscape expansions inside the active floodplain boundary.
- **Riparian Buffer Augmentation:** Enhance the existing riparian buffers and create natural shade zones using native plantations instead of building fixed concrete shelters.
- **Bioengineered Soil Stabilization:** Stabilize vulnerable river edges using soft bioengineering and vegetative measures, completely avoiding the use of rigid concrete embankments.
- **Controlled Activity Zoning:** Designate clearly defined, controlled zones for ritual bathing and seasonal religious events to reduce daily ecological disturbances on adjacent aquatic life.
- **Segregated Waste Infrastructure:** Install specialized, segregated ritual waste collection units to keep flowers, clay, and ceremonial materials from being dumped directly into the river channel.
- **Low-Impact Public Interfaces:** Introduce low-impact public amenities, prioritizing natural shaded seating, highly permeable walkways, and pedestrian-friendly access corridors.
- **Flood-Resilient Infrastructure:** Mandate the use of easily removable and flood-resilient interventions within all areas that experience seasonal inundation.
- **Floodplain Profile Preservation:** Focus all engineering efforts on preserving the natural floodplain profile and protecting the ecological character of the riverfront.



Figure 41 Before and after of Budhnath Ghat



2. Strategy 2: Edge Treatment & Outfall Remediation

• Edge Treatment Matrix

- Naturalized Edges: Uses native semi-aquatic grasses (*Saccharum spontaneum*), dense reeds, and riparian shrubs to naturally bind the shoreline soil.
- Terraced Floodplains: Links upper public paths to the river through wide, soft-sloped terraces. These terraces absorb fluctuating seasonal water levels without scouring the alluvial topsoil.
- Bioengineered Slopes: Stabilizes erodible alluvial banks using natural coir geotextiles paired with live vegetative stakes, creating a self-healing root structure over time. Hard masonry edges are used strictly at high-use ceremonial ghat steps (N1 and N6) to ensure safety during large public gatherings.



Figure 42 Edge Treatment



- **Treatment of Outfalls**

- **Constructed Wetlands:** Routes incoming stormwater through shallow constructed wetlands filled with *Typha latifolia* and *Phragmites karka* to absorb heavy nutrients through natural phytoremediation.
- **Mechanical Trash Booms:** Deploys floating trash traps and heavy-duty booms across outfall channels. This system captures plastics and solid trash before they can escape into the main river channel, reducing the direct pollution load.



Figure 43 Outfall Treatment



Intervention	Responsible Agency	Intervention type
Eco-Sensitive Riverfront Zonation, Bioengineered Edge Stabilization, and Outfall Phytoremediation Project	Water Resources Department (WRD) (Lead on edge treatments and floating structures), Bhagalpur Municipal Corporation (BMC) (O&M, solid waste management, and kiosk regulation), and Forest Dept / VGDSM (Sanctuary boundary enforcement).	Project
Estimated Budget	Potential Funding Sources	Timeline
INR 95,048,900	NMCG or AMRUT 2.0	3-5 years



4.9. Objective 9 & 10: River Sensitive Behaviour and Engage Citizen In River Management

Rationale: Objectives 9 and 10 collectively focus on cultivating river-sensitive behaviour and institutionalising citizen participation in river management. The focus is on building a shared culture of stewardship where citizens recognize the benefits of healthy rivers and their role in protecting them. Irresponsible waste disposal, overuse of water, and lack of awareness about river ecology all undermine formal efforts. Further, Objective 10 calls for citizens to become active participants in river management. Community groups, NGOs, and volunteers can be mobilized for monitoring, clean-up, and stewardship activities, which become critical for maintaining ecological assets in urban settings.

4.9.1. Existing Situation

Bhagalpur demonstrates a well-established culture of river stewardship, underpinned by its unique ecological identity as the "Dolphin Capital of India" and its association with the Vikramshila Gangetic Dolphin Sanctuary. Awareness and sensitisation efforts span multiple institutions and community groups.

The city has implemented sustained IEC (Information, Education & Communication) campaigns under the **Swachh Bharat Mission (Urban)** and **NMCG**, using culturally embedded formats street rallies, folk-music performances in local dialects, cycle awareness drives, and temple/ghat announcements to promote clean river practices. During high-footfall festivals such as Chhath and Ganga Dussehra, targeted messaging on waste segregation and plastic reduction is deployed, alongside dedicated flower-waste collection points at major ghats including Barari, Budhanath, and Kachahri.

The Ganga Prahari programme, coordinated by NMCG and WWF-India, has built a cadre of trained "river guardians" comprising fisherfolk, boat operators, college students, and river-dependent communities. The Vikramshila Biodiversity Research and Education Centre (VBREC) at T.M. Bhagalpur University anchors scientific orientation through citizen-science field walks and seasonal river ecology camps, embedding ecological awareness into everyday ghat and riverside practices.

Figure 44 Bhagalpur Migratory Bird Festival



Figure 45 IEC activity along Ganga River



Additional efforts include large-scale afforestation along riverbanks under the **Jal-Jeevan-Hariyali Mission** implemented through SHGs, youth eco-clubs, and the District Forest Department as well as dolphin-themed murals and signage at major ghats that reinforce emotional connection and ecological pride. Over 170 schools and colleges operate eco-clubs conducting river clean-ups, awareness rallies, and field visits to the sanctuary stretch, contributing to long-term behavioural shaping among the youth.

Key Gaps

- No dedicated IEC programme for river management; outreach remains embedded within broader urban sanitation schemes rather than standing independently
- No earmarked municipal budget for citizen sensitisation activities
- No dedicated river information portal or municipal webpage for public updates on river quality and events
- Eco-club programming limited to one-off activities; no structured annual calendar of river-focused engagement for schools
- No formal ward-level citizen committees or ghat stewardship bodies for structured community participation in river governance
- Citizen participation in river health monitoring is entirely absent; no participatory data mechanisms in place
- No verified CSR investment channelled into river awareness infrastructure
- City-level river days (Ganga Day, Dolphin Day) lack institutionalisation and consistent programming
- Citizen engagement score of 1 reflects that community involvement remains event-driven and informal, without integration into governance or management frameworks

4.9.2. URMP Score

Citizen sensitization Score (Objective 9):

Based on baseline assessment, site visits, and stakeholder consultations, Bhagalpur achieves an average level of citizen sensitization, with a points of 40 out of 100., translating to a score of 3.

Citizen Engagement Score (Objective 10):



Bhagalpur receives a low citizen engagement score of 1. Citizen engagement in Bhagalpur is currently low but holds significant potential for improvement. Formal integration of citizens into decision-making processes and committees is absent, limiting long-term ownership and accountability. Structured platforms such as digital reporting tools, participatory forums, and institutional partnerships can help bridge this gap.

4.9.3. Interventions

4.9.3.1. Intervention 9-1: Institutionalising and Scaling “Dolphin Mitra” Programme

Objective

To transform the Dolphin Mitra initiative from a localized volunteer effort into a structurally embedded, financially sustained, and technically robust community conservation cadre for river dolphin protection and aquatic ecosystem monitoring.

Key Components

Institutional Anchoring

- Formal notification/order integrating Dolphin Mitra under the State Forest/Wildlife Department or River Conservation Authority, with a defined organogram linking Mitras to Range Officers, Divisional Forest Officers, and District Ganga/River Committees.
- Creation of a dedicated Dolphin Mitra Cell at state level for coordination, data management, and grievance redressal.
- MoUs with Panchayati Raj Institutions, Urban Local Bodies, and River Basin Management Authorities to formalize the Mitras' role in local governance structures.

Recruitment and Cadre Structure

- Village/ghat-level selection of Mitras from fisherfolk communities, boatmen associations, riverside youth groups, and women's SHGs 4prioritizing local ecological knowledge.
- Tiered structure: Village-level Mitras → Cluster Coordinators → District Master Trainers, enabling career progression and peer mentoring.
- Minimum tenure and rotation policy to balance continuity with fresh participation.

Capacity Building and Certification

- Structured training curriculum covering dolphin biology and behavior, GPS-based sighting protocols, threat identification (gillnet entanglement, boat strikes, pollution indicators), first-response to strandings, and basic data recording.
- Partnership with WII (Wildlife Institute of India), WWF-India, or state biodiversity boards for technical training and certification.
- Refresher training annually; certification linked to incentive eligibility.

Monitoring and Technology Integration

- Standardized dolphin sighting/mortality reporting app or SMS-based tool with GPS tagging, photo upload, and offline sync capability.
- Centralized dashboard for real-time population trend analysis, hotspot mapping, and threat pattern identification.



- Integration with existing river health monitoring systems (e.g., National Mission for Clean Ganga's monitoring network).

Financial Sustainability and Incentives

- Honorarium/stipend structure (monthly or activity-based) sourced from CAMPA funds, CSR contributions, District Mineral Foundation funds, or dedicated river conservation cess.
- Performance-linked incentives for verified sightings, rescue participation, and reporting consistency.
- Livelihood diversification supports eco-tourism guiding certification, handicraft/homestay linkages to reduce dependency on honorarium alone.

Convergence and Partnerships

- Linkage with Fisheries Department to address bycatch and promote dolphin-safe fishing gear.
- Convergence with MGNREGA for riverbank restoration works implemented by Mitra-identified priority sites.
- Academic partnerships for research collaboration, giving Mitras co-authorship/acknowledgment in scientific outputs to build ownership.

Recognition and Visibility

- Annual "Dolphin Mitra Samman" awards at district/state level.
- Media features, documentary support, and inclusion in state biodiversity reports to build social prestige around the role.

Intervention	Responsible Agency	Intervention type
Institutionalizing and Scaling "Dolphin Mitra" Programme	Bhagalpur Nagar Nigam	Policy/ Program
Estimated Budget	Potential Funding Sources	Timeline
10-15Lakh ¹⁶	NMCG, Nagar Nigam, Dolphin Sanctuary development budget	1-2 years

4.9.3.2. Intervention 9-2: Community Awareness and Stewardship Programme for Aquatic Ecosystem Conservation

Objective

To build sustained community ownership over river health through structured, culturally rooted engagement rather than one-off awareness events.

Key Components

Segmented Audience Strategy

- **School and youth engagement:** River ecology modules in schools, "Junior Dolphin Mitra" clubs, riverside nature walks, and science-fair style project competitions.
- **Fisherfolk and boatmen:** Targeted sessions on sustainable fishing practices, safe navigation near dolphin pods, and gear modification support.

¹⁶ Can be used for ICF activities from the Dolphin Sanctuary development budget



- **Women's SHGs:** Linking ghat-based livelihoods (washing, water collection) with water quality awareness and household waste practices.
- **Religious and cultural institutions:** Engaging priests/pandas at ghats (rivers often have strong ritual significance) to integrate conservation messaging into existing religious gatherings and immersion practices.

Participatory Stewardship Models

- River Protection Committees (Nadi Suraksha Samitis) at village/ward level with defined roles, meeting schedules, and linkage to Gram Sabha.
- Adopt-a-Ghat or Adopt-a-Stretch schemes assigning specific river segments to schools, colleges, RWAs, or corporate CSR teams for monitoring and upkeep.
- Citizen science initiatives water quality testing kits, biodiversity logging to convert passive awareness into active data contribution.

Communication and IEC Strategy

- Multi-lingual, low-literacy-friendly IEC materials (wall art, folk theatre/nukkad natak, community radio) reflecting local dialect and river-specific cultural narratives.
- Seasonal messaging calendar aligned with festivals (Chhath, Ganga Dussehra, immersion periods) when river engagement peaks.
- Influencer/champion model respected local figures (retired teachers, panchayat heads) trained as community spokespersons.

Monitoring of Behavioral Outcomes

- Baseline and periodic KAP (Knowledge–Attitude–Practice) surveys to track shifts in community behavior, not just awareness recall.
- Feedback loop mechanism where community-reported issues (illegal fishing, dumping) trigger visible administrative action, reinforcing trust.

Intervention	Responsible Agency	Intervention type
Community Awareness and Stewardship Programme for Aquatic Ecosystem Conservation	VGDS & Bhagalpur Nagar Nigam	Program
Estimated Budget	Potential Funding Sources	Timeline
5–10 Lakh ¹⁷	NMCG	Short Term

4.9.3.3. Intervention 9–3: Citizen–Science Portal for Socio–Ecological Data Collection, Reporting, and Knowledge Sharing

Objective

To establish a digital platform that converts fragmented, on-ground observations (dolphin sightings, water quality, pollution incidents, fishing practices, community stewardship activity) into a systematic, verifiable, and publicly accessible knowledge base

Multi-Tier Data Contribution Architecture

¹⁷https://jjm.up.gov.in/Content/ngddashboard/pdf/Namami_G-12-09/Letter%20of%20approval%20Annual%20Plan%20UP%20C&PO%20UP%202023-24.pdf



- **Field-level tier:** Dolphin Mitras and trained volunteers submit structured data (GPS-tagged sightings, mortality, threats, water quality readings) via a mobile app with offline-sync capability for low-connectivity river stretches.
- **Public/citizen tier:** A simplified public-facing app/web interface allowing any citizen, tourist, or student to report a sighting, pollution incident, or waste dumping with photo and location — lower data rigor but wider reach.
- **Institutional tier:** Researchers, NGOs, and government departments upload verified survey data, water quality lab results, and population census data — providing the scientific backbone against which citizen data is cross-validated.

Data Categories Covered

- Dolphin sightings, strandings, and mortality records
- Water quality indicators (turbidity, BOD/COD where field-testable, visible pollution)
- Waste and dumping incident reports with geo-tags
- Fishing gear and bycatch observations
- River Protection Committee activity logs (clean-up drives, campaign reach, adoption of ghats)
- Socio-economic observations relevant to river dependency (livelihood shifts, ghat usage patterns)

Verification and Quality Control Workflow

- Tiered validation: automated flagging (implausible GPS/duplicate entries) → Cluster Coordinator review → District Master Trainer/expert sign-off for scientifically significant records (e.g., mortality, new hotspots).
- Photo/geo-tag mandatory for high-value reports to reduce false or unverifiable submissions.
- Gamified credibility scoring for repeat contributors to build a trusted-reporter tier over time.

Portal Features and Functionality

- **Interactive dashboard/map:** real-time and historical visualization of dolphin population trends, pollution hotspots, and campaign coverage — publicly viewable in aggregate, with sensitive location data (e.g., calving areas) access-restricted to prevent misuse.
- **Reporting-to-action linkage:** pollution/dumping reports auto-routed to the relevant Pollution Control Board or ULB with status tracking (reported → verified → action taken), closing the feedback loop that sustains community trust.
- **Knowledge repository:** open-access research papers, IEC materials, training modules, and success stories, searchable by region/theme.
- **Multi-lingual interface** with voice-input/SMS fallback options for low-literacy and low-connectivity users.

Integration with Existing Systems

- Direct data feed from the Dolphin Mitra reporting app (avoiding duplicate data entry).



- API-level linkage with National Mission for Clean Ganga's monitoring systems and State Biodiversity Board databases.
- Alignment with national citizen-science platforms (e.g., India Biodiversity Portal, eBird-style models) for cross-referencing and wider visibility.

Capacity Building for Portal Use

- Digital literacy training for Mitras and community volunteers on data entry, photo-tagging, and app navigation.
- School/college onboarding drives with credit-linked participation (eco-club project hours) to sustain youth engagement.
- Periodic "data sprints" — time-bound community challenges (e.g., monsoon water quality mapping) to boost contribution volume.

Governance, Privacy, and Data Ownership

- Clear data-use policy: community-contributed data attributed to contributors, with opt-in consent for public display of names/locations.
- Sensitive ecological data (dolphin breeding zones, rare sighting locations) access-tiered to prevent exploitation (e.g., poaching, disturbance tourism).
- Institutional custodian (Forest Department/designated research partner) responsible for data integrity, backup, and long-term archiving.

Sustainability and Scaling

- Open-source/low-cost tech stack to minimize maintenance costs; hosting supported through CSR/technical partner (e.g., academic institution or tech-for-good organization).
- Annual data-impact report published publicly to demonstrate value and sustain institutional and donor interest.
- Modular design allowing the portal to expand beyond dolphins to other aquatic species/river health parameters in future phases.

Intervention	Responsible Agency	Intervention type
Citizen-Science Portal for Socio-Ecological Data Collection, Reporting, and Knowledge Sharing	Vikram Shila Gangetic Dolphin Sanctuary, BMC	Project
Estimated Budget	Potential Funding Sources	Timeline
~ 10 lakhs	NMCG	Short Term



5 M&E Plan

5.4 Purpose and Rationale

The Monitoring and Evaluation (M&E) Plan for the URMP for Bhagalpur establishes a structured mechanism to track implementation progress, assess outcomes, and guide adaptive management across all URMP objectives. The plan aligns with the URMP framework issued by NMCG and NIUA and translates the framework's indicators into an actionable city-level monitoring system.

The URMP Index serves as the central evaluative tool, allowing Bhagalpur to assess its performance over time and benchmark progress against baseline conditions established under this study:

5.5 Monitoring Framework and Approach

Monitoring under URMP Bhagalpur follows a hybrid quantitative–qualitative approach, combining spatial analysis, infrastructure performance data, environmental monitoring, and institutional/process indicators.

Key principles guiding the M&E framework include:

- **Outcome-oriented monitoring**, focusing on improvements in river health and urban resilience rather than only asset creation;
- **Indicator-based assessment**, using standardized URMP indicators to ensure comparability;
- **Phased baseline development**, with initial baselines refined within the first six months of implementation; and
- **Adaptive governance**, enabling mid-course corrections based on monitoring results.

Monitoring will be undertaken at multiple temporal scales—monthly, annual, and multi-year—depending on the nature of the indicator.

Implementation progress under URMP Bhagalpur shall be monitored using the ten indicators prescribed in the URMP framework. These indicators collectively capture environmental, infrastructural, governance, and socio-economic dimensions of river management.

Table 4 :URMP Progress Monitoring indicator for URMP Bhagalpur

S. No.	Indicator	Basis of Assessment	Monitoring Frequency
1	Floodplain Management Score	Qualitative assessment of regulation, zoning, and enforcement in floodplains	Annual
2	Net Dissolved Oxygen (DO) Score	Difference in DO levels between upstream and downstream river stretches	Monthly
3	Waterbody Revival Score	Proportion of assessed waterbodies in acceptable ecological condition	Annual
4	Riparian Buffer Score	Length of riverbank protected by minimum-width vegetated buffers	Annual
5	Wastewater Reuse Score	Percentage of treated wastewater reused for non-potable purposes	Monthly
6	Return Flow Score	Quantity and quality of treated water returned to the river	NA



7	Eco-Friendly Riverfront Score	Qualitative assessment of social, ecological, and economic performance of riverfront projects	Annual
8	River Economy Score	Number and diversity of eco-friendly river-based economic activities	Annual
9	Citizen Sensitisation Score	Modalities and outreach mechanisms for river awareness	Annual
10	Citizen Engagement Score	Degree of community participation in river management activities	Annual

5.6 Baseline Development and Data Sources

For Bhagalpur, baseline values for most indicators have been established as part of the URMP Baseline Assessment (2025). However, select indicators, particularly those related to **return flows**, **reuse**, and **river economy outcomes**, will require refinement once key infrastructure (riverfront projects) becomes operational.

Primary data sources include:

- Water quality monitoring stations (DO, BOD, COD);
- GIS-based spatial datasets (floodplains, riparian buffers, waterbodies);
- Project progress reports from implementing agencies;
- Periodic field surveys and stakeholder consultations.

Satellite-based tools such as NDVI analysis will be used annually to track riparian vegetation health and detect degradation trends early.

5.7 Institutional Roles and Responsibilities

Effective monitoring requires clear institutional ownership. The following institutional arrangement is proposed:

- **Bhagalpur Nagar Nigam:** Nodal agency for overall M&E coordination, data consolidation, and reporting.
- **BUIDCO:** Providing technical support in provision of services for infrastructure projects
- **District Ganga Committee (DGC):** Oversight, inter-departmental coordination, and escalation of issues.
- **State Pollution Control Board (BSPCB):** Water quality monitoring and compliance verification.
- **Water Resources Department / PHED:** Data on flows, drainage, and treatment infrastructure.
- **Forest Department:** Monitoring of riparian buffers, plantations, and ecological assets.
- **Agriculture department:** monitor the quality of organic manure, compost produced by the city
- **Tourism and Fisheries Departments:** Tracking river-based economic activities.
- **Ward Committees and Community Groups:** Inputs for citizen engagement and sensitisation indicators-



5.8 Outcomes of the Monitoring and Evaluation Framework

The URMP Bhagalpur Monitoring and Evaluation Plan ensures that the city's transition from a pollutant discharger to a river steward is measurable, transparent, and accountable. By institutionalising regular tracking of environmental health, infrastructure performance, and socio-economic benefits, the framework enables Bhagalpur to:

- Systematically improve river health outcomes.
- Demonstrate compliance with national river management goals;
- Strengthen inter-agency coordination; and
- Build a replicable model for medium-sized river cities in Bihar and beyond.



6 Annexures

Annexure 1: Policies Governing Floodplains in Bhagalpur

National Policies and Judicial Orders

1. Model Bill for Flood Plain Zoning, Central Water Commission, 1975¹⁸: Proposed: proposed delineating the areas that are subject to flooding including classification of land with reference to relative risk of flood.
2. The National Green Tribunal (NGT) orders: Issued orders for demarcation and protection of floodplains, referencing standards such as the 1:100-year flood elevation plus contour buffers for accurate mapping and regulation. NGT has instructed Ganga basin states (including Bihar) to remove encroachments, regulate development, and ensure river rejuvenation. Some of important relevant orders are:
 - Order dated 13.07.2017 in the matter of O.A. No. 200 of 2014 – M C Mehta Vs Union of India : Established no-development zones (NDZs) within 100 meters of the river edge and prohibited waste dumping within 500 m of the Ganga and imposed environmental compensation. (note – NDZ provisions have not been notified for Bihar.)
 - Indian Council for Enviro-Legal Action vs NGRBA & Ors (2015): Mandated segment-wise rejuvenation of the Ganga (Bihar under Phase III/IV), with time-bound actions for drains, STPs, CETPs, and demarcation of floodplains.
3. Draft Notification for River Regulation Zones, Ministry of Environment, Forests and Climate Change (MOEF & CC), February 2016: intended to regulate developmental and industrial activities upto 5 kms from the banks of the river stretches having floodplains and an equivalent area for mountain/ hill stretches under three River Conservation Zones (RCZ) demarcated with reference to the Highest Flood Level (HFL) with a 100 year return period. Draft Notification for River Regulation Zones, Ministry of Environment, Forests and Climate Change (MOEF & CC), February 2016: Intended to regulate developmental and industrial activities up to 5 kms from the banks of the river stretches having floodplains and an equivalent area for mountain/ hill stretches under three River Conservation Zones (RCZ) demarcated with reference to the Highest Flood Level (HFL) with a 100 year return period. Further the river stretches and their tributaries are classified into three categories namely floodplain rivers, seasonal rivers and mountain rivers/hill streams.

Table 5: Defined flood plain zones , Draft Notification for River Regulation Zones, MOEF&CC, 2016

No	Demarcation	Zones	Flood frequency
1	RCA-PA	Prohibited Activity Zone – areas which are subjected to frequent flooding and are most vulnerable to adverse impacts of human activities.	up to 500 meters from the highest flood level in past 50 years

¹⁸ <https://www.ielrc.org/content/e7503.pdf>



		In case of the presence of embankments in the floodplain area, then this zone would extend from the riverbank to the present outermost embankment and further a 100m buffer is provided outside that embankment.	
2	RCA-RA I	Restricted Activity Zone – include the floodplain areas which are less frequently affected by the floods and lie farther from the river.	Outer limit of prohibited zone to 1 kilometre
3	RCA-RA II	Regulated Activity Zone – extends up to 3 km from the outer limits of the restricted activities zone. Certain activities will be permitted in this zone.	Outer limit of restricted zone to 3 kilometres

4. Technically guidelines on Flood plain zoning, Central Water Commission, Department of Water Resources, River Development & Ganga Rejuvenation, Ministry of Jal Shakti, July 2025¹⁹

- **Immediate** Restrictions: Until floodplain identification and demarcation are completed, no activity is permitted within 100 meters of the river edge, designated as a No-Development/Construction Zone. States and UTs may be given phased compliance, with exceptions permitted for essential infrastructure such as railway lines, bridges, and public utilities.
- Defining River's Edge: For enforcement purposes, the "river edge" may be determined by adopting either the maximum dry-season waterline or the maximum flood line recorded during the past five years

Table 6: Flood zones and prohibited activities, Technical Guidelines on flood plain zoning, Central water Commission, 2025

No	Demarcation	Flood frequency	Zones	Prohibited Activities
1	Protected Zone (both rural and urban areas)	Up to 1 in 5 years	Active flood zone and subjected to most frequent flooding.	i. All kinds of permanent construction including addition of floor area/elevation of any existing structure except Civil and Railways Infrastructures (Embankments/Bridges specifically for railway infrastructure with adequate safety measures, Flood/Bank protection works, but the construction of new embankments remain prohibited activity) ii. Any construction disturbing the natural course of the river channel except Essential Services and Infrastructure (gas/petroleum lines, power line transmission pylons, pipelines for water supply, bridges and barrages/construction of ghats, green-riverfronts, and jetties for navigation) and Temporary Structures (Defence establishments, disaster

¹⁹ https://nmcg.nic.in/writereaddata/fileupload/56_Tech%20Guidelines_Full.pdf



No	Demarcation	Flood frequency	Zones	Prohibited Activities
				management activities due to natural calamities, religious and socio-cultural activities, recreational activities not requiring the erection of any permanent structures) iii. Dumping of solid waste/creation of landfills iv. Storage of highly volatile, inflammable, explosive, toxic materials v. Establishment of large-scale commercial or industrial facilities except Sustainable Activities such as groundwater withdrawal by handpumps for non-commercial uses, traditional organic farming, traditional fisheries, grazing by animals and eco-friendly tourism and Permanent Utilities such as Parks, Playgrounds, Gardens, discharge of domestic wastewater after treatment.
2	Regulatory zone (both rural and urban areas)	Between 1 in 5 year and 1 in 25-year	Activities in this zone will be regulated. The severity of flood in this area will be lesser than that of the Protected zone	i) Residential settlement except Public Institutions, Government offices, Universities and Educational Institutions without residential facilities, public libraries, sewage treatment plants, community halls, subject to the condition that the Minimum plinth level of the building should be above the level corresponding to the 1 in 100 -year flood and subject to earthquake safety and the ground floors of such facilities can be utilized for non - residential purposes and controlled afforestation and conservation projects to enhance green cover without disrupting the natural flood flow of the river ii) Critical Defence Installations iii) Construction of basements
3	Warning Zone (only Urban areas)	Between 1 in 25 year and 1 in 100 year	Outermost zone in which most of the activities can be permitted by mapping their vulnerability so that that risk flooding hazards remain minimal	i) Hazardous Waste producing chemical industries except other industries, public utilities like hospitals, power installations, water supply, telephone exchanges, railway stations, airports, commercial centers, etc. subject to the condition that the minimum plinth levels of structures should correspond to 1 in 100-year flood. ii) Nuclear Plants

Note - Demarcation of floodplain corresponding to 100-year return period flood shall necessarily be done for both urban and rural areas



Governing policy–Governing policies / guidelines at State Level:

1. Notification on Flood plain zoning, Water Resource Department, Bihar (March 2025):

Given that the State is currently in the process of determining the High–flood line (red and blue lines) and flood plain zones, it has directed temporary provisions to demarcate flood plain zones with uses as “prohibited zone”. The current notification is Phase –1 and is applicable for cities with rivers having exiting embankment. Refer Annex 1 for the notification.

Defining “flood plain zones”:

- For rivers with existing embankment on both edges, the embankment will be considered as the flood line, and the area in between will be considered as flood plain zone
- For rivers having embankment only on one side of the river, the area from the embankment including the width of the river and 500 meters from the river edge of the other side, will be considered as flood plain zone
- Flood plain zones area earmarked as “Prohibited zone”

Table 7: Permissible activities in the Flood plain zone, WRD Bihar Notification, 2025

Demarcation	Permissible activities in the Prohibited Zone
Prohibited Zones– Flood plain zones	i. Traditional organic and natural farming, in which no type of agricultural chemicals or heavy machinery is used. ii. Parks, playgrounds, gardens, recreational activities, etc., in which no permanent structure is constructed/installed. iii. Traditional fish farming, in which no chemicals, toxic substances, explosives, or electricity connections are used. iv. Pasture for grazing animals. v. Extraction of groundwater from hand pumps for domestic and other non-commercial uses. vi. Construction of temporary/mobile structures related to defence after taking permission from the concerned competent authority. vii. Construction of structures related to flood protection. viii. Construction for essential services such as gas/petroleum pipelines, power line transmission towers, water supply pipelines, bridges, and barrages. ix. Construction of temporary/mobile structures and housing for special situations like natural calamities and disaster management. x. Discharge of domestic wastewater from cities or towns after treatment as per prescribed standards. xi. Religious and socio-cultural activities (such as Kumbh Mela, puja rituals, etc.) and their related purely temporary/movable structures, but only during the non-monsoon season. xii. Construction of temporary/movable jetties and riverfront. xiii. Eco-friendly tourism activities, which do not involve the construction of permanent structures and include nature-friendly practices such as the use of non-diesel motorboats. xiv. Construction of new railway infrastructure like embankments/bridges with adequate protection. xv. Plantation of local trees/shrubs for commercial use. xvi. Permission for Regulated Sand/ Stone/ sediment/ river borne material mining as per the guidelines of Ministry of Environment, Forest and Climate Change, Government of India and rules laid down by the State Government from time to time.



Demarcation	Permissible activities in the Prohibited Zone
	xvii. Essential repairs to buildings already constructed, but not including any expansion/new construction will be prohibited. xviii. Works related to STP, Conservation and NMCG. xix. Construction of completely temporary/mobile buildings, dwellings and structures which can be unfolded or moved in their original form, keeping in view the existing riverbank, except for a distance of 250 metres from the riverbank. <u>NOT PERMISSIBLE in Prohibited zone:</u> i) Any increase in the floor area or height of any existing structure of any kind. ii) Dumping of solid waste/creation of landfills. iii) storage of highly volatile, flammable, explosive, toxic substances. iv) Establishment of large-scale commercial or industrial facilities. v) Construction activities obstructing the natural course of the river channel, except those permitted.

1. **Bihar State Pollution Control Board (BSPCB) Directives:** regulate effluent discharge, sand mining, and solid waste in floodplain-adjacent wards, but enforcement capacity is thin in smaller cities like Buxar
2. **State Disaster Management Plan (2015, updated 2021):** Identifies flood-prone districts and stresses non-structural measures, but implementation remains limited.
3. **Draft Floodplain Zoning Considerations:** Bihar has initiated consultations for adopting a state-specific floodplain zoning act, but as of 2025, no legislation has been notified
4. **Jal Jeevan Hariyali Mission:** Bihar's flagship program for water conservation and climate resilience, focusing on the rejuvenation of water bodies, check dams, rainwater harvesting, afforestation, and sustainable farming.

Local Level Provisions

- Buxar lacks a fully notified Development Plan or floodplain zoning overlay. A masterplan is currently being drafted.
- The Nagar Parishad has supported embankment construction in certain stretches but has not developed bye-laws on permissible activities



Annexure 2: Common Native Species List

A. Grasses and Sedges (Suitable for frequently inundated zones; erosion control)

Agrotis Capillaris



Cyperus rotundus



B. Shrubs and Herbs (Suitable for moderately flooded zones; runoff filtration and biodiversity support)

Justicia procumbens



Phyllanthus amarus



Abutilon indicum



Boerhavia diffusa



Mimosa pudica



C. Trees (Suitable for higher floodplain edges; bank stabilisation and habitat)

Dalbergia sissoo



Azadirachta indica



Syzygium cumini



Ziziphus mauritiana



Mangifera indica



Using the iNaturalist (<https://www.inaturalist.org/>) website which is a global citizen science platform that allows users to record, identify, and share observations of plants, animals, fungi, and other organisms using photographs, sound recordings, and location data.

In the context of an Urban River Management Plan, iNaturalist can serve as a practical tool for building and updating ecological evidence at the river–corridor scale. Observations along the river and its floodplain can help document riparian vegetation, aquatic and semi-aquatic species, birds, insects, and invasive species, forming a baseline of urban river biodiversity that is often missing in conventional surveys. Spatial patterns from iNaturalist data can highlight ecologically sensitive stretches, degraded reaches, or biodiversity refuges that warrant protection or restoration. Over time, repeated observations can support monitoring of river health, assess outcomes of interventions such as riparian buffers or wetland restoration, and enable community participation



in stewardship, strengthening both ecological management and public ownership of the river system.



Black Necked Stork



Bar- Headed Goose



Ruddy Shelduck



Northern Pintail



Fish Eagle



Black Kite





Annexure 3: Stormwater Drainage System

Name of the drain	Flow (MLD)	BOD (mg/l)	Pollution Source (Domestic/ Industrial/ Mixed)	Catchment Area (Sq. Km)	Traceable Length of Drain (in Km)	Recipient
Adampur Drain	18.91	15	Domestic	Budhanath Park, Budhanath Baba Madir, Adampur	0.5	Ganga River
Hathiya Drain near the intake well	7.54	9	Domestic	Mustafapur, Hanuman Ghat, Sant Nagar, Mayaganj	0.5	Ganga River
Kuppa Ghat Drain	4.43	8	Domestic	Maharshi Mehi Ashram, Mustafapur, Mayaganj	0.6	Ganga River
Koyla Ghat	7.63	125	Domestic	Chhoti Khanjarpur, Koyla Ghat, Kachahari, Faris Lane Road, Ward No. 22, 25	0.5	Ganga River
Hathiya Nala, Near Tilkamnajhi University	22.66	145	Domestic	Tilka Manjhi University, Maharaj Ghat, Naya Bazaar, Parbatti Mohalla, Tatarpur, Vikramshila Mohalla, Urdu Bazar, Chunihari Tola	1	Ganga River
STP Drain Bhagalpur	1.77	130	Domestic	Sahebganj Mohalla	0.8	Ganga River
Sahebganj Mayabari Drain	4.51	32	Domestic	Karnagarh, Sahebganj	0.8	Ganga River
Champa Nala - 1	11.57	95	Domestic	Champa Nagar, Nath Nagar	0.5	Ganga River
Champa Nala - 2	8.38	42	Domestic	Nath Nagar, Medini Nagar	0.8	Ganga River



Annexure 4: SPCB River Water Quality Monitoring in Bhagalpur (2019–2024)

The Bihar State Pollution Control Board (SPCB) conducts systematic monitoring of river water quality in compliance with Central Pollution Control Board (CPCB) protocols. Water samples are collected monthly at designated stations and analysed for DO, BOD, COD, pH, and other physical, chemical, and biological parameters.

For Bhagalpur city, data from 2019–2024 were considered across three monitoring stations:

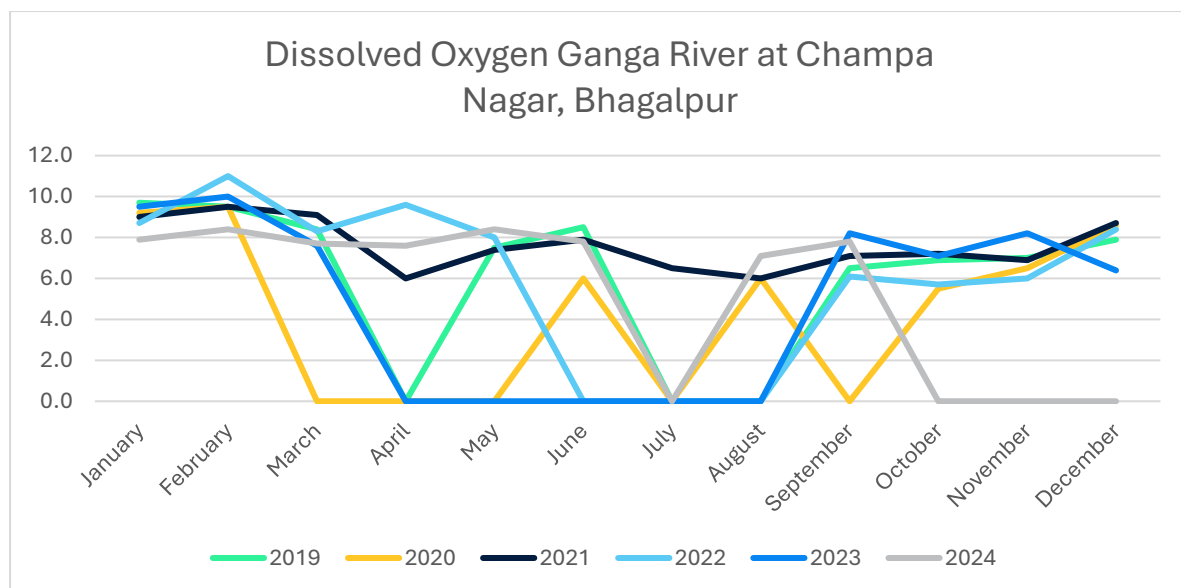
- Upstream at Barari Ghat
- Downstream at Ganga Bridge
- Champa Nagar, Bhagalpur

The State Pollution Control Board (SPCB) provides a robust longitudinal perspective based on five years of monthly water quality monitoring at these stations.

FINDINGS

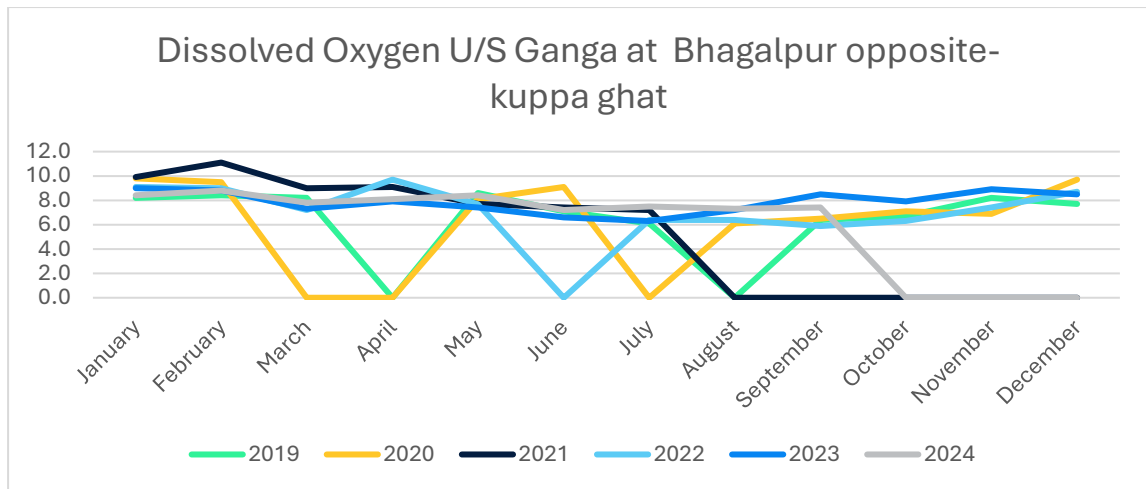
1. Dissolved Oxygen (DO)

- **Champa Nagar:** Across the observed years (2019–2024), DO levels at Champa Nagar show high seasonal fluctuation, with values remaining above 6–8 mg/L during winter months, but falling sharply during late summer and monsoon (May–September). In several years (particularly 2020, 2021 and 2024), DO values drop to 0–3 mg/L, indicating critical oxygen depletion. Such low DO conditions reflect heavy organic pollution load, likely driven by untreated sewage inflows, reduced river flow velocity during lean season, and high biological oxygen demand.



- **Upstream Kuppa Ghat:** At the upstream location near Kuppa Ghat, DO levels generally remain within the acceptable range (6–10 mg/L) during the cooler months (November–February), when dilution capacity and river flow are relatively higher. However, across multiple years (notably 2020, 2022, and 2024), DO levels decline sharply to critical low values (0–3 mg/L) during the late summer and monsoon period (April–September).





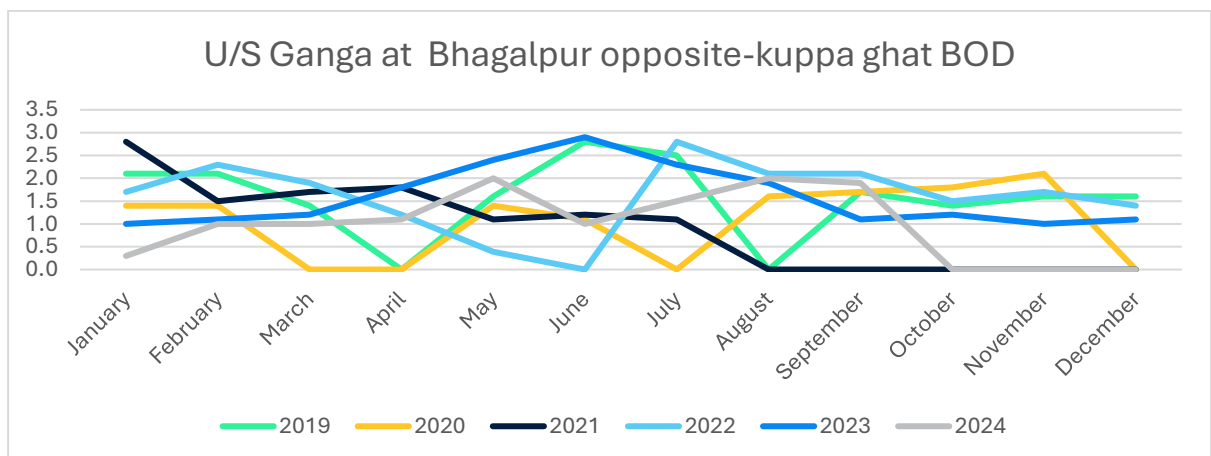
Key Observations

- Acceptable DO (>5 mg/L) is mostly observed from November to February.
- Severe depletion to near-anoxic levels (0–2 mg/L) is consistently observed during June–August (During Monsoon), indicating:
 - i. High wastewater discharge from Champa Nala and upstream drains
 - ii. Low dilution capacity of the river during lean flow
 - iii. Increased organic decomposition and algal activity

2. Biochemical Oxygen Demand (BOD)

- **Upstream at Kuppa Ghat:** Across the observed years, the upstream stretch opposite Kuppa Ghat generally remains **within this threshold**, with BOD levels typically ranging from **1.0–2.5 mg/L**, indicating comparatively better water quality than the core urban riverfront.

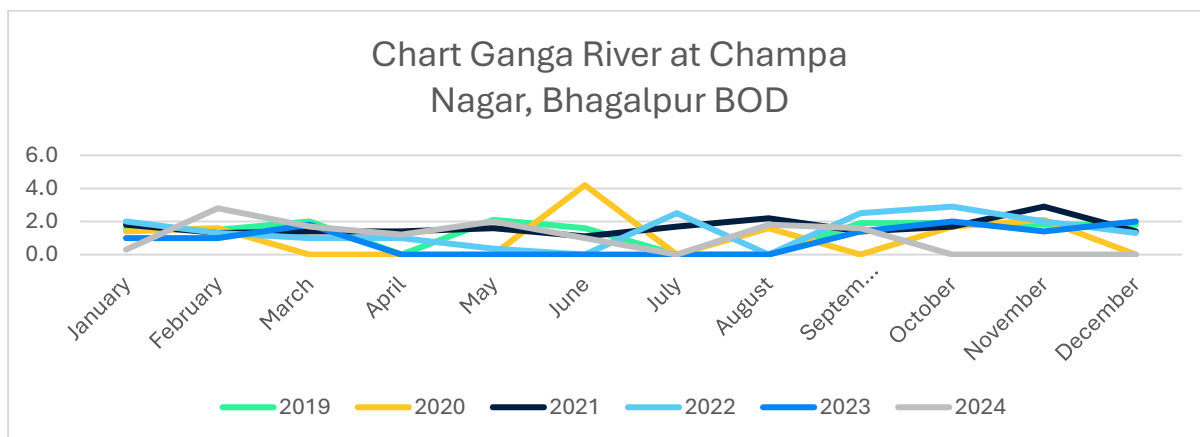
However, **seasonal peaks** are consistently observed, particularly during **June–August** and again during **September–November**. These periods coincide with both **monsoon conditions** and **major cultural and religious observances** such as *Ganga Dusshera*, *Pitru Paksh (pind-daan rituals)* and *Chhath Puja*. During these events, large numbers of people undertake ritual bathing, and offerings are placed directly in the river, which contributes to short-term increases in organic load. As a result, BOD levels during these months often **approach or marginally exceed 2.5–3.0 mg/L**.



- **Champa Nagar:** The **CPCB Class B (bathing quality) standard** requires **BOD ≤ 3 mg/L**. At Champa Nagar, BOD levels across the observed years (2019–2024) **generally fall**



within this acceptable range, typically between **1.0–2.5 mg/L** for most months. This suggests that, despite localised pollution sources, the river maintains **moderate assimilative capacity** at this stretch during much of the year. However, **short-term BOD elevations** are observed in **June–August** and again during **September–October** in some years, with peak values **approaching 3–4 mg/L**.



These episodic increases are further influenced by:

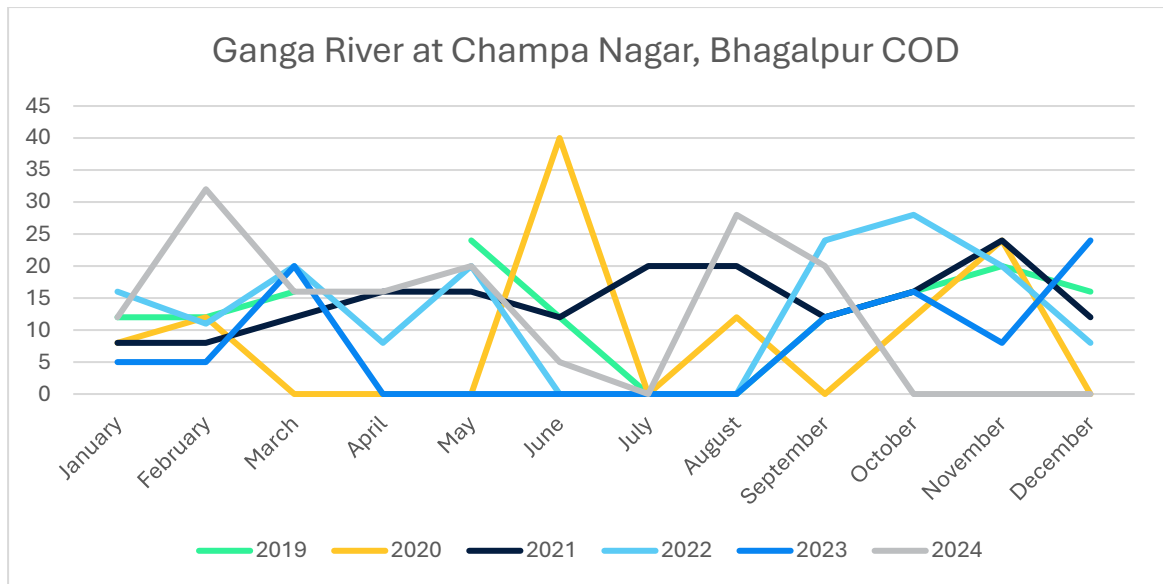
- **Monsoon-driven overflow from nearby drains**, especially **Champa Nala**, which carries untreated domestic wastewater.
- Stormwater–sewage mixing in unsegregated drainage networks, where rainfall events lead to sudden pulses of untreated wastewater, particularly near ghats that experience high footfall during festivals and ritual ceremonies.
- Reduced natural re-aeration and elevated biological oxygen demand during warm and humid months, when the river's self-purification ability is already low, intensified further by offerings such as flowers, food, and biodegradable religious materials placed directly in the river during Ganga Dusshera, Pitru Paksh, and Chhath Puja.

3. Chemical Oxygen Demand (COD)

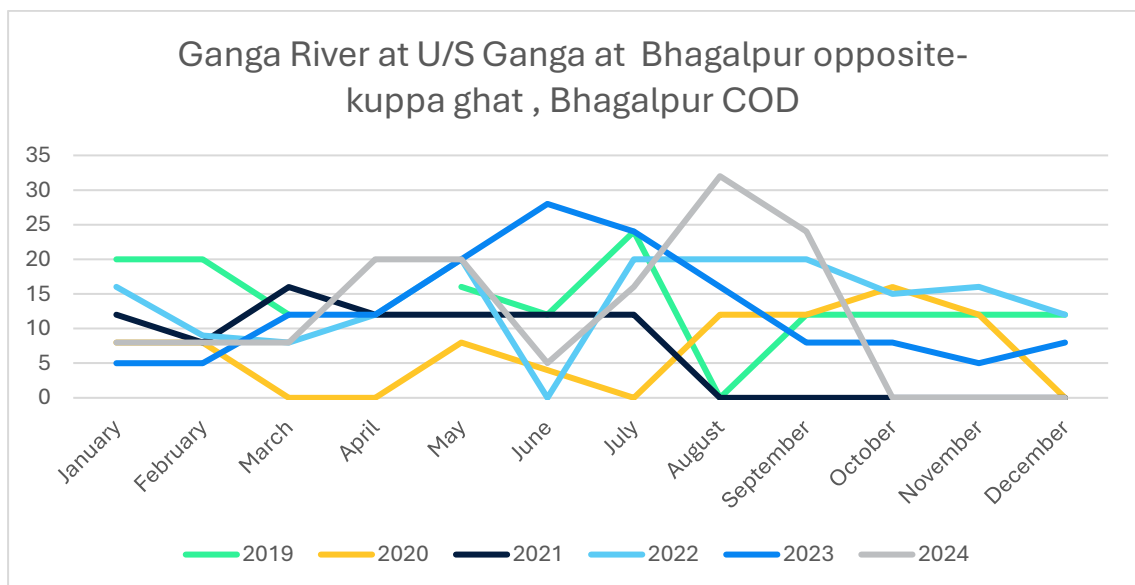
- **Champa Nagar:** The Chemical Oxygen Demand (COD) data at Champa Nagar show high variability across months and years, with several instances where values spike sharply, indicating periodic surges in organic and chemical pollutant loads. While moderate COD levels (10–20 mg/L) are observed during certain months, multiple years show elevated peaks exceeding 25–40 mg/L, particularly in June–August and occasionally during October–November.

There is no fixed CPCB numeric limit for COD in river water. Still, COD values above ~20 mg/L are generally indicative of significant pollution, especially where untreated sewage and organic waste inputs are present. The frequent peaks above this level at Champa Nagar, therefore, reflect a **substantial influence of wastewater discharge, consistent with its location near major drain outfalls**.





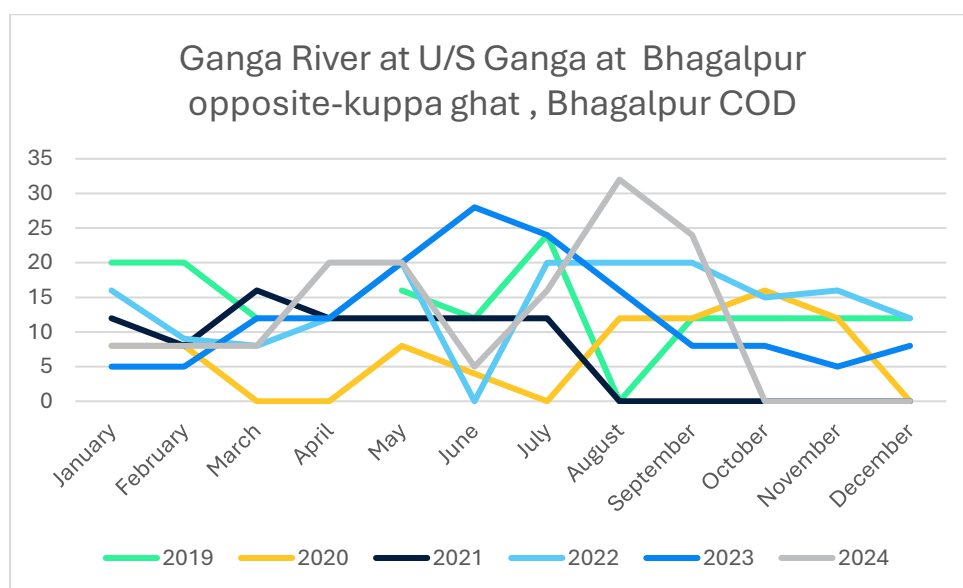
- Kuppa Ghat:** Although CPCB does not prescribe a fixed numerical standard for COD in river water, **values above ~20 mg/L are generally indicative of significant organic and chemical pollution**. At this upstream section, COD levels are **moderate (8–18 mg/L)** for most months, suggesting **better baseline water quality and dilution conditions** compared to more urbanised downstream stretches.



Key Interpretation

- High COD peaks point to high amounts of oxidizable organic and chemical pollutants**, aligning with the observed **low DO** and **high BOD** patterns during the same period.
- Pronounced peaks in **June–August** corresponds with:
 - Monsoon-driven drain overflow** and **sewage-stormwater mixing**.
 - Reduced dilution capacity of the river** during lean-flow periods.
- Seasonal increases during **October–November** coincide with **intensive ritual bathing and immersion activities** during **Pitru Paksh** and **Chhath**, where **floral offerings, food, ash, and biodegradable material** enter the river at higher rates.





Annexure 5: Water Body Inventory of Bhagalpur City

Table 8 :Water body inventory for Bhagalpur City

1. SI No	Water Body Name	Water Body Ownership	Water Body Nature	Water Body Spread Area	Water Body Max Depth	Current Use
1	CHAITI DURGA MANDIR	Other private body	Natural	0.2	4	NA
2	NIJI	Other private body	Natural	0.2	6	NA
3	KAMPANI BAG TALAB	Municipal authority	Natural	0.2	6	Pisciculture
4	BHUTNATH MANDIR KE PAS	Municipal authority	Natural	0	2	NA
5	ZOOLOGY DEPARTMENT KE PICHHE	Municipal authority	Natural	0	NA	NA
6	BIHAR RAJY JAL PARSHAD	Other private body	Natural	0	NA	NA
7	BIHAR RAJY JAL PARSHAD	Other Govt. Agency	Natural	0.2	6	NA



8	BHUTNATH MANDIR ROAD KE PAS	Other private body	Natural	0	5	NA
9	NIJI	Other private body	Natural	0.25	4	NA
10	BIHAR RAJY JAL PARSHAD	Other private body	Natural	2.69	4	NA
11	BIHAR RAJY JAL PARSHAD	Other private body	Natural	2.35	4	NA
12	BOTANY DEPARTMENT PICHHE KE	Other Govt.Agency	Natural	0	NA	NA
13	TNB STADIUM PICHHE KE	Municipal authority	Natural	0.22	6	NA
14	NIJI	Other private body	Natural	0.2	6	NA
15	NIJI	Other private body	Natural	0.2	6	NA
16	HIGH SCHOOL MIRJANHAT KE SAMNE	Municipal authority	Natural	0	2	NA
17	OLD PG OF BOTANY KE PICHHE	Municipal authority	Natural	0.25	5	Irrigation
18	ZOOLOGY DEPARTMENT PICHHE PG KE	Municipal authority	Natural	0.2	6	Irrigation
19	NIJI	Other private body	Natural	0.2	5	NA
20	SENDIS COMPOUN TALAB	Municipal authority	Natural	0.22	6	NA
21	NAYA THAKURBARI KE PICHHE	Municipal authority	Natural	0.2	2	NA
22	PURANI TALAB	Municipal authority	Natural	0.2	6	Pisciculture



23	MAHADEV TALAB	Municipal authority	Natural	0.23	6	Recreation
24	BHAIRWA TALAB	Municipal authority	Natural	0.23	6	NA
25	NIJI	Municipal authority	Natural	0.2	6	NA
26	CENTRAL LINBRARY KE PAS	Municipal authority	Natural	0.25	6	Pisciculture
27	LALBAG TALAB	Municipal authority	Natural	0	2	NA
28	DHOBIYA KALI MANDIR KE PICHE	Municipal authority	Natural	0.25	6	Pisciculture
29	KAWWALI ME LA MAIDAN TALAB	Municipal authority	Natural	0.2	6	NA



Annexure 7: Detailed BOQs

7.1 Cost Estimate – Champa River Restoration

S.No	Item	Unit	Quantity	Rate (INR)	Cost (INR)
	Selective De-siltation & evasive species removal	Lumpsum (Sqm)	2,50,000	400 ²⁰	100,000,000
	Riparian Buffer Plantation	meters	13,000	517	6,721,000
	Bioengineered River Edge Stabilization	meters	13,000	850 ²¹	11,050,000
	Reed Beds & Phytoremediation Zones	meters	6500	700 ²²	4,550,000
	Ecological Signage & Interpretation Panels	No.	20	35,000 ²³	700,000
	Waste Bins	No.	50	4,500 ²⁴	67,500
Zone 2					
	Silk Walk Development	meters	1080		
	Silk Interpretation Centre & Museum	Sqm	250		

7.2 Cost Estimates– Project Pokhar Rakshak: Silt Core Dredging and Native Bio-Fencing Initiative

	Item	Unit	Quantity	Rate (INR)	Cost (INR)
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²⁰ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf>

²¹ <https://bhel.com/sites/default/files/Revised%20SOR.pdf>

²² <https://www.cseindia.org/constructed-wetland-for-wastewater-treatment-at-indian-agriculture-research-institute-pusa-new-delhi-56>

²³ [https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English\(7June2024\).pdf](https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf)[4]

²⁴ Bihar BCD SOR 2024 street-furniture schedule reference + market rate for FRP/RCC dustbin units.



	1st Desilting and sediment removal (incl. disposal)	Lumpsum (Sqm)	1350	400 ²⁵	540,000
	Native Plantation	Lumpsum	30	517	15,510
	Ecological edge treatment and bank stabilization	meters	210	850 ²⁶	178,500
	Trash Booms	No.	1	15000 ²⁷	15000
	Total cost				INR 749010

7.3 Cost Estimates– Ecological Restoration of Central Library Pond, Ward 17

\	Item	Unit	Quantity	Rate (INR)	Cost (INR)
Path and Surrounding Areas					
	Low-height fencing / green hedge with entry gates	meters	274	350 ²⁸	95,900
	Stone/ Natural Path	meters	208	800 ²⁹	166,400
	Solar lights @ every 10m	No.	27	18,000 ³⁰	486000
	Benches @ every 25m	No.	11	20,000 ³¹	220,000
	Waste bins	No.	10	7000 ³²	70,000
	Signage, IEC boards & pond rules display	Lumpsum	1	35000 ³³	35000
	Native Plantation	Lumpsum	30	517	15,510

²⁵ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf>

²⁶ <https://bhel.com/sites/default/files/Revised%20SOR.pdf>

²⁷ <https://www.scribd.com/document/667044219/BCD-SOR-2023>

²⁸ <https://www.scribd.com/document/667044219/BCD-SOR-2023>

²⁹ <https://www.cspdcl.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf>

³⁰ [https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English\(7June2024\).pdf](https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf)

³¹ <https://www.tendertiger.co.in/global-keyword/chain-linked-fencing-tenders>

³² [https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English\(7June2024\).pdf](https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf)

³³ [https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English\(7June2024\).pdf](https://nregaplan.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf)



	Observation deck/viewing area	Sqm	137	4500 ³⁴	616,500
Water Spread Area					
	1st Desilting and sediment removal (incl. disposal)	Lumpsum (Sqm)	2700	400 ³⁵	1,080,000
	Removal of invasive aquatic vegetation (initial cycle)	Lumpsum (Sqm)	2700	70 ³⁶	189,000
	Ecological edge treatment and bank stabilization	meters	210	850 ³⁷	178,500
	Native riparian and aquatic plantation	Sqm	420	180	75,600
	Reed bed development	meters	210	700	147,000
	Floating treatment wetlands (FTWs)	No.	2	30,000 ³⁸	60,0000
	Floating aerators (solar/electric)	No.	1	90,000 ³⁹	90,000
	Total Annual CAPEX				4,065,410

7.4 Cost estimates– Eco-Sensitive Riverfront Zonation, Bioengineered Edge Stabilization, and Outfall Phytoremediation Project

S.No	Item	Unit	Quantity	Rate (INR)	Cost (INR)
Node 1– Religious & Biodiversity (Barari Ghat)					

³⁴ CPWD DSR 2023 — elevated timber/steel decking structure, composite rate per sqm.

³⁵ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compedium-by-CDD.pdf>

³⁶ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compedium-by-CDD.pdf>

³⁷ <https://bhel.com/sites/default/files/Revised%20SOR.pdf>

³⁸ <https://www.cspdcl.co.in/cseb/Files/SOR/SoR%20for%20FY%202024-25/Civil%20Wing%20Rates%202024-25.pdf>

³⁹ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compedium-by-CDD.pdf>



	Ghat Enhancement- Green integration	Sqm	1220	2,800 ⁴⁰	3,416,000
	Jetty for Dolphin Eco-Tours	No.	1	3,500,000 ⁴¹	3,500,000
	Interpretive Signage & Information Panels	No.	3	35,000	105,000
	Temporary Eco-Kiosks	No.	15	120,000	1,800,000
	Waste bins	No.	30	4,500 ⁴²	135,000
	Shaded Seating Areas	No.	15	35,000 ⁴³	525,000
	Ritual Waste Collection Infrastructure	No.	6	6,000 ⁴⁴	12,000
	Pedestrian Pathway Improvements	meters	527	3,200 ⁴⁵	1,686,400
	Constructed wetland/ Riparian Buffer	Lumpsum(Sqm)	536	1800 ⁴⁶	964,800
Node 2,3,4&5- Seasonal Ghat					
	Floating Ghat Platform	No.	4	120,000 ⁴⁷	480,000
	Bamboo Safety Barriers & Netting	Lumpsum (No.)	4	85000 ⁴⁸	340,000
	Ritual Waste Collection Units	No.	8	6,000	48,000

⁴⁰ CPWD DSR 2023 Ch.16 (Horticulture/Landscape) composite landscape-paving rate; Bihar BCD SOR 2024 CC paving items used as base and loaded for planter/edge works.

⁴¹ Market rate benchmarked against comparable Ganga floating-jetty works (IWAI/State riverfront projects, 2023-25).

⁴² Bihar BCD SOR 2024 street-furniture schedule reference + market rate for FRP/RCC dustbin units.

⁴³ CPWD DSR 2023 Ch.16 landscape furniture (pergola + RCC bench) composite rate; not separately listed in Bihar SOR.

⁴⁴ https://swachhbharatmission.ddws.gov.in/sites/default/files/Technical-Notes/Compendium-on-LWM-Technologies_3.pdf

⁴⁵ Bihar RCD SOR 2024, footpath/CC pathway items (per running metre for 2m width), Road Construction Department.

⁴⁶ . NMCG Namami Gange constructed-wetland cost norm for riverbank bio-filtration beds.

⁴⁷ <https://cddindia.org/wp-content/uploads/2019/04/WBR-compendium-by-CDD.pdf>

⁴⁸ Bihar Forest Dept bamboo-works rate



	Signage & wayfinding	No.	8	35000 ⁴⁹	280,000
Node 6– Religious Ghat (Budhanath Ghat)					
	Ghat Enhancement– Green integration	Sqm	480	2800	1,344,000
	Ritual Waste Collection Units	No.	3	6,000	18,000
	Park	Sqm	313	2200 ⁵⁰	688,600
Edge Treatment					
	Riparian Buffer Plantation	Lumpsum (Sqm)	14,650	180 ⁵¹	2,637,000
	Reed Beds & Native Grasses	meters	4,883	700 ⁵²	3,906,400
	Bioengineered Slopes (Coir + Vegetation)	Lumpsum (Sqm)	14,650	850 ⁵³	12,452,500
	Terraced Floodplain Treatment	Lumpsum (Sqm)	14,650		
Treatment of Outfalls					
	Constructed Wetlands	Lumpsum (Sqm)	2	30,000 ⁵⁴	60,000
	Phytoremediation Zones	Lumpsum (Sqm)	6	800 ⁵⁵	4,800
	Trash Booms	No.	12	15000 ⁵⁶	18,00,00

⁴⁹ [https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English\(7June2024\).pdf](https://nregaplus.nic.in/netnrega/writereaddata/Circulars/2477AMC2024-25%20English(7June2024).pdf)[4]

⁵⁰ CPWD DSR 2023 Ch.16 park–development composite rate (turf + walkway + planting); no single equivalent item in Bihar SOR.

⁵¹ Bihar Forest Department afforestation/riverbank plantation cost norm; CPWD DSR 2023 Horticulture chapter

⁵² <https://www.cseindia.org/constructed-wetland-for-wastewater-treatment-at-indian-agriculture-research->

⁵³ <https://bhel.com/sites/default/files/Revised%20SOR.pdf>

⁵⁴ <https://www.indiawaterportal.org/governance-and-policy/governance/islands-float-delhi-lake>

⁵⁵ NMCG/CPCB phytoremediation (rooted macrophyte) zone cost norm.

⁵⁶ <https://www.scribd.com/document/667044219/BCD-SOR-2023>



	Total Annual CAPEX				95,048,900
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7.5 Cost estimate- GIS based inventory for water body and assessment based on UWD tool

Item	Components	Amount (In INR)
	Capex cost:	
1	Water body mapping and creation of GIS based database (city map, with satellite imagery, secondary sources- WRD, Water census with specified attributes)	1,50,000
2	Primary- Water quality testing for ~12 water bodies in Chapra (primary) (for Uwd tool) - GPS tracker - DO meter - pH meter - Other water quality testing apparatus	1,20,000
3	Integration into the UWD tool**/ Central Dashboard for monitoring	2,00,000
4	Integration into a mobile app - SMS alerts to the nodal officer/ Collector if the water quality level drop	10,000
5	Integration with the Water quality dashboard and testing (intervention 5.2.3.1)	3,00,000
6	Installation of signages and boards at every water body	3,60,000
	Operational cost	
7	Agency fee (every quarter- 4 time a year)	8,00,000
8	Maintenance fee	5,00,000
9	Contingency/ Reserved fund	2,00,000
	TOTAL	26,40,000



There is a need for new thinking for 'River Cities'. 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 14th Dec 2019

**GNAMAMI
GANGE**

END OF REPORT

