Toolkit
for
Preparing City Action Plans for Reuse of Treated Used Water

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Title
Toolkit for “Preparing City Action Plans for Reuse of Treated Used Water”

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Abbreviations

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BOD	Biological Oxygen Demand
CEEW	Council on Energy, Environment and Water
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CSR	Corporate Social Responsibility
DJB	Delhi Jal Board
DO	Dissolved Oxygen
FC	Fecal Coliform
JJM	Jal Jeevan Mission
MLD	Million Litres per Day
NGT	National Green Tribunal
NIUA	National Institute of Urban Affairs
NMCG	National Mission for Clean Ganga
RCA	River Cities Alliance
RMC	Ready Mix Concrete
SBM	Swachh Bharat Mission
STP	Sewerage Treatment Plant
TDS	Total Dissolved Solids
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
TUW	Treated Used Water
ULBs	Urban Local Bodies
UTs	Union Territories

Messages from the Leaders

Director General, National Mission For Clean Ganga

Shri. G. Asok Kumar

I am pleased to announce the toolkit for cities to prepare an action plan for the reuse of treated used water. Developed through collaboration between NIUA, NMCG, and CEEW, this toolkit is a comprehensive guide to help cities assess existing treated used water resources, identify opportunities for reuse, and implement effective strategies.

As we face increasing challenges in water management, this toolkit represents a significant step towards sustainable urban water practices. In the pursuit of a sustainable future, this toolkit stands as a powerful tool for positive change. Let's forge ahead and make a lasting impact on the way we manage and utilise our water resources.

Director , National Institute of Urban Affairs

Dr. Debolina Kundu

Introducing the toolkit for “Preparing City Action Plans for Reuse of Treated Used Water” – a transformative initiative addressing India's escalating water challenges. With only 3% of treated used water currently being utilised across the country, this toolkit offers a beacon of hope for sustainable urban water management.

Amidst water scarcity concerns and looming stress on river basins, the toolkit equips cities to assess, plan, and implement effective interventions, fostering innovation and economic benefits. It signifies a crucial shift toward a resilient and sustainable urban water future, urging collective action for abundant, pure, and accessible water for all.

CEO, Council on Energy, Environment and Water

Dr Arunabha Ghosh

Water is an important link when thinking about a sustainable economy. Treating used water and re-using it provides not only environmental benefits but also economic ones. CEEW analysis shows that revenue generated from making use of treated used water for irrigation in India would have been INR 966 billion in 2021.

But for India's Urban Local Bodies to unlock this potential, there needs to be an understanding of existing policy support in India and exposure to approaches and business models implemented in other countries that are at an advanced stage of enabling a circular economy in water.

TABLE OF CONTENTS

BOX ITEMS

1. Introduction

India is witnessing high pressure on its limited freshwater resources. As per the Composite Water Management Index of India, about 70 per cent of India's water supply is contaminated (NITI Aayog 2019). Thus, both the quantity of freshwater available and its quality are of concern. In the urban context, the situation is likely to get worse with rapid unplanned urbanisation and industrialisation putting pressure on stressed freshwater resources. Therefore, there is a need to look beyond the conventional freshwater supplies, reusing treated used water offers one such opportunity. We need a paradigm shift to a circular approach in used water management that mainstreams used water treatment and reuse in the broader water management context. In response to escalating water scarcity and the challenges of climate change, the reuse of treated used water emerges as a pivotal strategy for sustainable water management. Reused treated water, meeting stringent quality standards, not only alleviates the burden on freshwater resources and fosters economic sustainability but also inherently contributes to climate resilience by diversifying water sources and reducing the vulnerability of traditional supplies to climate-induced fluctuations.

The safe and practical application of re-use of treated used water within urban limits has emerged as one of the priority areas as identified by the river cities. The key national missions like Namami Gange, AMRUT, and SBM have been instrumental in pushing the agenda and creating an enabling environment for the reuse of treated used water in urban areas. However, cities are facing challenges in implementing measures on the ground due to the lack of knowledge around the scientific application of re-use measures. To address the need of cities to implement an efficient reuse infrastructure, the National Institute of Urban Affairs (NIUA) along with the National Mission for Clean Ganga (NMCG) have prepared a Toolkit aimed at guiding the cities in taking a step-by-step approach to assess their current situation about the availability of treated used water and possible avenues for its reuse and application. The Toolkit also aims to help cities make informed decisions concerning the planning and implementation of treated used water reuse infrastructure. The Toolkit will be a guiding document for "Preparing City Action Plans for Reuse of Treated Used Water (TUW)" and will help with sustainable water management, diversification of water sources, and environmental protection.

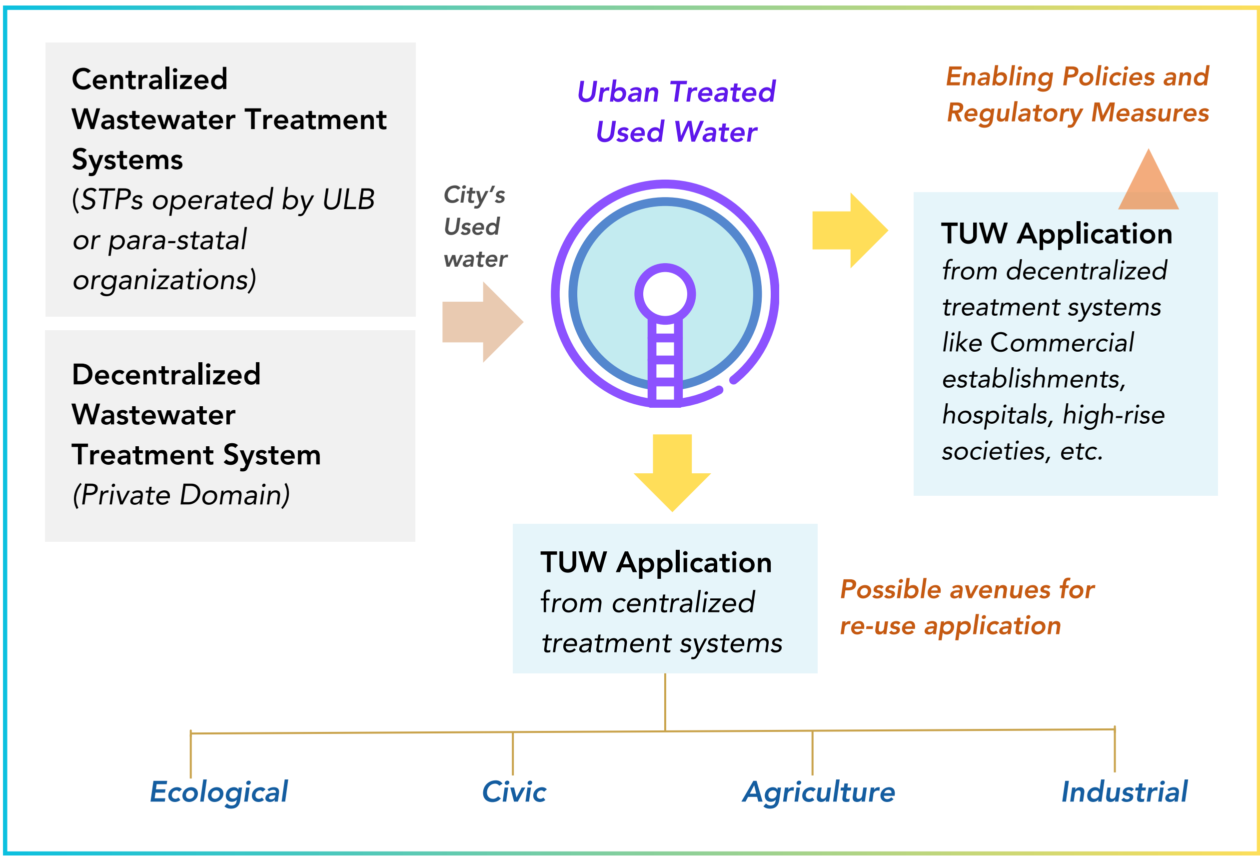
2. Objectives of the Toolkit

The overall objective of this Toolkit is to assist member cities of the River Cities Alliance (RCA) and other cities in India in preparing an action plan for managing the treated used water within their city limits. While the central focus is on the Ganga Basin Cities, the document also applies to other cities in India. The key objectives of the toolkit includes;

- Understanding of various reuse avenues and fit-for-purpose TUW quality standards required
- Strategy for mapping of TUW and prioritizing the reuse applications
- Safety protocols and precautionary principles of reuse applications
- To capacitate ULBs on practical aspects of the reuse of TUW within the city limits

3. Scope of the Toolkit

The scope of the toolkit is centred around treated used water generated within the city and managed by the Urban Local Body (ULB) and para-statal organizations within the cities. The toolkit also extends its influence to private establishments through a set of policy recommendations, encouraging them to adopt responsible used water treatment, disposal and reuse practices.



Box-1 The distribution of urban treated used water and the scope of the toolkit

4. Components of the Toolkit

The major components of the Toolkit include assessment of existing used water infrastructure in the city, regulatory compliance being followed by the ULBs, resource recovery, and environmental impact assessment of the reuse projects. It also talks about engaging the communities for implementing and sustaining the reuse projects, and policy recommendations for private establishments.

1. Mapping the existing TUW available for reuse

- Mapping all the existing treated used that are accessible for further usage.
- Assessing the treated used water quality.

2. Identifying reuse avenues and setting targets

- Identifying different reuse avenues like industrial processes, agricultural irrigation, landscape irrigation, cooling water for power plants etc.
- Prioritize the use of TUW based on need, feasibility, economic viability, water quality requirements, and potential benefits.
- Setting targets for the city to improve the reuse of TUW.

3. Planning and designing interventions

- Detailed plan for implementing projects by creating a roadmap that outlines the timeline, budget, and responsible parties for each project or initiative.
- Treatment technologies to be used, infrastructure requirements, and funding sources to enhance TUW quality, quantity and supply.

4. Enabling policy and regulatory measures

- To enable policies, and regulations that govern the quality, distribution, and use of treated used water.
- Responsibilities for oversight and compliance monitoring, including penalties for violations

5. Monitoring, evaluation and learning of reuse projects

- Implement a robust water quality monitoring program that includes routine sampling, analysis and monitoring to ensure it meets reuse standards.
- After meeting short-term goals, ULBs should aim and act to achieve the next target set by themselves.

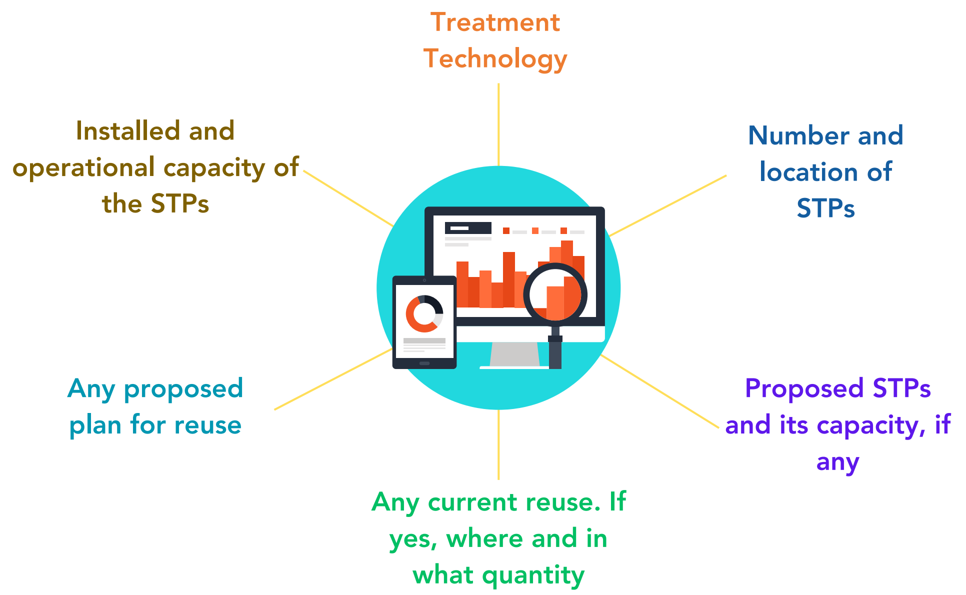
Box-2 *Components of the Toolkit*

4.1. Mapping the existing TUW available for reuse

The Toolkit begins with an assessment of the current wastewater treatment infrastructure within the city. This involves a thorough evaluation of treatment plants, and associated facilities managed by the ULB and other para-statal agencies in the cities.

4.1.1. Map the existing sewage treatment infrastructure and current reuse practices in the city

An updated existing infrastructure data is an essential pre-requisite for proper planning and designing of the TUW reuse action plan. The city needs to first map all the existing sewage treatment infrastructure under the ULB/Parastatal domain in the city. This data includes collection and conveyance system, the location and details of sewage treatment plants which includes the number of STPs, designed capacity, operational capacity, technology, level of treatment, proposed STPs and existing reuse applications in the city.



Box-3 Data points that the city needs to capture for mapping existing sewage treatment infrastructure

4.1.2. Assess the quality of treated used water from the STP outlet

Assessing the quality of treated used water (effluent) from STP is essential to ensure that it meets regulatory standards and is safe for discharge into the environment. The water quality parameters need to be assessed against the national regulatory standards as mentioned in Box 5. These standards define acceptable levels for various pollutants to ensure the treated effluents are safe for the environment and human health.

As per the Central Pollution Control Board (CPCB) and National Green Tribunal (NGT), the following parameters need to be assessed for treated used water.

Box-4 Used water quality parameters

Following are the minimum water quality standard that needs to be achieved for the effluent from the STPs. These parameters apply to all modes of disposal, whether on land or in a water body.

Parameters	**Standards (mg/l)**			
	Mega & Metropolitan Cities *(population more than 4 million)*	**Class 1 Cities** *(population more than 1 million)*	**Others** *(population less than 1 million)*	**Deep Marine Outfall**
pH	5.5–9.0	5.5–9.0	5.5–9.0	5.5–9.0
Biological Oxygen Demand	10	20	30	30
Total Suspended Solids	20	30	50	50
Chemical Oxygen Demand	50	100	150	150
Total Nitrogen	10	15	-	-
Total Phosphorus	1.0	1.0	1.0	-
Fecal Coliform	Desirable—10 Permissible—230	Desirable—230 Permissible—1000	Desirable—1000 Permissible—10,000	Desirable—1000 Permissible—10,000

Box-5 Showing minimum water quality standards by Central Pollution Control Board (CPCB) for disposal of TUW

4.2. Identifying reuse avenues and setting targets

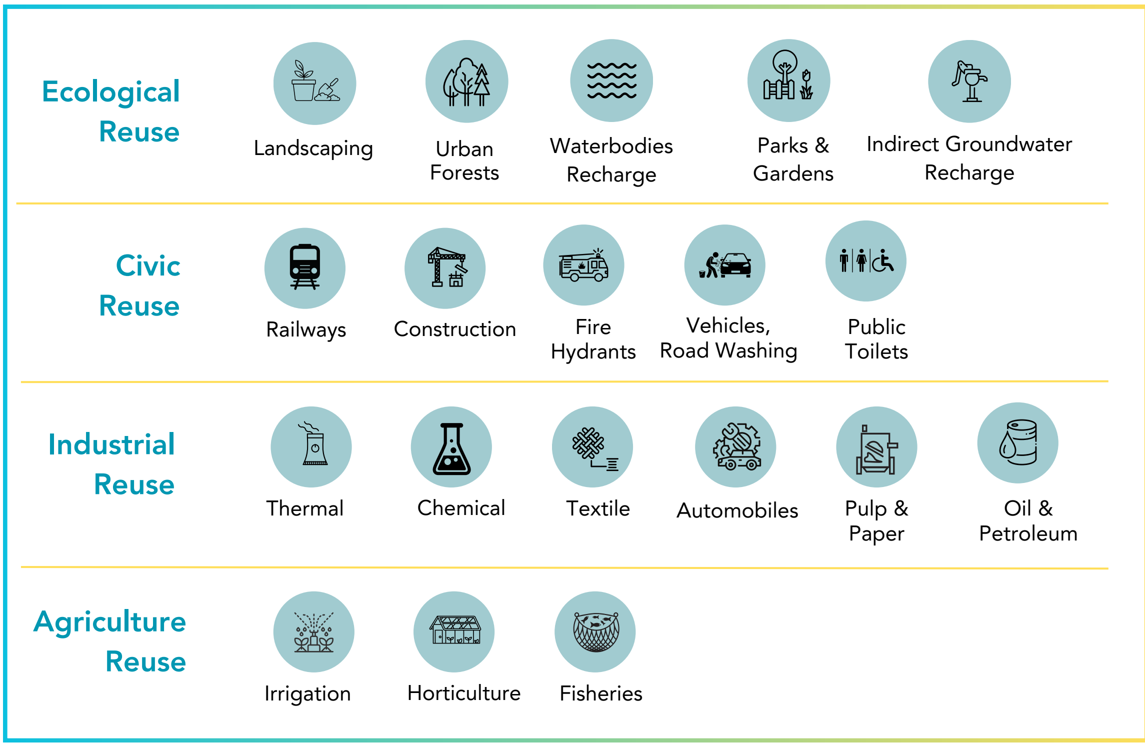
Identifying reuse avenues and setting targets is a critical aspect of sustainable water resource management. This process involves a comprehensive evaluation of the treated used water's quality and its potential applications. It encompasses assessing the used water's suitability for various reuse purposes, such as irrigation, industrial processes, or even direct potable reuse, depending on the level of treatment achieved. Setting city-specific reuse targets involves defining clear objectives for the volume and quality of treated used water to be reused, which can help conserve freshwater resources and reduce the strain on existing water supplies.

4.2.1. Identify the bulk water users in the city

Once the city has mapped the TUW available for reuse, the second pivotal step is identifying bulk water users. These users typically include industrial facilities, parks and gardens, bus depots, railway stations, fire hydrants, and construction sites, all of which have substantial water consumption demands in the context of urban reuse. By recognising and categorising these major consumers, local authorities and utilities can tailor strategies to regulate and optimise water usage. A city can strategise and prioritise reuse avenues based on both potable (indirect) and non-potable water demand within the city.

The following are the parameters which the city needs to consider for identifying the potential reuse avenues for financial viability, feasibility and sustainability of initiatives:

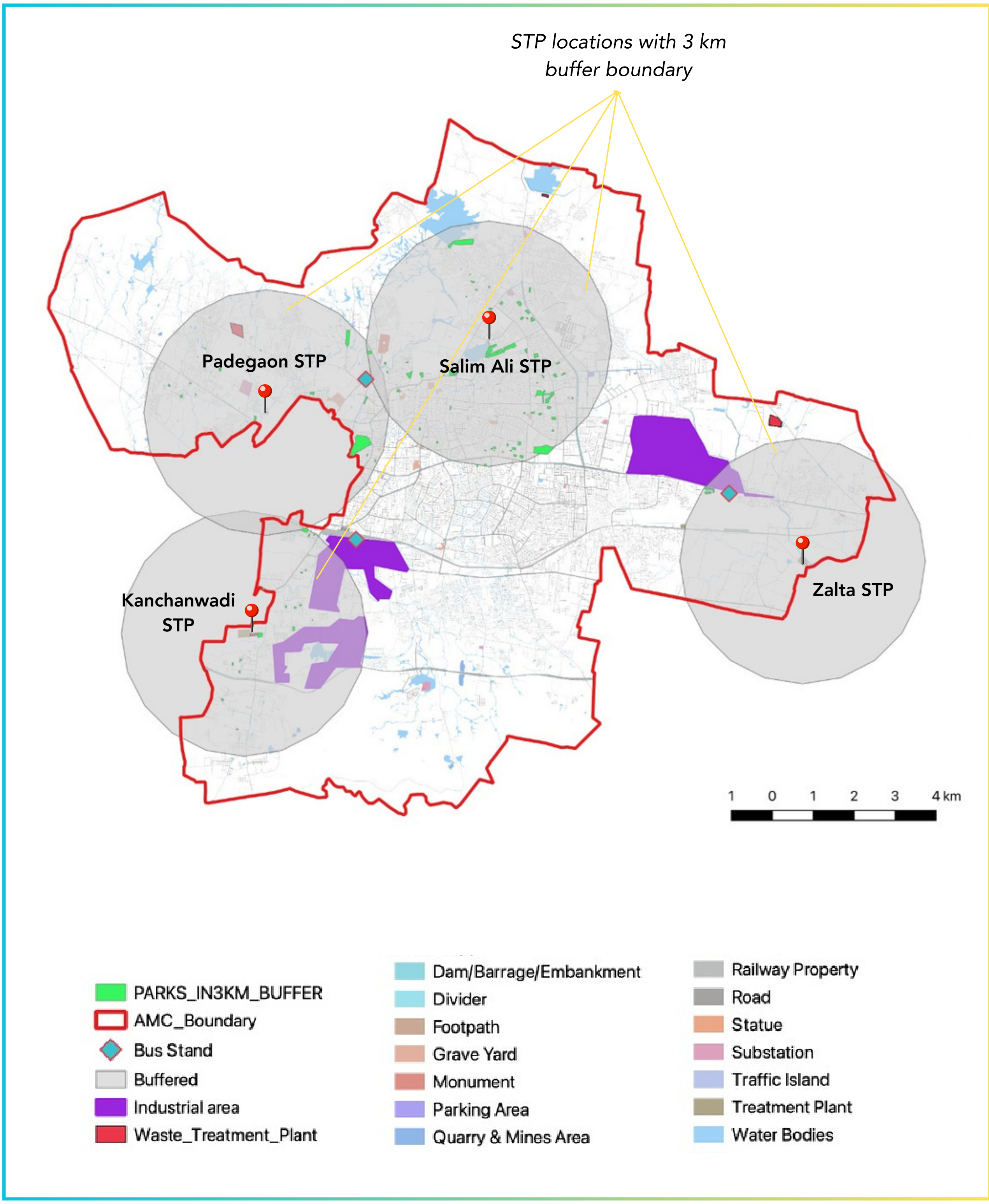
- Quantity of TUW required for the identified reuse application avenue
- Location of the avenue
- Frequency of reuse water required
- Quality of TUW required
- Mode of conveyance (from point of generation to point of reuse)
- Treatment and conveyance infrastructure upgradation required



Box-6 Potential avenues for the reuse of TUW in the urban context

4.2.2. Map the Identified bulk water users in the city

This process involves creating a spatial representation of all the identified bulk users to gain a clear understanding of their locations, consumption, and their proximity to the existing STPs. By spatially mapping these bulk users, local authorities and utility providers can better plan for water allocation, infrastructure development, and conservation efforts.



Box-7 Identified bulk water users in Chattrapati Sambhaji Nagar (erstwhile Aurangabad) City as an example

4.2.3. Estimate the water demand from identified avenues for reuse

It involves assessing the specific requirements for water in various reuse applications, such as irrigation, industrial processes, or waterbody rejuvenation, and calculating the expected volume needed to meet these demands. Accurate estimation ensures that the available treated used water is optimally allocated, minimising water wastage and maximising resource utilisation. It also enables the authorities to plan for the necessary infrastructure and treatment capacity to support these reuse initiatives effectively, promoting water conservation, reducing dependence on freshwater sources, and contributing to a more resilient and sustainable urban water supply.

Box-8 The process that the city can follow to estimate the water demand for various use cases.

S.No.	Reuse Category	Avenues	Process to be followed
1.	Ecological Reuse	Landscaping, parks & gardens	• Get data from the horticulture department on water required per day for all the lanscaping needs of the city including parks, gardens, road medians, etc. • The demand can be estimated using the formula given below *Total Water demand = total area (in hac) X water required per hac (25000 litre/Ha standard can be taken in case of no data)*
2.		Water body rejuvenation	• Collect data like surface area, depth, water table, soil texture, use of water body, etc. to calculate the volume of water body and water required to maintain positive water balance.
3.		Indirect Groundwater recharge	• Map the groundwater level in the city area to understand the critical locations where recharge can be done. *(It is important to note that direct injection of TUW into ground water should be avoided).* • Gather data for the identified location like soil type, ownership, quality of groundwater, etc. for creating artificial lake/pond. • Calculate volume of artificial lake/pond created for ground water recharge.

S.No.	Reuse Category	Avenues	Process to be followed
4.	Civic Reuse	Railways	• 12,000 litres to 14,000 litres of water used for cleaning one train consisting of 22-24 coaches • Apron washing: 10 litres/sqm • Platform washing: 5 liters/sqm • Washing of coaches on washing lines: 3600 litres (B.G), 2600 litres (M.G) • Cleaning of coaches on platform: 500 litres • Get data on water required for flushing in the toilet complex Water demand = water required to wash coaches + water required to wash platform + water required for apron washing + water required for flushing in the toilet complex
5.		Bus depot	• Water demand = Number of buses being washed at the depot X water required to wash 1 bus + water required for flushing in the toilet complex • Water required to wash 1 bus: 150 litres (standard water required for washing 1 bus) • Get data on water required for flushing in the toilet complex
6.		Construction	• Get data from the Ready Mix Concrete (RMCs) for water demand
7.		Fire hydrants	• Get data from the fire department for water required to maintain their water storage system To estimate the water demand • $Q = 100\sqrt{P}$, where Q is water required in cubic meters & P is population in thousands • Rate of fire demands is calculated by Kuichling's formula which gives amount of water required in litres/minute – $Q = 3182\sqrt{P}$
8.	**Industrial Reuse**	Industries	• Identify the type and units of the industries in the city • Get data from these industries regarding the processes where TUW can be reused and the quality and quantity of water required for the same
9.	**Agricultural Reuse**	Irrigation, horticulture, fisheries, etc.	• Get data on the existing area in and around the city requiring water for irrigation • Map the type of crops being cultivated to understand the quality and quantity of TUW required • Calculate the water required per day per acre for the identified crop type

4.2.4. Map minimum water quality standard required for identified use cases

This process involves the mapping of specific quality parameters like chemical composition, microbial content, and physical characteristics needed to meet the demands of various applications such as irrigation, industrial processes, vehicle washing, landscaping, etc. This facilitates precision in water quality management, safeguarding public health and the environment while allowing for targeted treatment processes and compliance with regulatory guidelines, ultimately contributing to sustainable and reliable water provision in the designated areas.

Box-9 The minimum water quality standards required for different use cases
Source - Ministry of Housing and Urban Affairs (MoHUA)

- *All values are in mg/l except for Turbidity, pH, Temperature, faecal Coliform, Helminthic Eggs, Colour and Odour.*
- *AA - As Arising when other parameters are satisfied*

S.No.	Reuse Category	Avenues	Minimum Water Quality Standard required
1.	**Ecological Reuse**	Landscaping, parks & gardens	• *Turbidity: AA* • *pH: 6.5-8.5* • *Temperature: Ambient* • *Oil/Grease: 10* • *TN: AA* • *COD: AA* • *FC: Nil (in 100 ml)* • *TDS: 2100* • *Min. Res. Chlorine: nil* • *BOD: < or = 6-10 (< or = 6 preferred)* • *TP: AA* • *SS: AA* • *Helminthic Eggs/litres: AA* • *Colour: Colourless* • *Odour: Aseptic which means not specific and no foul odour*
2.		Water body rejuvenation & indirect groundwater recharge	• *Turbidity: <2* • *pH: 6.5-8.5* • *Temperature: Ambient* • *Oil/Grease: nil* • *TN: 10* • *COD: AA* • *FC: 100 (in 100 ml)* • *TDS: 2100* • *Min. Res. Chlorine: 0.5* • *BOD: 10* • *TP: 1* • *SS: AA* • *Helminthic Eggs/litres: AA* • *Colour: Colourless* • *Odour: Aseptic which means not specific and no foul odour*

S.No.	Reuse Category	Avenues	Minimum Water Quality Standard required
3.	**Civic Reuse**	Vehicle exterior washing (Railways & Bus Depots)	• *Turbidity: <2* • *pH: 6.5-8.5* • *Temperature: Ambient* • *Oil/Grease: nil* • *TN: 10* • *COD: AA* • *FC: nil (in 100 ml)* • *TDS: 2100* • *Min. Res. Chlorine: 1* • *BOD: < or = 6* • *TP: 1* • *SS: AA* • *Helminthic Eggs/litres: AA* • *Colour: Colourless* • *Odour: Aseptic which means not specific and no foul odour*
4.		Fire hydrants	• *Turbidity: <2* • *pH: 6.5-8.5* • *Temperature: Ambient* • *Oil/Grease: nil* • *TN: 10* • *COD: AA* • *FC: nil (in 100 ml)* • *TDS: 2100* • *Min. Res. Chlorine: 1* • *BOD: 10* • *TP: 1* • *SS: AA* • *Helminthic Eggs/litres: AA* • *Colour: Colourless* • *Odour: Aseptic which means not specific and no foul odour*
5.		Public toilets (Flushing)	• Turbidity: <2 • *pH: 6.5-8.5* • Temperature*: Ambient* • Oil/Grease: 10 • TN: 10 • COD: AA • FC: Nil (in 100 ml) • TDS: 2100 • Min. Res. Chlorine: 1 • BOD: < or = 6 • TP: 1 • SS: AA • Helminthic Eggs/litres: AA • Colour: Colourless • Odour: Aseptic which means not specific and no foul odour

<table>
<tr><th>S.No.</th><th>Reuse Category</th><th>Avenues</th><th>Minimum Water Quality Standard required</th></tr>
<tr><td>6.</td><td>Industrial Reuse</td><td>Industries</td><td>
Boiler Feed - Calcium (0.01 - 0.4), Iron (0.05 - 1.0), Mangnese (0.01 - 0.3), Alkalinity (40 - 350), Chloride (-), TDS (200-700), Hardness (0.07-350), Ammonium-N (0.1), Phosphate-P (-), Silica (0.7-30), Colour (-)
Pulp and paper - Calcium (20), Iron (0.3 - 1.0), Mangnese (0.05 - 0.5), Alkalinity (100), Chloride (200-1000), TDS (-), Hardness (100), Ammonium-N (-), Phosphate-P (-), Silica (50), Colour (10-30)
Textiles - Calcium (-), Iron (0.1 - 0.3), Mangnese (0.1 - 0.05), Alkalinity (-), Chloride (-), TDS (100), Hardness (25), Ammonium-N (-), Phosphate-P (-), Silica (-), Colour (5)
Petroleum and Coal - Calcium (75), Iron (1), Mangnese (-), Alkalinity (125), Chloride (300), TDS (1000), Hardness (350), Ammonium-N (-), Phosphate-P (-), Silica (-), Colour (-)
Cooling Tower - Calcium (100), Iron (-), Mangnese (-), Alkalinity (-), Chloride (100), TDS (-), Hardness (-), Ammonium-N (1-3), Phosphate-P (0.6), Silica (20), Colour (-)
</td></tr>
<tr><td>7.</td><td rowspan="2">Agricultural Reuse</td><td>Non-edible crops</td><td>
Turbidity: AA
pH: 6.5-8.5
Temperature: Ambient
Oil/Grease: 10
TN: AA
COD: AA
FC: 100 (in 100 ml)
TDS: 2100
Min. Res. Chlorine: nil
BOD: < or = 6-10 (< or = 6 preferred)
TP: AA
SS: AA
Helminthic Eggs/litres: <1
Colour: AA
Odour: Aseptic which means not specific and no foul odour
</td></tr>
<tr><td>8.</td><td>Crops which are eaten 'Raw'</td><td>
Turbidity: AA
pH: 6.5-8.5
Temperature: Ambient
Oil/Grease: nil
TN: AA
COD: AA
FC: nil (in 100 ml)
TDS: 2100
</td></tr>
</table>

S.No.	Reuse Category	Avenues	Minimum Water Quality Standard required
			• *Min. Res. Chlorine: nil* • *BOD: < or = 6-10 (< or = 6 preferred)* • *TP: AA* • *SS: AA* • *Helminthic Eggs/litres: <1* • *Colour: Colourless* • *Odour: Aseptic which means not specific and no foul odour*
9.	**Agricultural Reuse**	Crops which are eaten 'Cooked'	• Turbidity: AA • *pH: 6.5-8.5* • Temperature*: Ambient* • Oil/Grease: nil • TN: AA • COD: AA • FC: < or = 50 (in 100 ml) • TDS: 2100 • Min. Res. Chlorine: nil • BOD: < or = 6-10 (< or = 6 preferred) • TP: AA • SS: AA • Helminthic Eggs/litres: <1 • Colour: AA • Odour: Aseptic which means not specific and no foul odour

4.2.5. Setting city-level targets to improve the reuse of TUW

This step includes setting specific targets for freshwater use reduction and improving the use of TUW. By establishing precise and achievable benchmarks, local authorities can align their efforts and resources toward these objectives, ensuring efficient TUW distribution and environmental protection. Urban Local Bodies (ULBs) can set these targets for the next 5 or 10 years, depending on the amount of TUW generated in the city, identified avenues for reuse, and infrastructure upgrades required to fully implement the reuse projects. This target setting will help cities create a vision to reduce the load on freshwater demand and work towards water security and climate resilience, as treated used water is a perennial source of water supply.

The targets can be set by stating -

- To reduce the freshwater consumption for non-potable consumption by at least a certain % by the targeted year
- To reach a certain % in reusing TUW by 2025
- To reach a certain % in reusing TUW by 2030

4.2.6. Safety protocols

Identifying safety protocols for the reuse of treated used water is essential for protecting public health and the environment. These protocols encompass a range of measures, including stringent water quality testing and monitoring, risk assessments for potential contaminants, validation of treatment processes, and the establishment of clear guidelines for approved uses of recycled water. Safety protocols also involve proper infrastructure design to prevent cross-contamination, ensuring adequate public awareness and education about the safe use of recycled water. By implementing robust safety protocols, authorities can ensure that treated used water is used responsibly and without harm, fostering a sustainable approach to water resource management while minimising health and environmental risks.

For example, safety protocols for using TUW for landscaping may include -

- Avoid direct contact with the TUW as much as possible during the reuse application
- Mechanised way of watering (sprinkles, pipe etc) should be adopted wherever possible
- Minimum distance to the freshwater supply source should be maintained
- Different labelled or coloured TUW supply system will help in minimising cross-contamination with other water supply systems
- The time of the application of TUW can help reduce the chance of direct contact with the public. Early morning times can be adopted for activities such as watering, etc.
- Regular monitoring of TUW quality

4.3. Planning and designing interventions

Creating a detailed plan for implementing projects is an important stage, ensuring that initiatives proceed effectively and efficiently. This step typically involves developing a comprehensive roadmap that outlines the specific timeline, budget allocation, and the responsible parties for each identified project. It includes planning for infrastructure requirements, encompassing the construction or enhancement of treatment facilities, pipelines, storage reservoirs, and distribution systems. It also involves identifying the sources of funding, including governmental grants, public-private partnerships, or utility fees, which are essential for project feasibility, financial viability, and sustainability.

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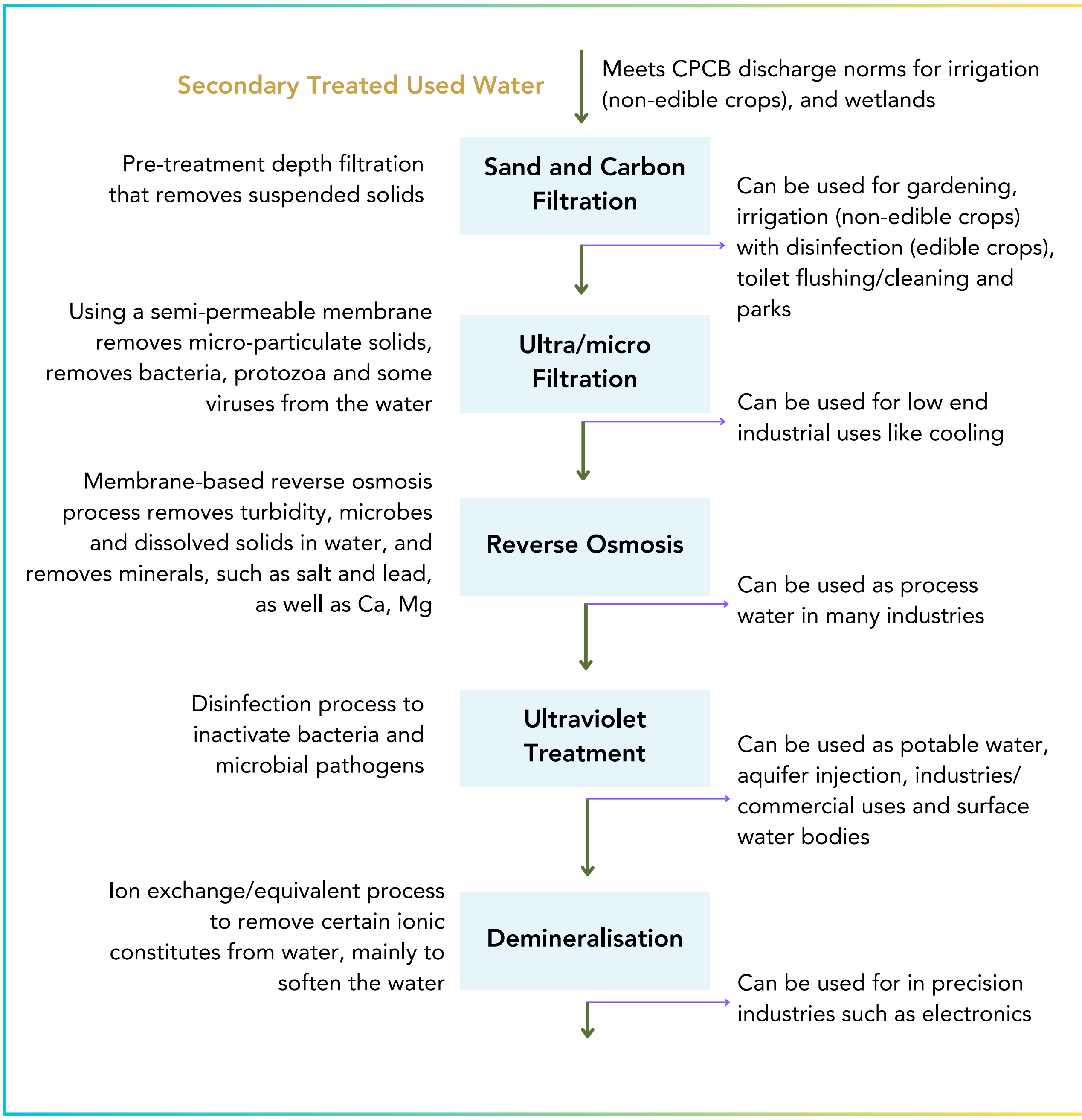
4.3.1. Technology and infrastructure upgradation required

Technology and infrastructure upgrades are imperative for ensuring the successful reuse of TUW. It entails the adoption of advanced treatment technologies capable of consistently meeting stringent water quality standards, including the removal of contaminants and pathogens. Upgrading existing infrastructure with retrofitting of advanced and novel technologies or establishing new facilities may be necessary to accommodate the treatment processes, storage, and distribution requirements for reclaimed water. Infrastructure improvements should ensure the prevention of cross-contamination and the safe conveyance of treated water to end-users. This includes the construction or retrofitting of treatment plants, pipelines, distribution networks, and storage reservoirs, as well as the integration of monitoring and control systems to guarantee the reliability and quality of reclaimed water.

Authorities need to identify the necessary technology upgrades for the intended use case of TUW. For instance, if an existing STP provides only secondary treatment and TUW is proposed for irrigation purposes, a new disinfection step must be introduced as a tertiary treatment. The authority must map the infrastructure required to meet the minimum water quality standard necessary for irrigation. Similarly, for all identified use cases, such as construction, road cleaning, bus depots, railways landscaping, etc., authorities need to assess the required technology upgrades and infrastructure needed to achieve the minimum water quality standards.



Box-10 Incremental technology interventions required to achieve different end uses of TUW, (Source - National Framework on safe reuse of TUW, National Mission for Clean Ganga)

4.3.2. Select mode for conveyance/distribution of TUW

Selecting the mode of conveyance for TUW is a crucial decision, and it depends on factors such as the volume of reclaimed water, distance to end-users, and existing infrastructure. The modes of conveyance could be dedicated pipe networks, tanker trucks, constructed drains (open/close) or a combination of these methods. Pipelines offer a cost-effective and environment-friendly solution for the conveyance of large volumes of TUW over a long distance but may require substantial upfront investments. Tanker trucks are more flexible and suitable for shorter distances or areas with limited infrastructure but are not environmentally sustainable for long distances and large volumes. The mode of transportation of TUW can be selected based on the following parameters -

- ***Identified avenue for reuse*** - The type of avenue identified for the reuse is important to understand before selecting the mode of transportation of TUW. The type can range from ecological reuse like waterbody rejuvenation to civic use like irrigating farmlands, washing vehicles, construction activities etc.
- ***Frequency of use*** - The frequency of use, whether it's continuous or intermittent, influences the mode of transportation and storage needs. Applications requiring a constant supply, like industrial processes, may need a pipeline against the intermittent supply required for landscaping that requires less volumes.
- ***Distance from the STP*** - The distance between the STP and the end-users is a key factor in mode selection. Longer distances may favour pipelines, while short distances can be accommodated through tanker trucks or local distribution systems like drains (open/close).
- ***Land use around the STP*** - The landuse around the STP is important because densely populated areas might pose challenges for laying pipelines due to space constraints and the need for coordination with existing infrastructure. In such cases, alternative modes like tanker trucks might be preferred.
- ***Storage infrastructure required*** - Evaluating whether existing storage infrastructure can be repurposed or if new infrastructure needs to be created is essential. Efficient storage is critical for managing fluctuations in demand and ensuring a reliable supply of treated water.
- ***Cost of different modes*** - The cost analysis is a pivotal consideration. Pipeline systems often have higher upfront costs but lower operational expenses in the long run, making them favourable for large and continuous uses. Tanker trucks may be more cost-effective for shorter distances or intermittent applications, but they entail ongoing operating costs and environmental considerations. *(Laying pipeline – approx. 1.3 Crore/km & Tanker – 2 to 8 lakh (one-time purchase), 5-10 Rs. / litres (if rented))*

4.3.3. Cost estimation

Cost estimation for implementing the TUW project is a critical process that involves a comprehensive evaluation of all financial aspects. City authorities need to conduct a detailed assessment of costs associated with the TUW reuse project, including technology upgrade costs, infrastructure costs for laying pipelines, construction costs, equipment procurement, labor expenses, operational and maintenance costs, and potential contingencies. A thorough understanding of the project scope, design, and technology requirements is essential for an accurate estimate.

In addition, it should consider factors such as regulatory compliance, infrastructure development, and any land acquisition or permitting costs. Proper cost estimation helps city authorities to allocate resources efficiently, secure funding, and establish realistic budgets, ensuring that the TUW project is executed within financial constraints while meeting quality and environmental standards.

4.3.4. Funding avenues

Identifying funding avenues for reuse of TUW, entails a comprehensive exploration of financial resources and mechanisms available to support the initiative. Funding sources can encompass government grants, subsidies, and allocations from central, state and local authorities, which are often instrumental in promoting environmental and sustainability goals. In addition, private sector investments, including public-private partnerships (PPPs), corporate social responsibility (CSR) contributions, and venture capital, may play a pivotal role in project financing. The details on national missions providing funding and creating an enabling environment for city to adopt reuse practices are provided below -

Box-11 National and state-level mission providing funding to adopt reuse of TUW

AMRUT 2.0

Aimed at making cities water secure and enhancing circular economy through recycling of wastewater in 500 cities in India. It envisages recycling of treated wastewater to meet 20% of the total city water demand and 40% of industry water demand in aggregate at the state level.

Swachch Bharat Mission (Urban) 2.0

Involves a component of used water management to ensure that no untreated used water is discharged into the environment, all used water is safely contained, transported, and treated, along with maximum reuse of treated used water, in all cities with less than 1 lakh population.

Namami Gange

Under NMCG, projects for the expansion and enhancement of sewerage networks and in-situ sewage treatment options have been sanctioned. MoUs have been signed by NMCG with the Ministry of Power, Ministry of Railways and Ministry of Agriculture for reuse of treated wastewater.

Jal Jeevan Mission

Jal Jeevan Mission includes components for water treatment facilities and greywater recycling.

15th Finance Commission

15th Finance Commission allocates funds to Urban Local Bodies tied to their performance on water and sanitation services.

State Level Fund
Eg. Tamil Nadu Green Climate Fund

A strategic opportunity exists for advancing projects focused on the reuse of TUW. By earmarking these funds for such initiatives, the state can bolster its resilience against climate change impacts while simultaneously addressing water scarcity challenges. Additionally, the funding can support awareness campaigns, stakeholder engagement, and capacity-building initiatives, ensuring that the benefits of TUW reuse projects extend across communities.

4.3.5. Map the nodal agency and other stakeholder

Mapping the nodal agency and other stakeholders is a crucial step in ensuring effective coordination and accountability. The nodal agency, typically a government department or authority, is responsible for project oversight, regulatory compliance, and decision-making. Meanwhile, stakeholders encompass a broad spectrum, including government bodies, local authorities, private sector partners, non-governmental organizations (NGOs), community representatives, and end-users. For each identified use case, city authorities need to identify the nodal agency and relevant stakeholders crucial for implementing the initiative. Accurate mapping of these entities helps establish clear lines of communication, define roles and responsibilities, and foster collaboration, ultimately contributing to the success and sustainability of the project.

For example - For the reuse of TUW in gardens and parks, the nodal agency will be the horticulture department of the city and other relevant stakeholders will be the pollution control department, the department looking after the O&M of STPs and the local community who are the users of these parks and garden.

4.3.6. Business Models

The reuse of TUW offers substantial environmental advantages, ranging from mitigating water scarcity by reducing the demand for freshwater sources to conserving natural ecosystems and alleviating water pollution. Additionally, it can create revenue-generation opportunities through the sale of treated water or by supplying water for various non-potable purposes, such as agriculture, industry, or urban landscape irrigation. To capitalize on these benefits effectively, it's essential to develop tailored business models that align with the specific end-use of the reclaimed water. These models can vary significantly, from public-private partnerships in industrial applications to community-led initiatives in agriculture. One of the major barriers to implementing reuse projects for local urban authorities is cost recovery. Hence, ensuring the financial viability of reuse projects is essential for developing a market for TUW. Sustainable business models should be a key part of city-level treated used water reuse plans.

Box-12 Case examples of some successful business models

Business Model	Implementation
Fixed price model (industrial reuse)	• The ULB enters into a long-term contract with an industry or a cluster of industries for bulk consumption of TUW at an agreed price. • The ULB can set up an additional tertiary treatment unit and operate it on its own. Alternatively, the ULB enters into a PPP arrangement with a private entity for the installation and O&M of a tertiary treatment unit. • The ULB ensures that the private entity supplies the agreed quantity of TUW to the bulk user (industry), and makes a net annuity payment to the private entity to ensure minimum revenue. • The private entity can further sell additional TUW to other consumers.
Investment by end-user model (industrial reuse)	• The ULB sells secondary treated water to an industry or industrial board at rates lower than industrial water tariffs paid by them otherwise. • The industry or industrial board is responsible for setting up the tertiary treatment unit and conveyance of the TUW to other participating industries at an agreed price.
Sale of TUW and other by-products	• The ULB can sell secondary treated water and treated sludge (biosolids) to farmers for reuse. • TUW can also be sold to the forest department for agroforestry reuse.
Corporate Social Responsibil-ity (CSR) model	• The private sector can be approached to invest in treatment infrastructure under their CSR programs. • Industries with in-house treatment units may be encouraged to provide a portion of their treated water for landscaping of urban greens as part of their CSR programs.

4.3.7. Set timelines

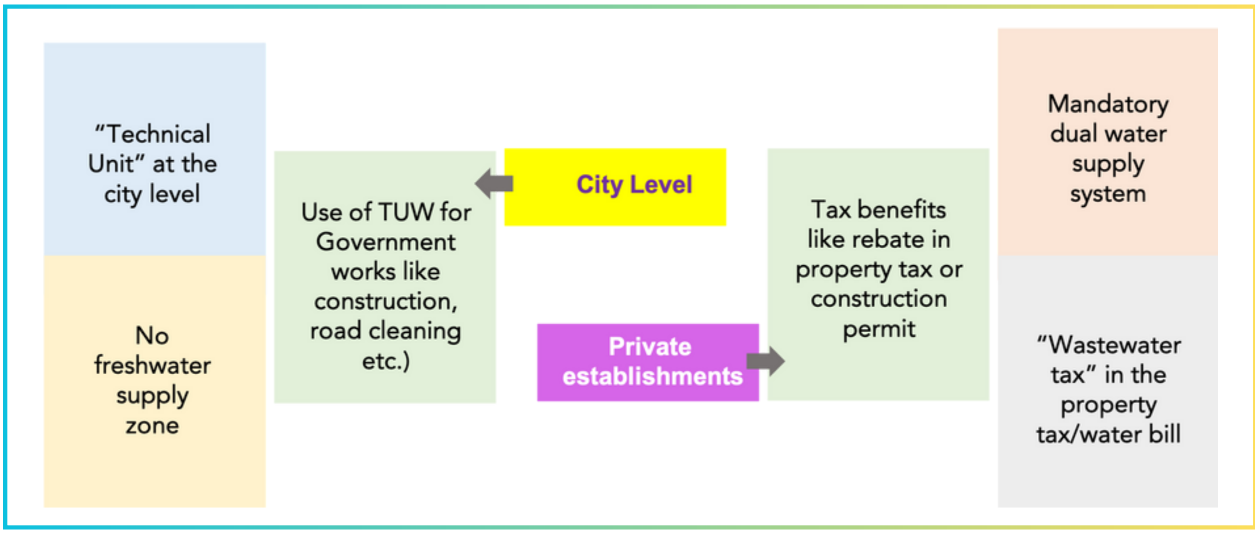
City authority needs to set the timeline and milestones in terms of short-term (0-6 months), medium-term (6-12 months) and long-term (more than 12 months) for implementing the identified projects for reuse of TUW. Short-term timelines will focus on immediate actions, such as project initiation, feasibility studies, and securing initial funding. Medium-term timelines will encompass critical phases like the upgradation of treatment plants, land acquisition process etc. Long-term timelines address ongoing operations, maintenance, and monitoring, emphasising the sustainable and efficient management of the TUW project over the years.

Box-13 Example of a set of activities and its timeline in terms of short, medium and long-term

S.No.	Activities/Actions	Timeline
1.	Mapping the existing TUW available in the city for reuse	Short-term
2.	Identify all the bulk users in the city and create a GIS map	Short-term
3.	Finalization of minimum water quality standards for the identified use case in consultation with CPCB	Short-term
4.	Retrofitting/modernization of non-complying STPs	Medium-term
5.	Land acquisition wherever necessary	Medium-term
6.	Laying of pipelines/construction of leading channels form STPs to use zones	Long-term
7.	Regular water quality monitoring of the effluent from the STP	Long-term

4.4. Enabling Policy and Regulatory Measures

Creating enabling policies and measures for the reuse of TUW in a city involves the development of a regulatory Toolkit that addresses various aspects of water management. This includes setting water quality standards, defining permissible end-uses, and establishing guidelines for the safe and efficient distribution of reclaimed water. Additionally, these policies should incentivize and promote water recycling, encourage private sector participation, and provide clear mechanisms for permitting and compliance. The enabling policies can address both the centralised treatment systems in the city operated by the ULB and the decentralised treatment systems operated by private entities. Around 15 States have prepared their state reuse policy and have listed down several policy measures that the city can take to promote the use of TUW. The city can leverage the policy measures listed in the state reuse plan and come up with a set of guidelines.



Box-14 Suggested policy measures that a city can take for both public and private treatment systems

4.5. Monitoring, Evaluation and Learning

Monitoring the project while simultaneously building capacity is a dual-pronged approach that enhances the project's effectiveness and long-term sustainability. To make the project technically feasible, financially viable, and sustainable, the city needs to create a detailed monitoring and evaluation plan. This plan involves continuous tracking of project performance, water quality, and operational aspects, providing real-time feedback to identify and address any issues promptly. CPCB has provided a set of guidelines for the same, which city authorities can refer to while preparing the monitoring and evaluation plan.

STP Monitoring Application

To help in close monitoring of the STP performance, CPCB has developed a mobile-based "STP Monitoring Application" launched in September 2020. This App will facilitate information flow from STPs to Urban Local Bodies, States and the Central level, and 1600+ STPs will be linked. This App can be downloaded from the Mobile App Store. Information on capacity and qualitative parameters like pH, TSS, COD, BOD and FC will be reported, and the same will be updated every week.

Simultaneously, the city authorities need to build the capacity of the city officials and other stakeholder in planning, designing, implementing and managing the TUW projects. Capacity building of the city officials will involve the knowledge and skills needed to manage and maintain the project. This encompasses training programs, workshops, and educational initiatives designed to enhance their understanding of used water treatment technologies, regulatory compliance, project management, and the complexities of TUW infrastructure. Capacity building extends to other stakeholders, including community representatives, local organizations, and utility providers, who play crucial roles in the success of TUW projects.

Engaging communities from the outset through awareness campaigns and public consultations helps build support for TUW projects. It educates residents about the benefits and safety of water reuse, mitigates concerns, and fosters a sense of ownership. Empowering communities to participate in monitoring involves establishing channels for feedback and reporting. This can include setting up community-based monitoring committees or online platforms where residents can report any issues or irregularities related to water quality, distribution, or project performance.

By fostering a culture of continuous learning and skill development, city authorities can ensure that these projects are not only implemented according to best practices but are also maintained and adapted to evolving circumstances.

"We must not let the opportunity simply disappear down the drain: it's time to realize the promise of wastewater as an alternative source of clean water, energy, and important nutrients."

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