INTEGRATED ACTION PLAN

FOR POLLUTION MITIGATION IN THE STORM WATER CHANNELS WITHIN THE CATCHMENT OF BOMMASANDRA - CHANDAPURA NINE LAKES SERIES

VOLUME - 02
ACTION PLAN

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INTEGRATED USED WATER MANAGEMENT PLAN –
FOR POLLUTION MITIGATION IN THE STORM WATER CHANNELS WITHIN THE CATCHMENT OF BOMMASANDRA-CHANDAPURA NINE LAKE SERIES – VOL 2

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VOLUME 2 – ACTION PLAN

CONTENTS

LIST OF FIGURES

Note: All photographs, maps, tables and infographics used in this document have been developed by CDD India unless otherwise credited.

LIST OF ABBREVIATIONS

AP	Action Plan
APA	Anekal Planning Authority
BAF	Bangalore Apartment Federation
BCC	Behaviour Change Communication
BIA	Bommasandra Industries Association/Area
BWSSB	Bangalore Water Supply and Sewerage Board
BMRCL	Bangalore Metro Rail Corporation Ltd.
BMRDA	Bengaluru Metropolitan Region Development Authority
CAPEX	Capital Expenditure
CETP	Common Effluent Treatment Plant
CPHEEO	Central Public Health and Environmental Engineering Organisation
CMC	City Municipal Council
CSO	Civil Society Organisation
CSR	Corporate Social Responsibility
ELCITA	Electronics City Industrial Township Authority
ELCIA	Electronics City Industrial Association
ETP	Effluent Treatment Plant
FC	Finance Commission
GP	Grama Panchayat
HH	Household
IEC	Information Education and Communication
JIA	Jigani Industries Association
KIADB	Karnataka Industrial Area Development Board
KSPCB	Karnataka state Pollution Control Board
KTCDA	Karnataka Tank Conservation and Development Authority
KUWSDB	Karnataka Urban Water Supply and Drainage Board
LB	Local bodies
LPCD	Litre per capita per day
LULC	Land Use Land Cover
LU	Land use
MLD	Million Litres per day
O&M	Operation and Maintenance
PG	Paying Guest Accommodations
RWA	Resident's Welfare Association
SBM	Swachh Bharat Mission
STP	Sewage Treatment Plant
SLB	Service Level Benchmarks
SWD	Storm Water Drainage Network
SWM	Solid Waste Management
TMC	Town Municipal Corporation
TP	Town Panchayat
UGD	Underground Drainage Network
ULB	Urban Local Body
VIA	Veerasandra Industrial Area
WASH	Water Sanitation and Hygiene
WTP	Water Treatment Plant
ZP	Zilla Panchayat

EXECUTIVE SUMMARY

This document constitutes the second volume of a two-part series focusing on the catchment area encompassing the nine-lake system located in the Electronic City–Hebbagodi–Bommasandra corridor. It has been prepared as part of an initiative led by CDD India, supported by the Wipro Foundation, and carried out between October 2024 and May 2025. The initiative was guided by two primary objectives: first, to investigate the characteristics and sources of pollution entering the stormwater channels that supply the region's lake systems; and second, to formulate a practical action plan for pollution mitigation.
A concurrent aim was to engage relevant stakeholders and encourage their participation in a collaborative platform committed to addressing pollution within the stormwater drainage network defined by the catchment's hydrological boundaries.

For this study, the catchment area under consideration encompasses a sequence of nine lakes—Shikaripalya, Maragondanahalli, Thirupalya, Veerasandra 1 and 2, Hebbagodi, Kammasandra 1 and 2, and Heelalige. This series represents one of four sub-catchments that ultimately feed into Chandapura Lake, which has been brought to the attention of the National Green Tribunal (NGT) due to its severe ecological deterioration.

Effective restoration of urban water bodies such as Chandapura Lake and its upstream lakes requires a catchment-level approach. In particular, this involves identifying pollution sources and addressing them at appropriate spatial and governance scales.

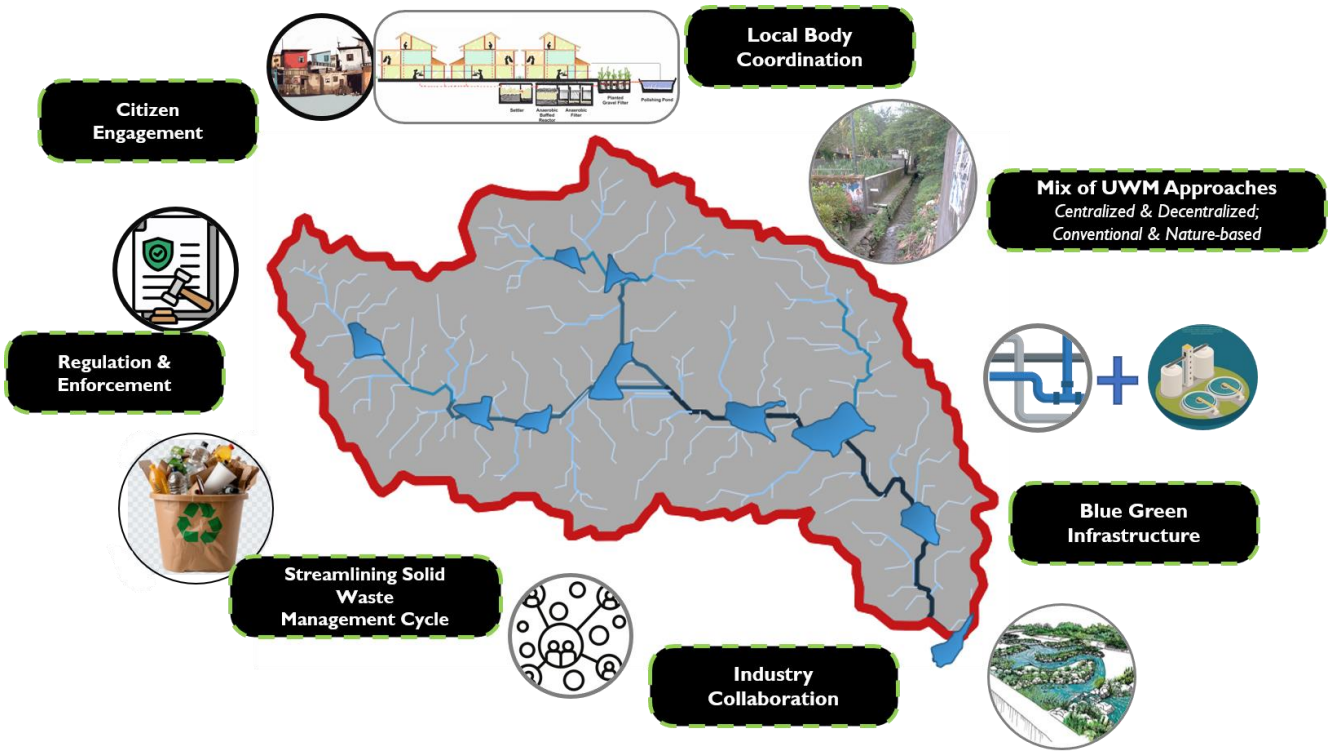
The first volume of this series presented a Situational Assessment of the catchment. It analysed existing land use patterns, identifies potential pollution sources, outlines relevant administrative jurisdictions, and examines how systemic issues manifest in the form of stormwater channel contamination, which eventually contaminate the lakes and groundwater resources. The degradation of the storm channels and disruption in flow pathways also heightens the risk of urban flooding.

This second volume presents a detailed Action Plan aimed at pollution abatement within the stormwater network. It is structured into six main sections as follows:

1) Salient Features of the Action Plan – outlines the geographical (hydrological) focus, main goal, and overarching framework of the Plan;
2) Visualizing the Action Plan around the Central Problem – articulates the core issue driving the intervention and presents the shared vision guiding the responses;
3) Root Causes Contributing to the Central Problem – identifies and categorizes the various direct and underlying causes which manifest into the central problem of stormwater and lake channel degradation;
4) Proposed Actions to Address Root Causes – details possible short-, medium-, and long-term interventions tailored to each identified root cause;
5) Planning for Used Water Management and Reuse – provides an overview of applicable water UWM & reuse strategies suited to the catchment's infrastructural and ecological context;
6) Priority Actions to Initiate Interventions – highlights a subset of high-impact actions intended to catalyse broader pollution mitigation efforts over varying timeframes.

The overarching purpose of this volume is to serve as a **shared reference document** for key stakeholders, including government agencies (across local, district, and state levels), civil society organisations, resident welfare associations, industrial bodies, and corporate social responsibility (CSR) entities. The report further outlines a set of prioritised interventions required to address what is

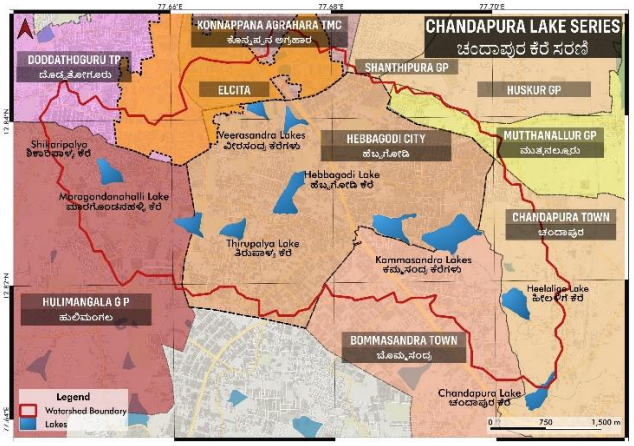
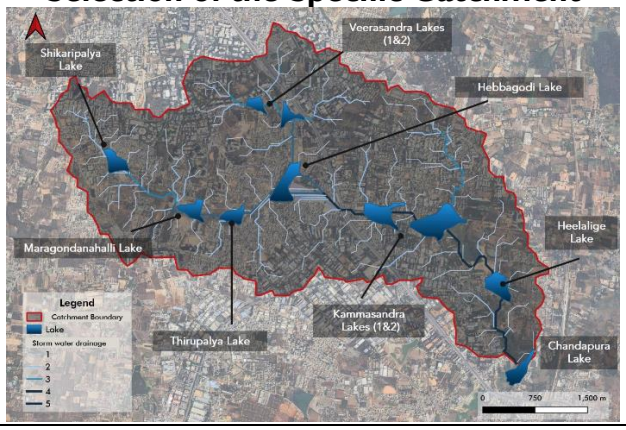
fundamentally a public environmental issue—the pollution and degradation of stormwater and lake-connecting channels. Left unaddressed, this degradation undermines regional water security by obstructing natural flow pathways, deteriorating water quality, and intensifying the risk of urban flooding.

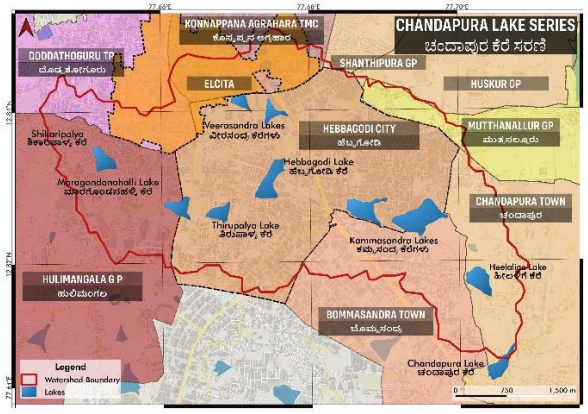


1 SALIENT FEATURES OF THE ACTION PLAN

This document is an attempt to develop a holistic strategy for used water management planning at the catchment scale of a lake series. In doing so, the Action Plan seeks to bring together multiple stakeholders, and engage them in short, medium and long-term actions which can improve the status of stormwater channels and recognise them as critical water resources.

The salient features of this Action Plan are as follows:

FEATURE	DESCRIPTION
Location Specific 	The Plan area is focused on a geographical boundary which is characterized by hydrology. In this case, referring to the **catchment** of a nine-lake series and comprises ~20 sq.km within Anekal region. The Action Plan is applicable to the particular catchment area.
Selection of the Specific Catchment 	The **selection of the specific catchment** is notable for two reasons – *(i)* it considers the catchment of not just one lake but an interconnected series of lakes; and *(ii)* it is an 'apex' or upstream-most catchment; implication being that it is more an "influencing" region than an "impacted" region within a larger river basin. To put it simply, positive changes here will have positive impacts downstream
Common Goal 	The Action Plan is bound together by **a single overarching purpose - improve the status of storm water channels (natural and human-made) by mitigating their pollution; and to establish them as important water resources in their own right.** This would involve a range of actions, direct and indirect, involving multiple stakeholders. In doing so, the Plan seeks to re-establish linkages between the interconnected channels through various actions and also reconnect the channels with their catchments

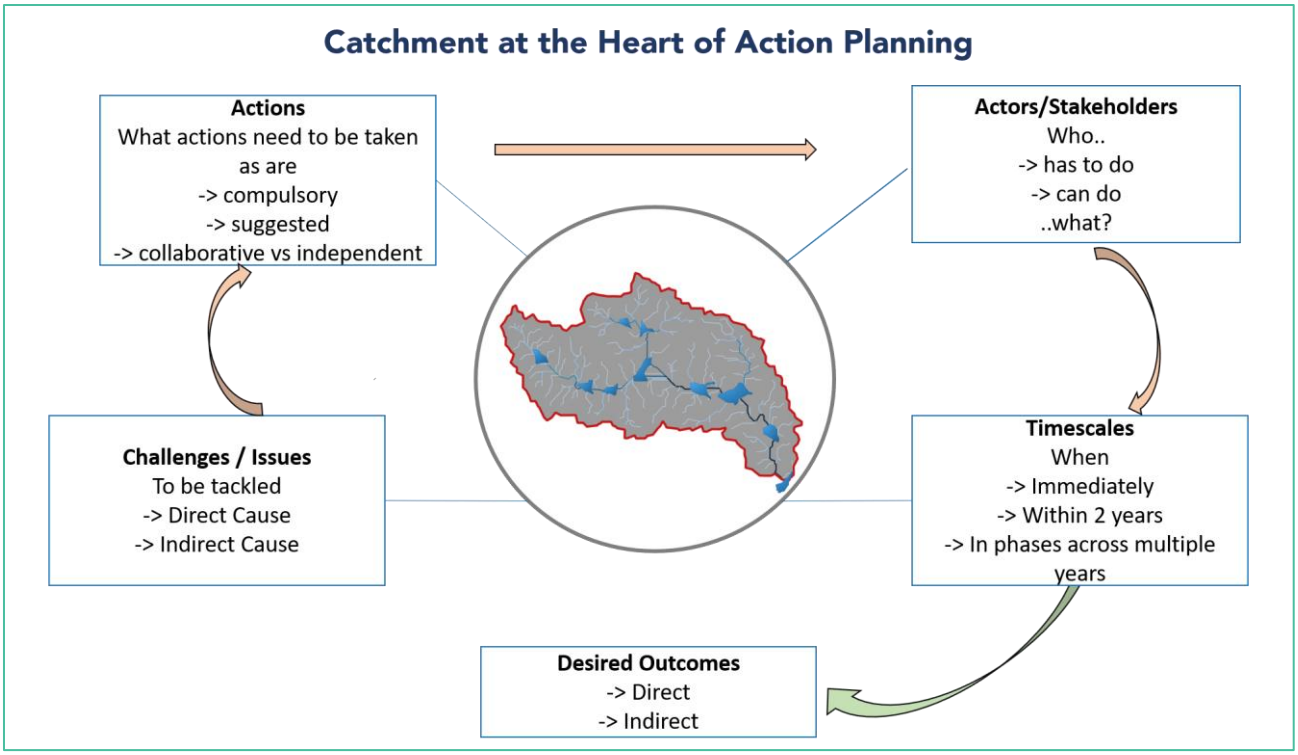
Uniting Local Body Action 	The catchment cuts across the jurisdiction of multiple local bodies (both urban and rural). The planning (or lack thereof) in body will affect the status of downstream drain channels in another. In turn, the impacts will affect larger water bodies (in this case, the network of lakes). The Plan targets these and other relevant stakeholders and seeks to unify their actions around the common objective
Water-resource centric WASH infra Planning 	The Plan envisions the improved delivery of WASH related infrastructure and services in the various local bodies. While this can be seen as a component of urban planning, in this case, the planning boundaries are defined not by municipal or panchayat jurisdictions but rather by placing the interconnected water resource system (lake network and their connecting channels) at the centre of such planning.
Pathways, Actors, Timescales 	The Action Plan triggers multiple courses of action, by multiple stakeholders across short, medium and long terms. These courses of action are likely also to be across different sectors. Equally, the role of the Plan is also to act as a unifying anchor for these actions, so that they are directed in a way that meets the common objective.

2 VIZUALIZING THE PLAN AROUND THE CENTRAL PROBLEM

The continued discharge of untreated used water into stormwater channels poses a significant threat to water security and requires urgent remediation. This persisting issue, however, is symptomatic of several underlying systemic causes. Among the most critical is the lack of city-scale planning for used water management, a gap that characterises many rapidly urbanising areas across India.

Anekal, located in the south-eastern periphery of Bengaluru, exemplifies this challenge. Rapid urban expansion in the region has not been matched by corresponding investments in basic water, sanitation, and hygiene (WASH) infrastructure and services. As a result, the stormwater channels—many of which serve as inflow paths for regional lakes—have deteriorated severely.

Figure 1 Conceptual Visualization of the Action Plan



This Action Plan therefore is formulated with one overarching purpose in mind – how to mitigate pollution in the storm water channels within the catchment. In doing so, how also to restore (or re-imagine) them as important water resources in their own right.
By setting a hydrological boundary for this purpose, (i.e. the 20 sq.km catchment of nine lakes), holistic set of actions can be visualised for the entire drainage network.

To achieve this overarching goal, multiple actors need to act at different scales across sectors. This is because (as stated above) the issues facing storm water channels manifests through different ways.

At first glance, the pollution of stormwater channels appears to be a "technical problem" that demands technical solutions—primarily, the implementation of appropriate used water treatment systems. However, the effective deployment of these solutions on the ground is contingent upon the existence of an enabling environment. The creation of such an environment depends on the coordinated functioning of administrative, regulatory, institutional, social, and policy mechanisms, alongside the active engagement of relevant stakeholders in managing diverse and often competing interests.

2.1 THE VISION OF AN INTEGRATED ACTION PLAN

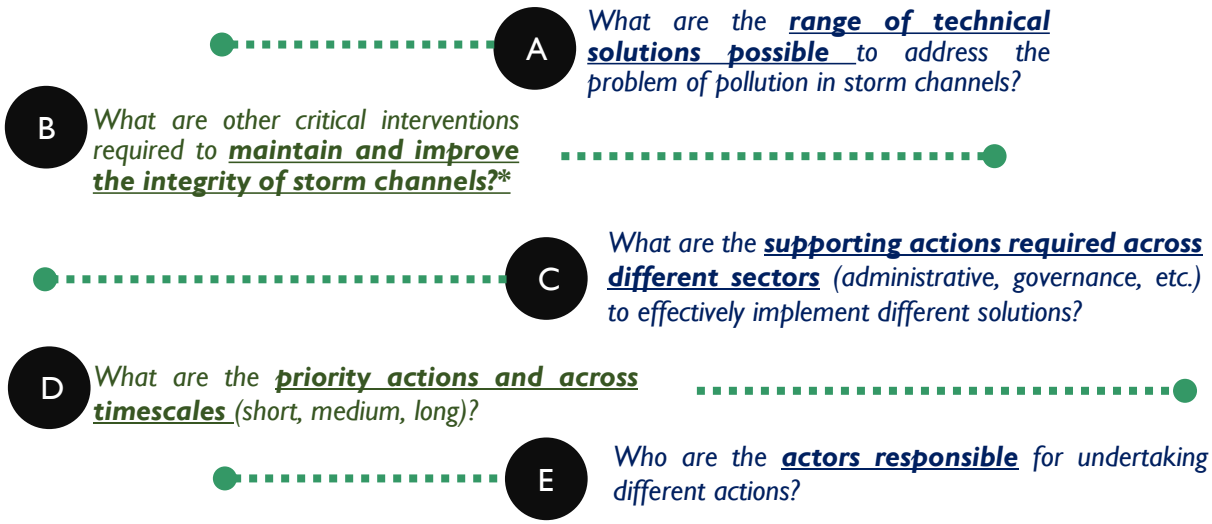
The common vision for the Action Plan is to restore stormwater channels and lake interconnecting channels as vital components of the regional water system, recognising them as valuable water resources, and not to be treated as receptacles of solid and liquid waste.

Between the Real & the Ideal, what is the Possible?

2.2 WHAT THIS ACTION PLAN AIMS TO UNPACK?

This Action Plan therefore seeks to unpack the following:

Figure 2 Questions Addressed by the Action Plan



**Interventions to restore their functions (in flood mitigation and contribution of rainfall runoff flows to lake systems) and to establish them as important water resources in their own right.*

To reiterate, all these actions and actors are situated in a particular context – the ~20 sq.km of catchment – of the 9-lake series in Bommasandra Chandapura region.

3 ROOT CAUSES MANIFESTING INTO THE CENTRAL PROBLEM

In the Bommasandra-Chandapura catchment, the degradation of the stormwater channels and interconnecting lake channels is most visible in three ways:

a. Untreated Used Water from various human activities in the catchment is ending up in the channels due to absence of separate and complete UGD network connected to treatment plant,
b. Solid Waste dumping in and burning along the channels, further deteriorating water quality and blocking flow paths,
c. Structural deterioration of storm channels – by encroachment, diversion of flow paths (often causing narrowing of channels) etc.

As a result of the above three, storm networks and *raja kaluves* are seen as receptacles of waste and not as pathways for water which is integral to the water security of the region.

This section represents what are the various root causes which contribute to the central problem of polluted storm channels in the Bommasandra-Chandapura catchment.

The following are the prominent causes for untreated used water culminating in storm channels: -

- **Increase in sources & types of used water generation**
  - Exponential population increase → following establishment of Electronic City and Bommasandra-Jigani-Veerasandra industrial areas → Leading to mushrooming growth of new types of settlements – from high-rise builder's complexes to independent multi-storey dwellings to converted layouts
  - Establishment of Industries & Coming Up of Commercial Establishments (in particular, paying guest accommodations) → Increase in quantity and quality of untreated used water in open environment
- **Haphazard sewer network ending in the channels**
  - Incomplete networks created during erstwhile rural government era → Not connected to a treatment system, meaning that end points for incomplete UGD networks are storm channels/raja kaluves
- **Lack of recognition to integrity of channels/kaluves** themselves (*the implication being that there is no importance being accorded to the channels as water resources in their own right*)
  - Flow pathways not being preserved during urban built up → forces change in pathways, instead of preserving the channel and maintaining buffer on either side.
    Private layouts, individual plots and government actions all equally responsible for this cause.
  - Encroachment of drains; general misconception of function as channels for used water as opposed to stormwater/connection between lakes
- **Existing infrastructure and services inadequate and inadequately utilized**
  - Existing treatment infrastructure (public and private) are not sufficient to meet used water generation demand
  - Private treatment infrastructure which could reduce the load of pollution not adequately maintained – cost of maintenance
  - Unwillingness to pay for treatment services despite existence of infrastructure – cost of treatment

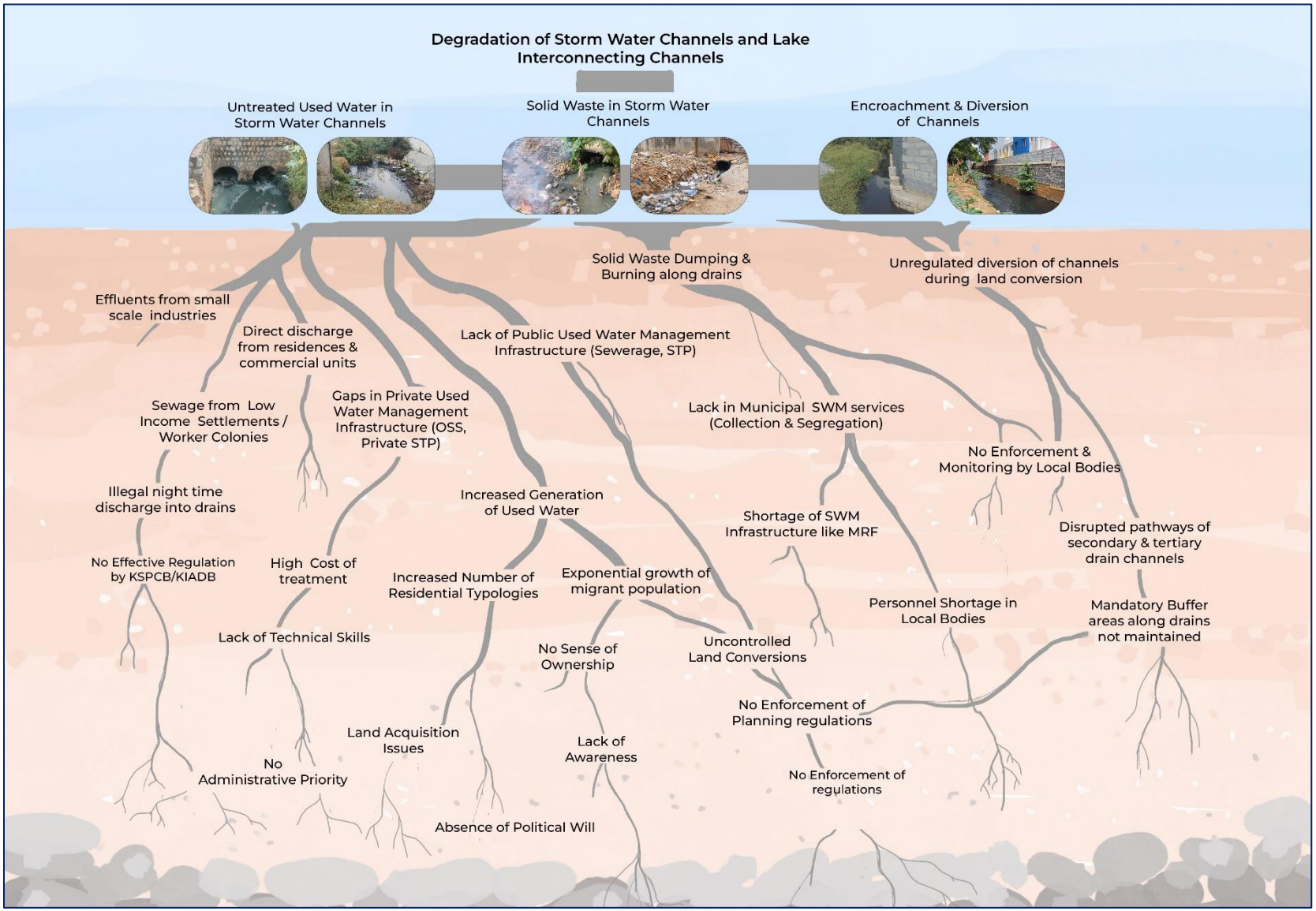
Other compounding causes degrading storm channels: -

- **Absence of end-to-end Solid Waste Management services** in the local bodies
  - In-sufficient infrastructure – vehicles for collection and promoting source segregation.
  - Timeliness of services – vehicles rounds not happening at convenient times for large sections
  - Inaccessible demographic – migrant populations for whom it is easier to discard and burn
  - Shortage of personnel

- **Unchecked Land Conversion**
  - Land conversion for non-agricultural purposes is unchecked and therefore not meeting Town Planning regulations. Ideally, the process requires conversion certificates from District Administration. These requests have to go through the urban local body. Additionally, the conversion has to be technically sanctioned by the Planning Authority, who will check that the conditions such as green space, buffer, offsets etc. are maintained. These processes are not being followed as the impression is that 'saleability' of land will be reduced and because they are time-consuming. In the interest of fast financial gains, private parties often convert land without due process. And in the face of lack of enforcement and political vested interests, the vicious cycle continues.
  - 'Artificial' Land Scarcity → created when private stakeholders are unwilling to allocate or relinquish land for essential infrastructure such as Sewage Treatment Plants (STPs) and Material Recovery Facilities (MRFs).
- **Poorly equipped local bodies (Personnel & Expertise)**
  - To deal with the fall-out from an exponential population growth – absence of regulation & monitoring,
  - Absence of critical records available with recently converted (rural to urban) local bodies (eg. old sewer network maps, number of commercial (PG) accommodations and independent multi-storey dwellings etc.)
  - Shortage of staff leading to sharing of personnel between smaller ULBs
- **Lack of Coordination between Concerned Departments**
  - Relevant state departments and boards (KUWSDB, KTCDA, APA, BMRDA, KSPCB, Revenue Dept) have roles and functions that directly or indirectly are responsible for maintaining the integrity of the storm channel network. A significant gap in governance is that these bodies at present do not work in tandem with each other or with the local bodies. This gap is to be overcome to efficiently address the root causes degrading the storm channels.

A visualisation of the root causes causing the degradation of storm channels and lake interconnecting channels in the Bommasandra-Chandapura 9 lake series catchment is represented in the figure below.

Figure 3 Root causes causing the degradation of storm channels in the lake series catchment



Source: Developed by CDD India

4 ACTIONS TO TACKLE THE ROOT CAUSES

As evident from Figure 3 in the previous section, the main three visible points of degradation of storm water channels manifests through different deep-seated causes.
Tackling these deeper issues will require a combination of technical, administrative, regulatory, institutional, social and policy actions. The different actions will require different stakeholders working together at different scales and across different time-scales.

In this Action Plan, time-scales are categories as follows: -

- Short-term actions: 0-2 years
- Medium-term actions: 2-5 years
- Long-term actions: 5-10 years

Additionally, in terms of geographical scales, there are two categories of classification: -

1. Based on Hydrological Units

   Hydrologic Units (HUs) refer to areas of the landscape that drain into specific segments of a stream or river network. A HU may encompass all or a portion of the total drainage area contributing to a particular outlet point. In the context of the present catchment, the landscape is almost entirely built-up, with minimal remnants of natural drainage pathways; most original channels have been encroached upon or significantly altered. Consequently, planning efforts must be oriented around the existing built stormwater infrastructure—regardless of whether it has been formally planned and regulated, or has evolved informally.

   From smallest to largest, the units are: -

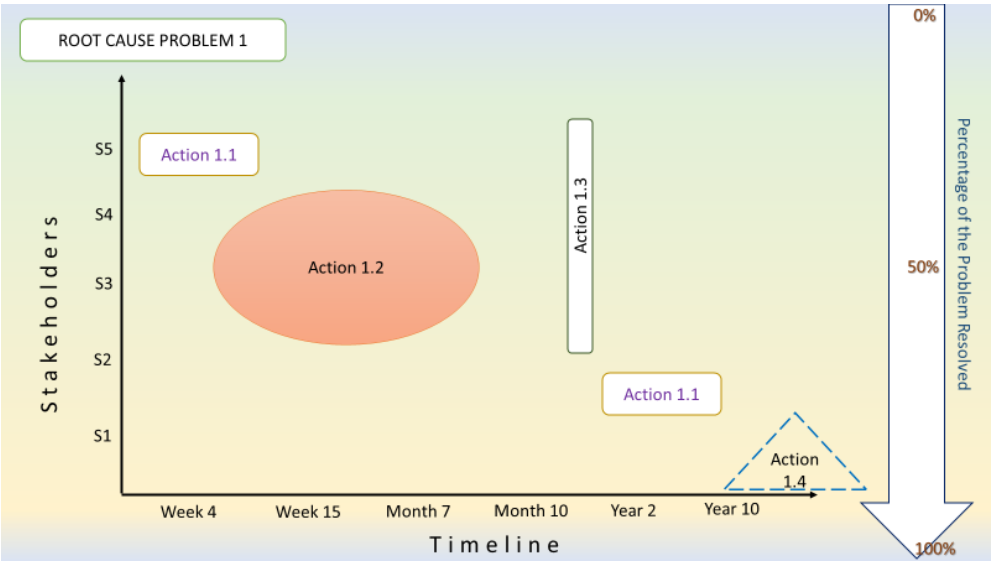
   i. Tertiary Drains/Channels – Smaller drains (lined or unlined) such as those originating in settlements and which feed into secondary drains
   ii. Secondary Drains/Channels – Medium sized drains such as those along main road sides which receive water from tertiary drains. The secondary channels feed the larger primary channels
   iii. Primary Channels – Larger main channels (*raja kaluves)* directly connecting to the lakes

2. Based on Local Administrative Units

   This refers to a settlement (cluster of residences), ward/village, or town-scales

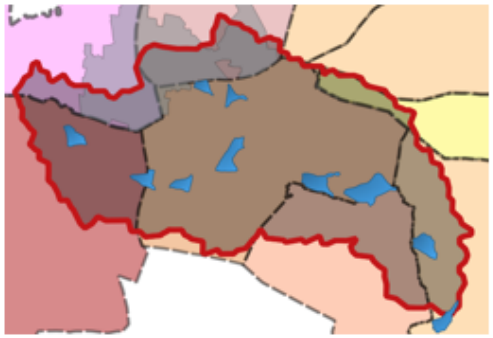
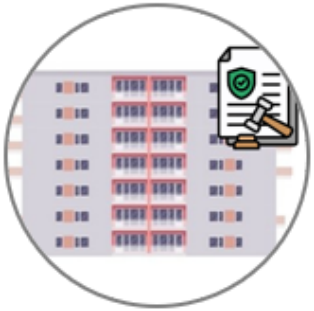
The range of actions proposed in the document are categorised according to the specific Root Cause meant to be tackled. This is envisioned as shown in Figure below.

Figure 4 Visualizing different actions for tackling specific root causes of pollution of storm channels



4.1 ROOT CAUSE 1: INCREASE IN SOURCES USED WATER GENERATION (RESIDENTIAL & COMMERCIAL)

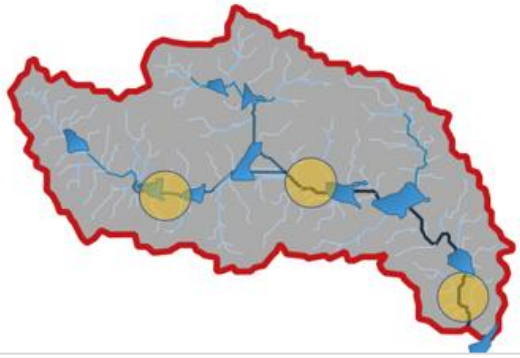
OVERALL EXPECTED OUTCOME: Identify and stop at source the various key polluters, especially the used water generators that are the result of recent residential and commercial built-up through technical and regulatory measures

Timeline		Action	Stakeholders	Potential Site
Short-term (1-2 Years)		Action 1 Guidelines for management of used water(UW) from commercial establishments like PGs, Hostels Objective Prevent pollution of secondary and tertiary channels from these commercial establishments, which are releasing untreated used water in bulk amounts (2-4 MLD)	1. KSPCB 2. Local Bodies 3. PG Owners	All Local Bodies 
		Action 2 Regulation of new Multi-Dwelling Units (defined as independent buildings with multiple floors and having several households per floor) Objective Ensure the new multi-dwelling units meet building code requirements (eg. rain water harvesting, sanitation infrastructure) Creation of bye-laws for operationalising existing state laws in local body	1. Local bodies 2. APA/BMRDA	All local bodies - Multi-Dwelling Units 

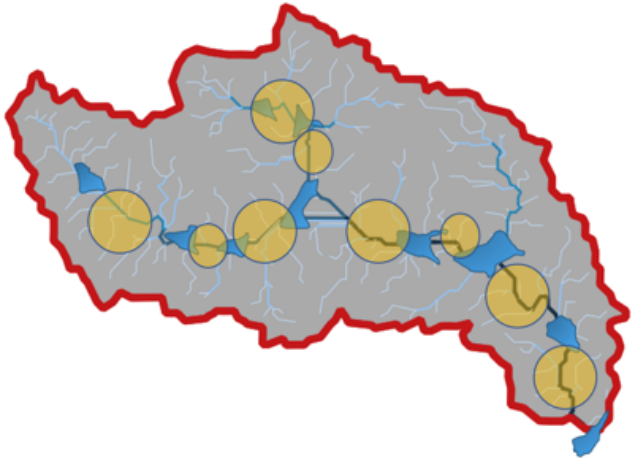
Timeline		Action	Stakeholders	Potential Site
Medium-term (2-5 Years)		In-situ or Cluster-based treatment systems in upcoming residential layouts **Objective** Manage the waste at sources and prevention of pollution of tertiary channels	1. APA/BMRDA 2. Local Bodies- GP 3. Property Owners 4. KSPCB 5. Technical Consultants	Rural Local Bodies - GP 
		Specific UWM Planning for settlements falling outside the upcoming UGD network, or in Low Income Settlements (LIS) likely to be left out of the network **Objective** Identify the pockets within catchment which will be left out of the four upcoming networks & plan for UWM in those areas	1. Local bodies 2. KUWSDB	LIS clusters 

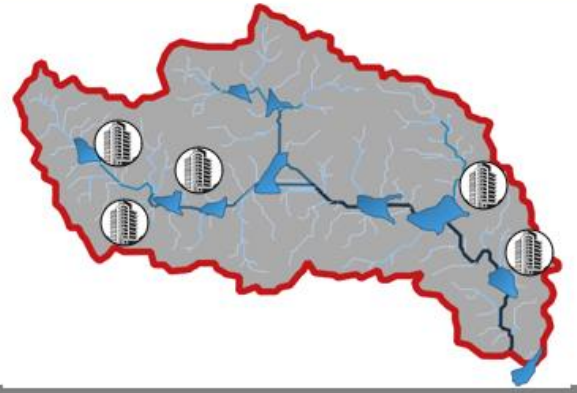
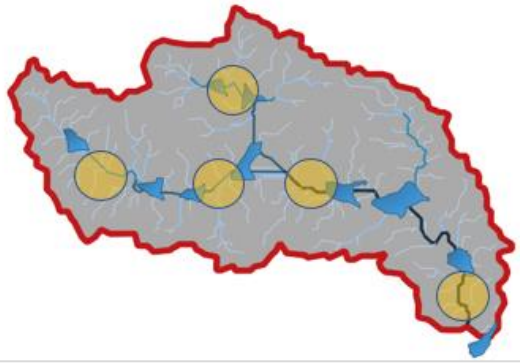
4.2 ROOT CAUSE 2: LACK OF RECOGNITION OF INTEGRITY OF STORM WATER CHANNELS

OVERALL EXPECTED OUTCOME: Recognize storm water channels and lake interconnecting channels as important water resources

Timeline		Action 1	Stakeholders	Potential Site
Short (1-2 years)		Preparation of Drainage Map (Drainage Master Plan) **Objective** To have a complete map of existing primary, secondary & tertiary storm channels (natural & human made) and plans for upgraded network, if needed	1. APA/BMRDA 2. Local Bodies 3. Minor Irrigation 4. Technical Survey Organisations 5. Non-Governmental Organisations (Eg: Paani.earth)	Whole Catchment 
Timeline		**Action 2**	**Stakeholders**	**Potential Site**
Continuous Efforts		Awareness campaigns about channels (eg. Kaluve walks; publications on catchment profile) **Objective** To promote recognition of channels and sense of ownership among local public	1. Civil Society Groups 2. Schools 3. Residents 4. Resident welfare organisations	Whole Catchment 

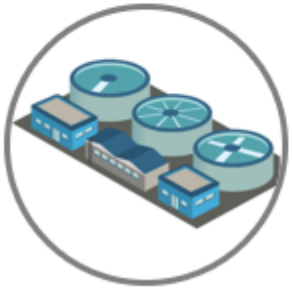
Short (1-2 Years)		Action 3	Stakeholders	Potential Site
		Removal of encroachments along primary channels	1. Revenue Department 2. DC Office	Main Kaluve Channels
		Objective		
		Maintain buffer around drains and prevent further degradation		
		Action 4		
		Operational policy for preventing channel pathway changes during new constructions	1. Minor Irrigation 2. Revenue Department 3. Local Bodies	
		Objective		
		Maintain integrity (flow path and buffer) of stormwater channels & raja kaluves during build up/site development activities		

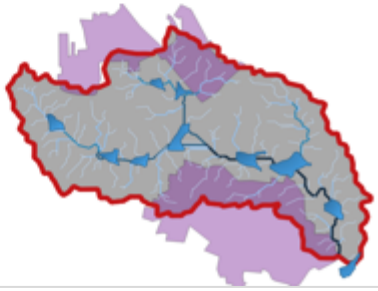


Medium (1-5 Years)	Timeline		Action 5 Engagement with builders'/ real estate groups – incentivise SUDS on their premises (in relation to raja kaluves) Objective Generate buy-in from large builders in catchment to retrofit / mandate in new constructions blue-green infra - continuity with buffer of lakes/kaluves; contribute to increase of blue-green infrastructure	1. Builders groups (Prestige, Icon, Brigade etc.) 2. RERA 3. Local Bodies	High-rise Apartments 
Medium (2-5 Years)			Action 6 Improving critical drain stretches Objective Application of Sustainable Urban Drainage Systems (SUDS) principles on main channels and restore them as aesthetic ecological corridors	1. Local bodies 2. Minor Irrigation 3. APA/BMRDA 4. KSPCB 5. Technical consultants 6. Academia 7. CSR	Whole Catchment 

4.3 ROOT CAUSE 3: ABSENCE OF SUSTAINED MONITORING OF INDUSTRIES

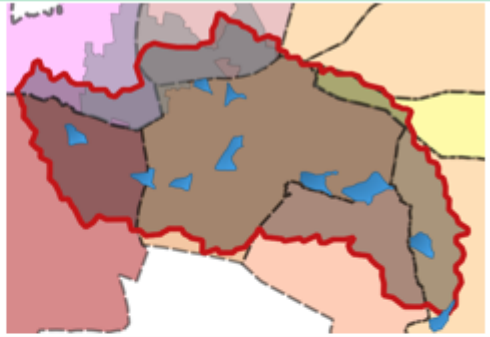
OVERALL EXPECTED OUTCOME: Improve industrial used water treatment infrastructure, its value chain in the industrial estates in the catchment

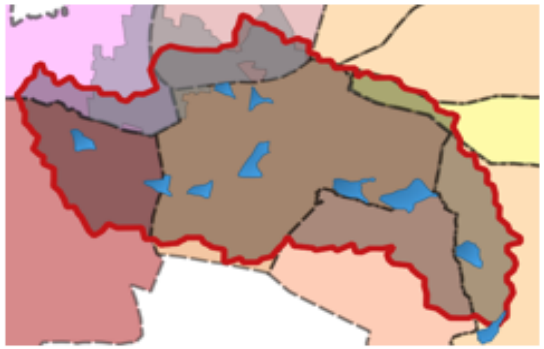
	Timeline		Action 1	Stakeholders	Potential Site
			Real-time monitoring of industrial effluent in drains and lakes, and creation of live database Objective To avoid the illegal discharge of effluents in drains and lakes	1.KSPCB 2.KIADB 3. Industrial Associations 4. Open Data Portal	VIA , BIA 
Short-term (1-2 Year)	Timeline		Action 2	Stakeholders	Potential Site
			Setting up of Common Effluent treatment plants Objective To treat industrial effluents from three major industrial areas: Bommansandra, Veerasandra and Jigani	1.KSPCB 2.KIADB 3. Industrial Associations	VIA 

Short-term (1-3 Years)	Timeline		Action 3 Pilot business model (or strengthen existing) of private STP catering to small-industries Objective To reduce the overdraft of ground water	Stakeholders 1. ELCIA 2. Industrial Associations 3. KIADB 4. Technical Consultants	Potential Site ELCITA, BIA 
Medium-term (2-5 Years)	Timeline		Action 4 Strengthen existing small-scale private STPs Objective To cater to sewage loads from small-scale industries	Stakeholders 1. Private STP operators 2. KSPCB 3. Local Bodies 4. Desludging Operators	Potential Site VIA, BIA 
Medium-term (2-5 Years)	Timeline		Action 5 Set up monitoring & enforcement mechanisms for small-scale industries Objective Stronger enforcement of existing environmental regulations	Stakeholders 1. KIADB 2. KSPCB 3. Industrial Associations	Potential Site VIA, BIA 

4.4 ROOT CAUSE 4: EXISTING PRIVATE INFRASTRUCTURE & SERVICES – INADEQUATE & UNDERUTILIZED

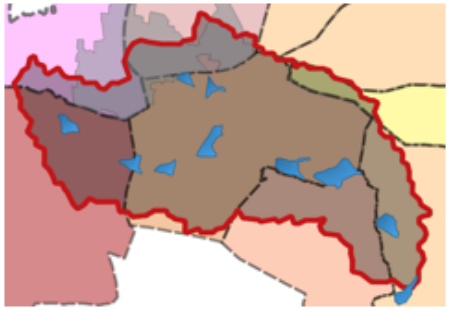
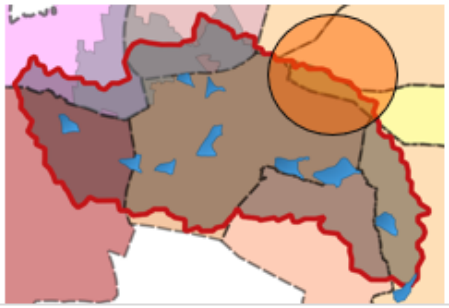
OVERALL EXPECTED OUTCOME: Upgrade existing UWM infrastructure (public and private) to meet standard service level benchmarks at town-scale

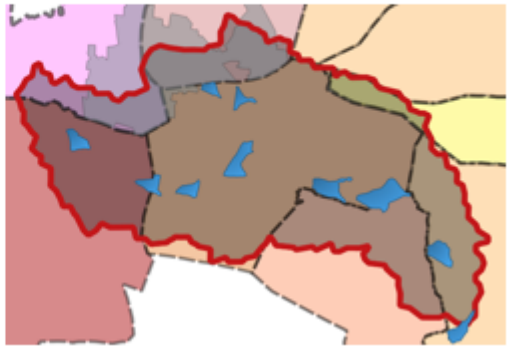
Very Short (Within an Year)	Timeline		Action 1: Create a database of all private STPs within catchment Objective: Capture realistic information w.r.t. existence and functional status of STPs (particualrly private apartments)	Stakeholders: 1.KSPCB; 2.BAF	Potential Site: All Local Bodies 
Short-term (2-3 Years)	Timeline		Action 2: Platform for private STP providers and operators of all private STPs (apartment) in the catchment Objective: Act as a support group/self-monitoring to help regulate the effective functioning of these systems	Stakeholders: 1. Local Bodies; 2. KSPCB; 3. BAF (to anchor)	Potential Site: Private STP Service Providers 

Short-term (3-4 Years)	Timeline		Action 3 Pilot business model (or strengthen existing) of private STP catering to small-industries Objective Where public systems are absent, tap into treatment potential in the private space	Stakeholders 1. KSPCB 2. Industrial Associations 3. KIADB	Potential Site Private STP Service Providers
Long-term (5-10 Years)	Timeline		Action 4 Extending coverage of sewerage network through laying of new network and establishing STPs Objective Monitor Plan for extending services (end-to-end) (beginning with the planned ones in Chandapura, Bommasandra, Heelalige)	Stakeholders 1. KUWSDB 2. BWSSB 3. Local Bodies 4. PRED	Potential Site All Local Bodies 

4.5 ROOT CAUSE 5: THE ABSENCE OF SOLID WASTE MANAGEMENT

OVERALL EXPECTED OUTCOME: Streamline SWM processes such that dumping and burning of solid waste by various users is eliminated

Timeline		Action 1	Stakeholders	Potential Site
Short-term (1-3 Years)		Streamline SWM services of local bodies	1. Local bodies 2. Technical Consultants 3. Service Providers	All Local Bodies 
		Objective		
		To enhance the local bodies to provide better delivery of services. Through the use of AI, service infrastructure (vehicles, personnel etc.)		
		Action 2	**Stakeholders**	**Potential Site**
		Revamping market spaces which are potential bulk waste generators	1. Muthanallur GP 2. Agriculture Produce Market Committee (APMC) 3. Technical consultants & Service Providers	APMC Muthanallur 
		Objective		
		Targeted SLWM for bulk generators Reduction of source generation		

Short-term (1-3 Years)	line		Action 3	Stakeholders	Potential Site
			Marketspace for start-ups dealing with solid waste management	1. Local bodies	All Local Bodies
				2. Technical Consultants	
				3. Service Providers	
			Objective		
			Provide an interface for start-ups, local bodies and small businesses, again in an attempt to streamline services through public-private-partnerships		

5 PLANNING FOR UWM & REUSE APPROACHES IN THE CATCHMENT: A NOTE

In the previous section, we have listed a range of actions to be initiated for tackling the various root causes of storm channel pollution. Some of them are direct actions which tackle the issue head-on while others are supporting actions to enable the direct actions. In the case of Used Water Management planning at the catchment, the direct actions include technical ones such as deciding the treatment approaches and scale. These include options such as:

- ➔ Creation of a separate UGD (sewerage) network which ends in a treatment facility of sufficient capacity. Implication being no untreated used water will enter the storm channels due to completely separate network. At present, this is being planned in Hebbagodi, Bommansandra and Chandapura towns, within the catchment in focus. Although land has been identified for STPs, there are delays in acquisition.
- ➔ Complete decentralization of treatment – with in-situ and localized treatment at all points of used water generation.

Both these are contrasting options lying at opposite ends of the used water management approach spectrum. The former centralized option is time consuming and costly, often running into delays such as land acquisition for treatment facilities and laying of the network. The latter complete decentralized approach with large numbers of smaller treatment units is impractical as well.

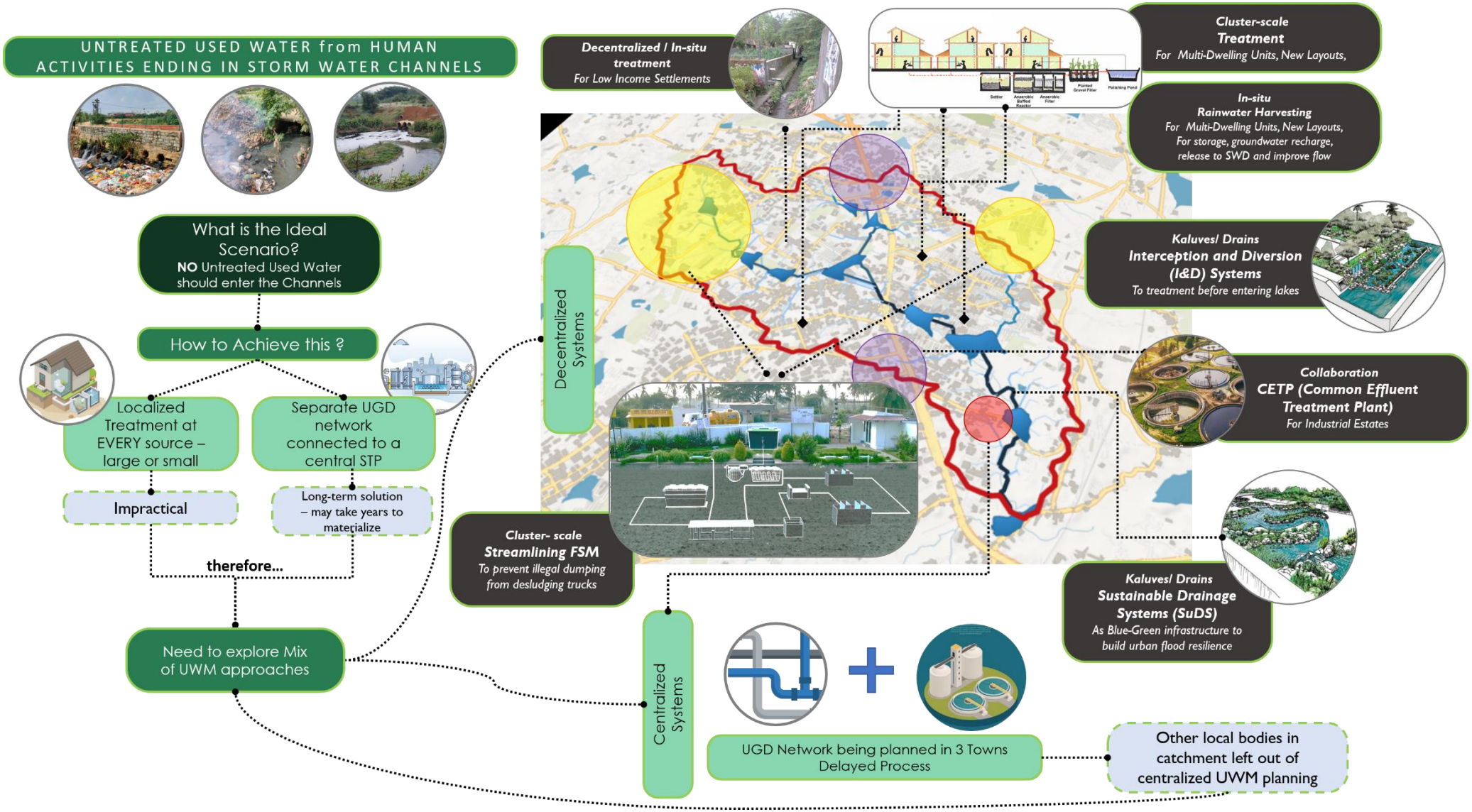
Therefore, a range of options will have to be explored for holistic Used Water Management & Reuse

- ➔ Partial diversion of untreated used water generated from various sources into treatment facility of sufficient capacity through non-networked systems (through tankers), or through creation of Interception & Diversion arrangements to divert used water from storm channels to facilities elsewhere (outside catchment). The implication being some untreated used water still moves through the storm channels, but in reduced volumes
- ➔ Interception & diversion of untreated used water from channels into smaller decentralized treatment systems (within catchment area) and re-entry of the treated used water back into the channels (i.e. reuse of treated used water for environmental flows, or for other reuse purposes
- ➔ Improved in-situ treatment units at appropriate locations within the catchment which can improve the quality at/near source of generation

Apart from UWM & treatment approaches, drain channels themselves can be rejuvenated by various nature-based methods. These include retrofitting and redesigning of drains, based on Sustainable Urban Drainage systems (SUDS) approach. Such an approach will have multiple benefits – urban flood mitigation, creation of public green spaces in a congested city space, improving water quality in drains, improved recharge of groundwater etc.

A visual representation of UWM approaches to be considered at the catchment scale is given in the following figure.

Figure 5 Approaches to UWM & Reuse for the Catchment

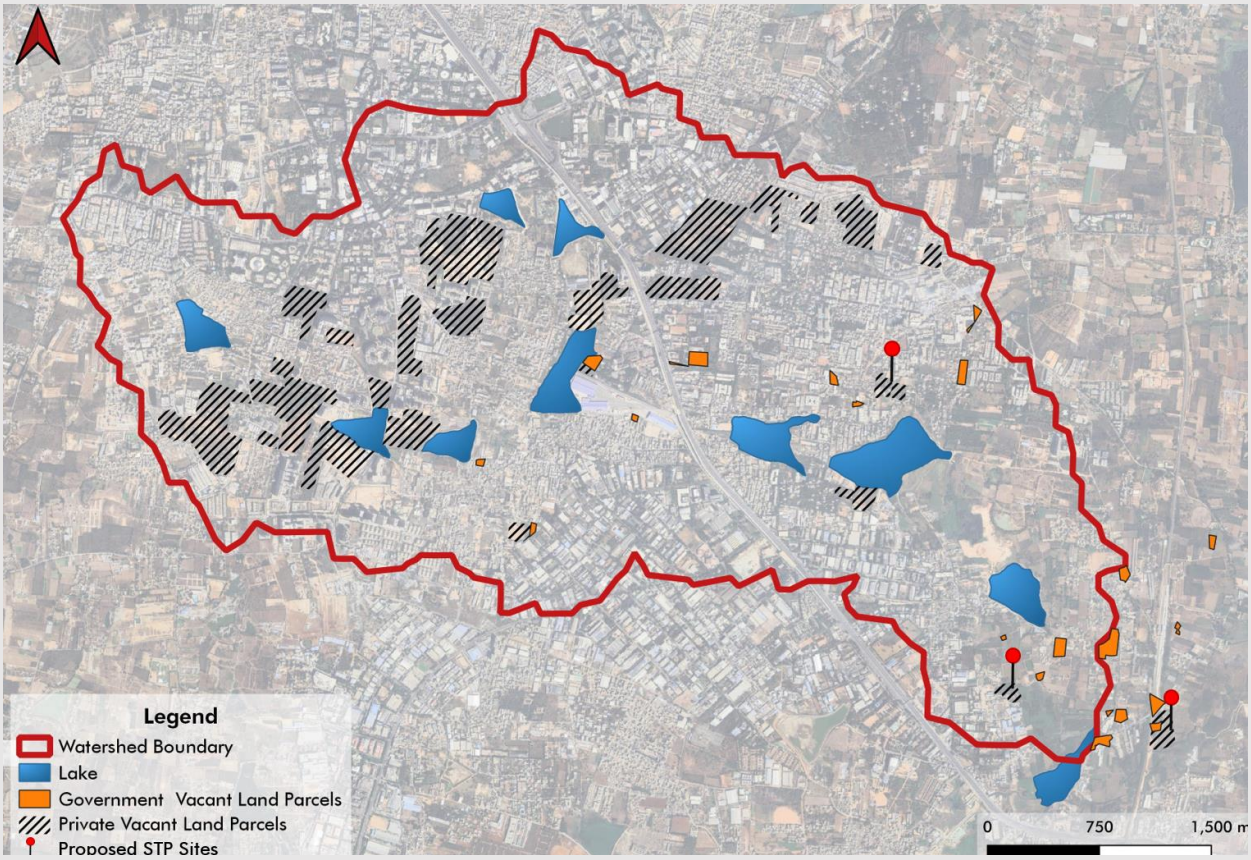


AVAILABILITY OF VACANT LAND IN THE CURRENT CATCHMENT

In the present catchment, with its almost 100% built-up, availability of vacant land is negligible.
The accompanying figure shows the patches of vacant land both government and under private ownership. The government land parcels are depicted in orange colour in the map. Most of these vacant parcels are located in Chandapura with a few in Hebbagodi. In total, about 12.76 acres of government land in the catchment is vacant. However, as is evident in the figure, this land is not contiguous, and the size of individual vacant plots are very small. On average, the size of individual parcels is around 0.30 acre. Only four land parcels are greater than one acre.

Apart from the government parcels, there is also vacant lands in the catchment which are under private ownership. These are marked by the striped blocks in the map below, and have been identified using satellite imagery. Combining the vacant lands under private ownership, the total area is around 385 acres. In the case of private vacant lands, there are contiguous patches ranging from 2 acres to 50 acres (average area of the identified patches is around 15 acres). However, the challenge is that these vacant lands are comprised of smaller plots owned by multiple private individuals. It makes the acquisition of land for any intervention difficult. This is already in evidence considering the three proposed sites for STPs (for the three ULBS in the catchment - Bommasandra, Hebbagodi & Chandapura). The proposed sites are distinguished in the figure below by the red location points. As shown, they are located with private land. While the land for Hebbagodi STP is reportedly finalised, the others remain in process. In general, the process for land acquisition is fraught with considerable time delays.

The implication of this relative shortage of vacant land/open space in the rapidly-urbanised landscape highlights the need for blue-green infrastructure which can serve multiple functions – improving water quality, dispersed water recharge, creation of public spaces through innovative landscape design and mitigate urban climate-related challenges such as urban flooding and heat island effects.



Section 4 aimed to illustrate the relationship between specific interventions and the root causes they are intended to address in the context of degraded stormwater channels. A comprehensive list of proposed actions is provided in the Annexure to this document.

Section 5 presents an overview of the key technical interventions and approaches required across different zones of the catchment to effectively manage the problem of untreated used water.

The subsequent section outlines a set of priority actions designed to initiate and support the implementation of the short-, medium-, and long-term measures identified in Section 4, thereby facilitating the adoption of the different technical solutions proposed in Section 5.

6 PRIORITY ACTIONS FOR TRIGGERING OTHER SMALL, MEDIUM AND LONG-TERM MEASURES

Action 1: Developing Drainage Master Plan

Central Idea: *Comprehensive mapping of primary, secondary and tertiary drainage network in the catchment. This is needed to develop a Drainage Master Plan, on the basis of which the need for planned drain network retrofitting/rejuvenation can be done. In the long-term, it will foster a collaborative initiative to tackle urban flooding and guide sustainable development by restoring run-off flow pathways in the catchment.*

Urban flooding, contamination of, and encroachments on natural drainage channels have become persistent challenges in the fast-urbanizing Electronic City region and its surroundings. Compounding the issue is the fact that new storm water channels built during unplanned urban growth do not always connect to larger channels to ensure undisrupted flows. All of these issues stem largely from the absence of scientific, spatially validated drainage data. It is necessary to recognize the hydrological boundaries as opposed to administrative boundaries if the issues of urban flooding is to be addressed by restoring/improving drainage pathways.

To address this critical gap, a necessary intervention is the **Development of Drainage Master Plan of the catchment** is being proposed. The aim is to create GIS-based, hydrologically informed drainage maps at catchment-scale, considering primary, secondary and tertiary drain channels. This master plan needs to be developed through the collaborative efforts of **Anekal Planning Authority (APA) and Bengaluru Metropolitan Region Development Authority (BMRDA),** who will take joint ownership of the project, as their jurisdictional boundaries fall within the natural catchment area of the **Chandapura Lake series** (Figure 10). They can collaborate with Urban Local Bodies (ULBs), GIS experts, and planning consultants to ensure technically sound execution and locally grounded outcomes.

The creation of a Drainage Master Plan outlining primary, secondary and tertiary channels and the interconnection with lakes, is the foundation for sustainable stormwater infrastructure planning. On the basis of such a comprehensive map, the critical flow pathways and points can be identified for priority actions (eg. removal of encroachments, points for rectification, possibilities for redesigning drain stretches based on Sustainable Urban Drainage System (SUDS) Principles etc.). These actions in turn will help mitigate flood risks, prevent stormwater-used water mixing, and protect natural drainage systems. Crucially, the drainage maps will also serve as a key input for **proposed land use planning**, ensuring that future urban development aligns with the region's hydrological realities. The project further supports Karnataka's broader objectives of climate resilience and water-sensitive urban design.

OBJECTIVES

(i) To develop **comprehensive GIS-based drainage master plans** across ULBs and lake catchments in Karnataka.
(ii) To **identify natural and built flow paths** and demarcate critical points (eg. encroached zones, waterlogging prone region, need for buffer enforcement, stretches to be reprofiled and redesigned etc.)
(iii) To support **evidence-based requirements for investments in grey and blue-green infrastructure** for stormwater management.

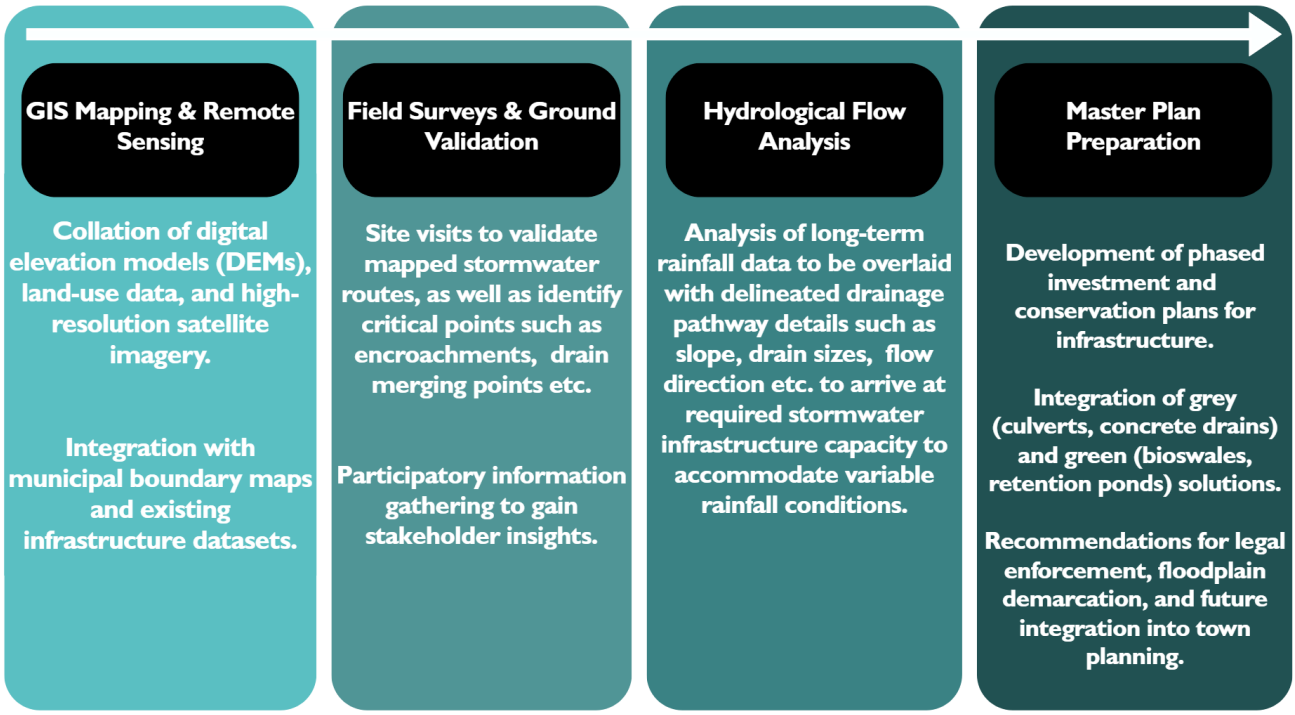
(iv) To **prevent pollution of storm channels** by clear demarcation as conduits for surface water run-off and possibly treated used water

(v) To **enhance the climate resilience** of urban areas by enabling integrated planning for future rainfall variability.

METHODOLOGY

The broad phases for the development of a Drainage Master Plan are as shown in the figure.

Figure 7 Phased Methodology for Development of GIS-Based Drainage Master Plan



EXPECTED OUTCOMES

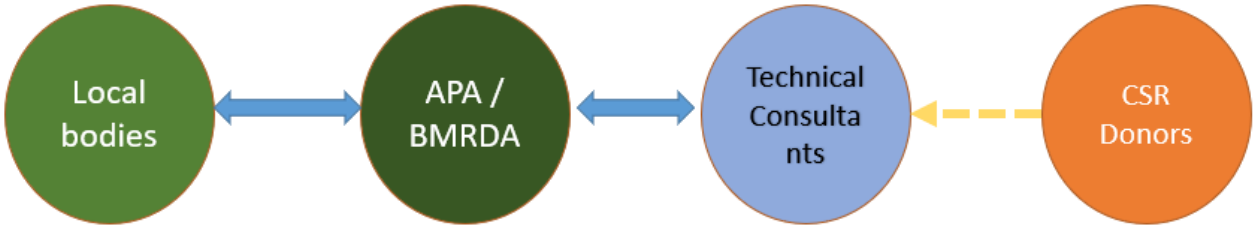
In the present catchment, low-lying areas near Hebbagodi lake, Veerasandra Lake, as well as newly built-up areas near outlet of upstream Shikaripalya have reported localized flooding. Urban flood risk can be significantly reduced by scientifically identifying natural flow paths, which guide the strategic placement of infrastructure and minimize flood-prone zones. By mapping and controlling stormwater routes, untreated used water discharge into storm channels is mitigated, ensuring cleaner urban water systems. The detailed mapping of natural drains also supports enforcement actions such as removal of encroachments and preservation of buffer area. It is also a prerequisite for planning blue-green infrastructure around drainage channels promoting concepts like Sponge City and SUDS, which in turn have larger implications such as building urban resilience by creating multi-functional spaces. In other words, this data-driven approach promotes sustainable infrastructure development that aligns with topography, hydrology, and environmental needs. Ultimately, such integrated planning strengthens climate resilience by enhancing preparedness for erratic rainfall and supporting long-term adaptive strategies at different scales.

Figure 8 Expected Outcomes of Systematic Drainage Mapping for Storm Water Management

PARTNERSHIP

The planning authorities should take a lead role in the development of a Drainage Master Plan so that it is in alignment with the larger regional Master Plans being prepared.

Figure 9 Possible partnerships for Drainage Mapping exercise



A Note on Planning Jurisdictions:
The catchment area falls across 2 planning districts – Anekal Planning Authority & BMRDA (see Figure 9). Therefore, both bodies will have to coordinated and take joint responsibility for the implementation of this course of action. They will work in close coordination with Urban Local Bodies (ULBs), GIS experts, and planning consultants to ensure comprehensive execution.

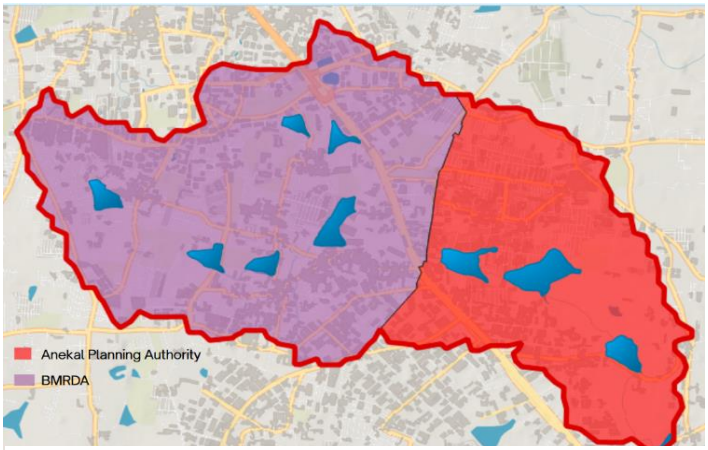


Figure 10 Planning jurisdiction boundaries within catchment

The development of scientific, GIS-based drainage master plans represents a critical step toward building urban flood resilience in the Electronic City region. By grounding urban planning in accurate hydrological data, this initiative will help create a long-term blueprint for sustainable drainage systems, which in turn will help mitigate immediate risks such as flooding and contamination. Integrating drainage insights into proposed land use planning ensures that future infrastructure development is both climate-responsive and environmentally conscious.

Action II: Developing Communications Campaign on Storm water Channels & Catchments

Central Idea: *Creating Social Behaviour Change Campaign (SBCC) to increase public awareness around urban stormwater drains and lake interconnecting channels. In doing so, the goal is to orient public mindset to recognize the important role of the channels as water resources and not as receptacles of waste (solid and sewage).*

Urban stormwater drains are often overlooked or misused, resulting in persistent problems like illegal dumping, encroachments, and water contamination. It is a particularly serious threat in cities like Bangalore and its suburban regions like Anekal, where interconnected lake systems are a characteristic hydrological feature. Storm water channels feed the primary lake channels which in turn feed the lakes one after the other.

A major driver of the neglect faced by storm channels (*raja kaluves)* is the modern public's limited awareness and emotional disconnect from these critical water infrastructures. In the Bommasandra-Chandapura catchment, large sections of the resident population are migrants (both blue-collar and white collar), attracted by the IT and industrial growth in the region. As such, they are often unaware of the interconnected nature of lakes and the channels that feed them. Moreover, drains are associated with waste and used water and are treated as such.

Therefore, an SBCC campaign with clear messaging and targeted roll-outs is proposed. It envisions a participatory, locally rooted approach to re-establish civic connection with urban water bodies and stormwater channels. Central to this initiative is the use of BCC activities, which will focus on educating citizens about the links between drainage channels and local water bodies and the threats to the channels from encroachment, used water pollution and solid waste dumping. Through targeted messaging and community engagement, the SBCC will help foster a sense of ownership and responsibility among citizens. As communities begin to care for and monitor their surroundings, they can also influence local authorities to maintain high standards and ensure accountability, creating a positive cycle of environmental stewardship and governance.

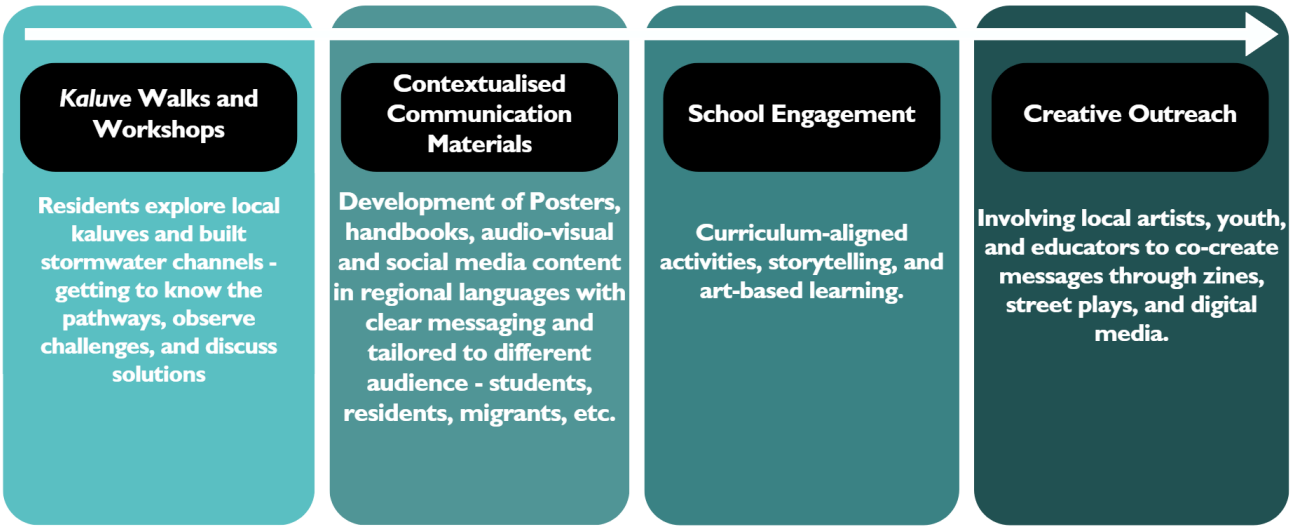
OBJECTIVES

(i) **To build public awareness** about the nature of stormwater drains and lake interconnecting channels and the threats to them
(ii) **To reduce misuse, encroachment, and pollution** of stormwater systems by engaging communities and translating technical issues into relatable narratives.

METHODOLOGY

The key phases of activities are as mentioned in the figure in the next page.

Figure 11 Community Engagement Methodology for Stormwater Awareness and Stewardship



EXPECTED OUTCOMES

Promoting behavioural change is essential to foster a sense of shared ownership and civic responsibility toward stormwater infrastructure. When communities recognize their role in maintaining these systems, they are more likely to respect and care for them. This shift in mindset plays a crucial role in prevention, as increased awareness and vigilance can significantly reduce instances of illegal dumping and encroachments that obstruct or damage the infrastructure. Sustained engagement is key to reinforcing this transformation, by delivering repeated, accessible, and localized messaging, community involvement becomes a continuous process rather than a one-time effort. Together, these interconnected elements create a resilient foundation for long-term infrastructure sustainability and improved urban water management.

Figure 12 Key Expected Outcomes of SBCC around storm water channels

PARTNERSHIP

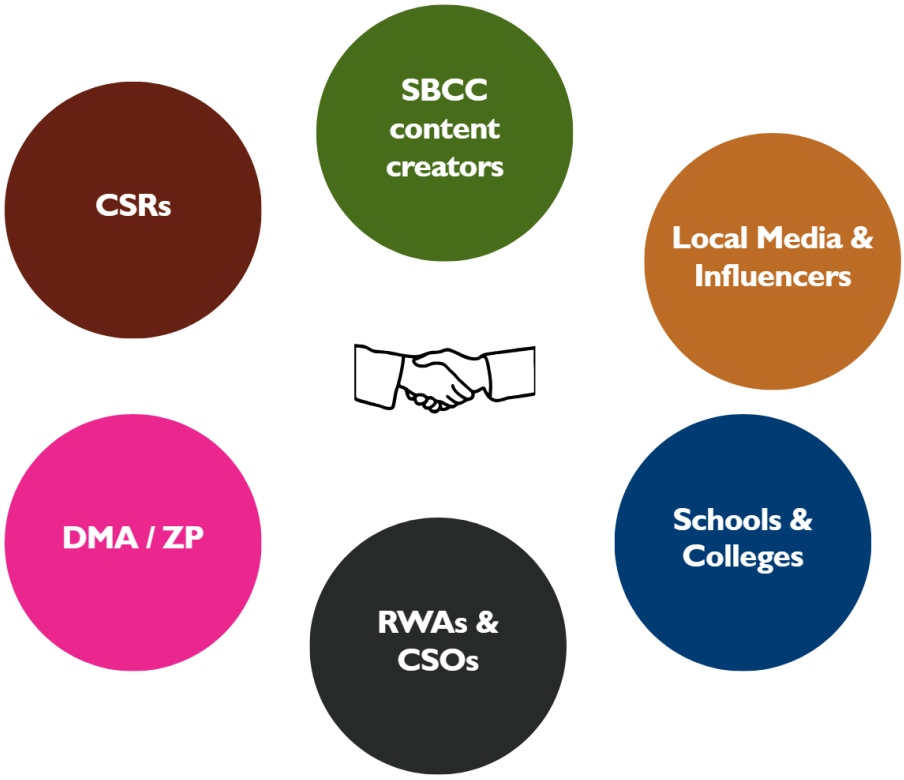


Figure 13 Possible Partnerships

Corporate Social Responsibility (CSR) entities can effectively anchor this action plan by leveraging their resources, networks, and expertise in community engagement over the period of 2 years. With approval from the district administration, CSRs can fund the creation of an SBCC campaign with clear messaging and content, as well as plan for outreach and roll-out.

Additionally, by collaborating with ULBs, NGOs, schools, and resident welfare groups, CSR initiatives can drive targeted awareness campaigns that promote responsible use and upkeep of urban stormwater channels. Activities such as street plays, school modules, wall art, clean-up drives, and citizen science walks can help foster local ownership and cultivate a culture of stewardship. These efforts contribute not only to behavioural change but also to the long-term sustainability of drainage infrastructure, positioning corporate partners as key players in building climate-resilient cities.

Importantly, such campaigns align with global goals, notably SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). By supporting this initiative, CSRs contribute to meaningful environmental outcomes while reinforcing their commitment to inclusive and sustainable urban development.

Action III: Marketplace of Private Solid Waste Management Service Providers

Central Idea: *Helping local bodies streamline their solid waste management (SWM) by creating an interface with innovative private service providers. This can help improve coordination and build a resilient, solid waste management system in urban local bodies of the catchment*

Solid Waste Management (SWM) in the catchment urban local bodies, faces serious gaps in service delivery, which results in unsegregated waste dumped in various points. Apart from being major threats to public health & environment, the dumping of solid wastes also leads to its accumulation in the storm channels. This is not only unsightly but also clogs the water ways increasing the likelihood of waterlogging and localized flooding.

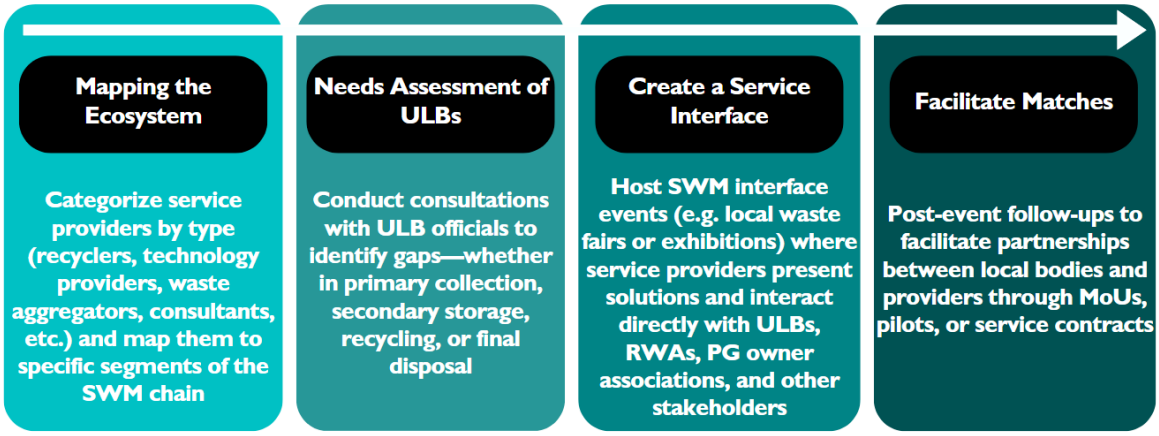
One key bottleneck to well-planned and executed SWM by ULBs is due to limited technical planning expertise and personnel shortage. There is also a need for innovative solutions to tackle the different aspects of the SWM chain from segregation at source to recovery of materials for repurposing, and therefore reduce the quantum of solid waste getting dumped in the environment.

A possible action to debottleneck this issue and streamline services in ULBs is to create an interface between the local bodies with private service providers. There are several small-scale service providers and start-ups with innovative solutions and business models working in the SWM space. Their services may be helpful to ULBs to streamline the overall SWM infrastructure and services.

How this Interface Can Manifest

(i) Categorize the different service providers according to the services they offer and place them within the larger SWM chain
(ii) Determine need of the local bodies w.r.t SWM components (collection and segregation as opposed to facilities for material recovery or disposal)
(iii) Bring together on to a common platform the different service providers and local body officials as well as representatives from RWAs, PG owners associations etc.
(iv) The first can be a physical interface (eg. fair or marketplace with stalls by different service providers)
(v) Facilitate the networking of local bodies and service provider according to need

Figure 14 Enabling Synergies in Solid Waste Management



EXPECTED OUTCOMES

Figure 15 Key Expected Outcomes

The initiative aims to strengthen solid waste management by improving coordination between Urban Local Bodies (ULBs) and private service providers, ensuring better service delivery. It promotes the adoption of decentralized, tech-enabled, and financially viable models that enhance the entire waste management chain, from segregation and collection to recycling and disposal. By empowering Resident Welfare Associations (RWAs) and informal stakeholders, the approach fosters inclusive, community-led governance. Ultimately, it creates a platform for replicating and scaling successful models across other regions, driving systemic and sustainable improvements in urban waste management.

PARTNERSHIPS

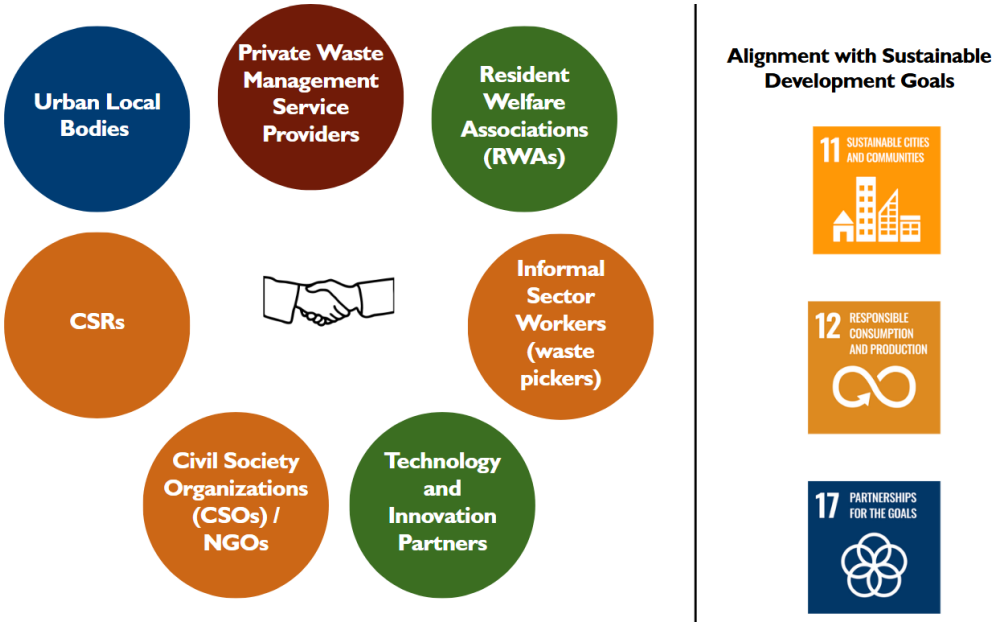


Figure 16 Partnership required for streamlining waste chain

The *Streamlining the Waste Chain* initiative presents a unique opportunity for CSR partners to take a leading role in creating a cohesive marketplace that brings together all key stakeholders in the solid waste management ecosystem. By establishing a unified platform that facilitates interaction among Urban Local Bodies (ULBs), private waste management service providers, Resident Welfare Associations (RWAs), informal sector workers, technology and innovation partners, as well as CSOs and NGOs, CSR partners can act as a catalyst for building lasting synergies.

Action IV: Regulation of Paying Guest Accommodations

Central Idea: *Promoting sustainable solid waste and used water management in Paying Guest (PG) accommodations through green business certification program by local bodies to encourage accountability and incentivize cleaner practices.*

Paying Guest accommodations (PGs) contribute significantly to solid waste and used water generation in the catchment study area, especially in Konappana Agrahara and Doddatoguru. At least 3-5 MLD of untreated used water from the PGs in these two local bodies are estimated to enter the stormwater channels and lake systems due absent systems for proper treatment or disposal. A root cause of this negligence is the absence of enforcement of building regulations by the municipal bodies on these commercial bulk waste generators.

Therefore, it is proposed that urban local bodies (particularly upstream ones such as Konappana Agrahara & Doddatoguru) regulate and/or incentivise PGs to adopt cleaner, more sustainable practices, and become part of the solution. ULBs can develop a Green Business Certification program where recognition is given to those PGs which comply with standards for used water & solid waste management, and rainwater harvesting. The proposed initiative seeks to create a culture of accountability, offering branding benefits, community recognition, and potential tax incentives in return for adopting environmentally responsible operations. Through collaboration between the Urban Local Bodies (ULBs) and Chamber of Commerce, the certification program will encourage compliance and promote sustainable business models in urban neighbourhoods.

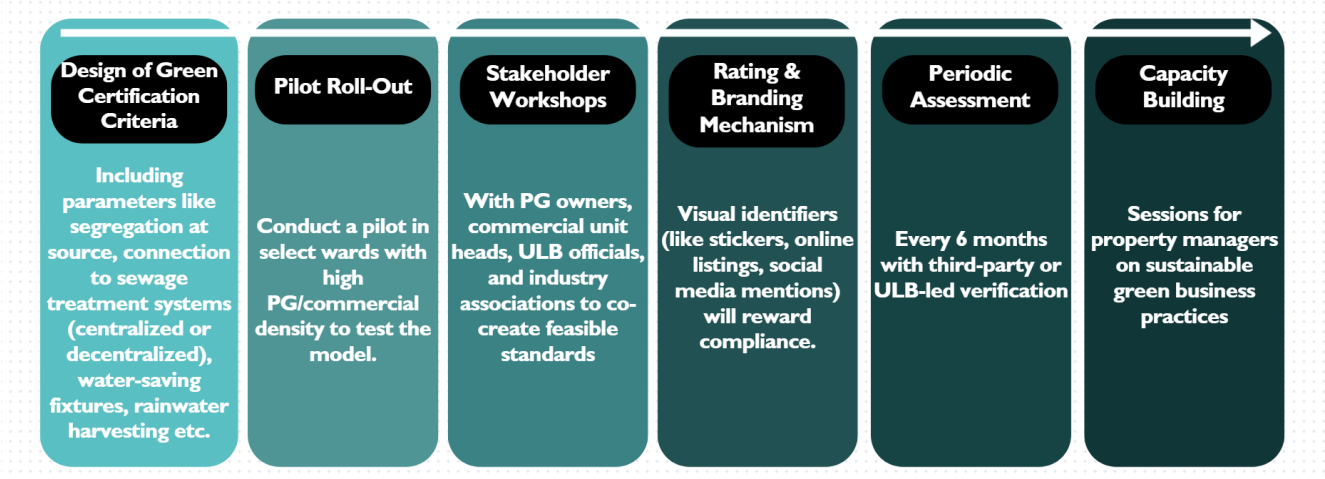
OBJECTIVES

(i) To convert PGs from being part of the problem to being part of the solution by ensuring they adopt proper used water management strategies.
(ii) To develop an incentive-based certification model which can encourage clean practices through recognition and branding.
(iii) To increase the potential for rainwater harvesting and local recharge of groundwater

METHODOLOGY

The proposed activities under this action is as shown here.

Figure 17 Methodology for developing UWM and SWM in PGs



EXPECTED OUTCOMES

Figure 18 Key Expected Outcome of Green Business Certification

The Green Business Certification initiative is aimed at converting PG accommodations in the catchment from being causes of the problem into part of the solution, through mandated waste management and water harvesting practices. Introducing a recognizable certification will improve the operational sustainability as well as set a replicable standard for similar businesses. This visibility is likely to increase public preference for certified "Green" establishments, creating a market-driven incentive for sustainable compliance.

PARTNERSHIPS

Figure 19 Partnerships required for improved waste management of PGs

The successful implementation of the Green Business Certification program hinges on strong institutional anchoring and multi-stakeholder collaboration. ULBs need to play a central role in anchoring this action plan. They should maintain a robust and regularly updated database of Paying Guest (PG) establishments, and follow up with monitoring their compliance status, and facilitating awareness among businesses and residents. Their leadership is critical not only in rolling out the certification process but also in ensuring sustained adoption through policy support, integration with business licensing, and public recognition.

ULBs can drive healthy competition among PGs to attain and promote their "Green" ratings, encouraging a race toward sustainability. NGOs can play a key role in community engagement, capacity building, and third-party assessments, while local media partners can help boost visibility and celebrate success stories. Crucially, the commitment of PG owners and managers to cleaner operations will determine the program's true impact and scalability. This collective effort can embed sustainable solid waste and used water management practices in commercial residential spaces, strengthening urban resilience and environmental health.

Action V: Strengthening Monitoring & Enforcement for Small-Scale Industries in Used Water Management

Central Idea: *Strengthening monitoring and enforcement for small-scale industries to ensure accountable used water management and protect urban water systems through participatory governance*

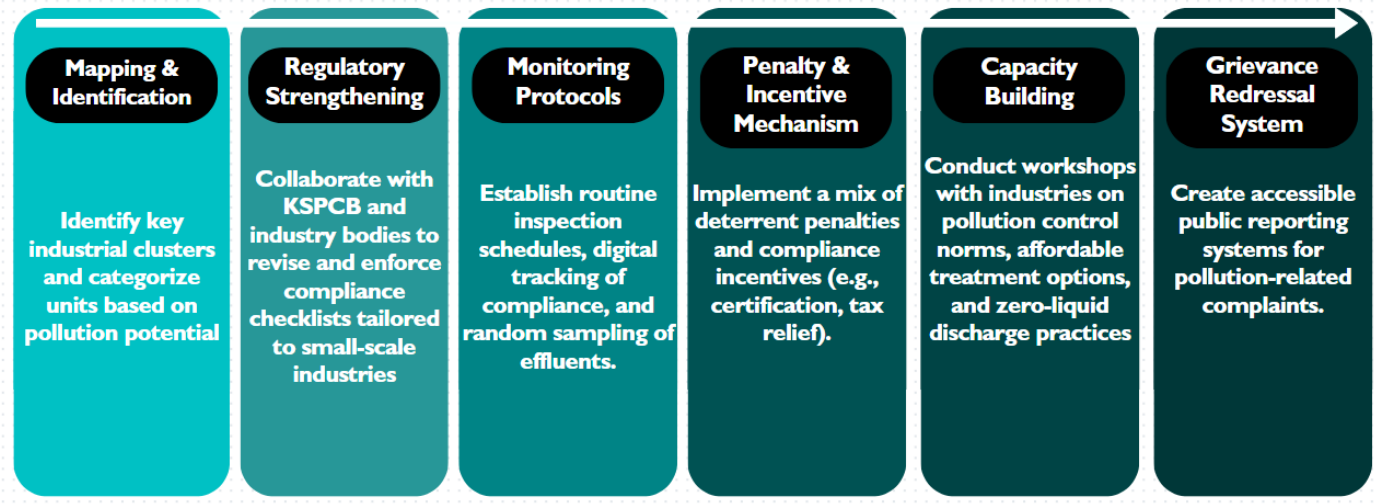
Small-scale industries located in industrial clusters such as Bommasandra Industrial Area (BIA), and Veerasandra Industrial Area (VIA), contribute significantly to the discharge of untreated or inadequately treated used water into stormwater drains and nearby water bodies. These discharges, often unmonitored or non-compliant with environmental standards, pose a serious risk to urban water systems and local ecosystems. Recognizing the need for participatory governance, this action plan will be anchored by a Steering Committee composed of representatives from these very industries, ensuring that compliance is not only enforced but co-created. By placing industries at the centre of the solution, and with support from regulatory and planning bodies, the initiative aims to foster ownership, drive peer accountability, and enable structured, context-specific enforcement mechanisms. Ultimately, the plan seeks to reduce pollution loads, strengthen institutional capacity, and ensure long-term environmental and water security across urban industrial zones.

OBJECTIVES

(i) To strengthen the enforcement of environmental compliance in small-scale industrial clusters.
(ii) To reduce illegal used water discharges into drains and water bodies by industries.
(iii) To institutionalize regular monitoring and penalties to deter non-compliance.

METHODOLOGY

Figure 20 Methodology for Steering committee



EXPECTED OUTCOMES

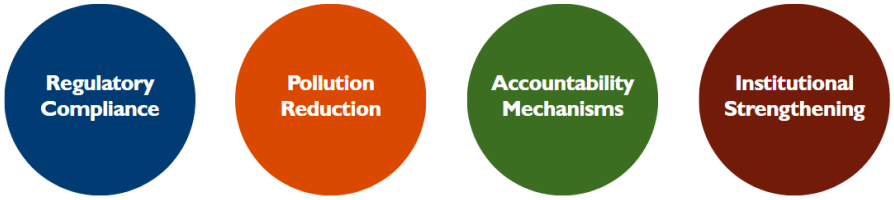


Figure 21 Key Expected Outcomes

The initiative aims to enhance environmental governance in industrial clusters by improving compliance with regulations among small-scale industries. Through transparent monitoring and enforcement mechanisms, it seeks to reduce illegal and untreated discharges into stormwater drains and nearby water bodies. It is expected that the efforts will not only curb pollution but also foster greater accountability within the system. Strengthening the institutional capacity of regulatory agencies further ensures long-term, consistent enforcement and oversight, creating a more resilient and environmentally responsible industrial ecosystem.

PARTNERSHIP

Figure 22 Partnership required for improving the used water management from Industries

This action is proposed to be anchored by a Steering Group, which can comprise of several major industrial players in the region under the purview of the Karnataka State Pollution Control Board (KSPCB), with the specific mandate to oversee the implementation and enforcement strategy. The Group may comprise representatives from small-scale industries operating within the BIA, VIA, and ELCITA industrial clusters, ensuring that those directly affected are actively involved in the design, execution, and refinement of compliance mechanisms. Once constituted, the Steering Group may independently drive the initiative, fostering a sense of ownership, accountability, and peer-driven motivation within the industrial community. It is also envisioned that KSPCB continue to provide regulatory oversight, standardize monitoring protocols, and support strategic inspection planning. KIADB's involvement is necessary to address infrastructure gaps crucial for effective effluent treatment and safe disposal. Industrial associations like BIA and ELCIA will mobilize industry participation, facilitate intra-cluster dialogue, and serve as liaisons with regulators. CSR wings of participating industries may be encouraged to fund technology upgrades, digital monitoring tools, communication materials, and peer training initiatives.

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7 CONCLUSION & WAY FORWARD

This Action Plan is intended to serve as a shared reference framework for the various relevant stakeholders operating within the region. These include the upstream local bodies of Hebbagodi, Bommasandra, Konappana Agrahara, Doddathoguru, and Hulimangala, as well as the downstream urban local bodies of Chandapura Town Municipal Council (TMC) and Muthanallur, which are both recipients of upstream used water discharges in addition to generating waste locally. Key state-level institutions such as the Karnataka Urban Water Supply and Drainage Board (KUWSDB), Karnataka State Pollution Control Board (KSPCB), Karnataka Tank Conservation and Development Authority (KTCDA), and the district administration play crucial regulatory and governance roles.

In addition to government bodies, other important stakeholders include Residents' Welfare Associations (RWAs), apartment federations, industries, industrial associations, and Corporate Social Responsibility (CSR) entities operating in the region. Despite their collective impact on the watershed, these stakeholders often function in silos, with limited coordination.

A core aim of this initiative is to convene these diverse actors on a common platform to collaboratively address the problem of stormwater channel pollution. This effort is rooted in the recognition that these channels are not merely conduits for untreated used water and solid waste, but critical hydrological assets that sustain downstream lake systems.

While the overarching goal is singular—pollution mitigation in storm water channels and lake interconnecting channels — the pathways to achieve it are multifaceted. This Action Plan seeks to unpack the various root causes driving the degradation of stormwater channels and, in turn, propose corresponding solutions. These include technical, regulatory, policy, behavioural, and other cross-sectoral interventions necessary to reverse the deterioration of these water channels.

It is further hoped that this document, and the broader initiative underpinning it, successfully emphasises the necessity of adopting a catchment-based planning approach as a prerequisite for the effective management and restoration of urban water bodies.

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