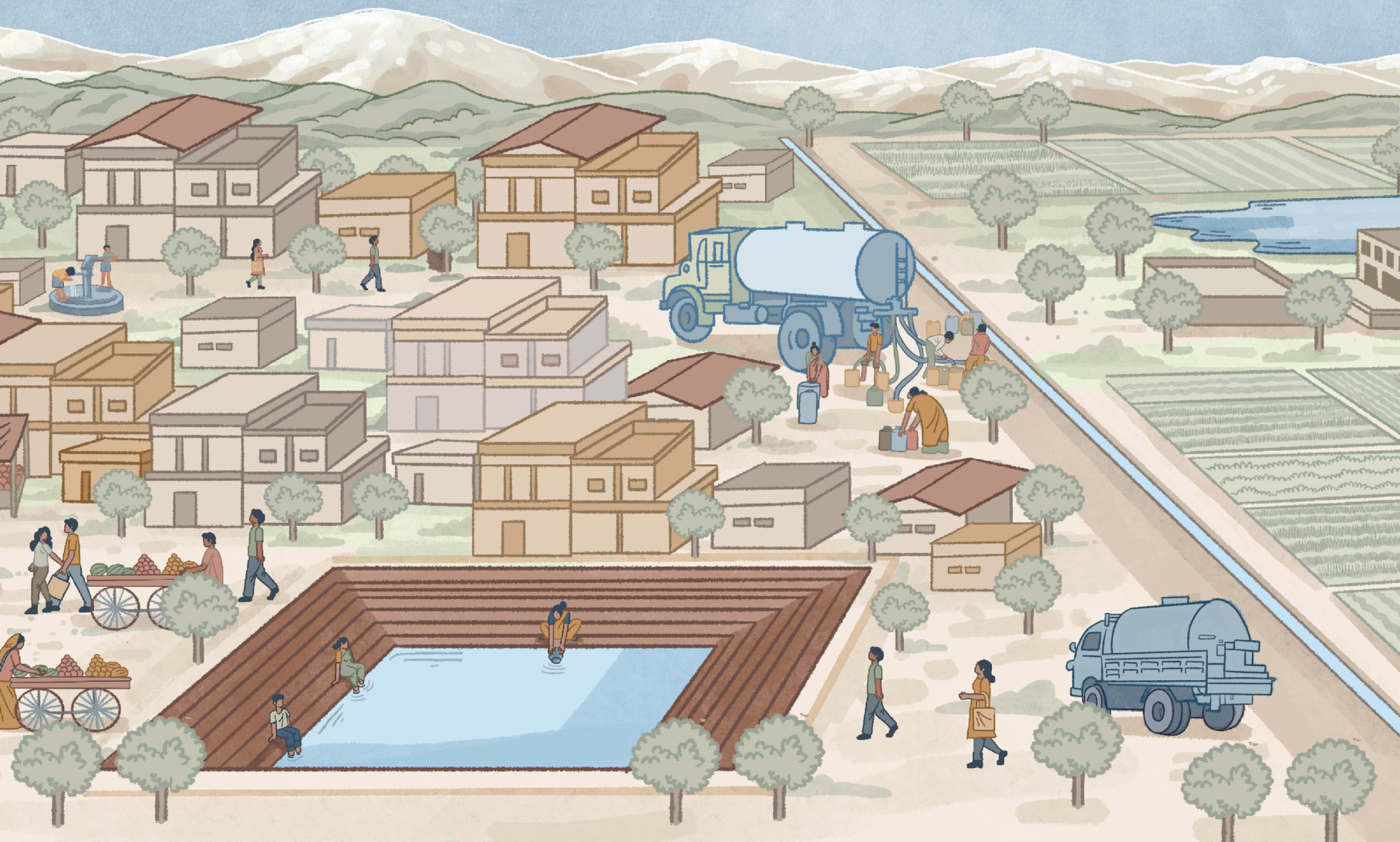
FOLLOWING THE FLOWS

Tracing the Total Water Flow in Emerging Urban Centres of South Asia



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Year 2025

FOLLOWING THE FLOWS

Tracing the Total Water Flow in Emerging Urban Centres of South Asia







in collaboration with

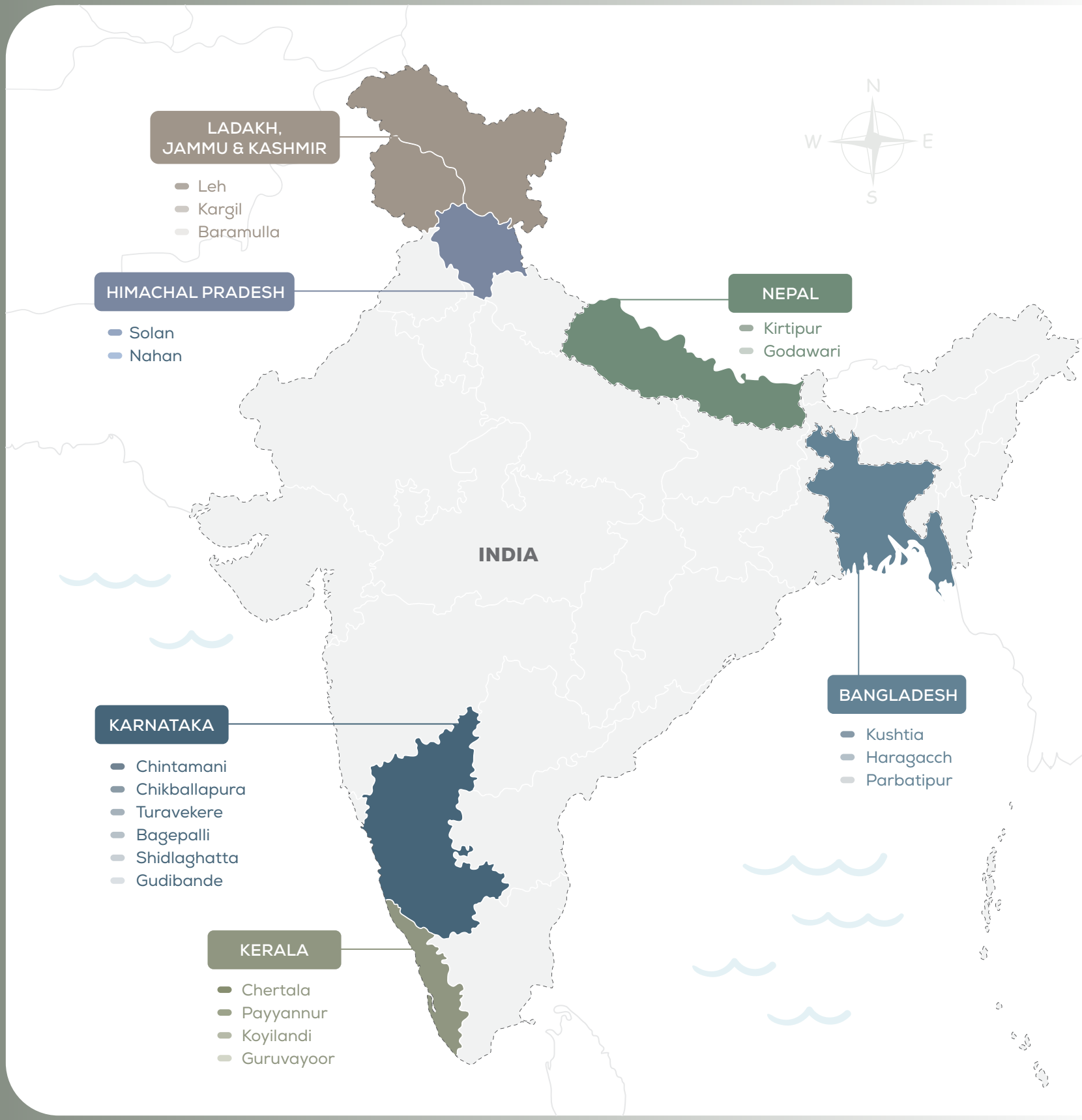











LADAKH,
JAMMU & KASHMIR
Leh
Kargil
Baramulla
HIMACHAL PRADESH
Solan
Nahan
NEPAL
Kirtipur
Godawari
INDIA
BANGLADESH
Kushtia
Haragacch
Parbatipur
KARNATAKA
Chintamani
Chikballapura
Turavekere
Bagepalli
Shidlaghatta
Gudibande
KERALA
Chertala
Payyannur
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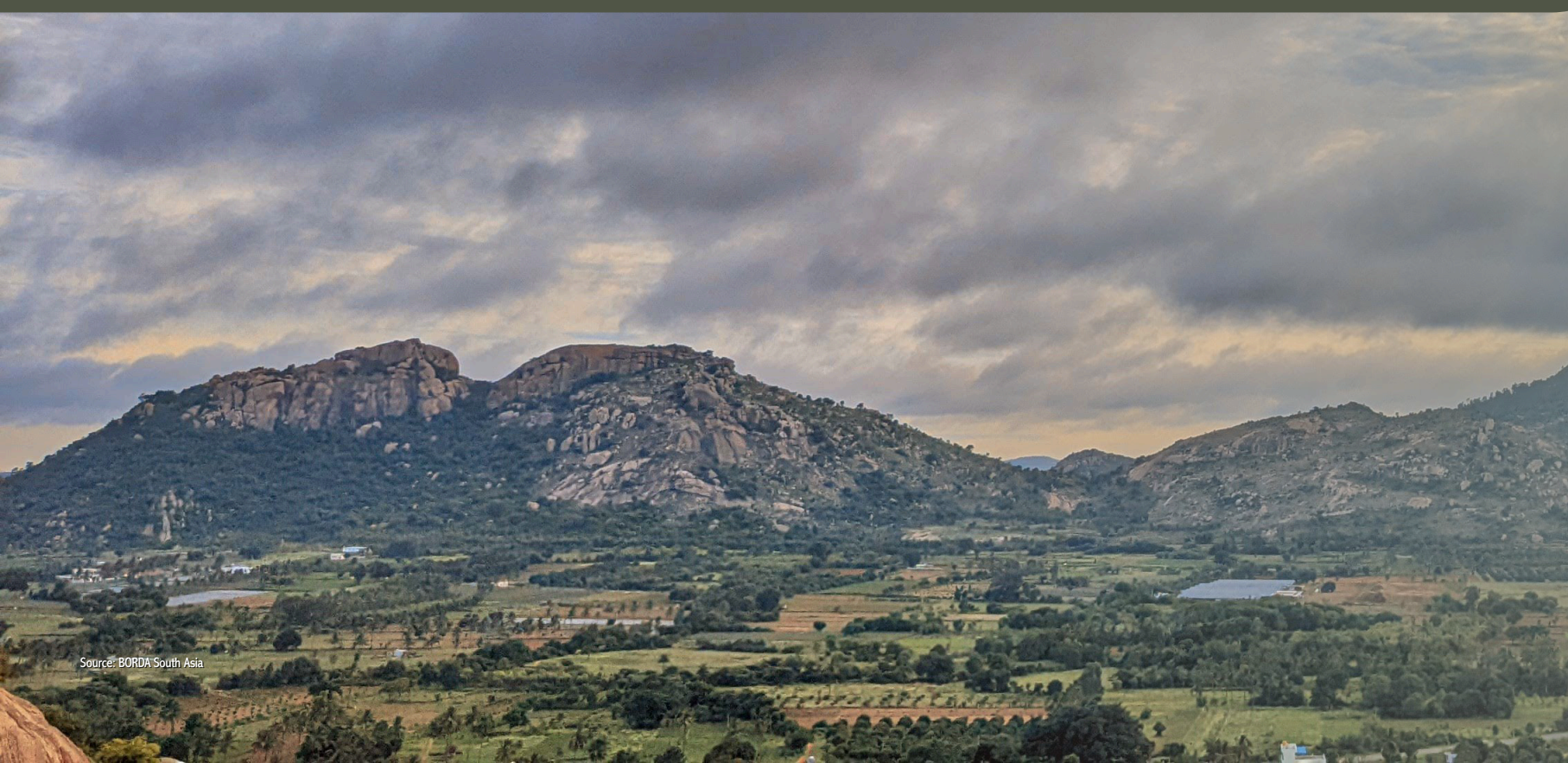
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In South Asia's emerging towns, water systems are stitched from fragments, vulnerable to climate shocks and governance gaps, leaving millions at the frontlines of an urban future without water security.



Source: BORDA South Asia

Setting the Flow

Across South Asia, a vast landscape of growing towns forms the connective tissue between rural hinterlands and metropolitan hubs. These emerging urban centres, often classified as small and medium towns, are where much of the region's urban future is unfolding.

In India, the number of towns with fewer than 100,000 residents rose from

3,984 in 2001 to **5,704** in 2011

a surge of over 40% in just a decade.

Many of these Tier-IV towns now contribute 39% of India's disposable income, on par with Tier-I cities[1].

By 2035, they are projected to host 40% of South Asia's urban population[2].

Yet, despite their growing economic and demographic weight, these centres remain underrepresented in policy priorities.

In recent years, national and state governments have launched schemes to extend water and sanitation services such as India's AMRUT 2.0, Swachh Bharat Mission (Urban), and the earlier UIDSSMT, along with Nepal's Urban Water Supply and Sanitation Policy and Bangladesh's National Strategy for Water Supply and Sanitation. Yet not all emerging centres are covered, and where schemes do apply, they often arrive as fragmented interventions. Pipes and treatment plants are typically planned by state departments using a one-size-fits-all approach that overlooks local realities. Local governments often lack the capacity to plan, design, operate, and sustain systems, leaving infrastructure disconnected from the broader goal of managing the entire water cycle. Without tackling these systemic gaps, investments risk staying piecemeal rather than transformative.

The urgency is heightened by climate risks, from erratic rainfall, droughts, and floods to salinity intrusion and landslides, all of which strain service delivery. Building resilience requires integrating water resources management into daily operations, not just reacting to disasters. However, most emerging urban centres lack the data, skills, and institutional frameworks to anticipate and adapt to these risks.

The **Following the Flows study**, led by BORDA South Asia, examines how water and sanitation systems are shaped and function in such emerging urban centres. Rather than an infrastructure audit, it explores lived realities, mapping the connections, gaps, and everyday practices that define services. Drawing on in-depth interviews with municipal and state officials, water and sanitation experts, GIS mapping, spatial observations, and secondary data from urban local bodies, the study traces water's journey from source to distribution, collection, treatment, and reuse, supplemented by stories and profile mapping that reveal the layered technical, institutional, and behavioural dynamics of service delivery.

Covering emerging urban centres in the hills of Himachal Pradesh, Ladakh, and Nepal; coastal Kerala; Karnataka's peri-urban belts; and deltaic Bangladesh, the study makes visible where breakdowns occur and why, creating a foundation for governments, development partners, and local institutions to design context-specific, loop-closing, and climate-resilient solutions, ensuring these centres not only grow, but do so sustainably, equitably, and with water security at their core.

1. Times of India. (2016, October 5). *The state of India's small towns*. The Times of India. https://timesofindia.indiatimes.com/india/the-state-of-indias-small-towns/articleshow/54674679.cms

2. United Nations Economic and Social Commission for Asia and the Pacific. (2024). *Asia Dialogue Series on SDG 6: Universal access to water and sanitation by 2030*. United Nations ESCAP. https://www.unescap.org/events/asia-dialogue-series-sdg-6-universal-access-water-and-sanitation-2030


Source: Technology Informatics Design Endeavour
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KARNATA



KA

Regional Flowscape

Karnataka's emerging urban centres face multifaceted water and sanitation challenges shaped by infrastructure legacies, governance structures, and environmental pressures. Water supply in these towns largely depends on surface water yet remains intermittent and unreliable. This has led to increasing reliance on private borewells and informal sources, particularly in arid regions where groundwater depletion and seasonal variability further strain supply. Contamination risks also persist, making water safety a key concern.

Sanitation infrastructure, implemented through various schemes by the state, varies based on town size and urban development history. Larger, established towns often have partial UGD networks linked to STPs, typically serving older urban cores. However, these systems seldom extend to peri-urban areas, informal settlements, or newly developed zones. In contrast, smaller towns and recently urbanized areas lack UGD systems entirely and instead depend on onsite and decentralized sanitation. Karnataka has actively supported faecal sludge and septage management through policies mandating regular desludging and investments in FSTPs, particularly for non-sewered towns.

Institutional responsibility lies primarily with state-level agencies such as the Karnataka Urban Water Supply and Drainage Board (KUWSDB) and Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC), with the Directorate of Municipal Administration (DMA) overseeing governance and capacity-building. Although digital dashboards and monitoring tools are being used to improve transparency, data inconsistencies remain a challenge.

The coexistence of intermittent water supply, limited sewerage coverage, and expanding decentralized systems necessitates strengthened institutional coordination, targeted investments, and climate-resilient planning to ensure sustainable water and sanitation services in Karnataka's rapidly evolving emerging urban centres.

Chintamani

Town Area (sq.km)	Population	Agro-climatic Zone
15.2	~ 1,02,268 (2025 est)	Plain, Eastern Dry Zone

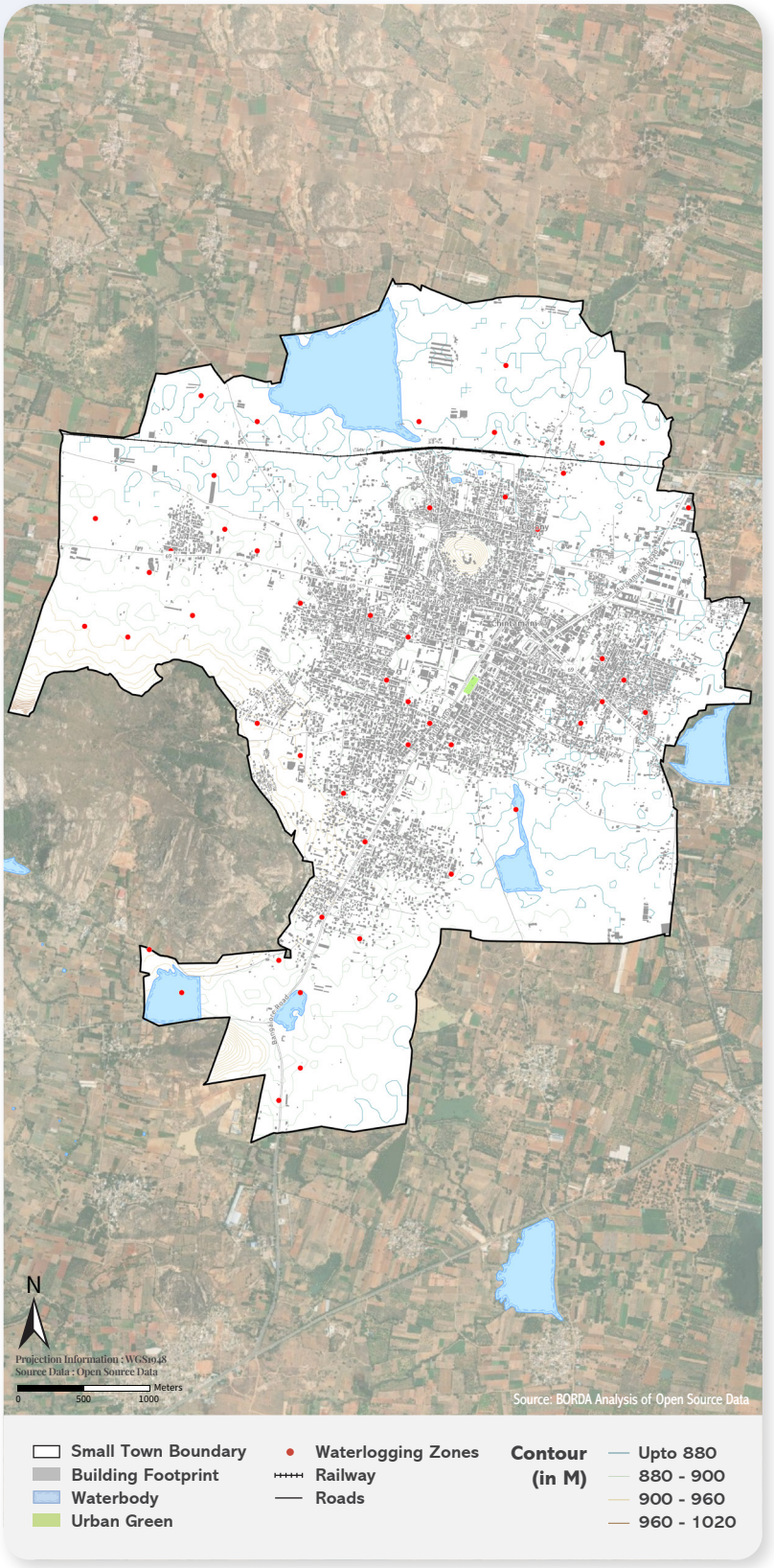
Charting the Flow : Chintamani in Focus

Chintamani, an emerging urban centre in Karnataka, meets its 6.9 MLD water demand equally from surface water sourced at Kannampalli Lake and groundwater. This dual-source arrangement offers some resilience but remains vulnerable to seasonal fluctuations, over-extraction, and contamination risks, particularly without integrated water resource management.

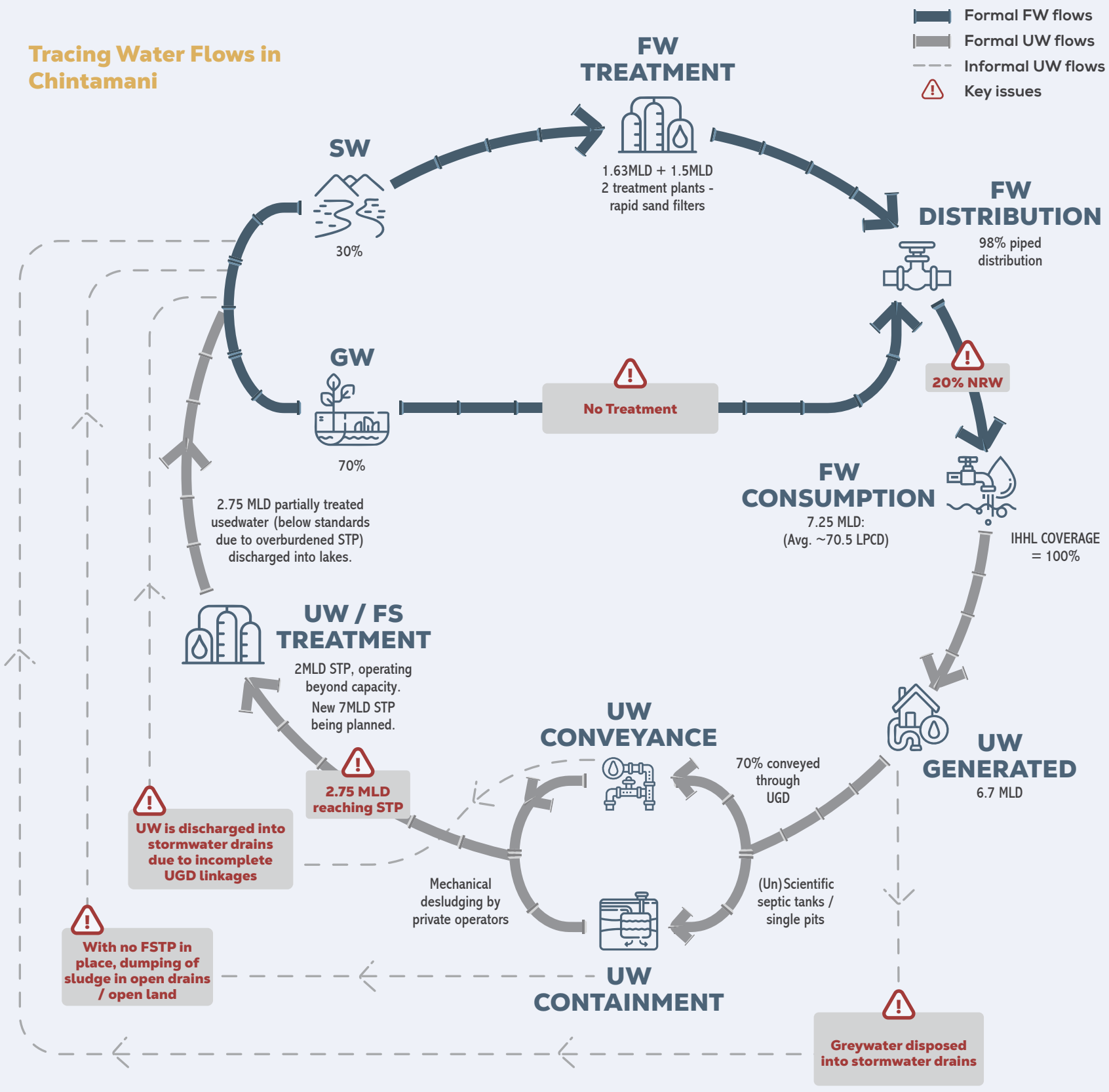
Sanitation services are fragmented and overstretched. The town's core has an underground drainage (UGD) network, but large peri-urban and informal areas depend on on-site systems including scientific and unscientific septic tanks and pits. Chintamani generates around 5.5 MLD of wastewater, yet its sole sewage treatment plant, designed for 2 MLD, receives 2.75 MLD, exceeding capacity and releasing only partially treated effluent into downstream water bodies. Another 2.75 MLD remains untreated, entering drains and natural ecosystems.

A proposed 7 MLD STP and UGD expansion is planned but may take a couple of years to materialise. Meanwhile, there is no FSTP, no regular desludging, and minimal oversight. Informal operators dominate desludging, often disposing sludge unsafely, posing public health and environmental risks.

Addressing these gaps requires synchronising infrastructure expansion with institutional strengthening, integrating FSM, and embedding climate resilience in service delivery. Immediate actions should focus on scaling treatment capacity, introducing decentralised FSM solutions, and enabling safe reuse of treated water and sludge. These steps are essential to protect water bodies, safeguard public health, and strengthen Chintamani's capacity to adapt to climate variability and urban growth.



Tracing Water Flows in Chintamani



Shidlaghatta

Town Area (sq.km)	Population	Agro-climatic Zone
5	~ 65,300 (2024 est.)	Plain, Eastern Dry Zone

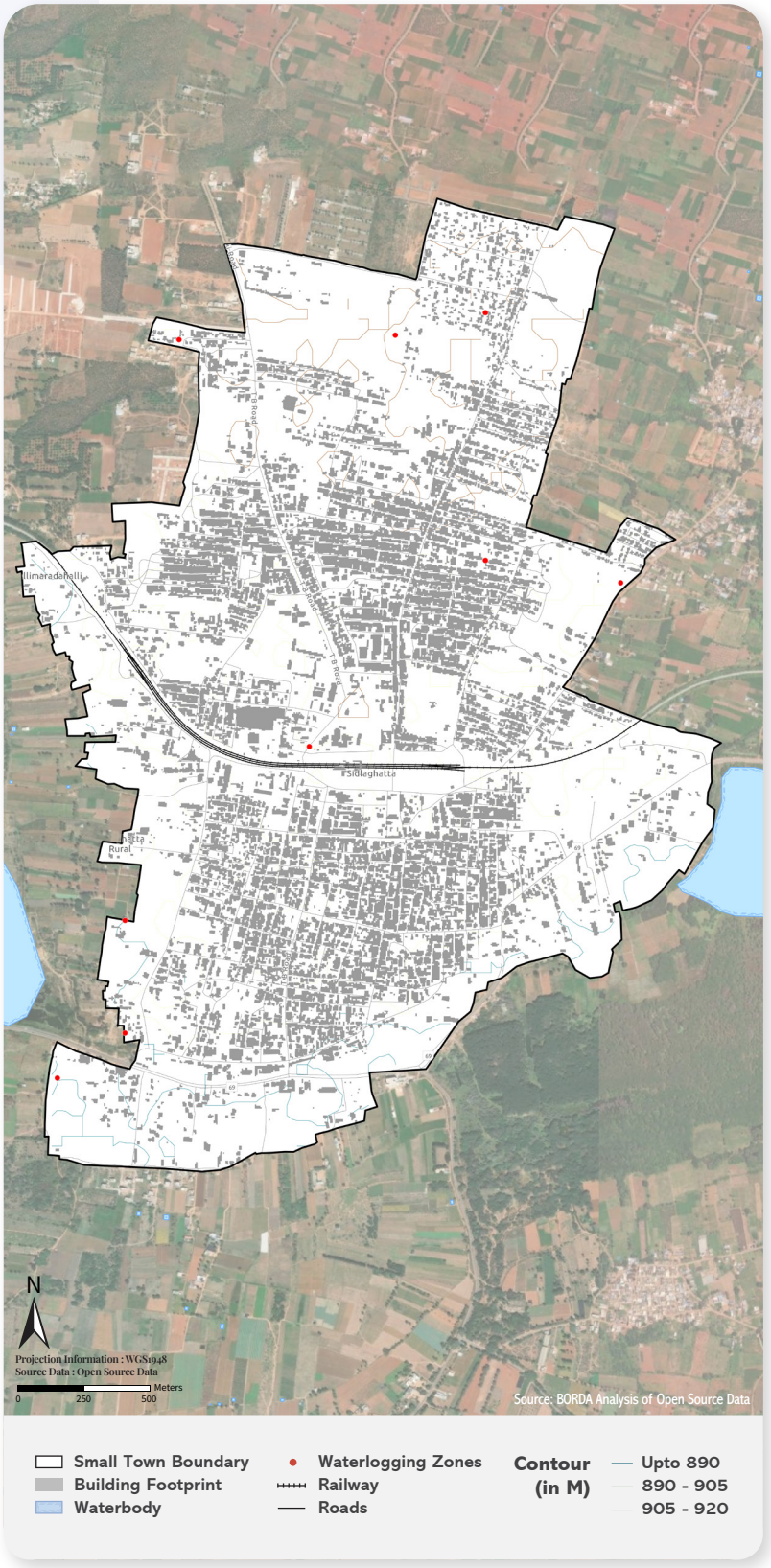
Charting the Flow : Shidlaghatta in Focus

Shidlaghatta, a town in Karnataka, relies entirely on groundwater to meet its daily water demand of 3.5 MLD. While this single-source dependence makes the system vulnerable to over-extraction and quality risks, most households use reverse osmosis (RO) units for drinking water. Around 60% of households are connected to the piped supply network, while the rest depend on private borewell, highlighting the need for more equitable and resilient access.

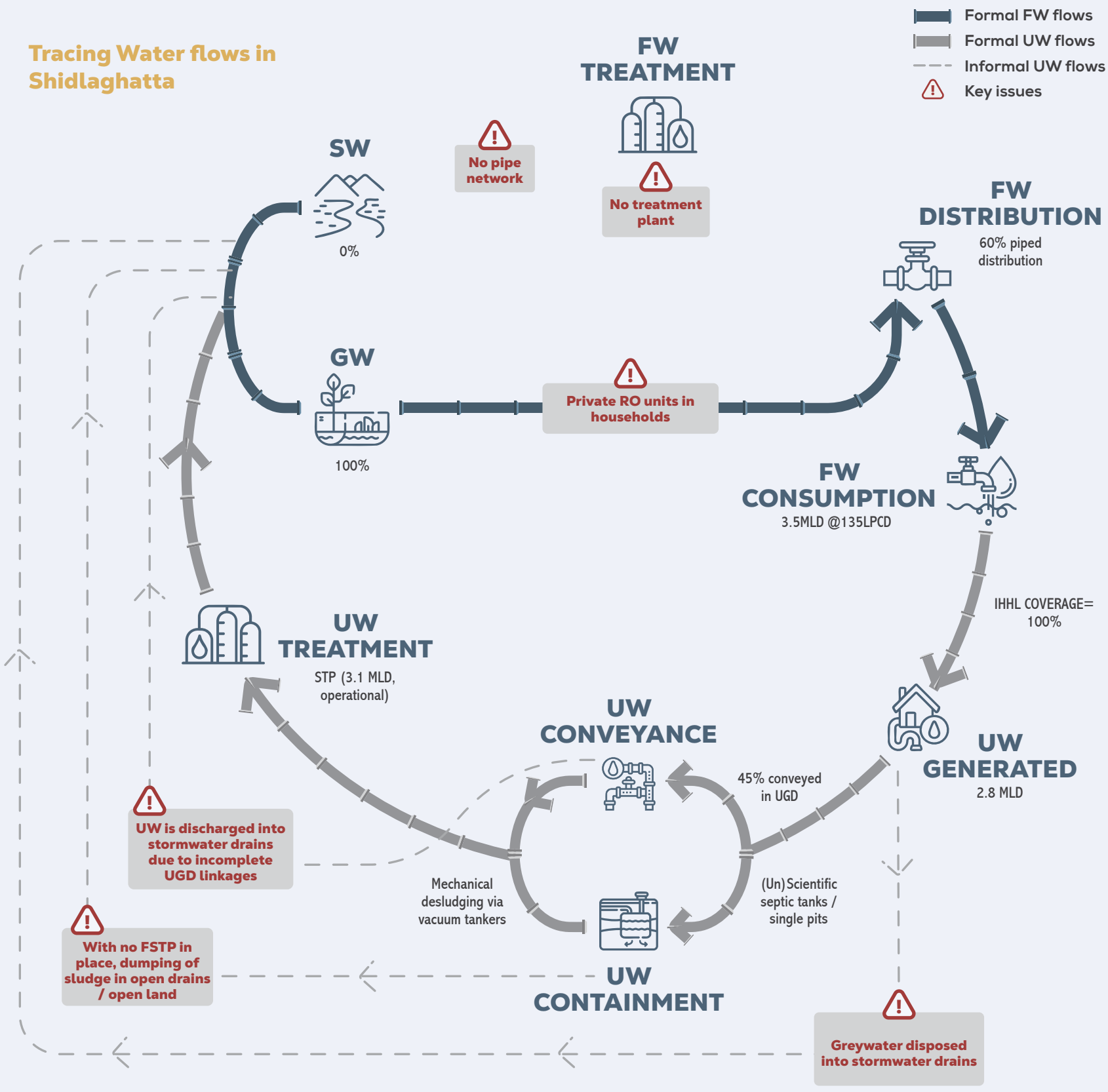
Sanitation coverage is relatively strong, with all households having access to toilets. Containment systems are a mix of on-site solutions such as scientific and unscientific septic tanks, alongside limited sewer connectivity. Mechanical desludging services, operated by both ULB and private providers are available for periodic emptying, but there is no FSTP to ensure safe treatment and disposal. This gap leaves desludged waste vulnerable to unsafe dumping.

The town generates approximately 2.8 MLD of wastewater, yet only 1 MLD, around 45% reaches the existing 3.1 MLD waste stabilisation pond based STP due to an incomplete UGD network. Broken or missing UGD links result in large volumes of used water being discharged into stormwater drains or directly into a nearby lake. This not only degrades water bodies but also poses significant public health risks.

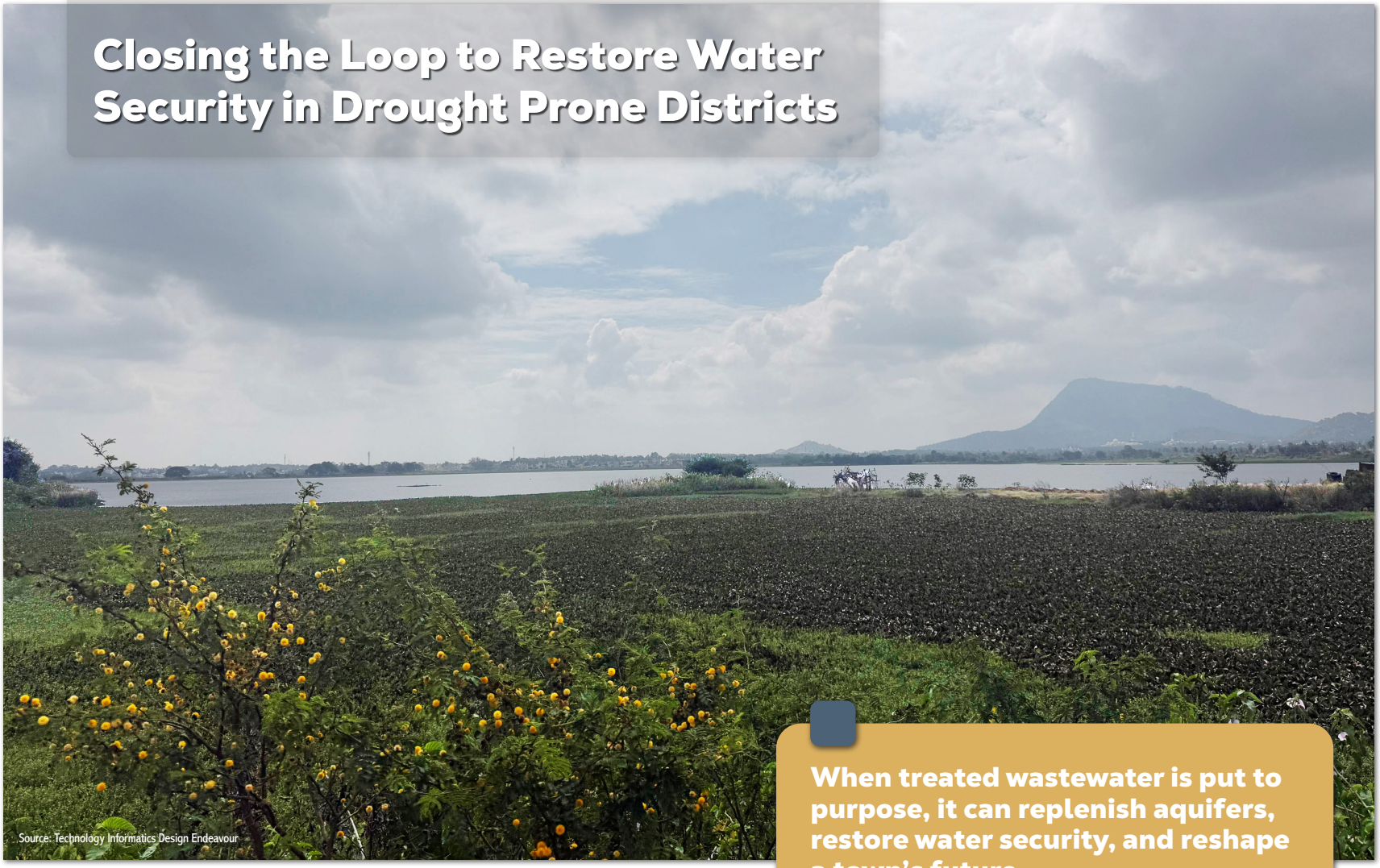
To build an integrated and climate-resilient system, Shidlaghatta must focus on completing and expanding UGD coverage, ensuring optimal STP utilisation, and enabling safe reuse of treated wastewater. Parallel efforts to extend piped water coverage and strengthen source sustainability will move the town towards a circular water management approach that safeguards environmental health and community well-being.



Tracing Water flows in Shidlaghatta



Closing the Loop to Restore Water Security in Drought Prone Districts



Source: Technology Informatics Design Endeavour

When treated wastewater is put to purpose, it can replenish aquifers, restore water security, and reshape a town's future

Chikkaballapura, a drought-prone emerging urban centre on the outskirts of Bengaluru, has long lived with water scarcity. For years, borewells ran dry, tanks stood empty for most of the year, and the town watched its groundwater levels sink lower. Water had become a crisis everyone felt.

Today, the picture is changing. Tanks that once lay cracked now hold steady volumes of water, helping replenish underground reserves. Beneath the surface, aquifers are steadily recharging, and borewells that had been abandoned are producing water once more.

The shift began in Bengaluru, just 70 kilometres away. Every day, the city's sewage treatment plants - Hebbal (150 MLD), Hennur (40 MLD), and Horamavu (20 MLD) - generate millions of litres of tertiary-treated wastewater. Through the Hebbal and Nagawara (HN) Valley Project, 210 MLD of this water is pumped to replenish 65 interconnected tanks across Bengaluru Rural and Chikkaballapura districts.

Instead of sending the water directly to farms, the project was designed for groundwater recharge. The treated water, clean enough for percolation and abundant in volume, fills the tanks, seeps underground, and revives aquifers that had been in decline for decades.

The results are visible: tanks stay fuller for longer, streams flow further into the dry season, and the tank network is once again storing and sharing water. Chikkaballapura's story shows that with thoughtful planning, even drought-prone towns can turn an urban waste stream into a source of resilience, reviving not just their water supply, but the systems that sustain it.

Long before modern pipelines and pumps reached Chintamani, water flowed through a network of intricately carved stone stepwells known as Kalyanis. These century-old structures were more than engineering feats, they were vital cultural hubs designed to harvest rainwater, recharge aquifers, and serve both pilgrims and townsfolk. Built during the Hoysala era and later dynasties, Kalyanis blended spiritual significance with practical water wisdom.

Today, Chintamani has nearly 74 such Kalyanis. Once the lifeblood of this semi -arid town, most now lie neglected. Some are clogged with garbage, others choked by weeds and encroachments. Many remain dry year-round, cut off from their natural catchments and clogged with silt. A few still support temple rituals, but even these face water quality challenges due to poor upkeep.

The root of this decline is not just ecological, it's institutional. Governance of these heritage water bodies is fragmented. While some fall under the Endowments Department, others are managed by the Revenue Department or the Chintamani City Municipal Council. This splintered oversight has led to neglect, with no clear accountability for their protection or revival.

Chintamani's Kalyanis stand as a powerful reminder that small towns carry a legacy of sophisticated water management. Yet without integrated planning and community stewardship, this legacy risks being lost. Reviving these structures is more than preserving heritage, it's about restoring the town's water security by reconnecting to its forgotten past. A coordinated revival plan is urgently needed, one that unites departments and involves local communities to reclaim these Kalyanis as climate-resilient water sources for Chintamani's future.

Fragmented governance endangers the legacy that once sustained entire towns.



Neglected Kalyanis, a Lost Legacy in Chintamani

Source: Technology Informatics Design Endeavour

Chikkaballapura

Town Area (sq.km)
18.25

Population
~ 85,000 (2024 est.)

Agro-climatic Zone
Hilly, Eastern Dry Zone

Flow Snapshots:

40% from untreated groundwater
60% from Jakkalamadagu reservoir
treated by a 6.5 MLD sand filter (against a 10 MLD demand)

90% of water is supplied via piped distribution

Sanitation through

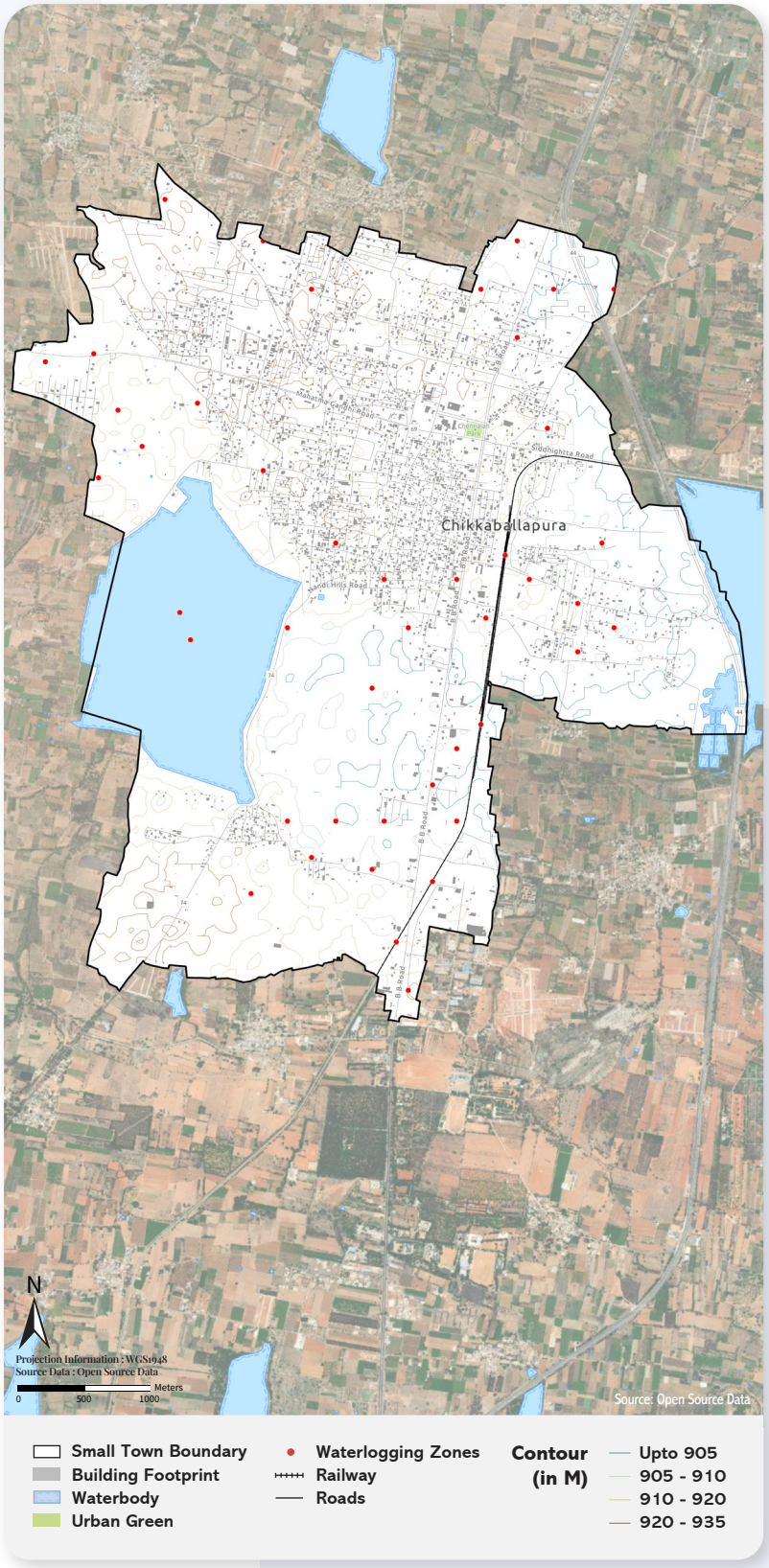
- single pits,
- (un)scientific septic tanks
- partial underground drainage coverage

8 MLD of used water generated daily, but **only 3.3 MLD is treated** by STP

Over half of used water remains untreated owing to partial sewer coverage and leaks in the network.

Discharge of used water and sludge into **Drains • Open Lands • Water Bodies**

Resulting risk of contamination to **SURFACE and GROUND WATER**



The STP That Stood in the Lake's Way



Source: Technology Informatics Design Endeavour

Disconnected plans and distant decisions cannot build resilience, it grows from local wisdom and systems grounded in the land.

Chikkaballapura saw hope with the inauguration of a 10 MLD Sewage Treatment Plant built on the dry bed of Gopalkrishna Aminikere Lake. Constructed using Waste Stabilisation Pond technology, the plant aimed to treat the town's wastewater and prevent contamination of nearby water sources. At the time, the lake had long been dry, its boundaries blurred by years of drought, making it appear suitable for construction.

Then came the HN Valley Project, a visionary effort to channel treated wastewater from Bengaluru into a network of lakes across the region, including those around Chikkaballapura. As inflows began, the water cycle slowly revived. The air grew cooler, moisture returned, and monsoons turned more reliable. By 2021–22, the long-parched lake filled once again, brimming with life. But as the waters rose, the access road to the STP was submerged, leaving the plant cut off behind a protective bund.

With no routine O&M possible, its performance now remains uncertain - effluent still flows, but no one knows how well the system is truly working.

Recently, one section of the plant was partially cleared after farmers were engaged to desludge it manually, offering temporary relief. Yet the deeper issue lies in how it was planned. The decision to site the STP on the lakebed was made by a parastatal agency, with little consultation with the municipality or local communities, those who understood the land best. Now, as hydrology shifts with changing climate and new projects, the municipality bears the consequences of decisions it never shaped. With no land available for a new facility, officials are attempting to expand the existing one by adding extended aeration tanks which will allow for a more stable, higher-quality effluent.

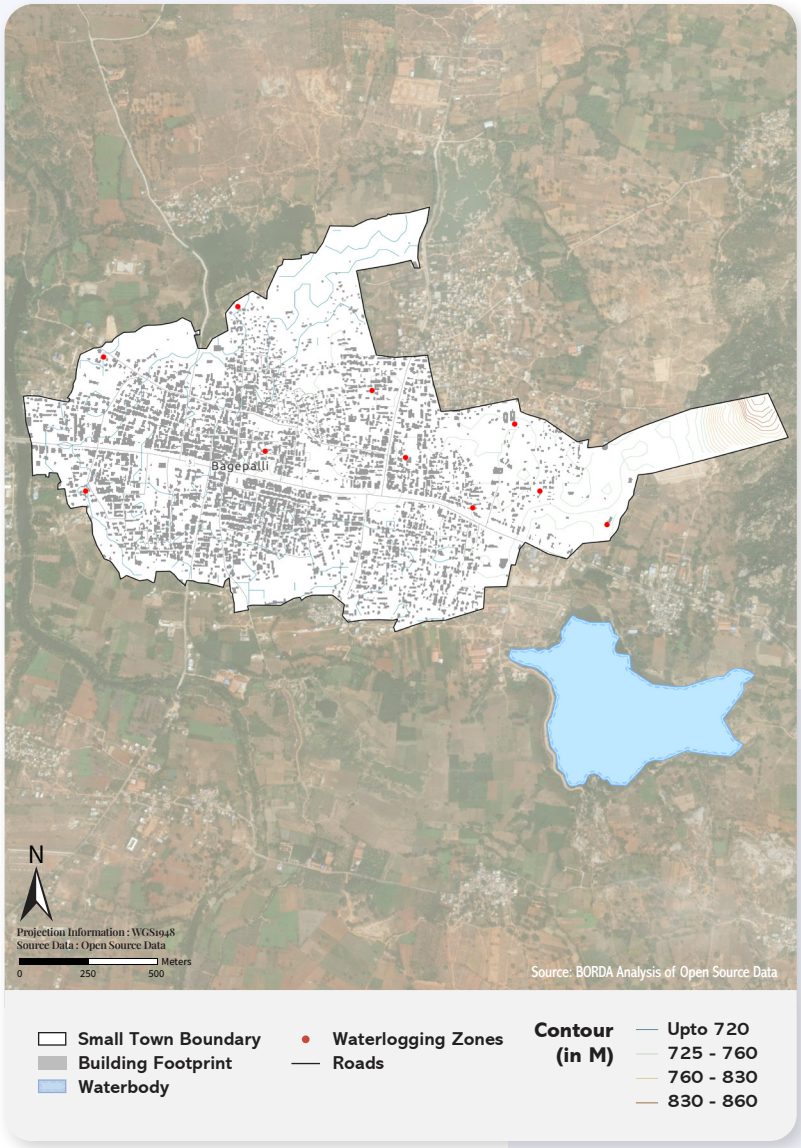
The story of Gopalkrishna Lake is not just about flooding or infrastructure failure. It is about how disconnected planning erodes local resilience and how nature, when it returns, remembers everything we forgot.

Bagepalli

Town Area (sq.km)
2.31

Population
~ 35,000 (2024 est.)

Agro-climatic Zone
Undulating, Eastern Dry Zone



Flow Snapshots:

40% from untreated groundwater
60% from Chitravati dam
treated by a 3.4 MLD sand filter (against a 4.3 MLD demand)

Sanitation through

- (un)scientific septic tanks
- single pits



3.4 MLD of used water generated daily with 4.5 MLD STP constructed. Due to absence of last mile connectivity, the STP is not commissioned.

Most used water remains untreated due to absence of UGD network or FSTP, despite mechanical desludging efforts.

Discharge of used water and sludge into **Drains • Open Lands • Water Bodies**

Resulting risk of contamination to **SURFACE and GROUND WATER**

“Schools in Bagepalli tackle fluorosis through nutrition programs and awareness drives, combining fortified meals, amla planting, and interactive “Speaking Walls”.

The Silent Crisis of Sewage Treatment Plants in Karnataka's Emerging Urban Centres



Source: Technology Informatics Design Endeavour

Infrastructure alone won't deliver resilience. Emerging urban centres need aligned planning, coordinated departments, and empowered local institutions to close the loop.

Across Karnataka's emerging urban centres, significant investments have brought modern STPs to life on paper. Parastatal agencies like KUWSDB and KUIDFC, through various government schemes, have funded infrastructure in towns such as Turuvekere, Shidlaghatta, and Bagepalli, ranging from low-cost waste stabilization ponds to nature-based Soil Biotechnology systems.

Yet, many of these plants remain silent. In Turuvekere, a 1.95 MLD STP lies uncommissioned; its sewer network is incomplete, with no arrangements for reuse or safe disposal. In Shidlaghatta, a 3.1 MLD facility runs far below capacity because most of the town's 5 MLD wastewater bypasses the plant, flowing into open drains and polluting Shidlaghatta Lake due to missing linkages in the UGD network. Bagepalli, newly upgraded to ULB status in 2020, has two SBT-based STPs (4.5 and 0.5 MLD), but both are idle, awaiting full UGD connections.

The core challenge is not the absence of technology but the absence of integration. STP construction is funded, but sewerage networks lag, slowed by land acquisition hurdles, technical complexities, and gaps in financing. Different schemes address isolated parts of the sanitation chain with little coordination, leaving treatment plants stranded without inflow.

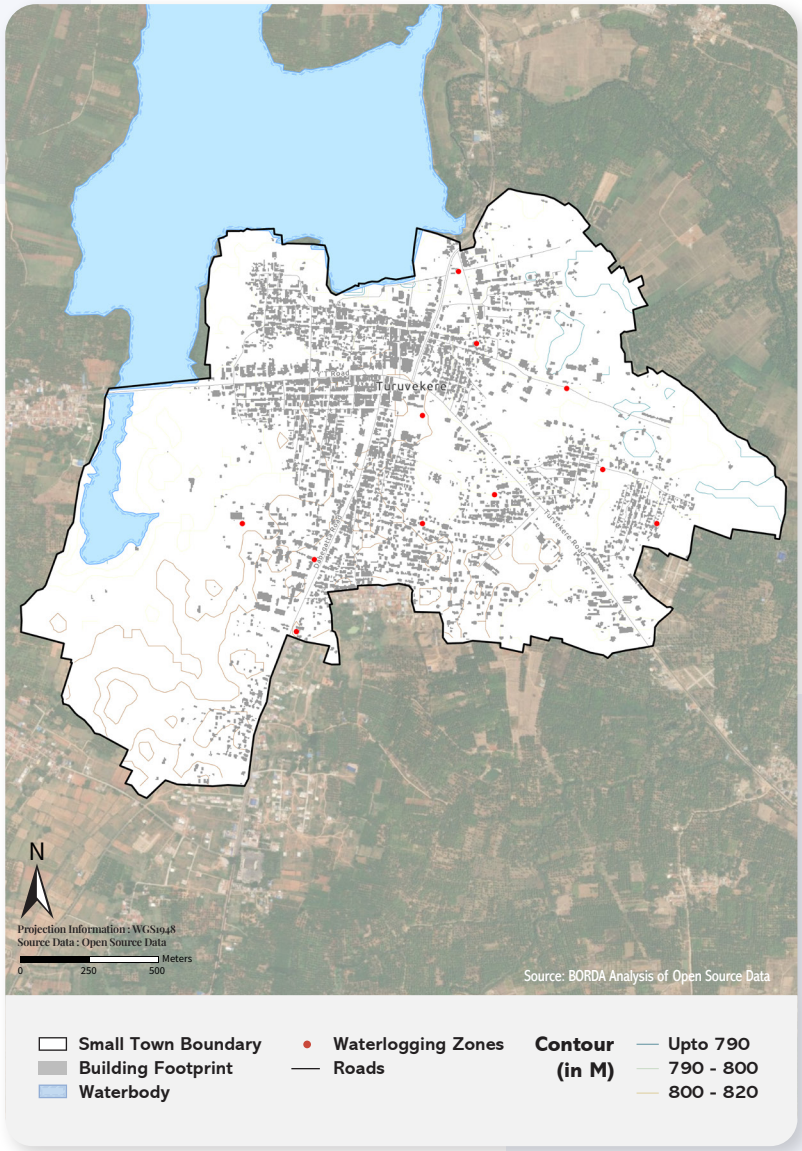
The lesson is clear: infrastructure alone does not deliver resilience. To close the loop, emerging urban centres need convergent planning that aligns networks, treatment, and reuse; inter-departmental coordination to overcome bottlenecks; and empowered local institutions to manage systems end-to-end. Until these missing links are forged, STPs will remain monuments of potential, built to protect water security and community health, but stalled in purpose.

Turuvekere

Town Area (sq.km)
0.64

Population
~ 18,000 (2024 est.)

Agro-climatic Zone
Hilly, Southern Dry Zone



Flow Snapshots:

25% of supply from untreated groundwater
75% from Mallaghta tank surface water
treated by a 2.25 MLD sand filter (against a 2.5 MLD demand)

72% of water is supplied via piped distribution

Sanitation through

- (un)scientific septic tanks
- single pits

1.95 MLD of used water generated daily, **1.95 MLD STP is constructed,** however it is not commissioned due to unavailability of last mile connection and treated water disposal mechanism in the STP

Over half of used water remains untreated as UGD discharges directly into the lake.

Discharge of used water and sludge into **Drains • Open Lands • Water Bodies**

Resulting risk of contamination to **SURFACE and GROUND WATER**

> **Larger towns rely on partial sewers and STPs, while smaller towns rely largely on onsite systems with FSM/FSTPs as key solutions.**

Every year, towns like Chintamani receive around eight lakh rupees under the 15th Finance Commission's funds, earmarked for water security - a modest sum meant to strengthen local resilience. Across Karnataka, municipalities identify the wards facing scarcity, list their water needs, and send proposals to the District Urban Development Cell. From there, plans move to the Directorate of Municipal Administration, where funds are released under clear guidelines: they cannot be used for major works like new pipelines or bore wells, only for minor repairs or alternate water sourcing.

In practice, this has taken a familiar shape. In wards where municipal bore wells have gone dry, the town turns to nearby private farmer wells. Each year, the municipality pays a fixed sum per private bore well to draw water from them, an arrangement that keeps taps running but deepens dependence on fragile groundwater reserves. With aquifers depleting and recharge levels falling, these emergency measures have become routine. What began as a stopgap has turned into a system, sustained by the same funds meant to secure the town's water future.

Recently, the inflow of funds has thinned, owing to the Bhaktharahalli surface water scheme in the region. At the same time, the Shallow Aquifer Management (SAM) Project, led by NIUA, has arrived in the city, promising to restore groundwater through shallow aquifer recharge interventions. Yet, even as these efforts take root, the town continues to rely first on groundwater, not on surface water. Whether due to pumping costs, distance, or habit, the pattern endures: private wells before public systems, short-term fixes before long-term security.

The story of these small towns is not just about funding or scarcity, it is about how reactive decisions, shaped by limited means and immediate needs, can quietly drain resilience drop by drop. As shallow aquifers are studied and managed, the deeper question remains: how do towns move from dependence to stewardship, aligning with Chintamani's WASH Climate Action Plan's call to increase reliance on surface water rather than groundwater, before the wells run dry for good?

What began as an emergency fix has quietly become the foundation of water supply.



Borrowed Wells, Borrowed Time

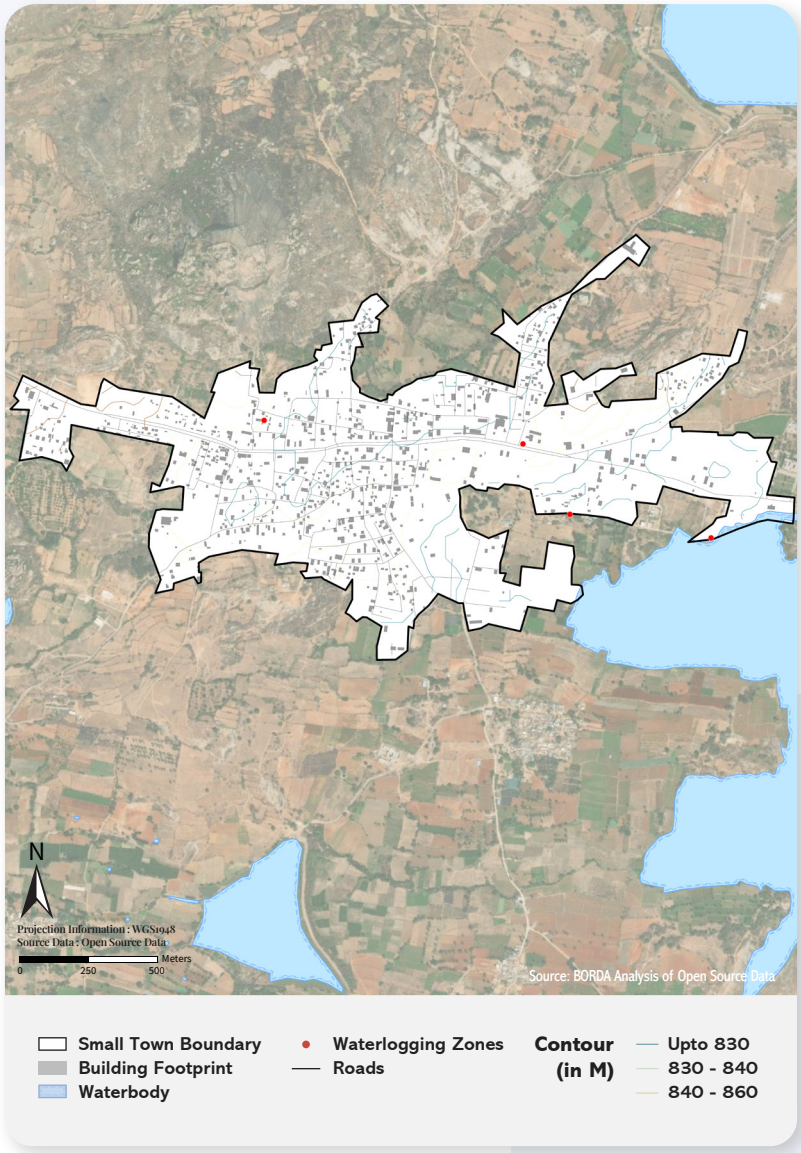
Source: Technology Informatics Design Endeavour

Gudibande

Town Area (sq.km)
15.2

Population
~ 10,600 (2024 est.)

Agro-climatic Zone
Plain



Flow Snapshots:

50% of supply from untreated groundwater
50% from surface water
treated by a 1.64 MLD sand filter (against a 0.88 MLD demand)

80% of water is supplied via piped distribution

Sanitation through
- single pits
- (un)scientific septic tanks

0.75 MLD of used water generated daily, **FSTP is under construction.**

Over half of used water remains untreated due to lack of operational FSTP despite mechanical desludging efforts.

Discharge of used water and sludge into **Drains • Open Lands • Water Bodies**

Resulting risk of contamination to **SURFACE and GROUND WATER**

> **Incomplete and leaking sewer networks in small towns of Karnataka prevent most wastewater from being treated, contaminating lakes and surroundings.**

Tailored Sanitation Solutions for Gudibande's Rocky Terrain



Source: Technology Informatics Design Endeavour

Tailored, terrain-sensitive sanitation solutions are critical, one size does not fit all, especially in challenging landscapes like Gudibande.

Gudibande, a historic emerging urban centre town nestled in the granite uplands of Karnataka's Chikkaballapura district, faces a tough sanitation challenge. The town's rocky terrain makes laying UGD networks both technically difficult and prohibitively expensive. Traditional centralized sewerage systems simply won't work here.

Understanding this, KUWSDB chose a practical, terrain-sensitive approach: an FSTP for blackwater and nature-based solutions for decentralized greywater treatment. This model aims to safely manage sanitation without digging through solid granite. The FSTP is under construction and expected to be ready soon to treat sludge. "The terrain ruled out UGD, so the FSTP was the logical alternative," says an Assistant Executive Engineer from KUWSDB. Yet despite land allocation, contracting delays mean actual construction work has yet to begin.

Turning plans into reality, however, is more than building infrastructure. A ULB official notes, "Construction is often the easiest part. Coordinating desludging services, raising awareness among households, and assigning operational responsibility takes much longer." Funding gaps, lack of trained local staff, and limited capacity among private operators have further slowed progress.

Meanwhile, residents rely on single pits for blackwater disposal. Without regular desludging or proper greywater management, overflows and groundwater contamination are rising, posing serious health and environmental risks. Experts at DUDC, Chikkaballapura stress the need for terrain-sensitive sanitation planning. "In hilly, rocky towns like Gudibande, decentralized systems, FSTPs for faecal sludge and NbS for greywater, aren't just appropriate; they're essential for sustainable sanitation." Gudibande's experience highlights the importance of tailored solutions that respect local realities rather than forcing one-size-fits-all models.



Following Karnataka's Flows

Water source

Karnataka's water security rests on lakes, reservoirs, kalyanis, borewells, and TUW through HN Valley, but unchecked dependence on groundwater threatens this balance.

Water supply

Pipelines and tankers connect households, but NRW losses, missing linkages, and rising tanker dependence signal a system under strain.

UW generation

Untreated used water from homes, markets, and industries flows into lakes and drains, polluting surface and groundwater.

UW containment & conveyance

UGD - STP networks and septic tanks -FSTP systems complement each other, yet limited coverage, and desludging tanker reliance leave water systems vulnerable to contamination.

UW treatment

Wastewater is treated in STPs or FSTPs where available, but much sludge is still dumped untreated into open areas, fields, or water bodies, posing health and environmental risks.

Reuse and closing the loop

Despite its potential to strengthen water security, treated used water reuse is still untapped in the region.

Source: Sameer Prabhat, Pexels

കേരളം
KERALA



Regional Flowscape

Kerala's emerging urban towns present a distinctive water and sanitation landscape shaped by decentralized governance, progressive policy frameworks, and the complexities of a dense "rurban" settlement pattern. The blurring of rural-urban boundaries creates a continuous and highly populated stretch that challenges conventional infrastructure planning and demands localized solutions. Service delivery is led by Local Self-Government Institutions, which encourage community participation but often require enhanced technical capacity and stronger coordination across institutions.

The state has been at the forefront of adapting national missions to local contexts. The Jal Jeevan Mission and Jalanidhi have promoted community-led water supply systems, resulting in widespread household tap connections. State-led initiatives such as the Suchitwa Mission and Haritha Keralam Mission integrate sanitation, solid waste management, and water conservation, while Kerala was among the first states to achieve ODF status. More recently, the NAMASTE scheme has addressed sanitation worker safety and promoted mechanized desludging.

Water supply in small towns depends largely on Kerala Water Authority's piped surface water systems, supplemented by decentralized wells. While official coverage is near universal, distribution is uneven, particularly in hilltop and remote areas. Concerns over bacterial contamination and salinity have driven many households to adopt independent water treatment. Despite Kerala's high rainfall, rainwater harvesting remains underutilized. Sanitation in towns is predominantly on-site, with very limited sewerage coverage. Faecal sludge management faces challenges of social resistance, informal disposal practices, and logistical barriers such as narrow roads that hinder mechanized desludging.

Although Kerala's policy environment is progressive, low municipal-level investment in WASH and infrastructure gaps undermine equitable and resilient service delivery. Strengthening institutional capacity, investing in decentralized solutions, and leveraging the state's strong community orientation remain essential to ensure sustainable water and sanitation services in Kerala's small towns.

Source: Technology Informatics Design Endeavour

Cherthala

Town Area (sq.km)	Population	Agro-climatic Zone
16.18	~ 50,000 (2024 est)	Coastal

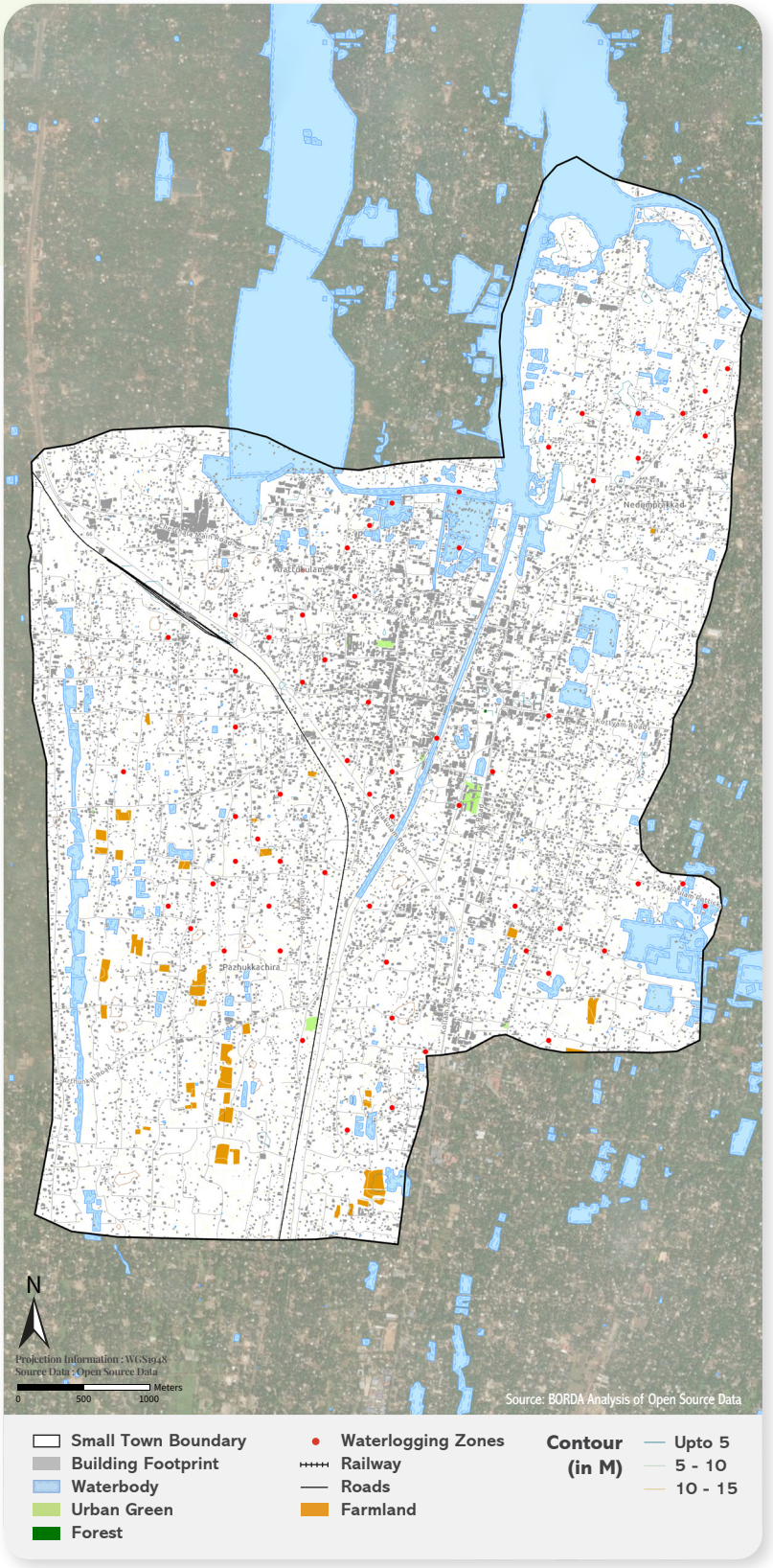
Charting the Flow : Cherthala in Focus

Cherthala's water and sanitation systems reflect the coexistence of formal infrastructure and household-level practices. The Kerala Water Authority (KWA) supplies 100% piped surface water to the town, drawing from the Muvattupuzha River. Treatment is undertaken at a 107 MLD conventional water treatment plant that serves the wider region, ensuring reliable bulk supply across multiple towns. While reported coverage is universal, households continue to rely on open wells as a supplementary source due to perceived gaps in service reliability, leaving them exposed to groundwater contamination and salinity risks.

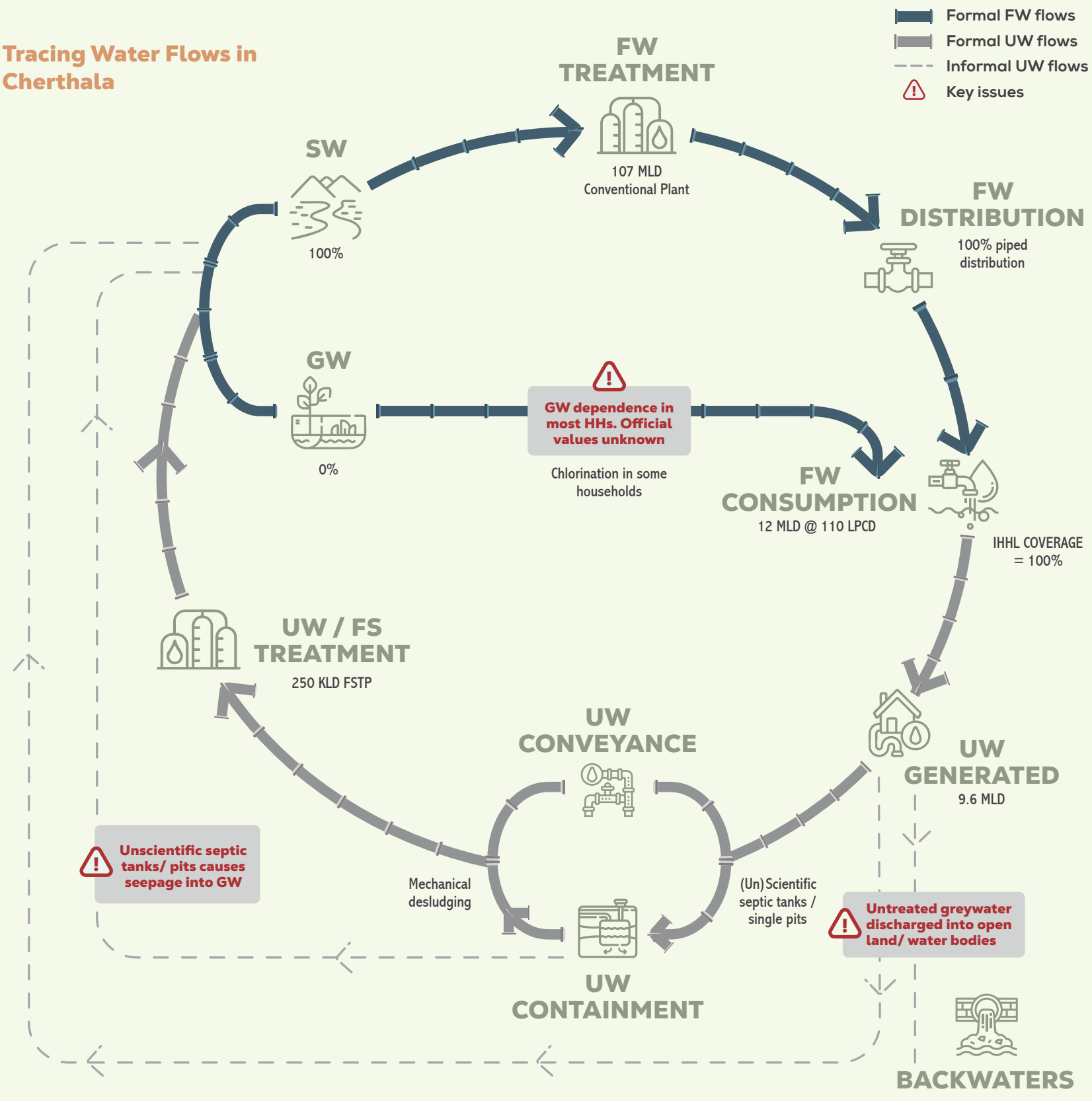
Sanitation infrastructure shows widespread toilet coverage, but most households depend on septic tanks and pit latrines, many of which are unscientifically constructed. These on-site systems often allow effluent to seep into the ground, contributing to groundwater pollution. Greywater is commonly discharged untreated into drains, fields, and nearby water bodies, including the ecologically sensitive Vembanad backwaters.

Desludging services are carried out primarily by private operators and also by ULB by using vacuum trucks. However, desludging is infrequent and many residents are unaware of when their tanks were last emptied due to the big sized tanks they build. To address access constraints in narrow lanes, small-scale innovations such as two-wheeler and auto-based desludging units have emerged, though with limited technical capacity. A 250 KLD faecal sludge treatment plant (FSTP) has recently been commissioned, enabling localized treatment. This facility has significantly reduced illegal dumping, though some untreated disposal still persists.

Cherthala's experience underscores the need to strengthen containment design, expand safe desludging services, and embed circular and climate-resilient approaches, ensuring that both water resources and fragile backwater ecosystems are safeguarded in the long term.



Tracing Water Flows in Cherthala



Koyilandi

Town Area (sq.km)	Population	Agro-climatic Zone
29.05	~ 28,900 (2024 est)	Coastal

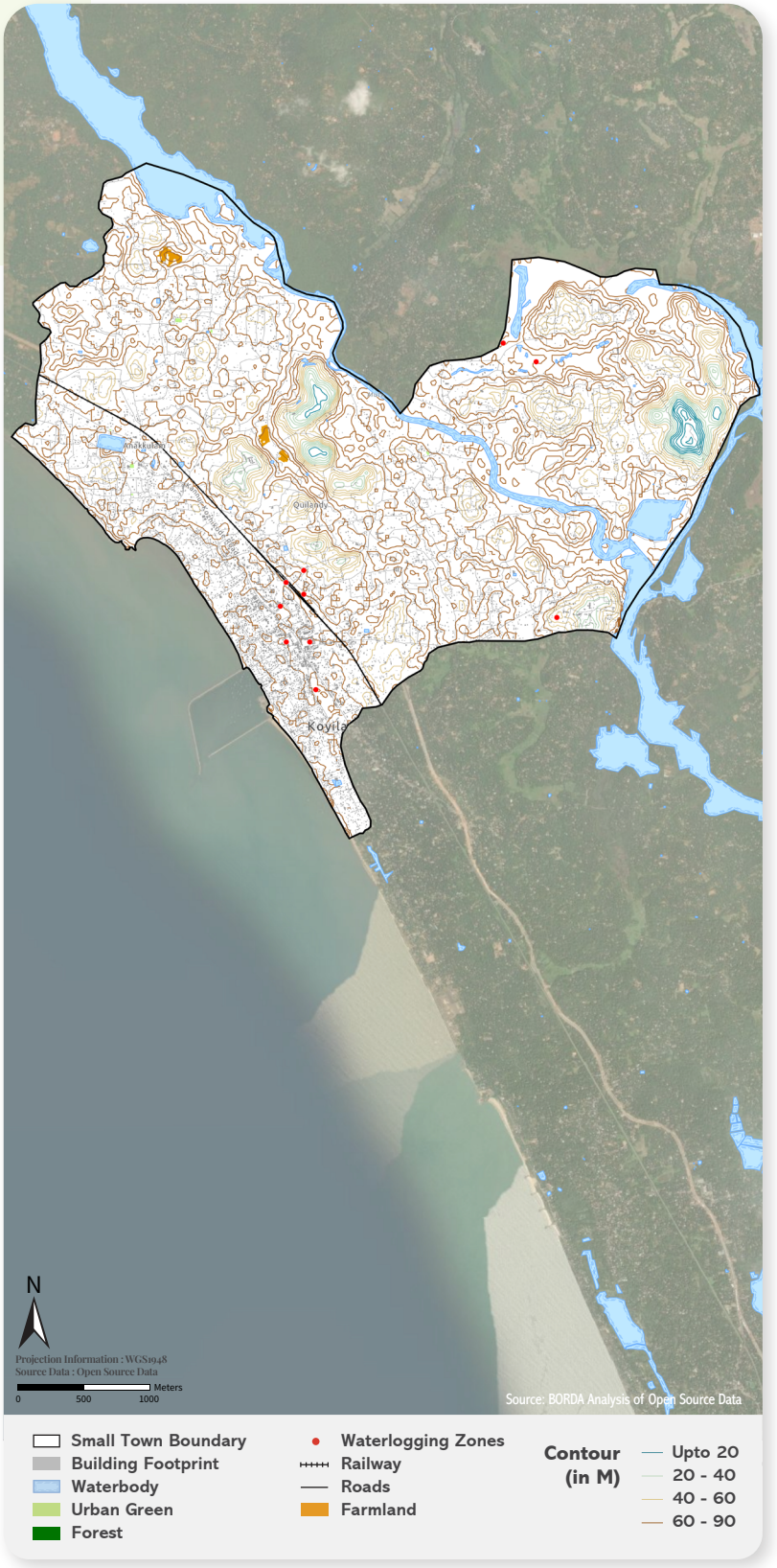
Charting the Flow : Koyilandi in Focus

Koyilandi, a coastal town in Kerala, operates with complete dependence on groundwater, supplied through decentralized mini water schemes. Despite the presence of a regional 174 MLD surface water treatment plant, the town currently does not access surface water, though a new project is in the pipeline. While the town boasts 100% piped distribution, its high per capita water consumption, estimated at 150 LPCD, places significant pressure on fragile groundwater reserves, especially amid concerns of over-extraction and salinity intrusion.

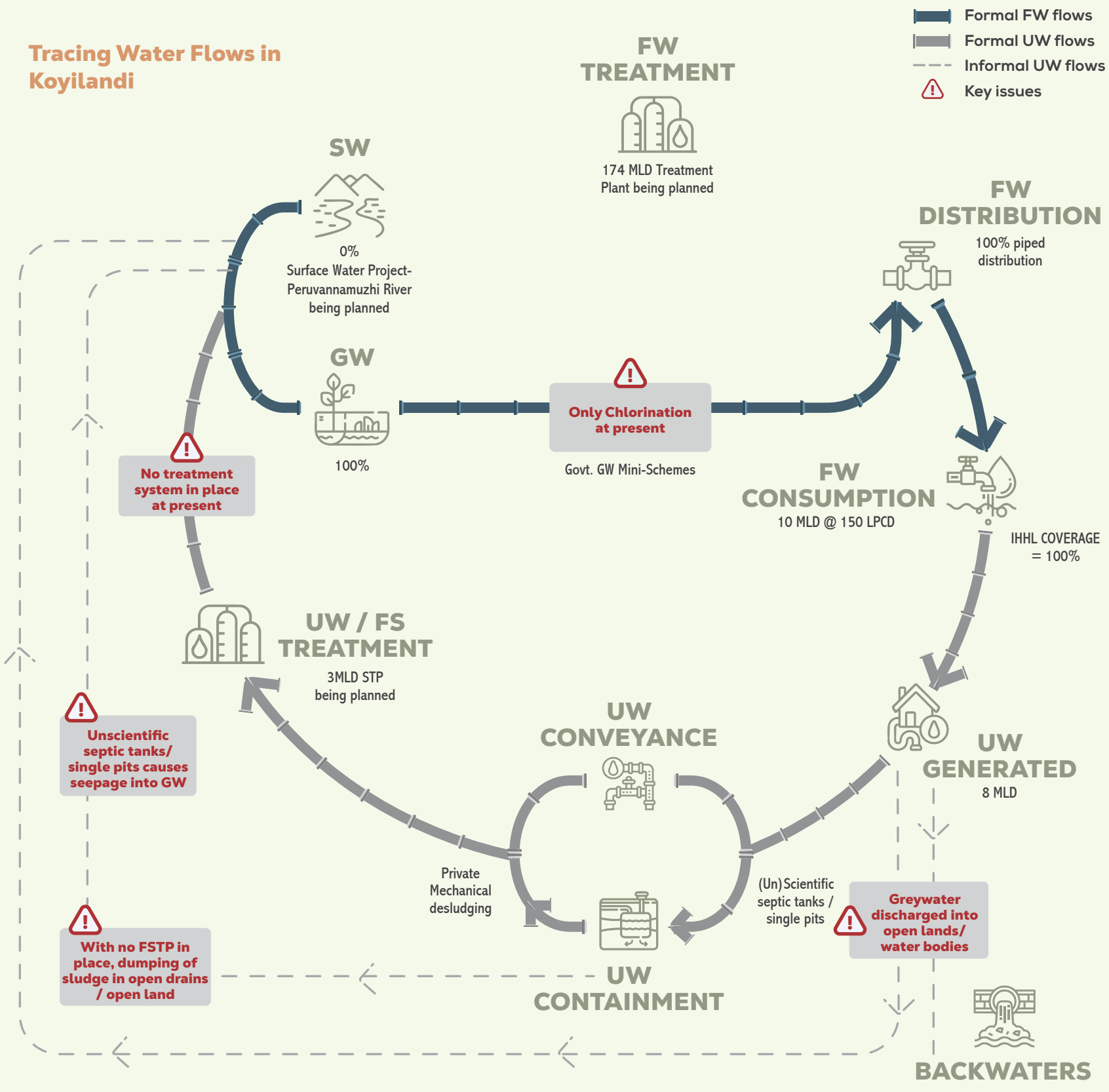
Sanitation in Koyilandi is characterized by decentralized, on-site containment systems such as septic tanks and pit latrines. However, these systems are often unscientific and poorly maintained, leading to groundwater contamination through seepage. Desludging is carried out by private operators using vacuum trucks, but in the absence of a functional faecal sludge treatment plant, sludge is frequently dumped into canals, open land, or backwaters, posing severe risks to public health and ecosystems. Similarly, greywater from households is discharged untreated into natural water bodies.

To address these challenges, a 3 MLD sewage treatment plant and sewerage connections are being planned. While this presents an opportunity to transition towards more centralized sanitation management, the shift must be accompanied by regulatory oversight, improved containment design, and integration of faecal sludge, co-treatment and grey water management.

Koyilandi's case highlights the urgent need for integrated planning that connects water source sustainability, wastewater treatment, and environmental protection. Building resilience in such towns demands not only infrastructure investments but also institutional reforms, community engagement, and nature-based solutions that can adapt to the town's coastal vulnerabilities and evolving urban pressures.



Tracing Water Flows in Koyilandi



Kerala's Unfinished Sanitation Agenda



Source: TAGS Forum

Kerala's universal toilet coverage is often hailed as a model, but beneath the surface lies an invisible crisis: what happens after the flush.

In most small towns, households rely on onsite systems like septic tanks and pits. Yet few follow IS 2470 standards. Instead, families build oversized pits or honeycomb structures, sometimes five to ten times larger than required, so desludging can be postponed for decades. By the time operators arrive, the sludge is so hardened they must flood pits with water to loosen it. "Most masons have never seen the standards," admitted a sanitation expert. "People just go with what the local contractor suggests."

Real sanitation isn't about having a toilet. It's about what happens after the flush.

Even when desludging is possible, access is difficult. Large vacuum trucks cannot navigate Kerala's narrow lanes, leaving many households unreachable. Local operators have improvised smaller honey-sucker units on autos or two-wheelers, offering vital services in dense neighbourhoods. Yet these remain informal, lacking training, regulation, or financial support.

The problem doesn't end with collection. Without effective monitoring and required treatment systems, much of the sludge ends up dumped into drains, fields, or waterways. A Thelineerozhukum Navakeralam study by Suchitwa Mission in 2022 found coliform bacteria in 79 % of over 62,000 waterbody samples from rivers, ponds, and canals across Kerala. Outbreaks of shigella and salmonella linked to polluted water highlight the public health risks.

Kerala proved large-scale behaviour change possible with toilet adoption. The same urgency is now needed for pits, desludging, and safe disposal. Without it, small towns will remain trapped in a cycle of hidden pits and untreated waste silently poisoning their environment.

Closing Kerala's Sanitation Gap



Source: TAGS Forum

Kerala's sanitation chain breaks not at the toilet, but at the treatment stage, where distance, funding gaps, and resistance converge.

While households grapple with unscientific pits and irregular desludging, the other end of Kerala's sanitation chain faces a deeper bottleneck - treatment. The state has six regional faecal sludge treatment plants (FSTPs), like the one in Cherthala, but they are too dispersed to be practical. For desludging operators, hauling sludge over long distances is costly and unviable. The result: waste collected but often dumped illegally, leaving the chain broken.

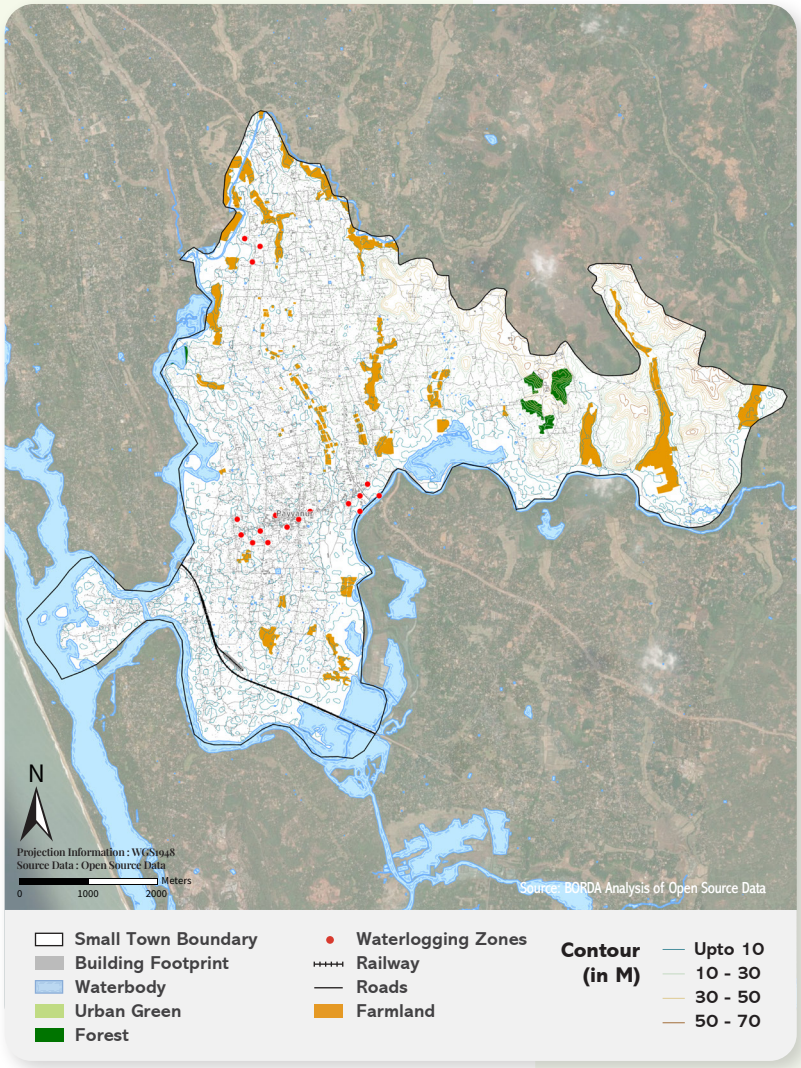
Compact, modular FSTPs in the 50–250 KLD range could change this, bringing treatment closer to where waste is generated. Suchitwa Mission has submitted proposals, but most remain stuck in approvals. National schemes like AMRUT still favour large sewerage projects that don't fit Kerala's dispersed urban pattern. Without context specific funding, towns are left waiting.

Even if municipalities secure funds, strong community resistance emerges. FSTPs face local protests over odour, stigma, and land value concerns. This "not in my backyard" sentiment has stalled several projects, slowing Kerala's transition to safe treatment. In the absence of accessible plants, local innovations are filling gaps. Mobile Treatment Units (MTUs) treat sludge at the point of collection. With over 20 units in use, MTUs are proving effective, but they remain outside formal policy frameworks, lacking financing and regulatory backing.

Closing Kerala's sanitation gap will require shifting funding norms toward decentralised systems, legitimising innovations like MTUs, and building trust in treatment facilities. Until then, small towns remain flush-equipped but treatment-starved.

Payyannur

Town Area (sq.km)	Population	Agro-climatic Zone
55.63	~ 99,000 (2024 est.)	Coastal



Flow Snapshots:

100% of water supply is from surface sources – Pazhassi dam (KWA), though households rely heavily on untreated groundwater, typically chlorinated or boiled.

A 90 MLD conventional water treatment plant operates at the regional level; **total water demand is 8 MLD**, with **90%** of water supplied via piped distribution.

About 6 MLD of usedwater is generated daily, contained through

- (un)scientific septic tanks, and
- single pits

conveyed through mechanical desludging

No FSTP/STP or other usedwater treatment facility exists.

Discharge of used water and sludge into — Drains • Open Lands • Water Bodies

Resulting risk of contamination to — SURFACE and GROUND WATER

> **The 'Malambhootham' campaign, launched by the Local Self Government Department, Suchitwa Mission, and UNICEF WASH Institute in Kerala seeks to prevent water pollution through community engagement, facility gap assessments, and stronger local action towards a waste-free Kerala.**

The Invisible Crisis in Kerala's Wells



Source: TAGS Forum

Kerala's trusted wells are no longer a source of life, but a pipeline for disease.

For generations, Malayali households have trusted their wells. A pot of boiled water on the stove once symbolised safety, even resilience. But today, that tradition is faltering.

An Indian Journal of Medical Research (IJMR) study in 2018 revealed that 83% of Kerala's open wells are contaminated with faecal coliform and pathogens like E. coli, Salmonella, and Vibrio cholerae. In Alappuzha, samples showed up to 9,000 coliforms per 100 ml - levels linked to outbreaks of hepatitis A, typhoid, and leptospirosis. Along the coastal belts, saline intrusion adds another invisible threat, seeping inland through overdrawn aquifers and turning once-sweet water brackish.

The culprit hides in plain sight: unscientifically designed septic systems and unregulated groundwater extraction. Most tanks are unlined pits or honeycomb structures, built just a few metres from wells, far short of the seven-metre safety buffer mandated by law. As plots shrink, rainfall intensifies, and saltwater creeps inland, effluents and saline water alike leach into the same aquifers households depend on. Especially during monsoons and floods, when contamination spreads fastest, one WASH expert put it bluntly: "You can boil till you drop, but if your well is infected, nothing changes."

Boiling may kill microbes but cannot remove nitrates or salt, nor prevent recontamination. Yet the practice persists, offering a false sense of security. Weak enforcement and irregular desludging mean septic tanks silently overflow, turning Kerala's wells , once symbols of purity, into conduits of contamination.

Municipal chlorination and well-disinfection drives remain patchy. What's needed is systemic change: regulated septage management, recharge to curb saline ingress, safe well construction, and a cultural shift that recognises water safety begins not in the kitchen, but underground.

Guruvayoor

Town Area (sq.km)
29.66

Population
~ 76,000
(2024 est.)

Agro-climatic Zone
Coastal

Flow Snapshots:

100% of water supply is from surface sources – Karuvannur river (KWA), though households rely heavily on untreated groundwater, typically chlorinated or boiled.

90% A 28 MLD conventional treatment plant operates at the regional level; **total water demand is 23 MLD at 150 LPCD,** with piped distribution coverage.

About 17 MLD of usedwater is generated daily, contained through

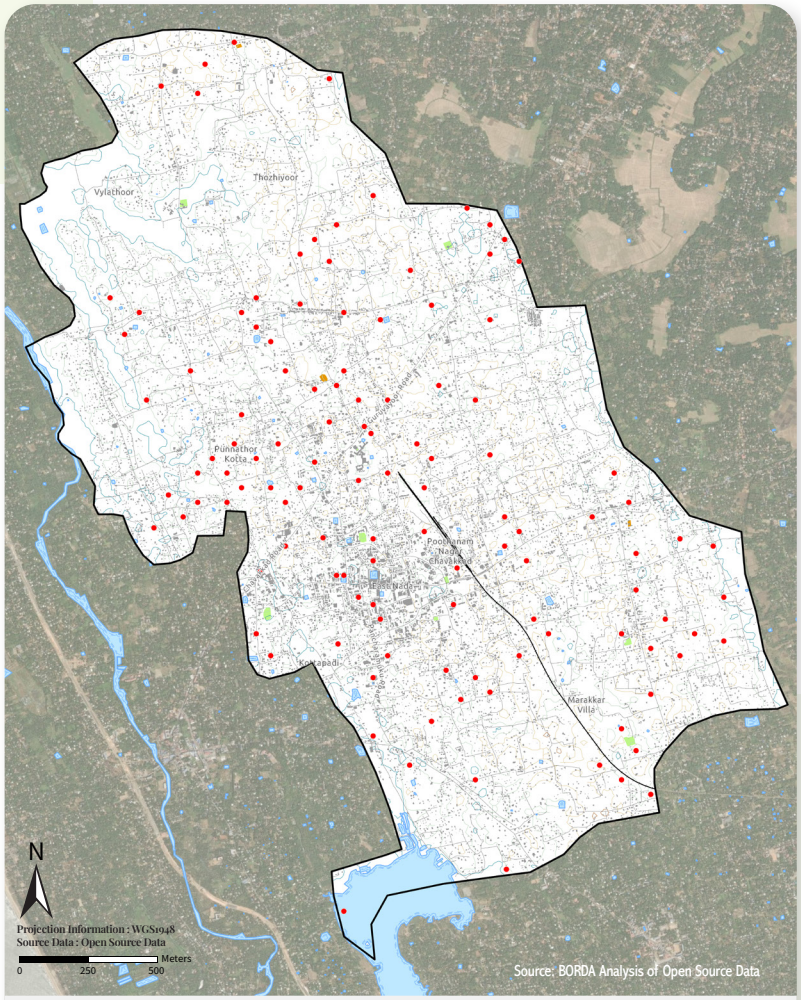
(un)scientific septic tanks, and single pits

conveyed through mechanical desludging

3 MLD STP with proposed upgradation to 5 MLD. Co-treatment of faecal sludge occurs at the current STP.

Discharge of used water and sludge into Drains • Open Lands • Water Bodies

Resulting risk of contamination to SURFACE and GROUND WATER



> **In Kerala's small towns, stormwater drains and canals are clogged with solid waste and encroachments, shrinking their flow and thereby intensifying urban floods.**

For centuries, Kerala's wetlands, backwaters, and mangrove belts acted as natural buffers, absorbing floodwaters and shielding both coastal and inland communities. But these defenses are shrinking fast. Wetland areas have reduced by nearly one-third, from about 2.35 lakh hectares in 1990 to 1.6 lakh hectares in 2011[1].

The decline is felt most acutely in small towns, where natural drainage once relied on paddy fields, canals, and backwaters. Today, many of these channels are silted, encroached, or built over. When heavy rains arrive, water has nowhere to go, flooding homes and roads within hours. In coastal belts, the loss of mangroves has left towns exposed to tidal surges, while inland towns face repeated waterlogging from blocked waterways.

Recent policy changes risk deepening the crisis. In 2024, Kerala's Coastal Zone Management Plan reduced the "No Development Zone" from 100 m to just 50 m and removed mandatory mangrove buffers on private land.[2] With weaker protections, mangroves, critical storm surge protectors, are being cleared faster, eroding the resilience of vulnerable settlements.

The risks are no longer hypothetical. The devastating floods of 2018 and 2020 revealed how deeply small towns are exposed. Inundated bus stands, schools repurposed as relief camps, and neighbourhoods left waterlogged for days underscored the fragility of everyday life. For small towns, these disasters are lived realities, not distant headlines.

As wetlands vanish and protective mangrove belts are cleared, both coastal flooding and inland waterlogging are worsening. Without wetlands to absorb rainfall or mangroves to shield against waves, even ordinary monsoons overwhelm the emerging urban centres and put lives at risk. Wetland reclamation and relaxed coastal regulations are not just environmental missteps, they are open invitations to disaster.

In an age of rising climate risks, Kerala's true flood shield lies in its backwaters and mangroves.



Kerala's Vanishing Shields Against Flooding

1. Times of India (2020). Wetlands shrinking rapidly in Kerala, fallout can be terrible. Accessed from https://timesofindia.indiatimes.com/city/kochi/wetlands-shrinking-rapidly-in-kerala-fallout-can-be-terrible/articleshow/121957156.cms

2. Onmanorama (2024). Centre approves Kerala's revised Coastal Zone Management Plan; Panchayats to get more relaxations. Accessed from https://www.onmanorama.com/news/kerala/2024/09/24/coastal-zone-management-plan-centre-approves-proposal-of-kerala.html



Following Kerala's Flows

Water source

Rivers, open and private wells anchor Kerala's water security but face saline intrusion, contamination, and tourism-driven demand, while backwaters, though vital, are increasingly polluted.

Water supply

Despite near-universal KWA coverage, households depend heavily on private wells and tankers, especially near tourist hubs, reflecting gaps in sustainable supply.

UW generation

Untreated used water and solid waste flow into canals, rivers, and backwaters, causing nutrient loading and ecosystem risks.

UW containment & conveyance

(Un)scientific septic tanks and single pits dominate, with desludging trucks conveying sludge to FSTPs where available, though much is still dumped in open land or water bodies.

UW treatment

With only six FSTPs and more proposed, most towns rely on on-site systems, leaving much greywater, blackwater, and untreated sludge in rivers and backwaters.

Reuse and closing the loop

Reuse of treated sludge, biosolids, and used water is minimal, though vital to enhance water security and reduce groundwater stress.



Source: Rahul Singh, Pexels

हिमाचल प्रदेश

HIMACHAL PRADESH



Regional Flowscape

Himachal Pradesh's emerging urban centres are shaped by mountainous terrain, dispersed settlements, and fragile ecology. With only about ten percent of the state's population living in urban areas, these towns are becoming pivotal service and migration hubs, acting as the first interface for rural-to-urban transitions. Yet they face systemic WASH challenges arising from difficult geography, seasonal hazards, and limited institutional capacity.

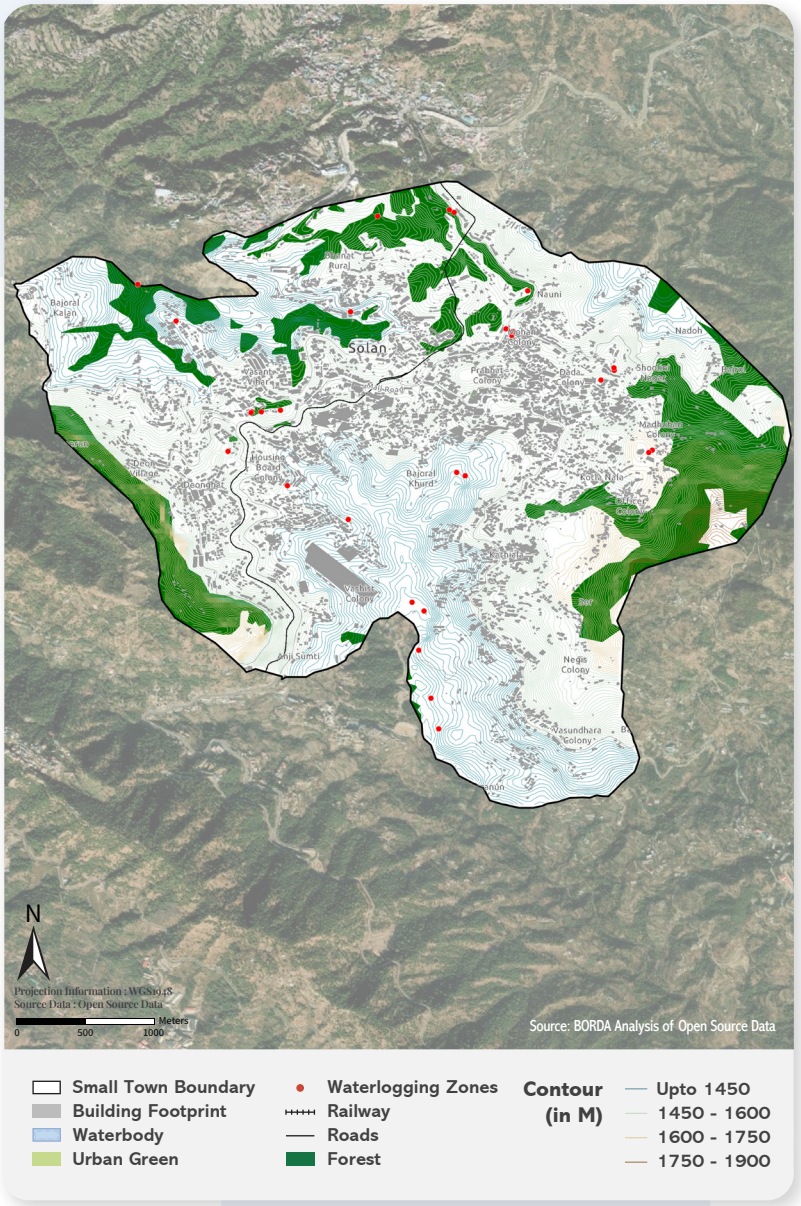
Water supply in these towns is almost entirely dependent on surface sources conveyed over long distances, often 20–40 kilometres, to treatment plants before distribution. Although household coverage is near universal, supply is irregular and highly vulnerable to sedimentation, landslides, and climate variability. Ageing pipelines and limited metering further reduce efficiency. Despite state mandates, rainwater harvesting remains underutilised, while groundwater, though not formally tapped, is informally accessed in peripheral and institutional areas, adding stress during dry spells.

Sanitation infrastructure is dominated by on-site systems such as septic tanks and pit latrines. Sewerage coverage remains negligible beyond a few larger towns, and many faecal sludge and sewage treatment plants are underutilised, defunct, or exist only on paper. Desludging, carried out by vacuum trucks, lacks safe treatment endpoints, leading to frequent disposal in open lands, drains, or alongside municipal waste. This fragmented chain, household containment managed privately, desludging on demand, and weak or absent treatment facilities, creates significant environmental and public health risks.

Responsibility for water and sanitation lies mainly with the Jal Shakti Vibhag, which plans and operates schemes across the state, while the Directorate of Urban Development oversees urban local bodies. Innovative models such as the autonomous Shimla Jal Prabandhan Nigam Limited show pathways for professionalised service delivery. Strengthening such institutional arrangements at a smaller town level, providing ULBs with clear roles, financial support, and technical capacity, and embedding climate-resilient approaches into planning are urgent steps to ensure sustainable WASH outcomes in Himachal Pradesh's emerging urban centres.

Solan

Town Area (sq.km)	Population	Agro-climatic Zone
11.64	~ 55,000 (2024 est)	Hilly, Western Himalayas



Charting the Flow : Solan in Focus

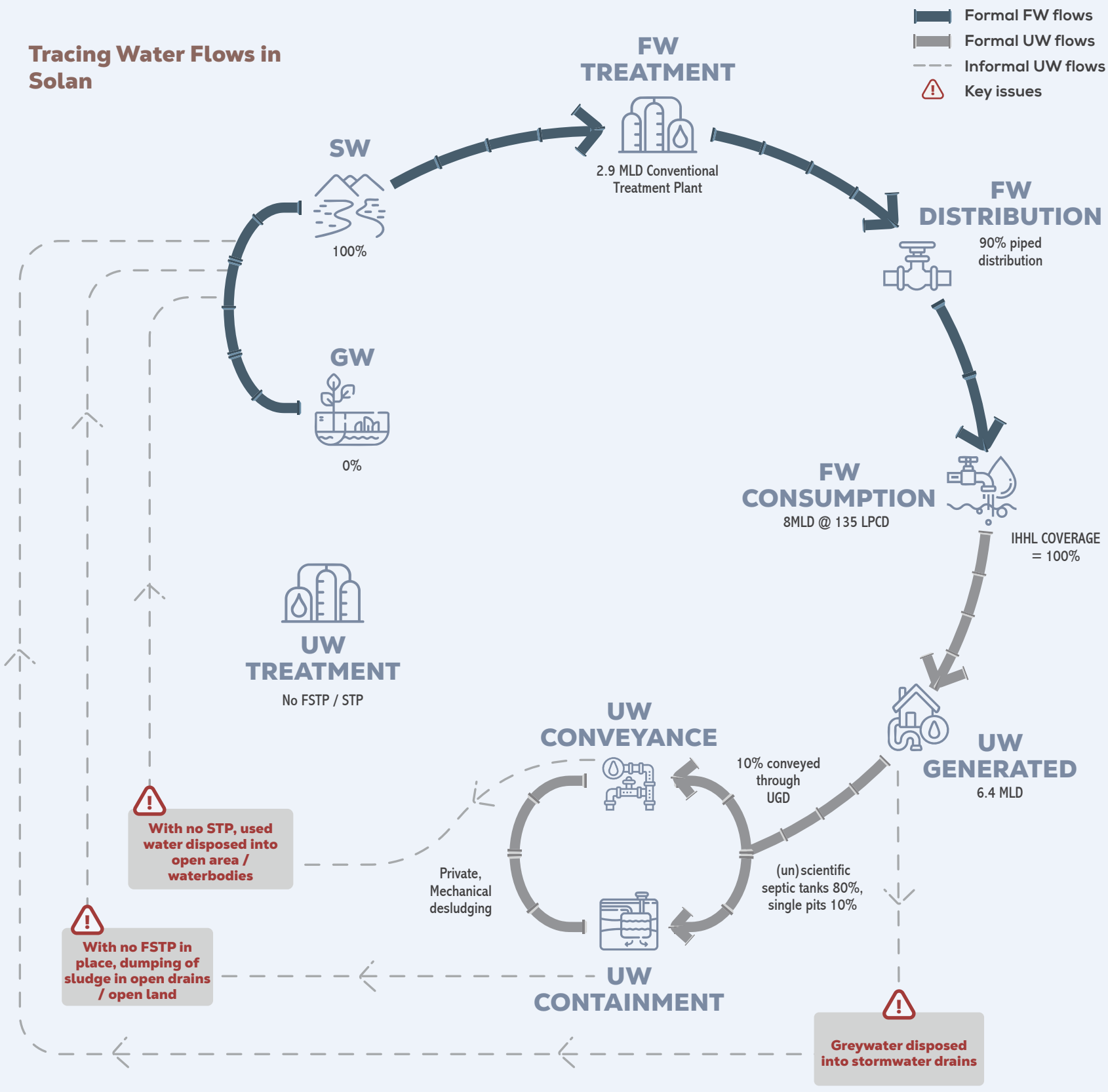
Despite near-universal piped water coverage on paper, Solan faces critical gaps in access, equity, and service reliability. The town is almost entirely dependent on a single surface water source, with about 90% of households connected to the piped network. Water is treated at a 2.9 MLD conventional plant before distribution, yet supply is restricted to two or three days a week. In hilly wards, low pressure means households may take an hour to fill a bucket, pushing many to rely on rooftop storage, private tankers, and informal borewells. Rainwater harvesting is legally mandated but rarely implemented or monitored.

Used water management is fragmented. Only about 10% of wastewater is conveyed through underground drainage, while nearly 90% of households depend on on-site containment via (un)scientific septic tanks and pit latrines. With no sewage or faecal sludge treatment plant in place, desludging is carried out mechanically and sludge is disposed in open lands or mixed with municipal waste. Greywater is commonly discharged into stormwater drains, contributing to contamination of local streams.

Stormwater networks are increasingly blocked by encroachments and unchecked paving, heightening flood risks during heavy rainfall. Institutional roles remain fragmented, with water supply managed by the Jal Shakti Vibhag and sanitation left to under-resourced urban local bodies. In the absence of treatment systems, source protection, and climate risk planning, Solan's water and sanitation flows remain highly vulnerable, underscoring the urgent need for decentralised, resilient solutions.

> **In Solan, fragmented institutions and missing infrastructure leave both taps and drains unreliable.**

Tracing Water Flows in Solan



Fragile Hill, Fragile Flows



Source: Ajay Bhargavguduru, Pexels

In the small hill towns of Solan and Nahan, nestled in Himachal Pradesh, the rhythms of daily life are increasingly disrupted by a changing climate. Each monsoon, heavy rains and sudden landslides damage fragile water pipelines, cutting off entire neighbourhoods from safe drinking water. What begins as a broken pipe quickly becomes a crisis, families wait for days without supply, relying instead on contaminated springs or paying steep prices for private tankers. For women and children, the burden is doubled, as they walk long distances to fetch water, often from unsafe sources.

Sanitation, too, is deeply fragile. When floods overwhelm septic tanks and pit latrines, waste spills into streets and seeps into water bodies, carrying with it invisible dangers. “During heavy rains, it feels like everything mixes, drinking water, sewage, mud,” says an expert. In Nahan, less than half of the used water is safely contained, leaving the rest exposed to the environment, especially during extreme weather events.

In Solan and Nahan, each landslide doesn’t just move earth, it breaks the fragile chain of safe water, sanitation, and health.

The knock-on effects touch hygiene and household economies. With water scarce, routines like handwashing and cleaning are reduced, driving up the risk of diarrhoeal diseases, especially among children. For daily-wage families, a few days of disruption can mean spending Rs. 500–700 on emergency water tankers, an impossible cost for many.

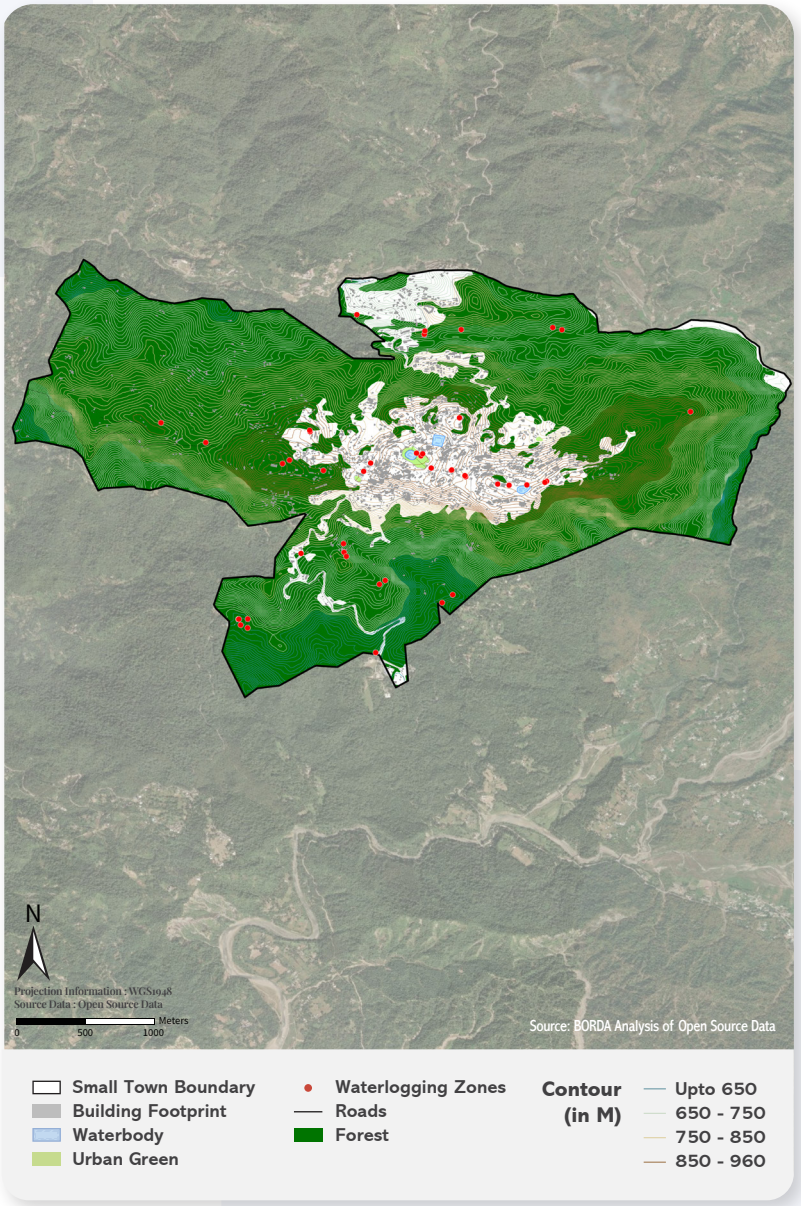
Solan and Nahan show how climate risks in these emerging urban centres are not abstract. They erode health, dignity, and financial security. Without climate-resilient WASH systems, the cycle of broken pipelines, unsafe sanitation, and mounting hardship will only deepen.



Source: Shalender Kumar, Pexels

Nahan

Town Area (sq.km)	Population	Agro-climatic Zone
3.6	~ 40,000 (2024 est.)	Hilly, Western Himalayas



Flow Snapshots:

70% of supply from surface water

Nehar-Swar	Dadahu	Kheri Kala Amb
40 km	35 km	20 km

treated by a 5 MLD sand filter (against a 9 MLD demand)

90% of water is supplied via piped distribution

Sanitation fully dependent on
(un)scientific septic tanks desludged by ULB-operated vacuum tankers

7.2 MLD of used water generated daily, with **no treatment plant** currently operational

A planned sewerage scheme includes STPs of 2.29 MLD, 1.54 MLD, and 0.63 MLD capacity.

Discharge of used water and sludge into **Drains • Open Lands • Water Bodies**

Resulting risk of contamination to **SURFACE and GROUND WATER**

> **In small towns of Himachal Pradesh, faecal sludge is collected but untreated, leaving septage dumped in the open with sanitation risks unresolved.**

The Gap Between Coverage and Access

In Solan and Nahan, nearly every household is officially connected to the municipal water supply, but taps often run dry, especially in hilly areas. Residents rely on rooftop tanks, private motors, and water tankers to meet daily needs. In Nahan, water is typically supplied once every two days, pushing households to invest in 1,000-litre rooftop tanks, while in summer many depend on tanker water. Solan, which draws 8 MLD and Nahan 9 MLD from surface sources located up to 40 km away, struggles to deliver water equitably across its terrain. *"Upper wards face pressure drops regularly, it can take an hour to fill a single bucket,"* notes a Solan ULB engineer.

Losses due to leakages and ageing infrastructure compound the challenge. In Solan, up to 40% of water is lost in summer through broken pipelines and uneven topography. In Nahan, the absence of household meters and a flat ₹50 monthly fee conceals inequities and discourages conservation. Without data on actual consumption, real-time monitoring or leak detection remains out of reach.

Despite near-universal piped connections, emerging urban hill towns face unreliable supply, pressure drops, and dependence on rooftop storage and tanker

The difficulties of emerging urban hill towns go beyond infrastructure. Gravity-fed systems, elevation differences, and reliance on distant surface sources make supply highly uneven. Official records may show near-universal piped coverage, yet access is deeply unequal across wards.

This disconnect between reported infrastructure and lived experience highlights a critical truth: reliable and equitable water supply cannot rest on pipelines alone. It requires consistent monitoring, fair pricing, and context-sensitive planning that accounts for geography, local consumption patterns, and the increasing pressures of climate variability.



Source: Vijit Bagh, Pexels



Following Himachal's Flows

Water source

Towns rely mainly on surface water from rivers, supplemented by tanks, step wells, and seasonal snowmelt, but fragile catchments and over-reliance on groundwater raise long-term scarcity risks.

Water supply

Household supply depends on rooftop tanks, pipelines, and private tankers, but is often disrupted by landslides and broken pipes.

UW generation

Used water from households, commercial establishments, and markets flows largely untreated into drains and nearby water bodies.

UW containment & conveyance

(Un)scientific septic tanks dominate but are often poorly designed, causing leakage; desludging occurs but disposal is unsafe, often into forests, rivers, or roadsides.

UW treatment

STPs built under AMRUT exist, but with limited UGD connections and poor O&M, most capacity remains underutilised, though new sewerage schemes are planned.

Reuse and closing the loop

Reuse is negligible, with both weak systems and cultural reluctance to accept treated wastewater limiting uptake.


Source: Dhirendra Singh, Pexels
লাদাখ
LADAKH
جموں اور کشمیر
JAMMU &
KASHMIR



Regional Flowscape

Ladakh and Jammu & Kashmir, India's northernmost Himalayan regions, are shaped by fragile ecologies, harsh climates, and complex governance transitions. Their emerging urban centres sit at the frontline of rapid change, balancing growing populations, tourism pressures, and limited institutional capacities. Water supply remains deeply climate dependent in Ladakh, where freezing winters cut off access to springs, shallow groundwater and impacts pipeline supply. In Kashmir, erratic rainfall and early snowmelt increasingly trigger floods and service disruptions. Infrastructure struggles to keep pace, with frequent shortages, pressure drops, and untreated wastewater entering rivers and fields. Seasonal variations make reliability as critical a challenge as availability.

Sanitation is mostly reliant on on-site systems such as pits and (un)scientific septic tanks, but service chains remain fragmented. Treatment plants, where they exist, often function only partially or shut down in winter, while desludging and safe disposal are irregular. Waste management faces similar stresses, where open dumping remains the norm, and seasonal spikes in tourism accelerate the accumulation of plastic and non-biodegradable waste. Efforts at segregation and decentralised solutions exist but are isolated and under-resourced.

Governance frameworks reflect two different trajectories. Jammu & Kashmir with master planning and smart city initiatives, and Ladakh with a vision of carbon-neutral, resource-efficient towns. Yet both regions face similar hurdles of limited staffing, weak local revenue bases, and high dependence on central transfers. Climate variability amplifies these structural weaknesses, pushing already vulnerable systems toward frequent breakdowns.

As these emerging urban centres continue to expand, the need is for decentralised, climate-adaptive WASH systems, stronger local capacities, and planning models that recognise the realities of mountain towns. Building resilience here is not just about infrastructure, but about reimagining governance and service delivery for fragile, climate-stressed geographies.

Leh

Town Area (sq.km)	Population	Agro-climatic Zone
9.15	34,789	Mountain, Cold Arid

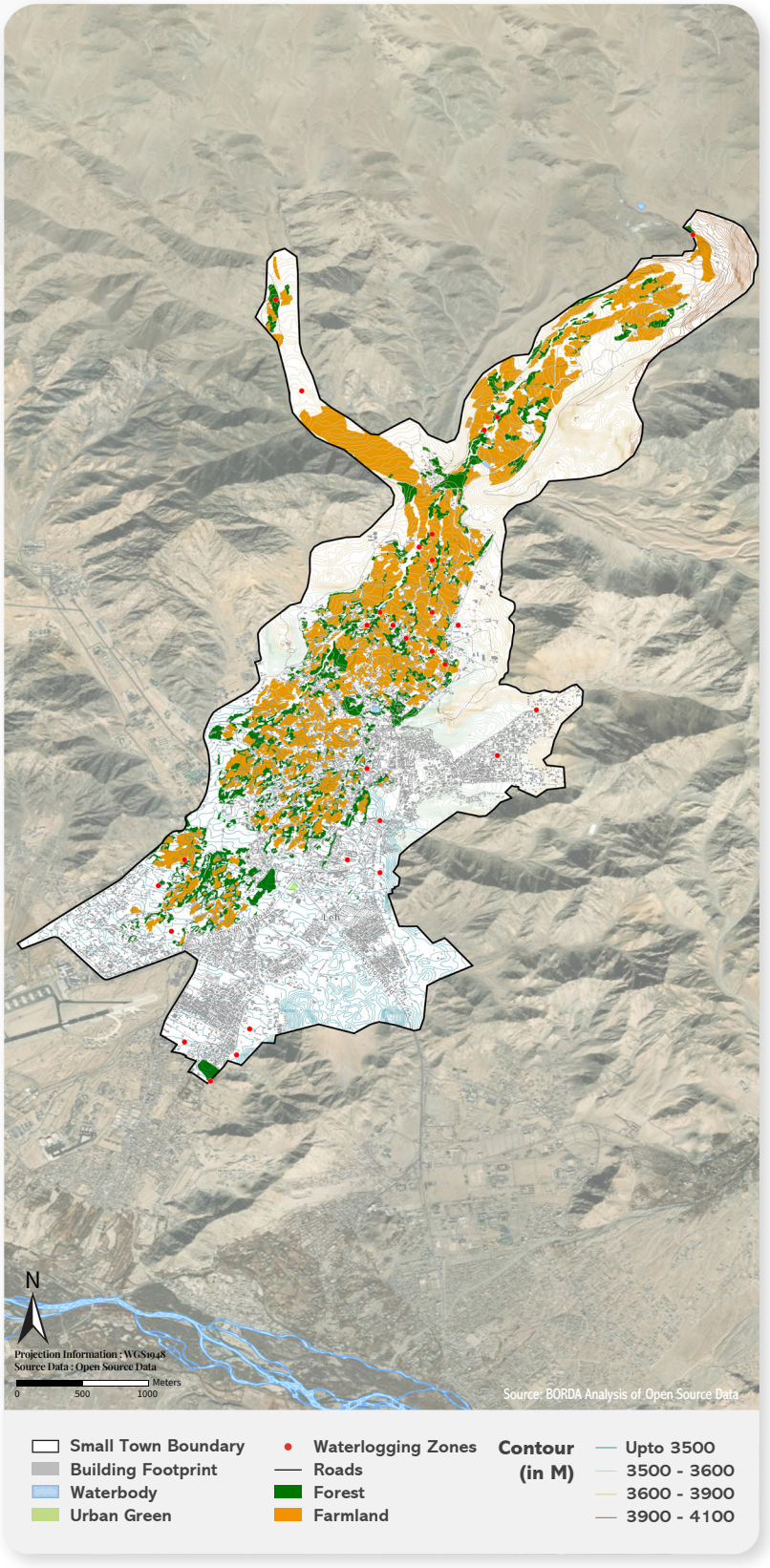
Charting the Flow : Leh in Focus

At over 3,500 meters, Leh is a town of 35,000 residents but must also absorb the seasonal pressures of tourists, migrant workers, and the military. This fluctuating population places enormous stress on fragile water and sanitation systems.

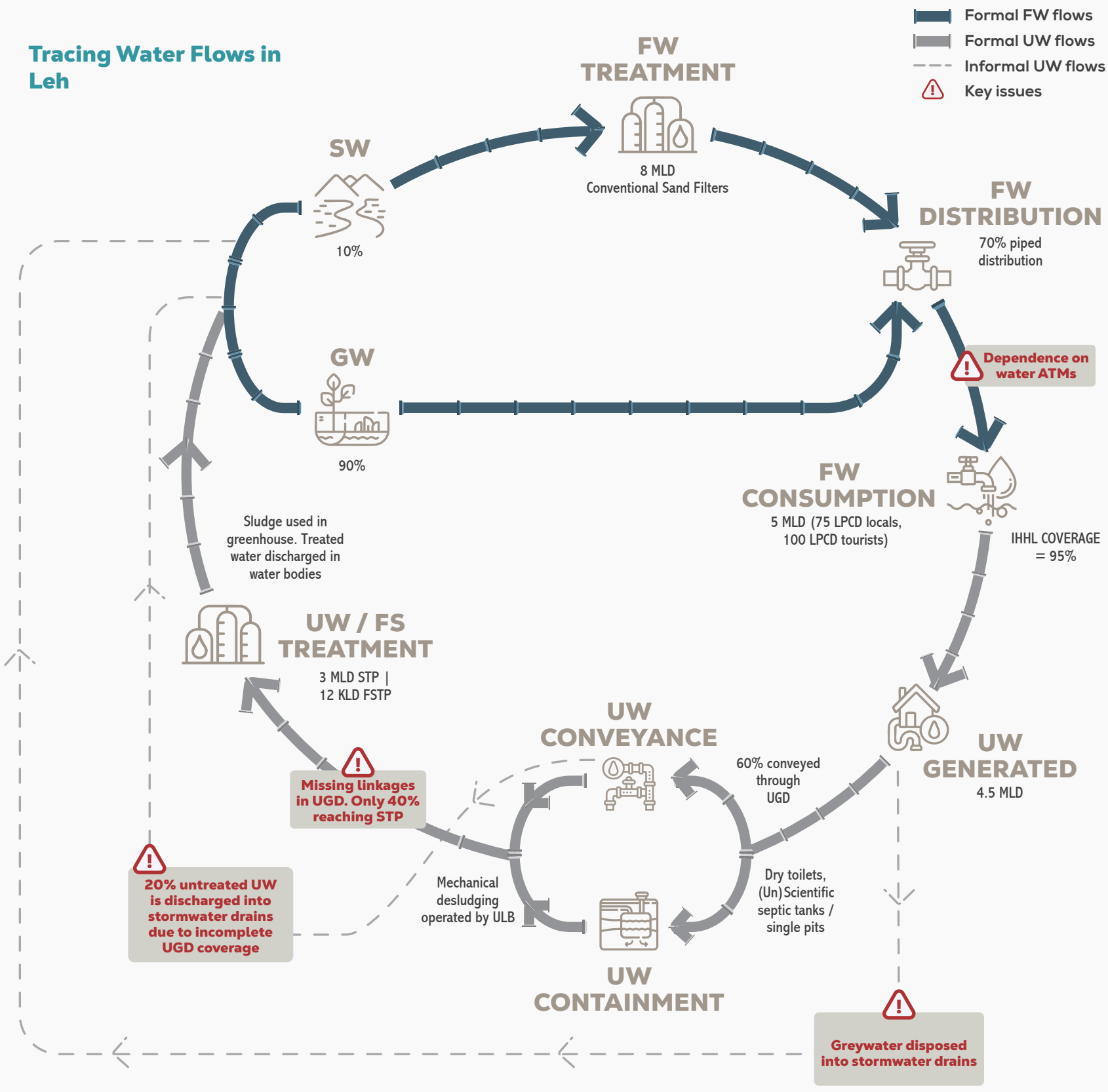
Nearly 90% of supply comes from groundwater, with the rest drawn from three major springs and the Indus and Zanskar rivers. An 8 MLD treatment facility and 70% piped network cover most households, but winters disrupt supply as pipelines freeze and sources shrink. Families cope by storing water in tanks, using water ATMs, or depending on tankers, often delayed by icy roads. Leakages and weak cost recovery further undermine reliability, making access uneven even in summer.

Sanitation faces its own gaps. About 60% of used water is conveyed through underground drains to a 3 MLD sewage treatment plant, which remains operational year-round thanks to winter adaptations. At present, treated water flows into open drains. Waste not conveyed through the sewer network enters storm drains, polluting local water bodies. The faecal sludge treatment plant shuts in winter, since desludging cannot be carried out in frozen conditions; in summer, the Urban Local Body undertakes regular mechanical desludging.

Yet resilience practices offer hope. Some households still use dry toilets that reduce water dependence. Sludge from treatment plants is being applied in greenhouses, boosting vegetable production in the fragile high-altitude setting, while decentralised composting supports waste management. With stronger regulation, seasonal planning, and climate-responsive finance, Leh can emerge as a model for high-altitude resilience.



Tracing Water Flows in Leh



Baramulla

Town Area (sq.km)
23.98

Population
74,068

Agro-climatic Zone
Hilly/Riverine, Western Himalayan

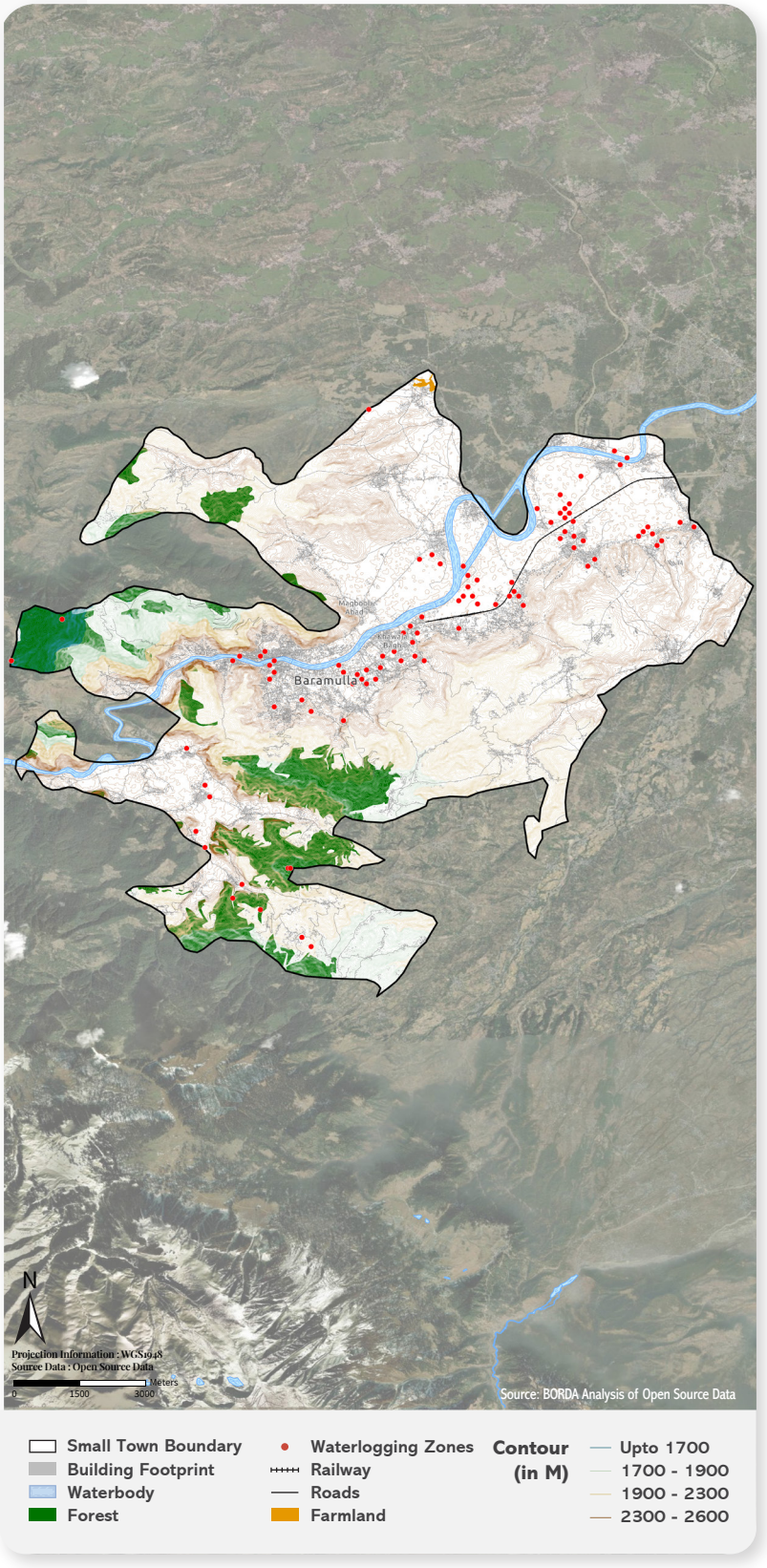
Charting the Flow : Baramulla in Focus

Baramulla, a growing town in the Kashmir Valley, sources most of its water from the Jhelum River, springs, and streams. Most households receive water from a treatment plant through a piped network, with tankers filling the gap during shortages. Another plant is under construction, but seasonal fluctuations and uneven distribution leave many households, especially in peripheral areas, facing unreliable supply and variable water quality.

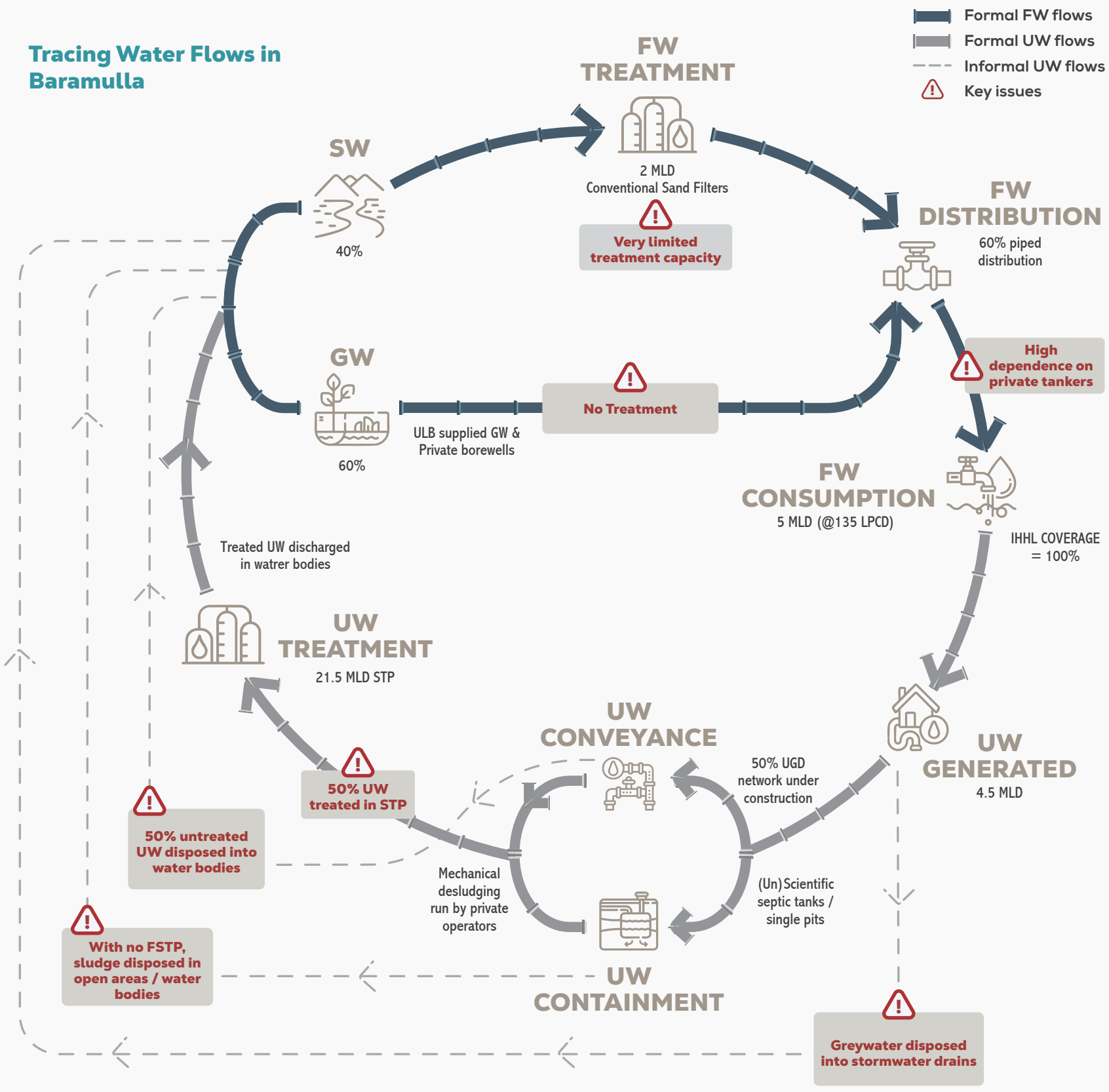
On sanitation, the town has achieved universal toilet coverage, with most households dependent on (un)scientific septic tanks and pits serviced through a mechanized desludging system. Sewer connectivity is relatively high, with about half of used water conveyed to a 21.5 MLD sewage treatment plant. Sludge is treated through biomethanization, but reuse of treated water remains minimal, and gaps in the network constrain safe management.

Baramulla's strength lies in its toilet access and sewer coverage, positioning it ahead of many towns in the region. Yet treatment infrastructure is still being developed, and water access fluctuates during shortages. To ensure equitable and sustainable services, the city must improve the reliability of supply, and extend coverage to underserved pockets to fully utilise the capacity of the treatment plant. Seasonal floods, snowmelt, and erratic precipitation continue to damage water and drainage systems, underscoring the fragility of existing networks.

Progress has been made on basic service delivery, but policy focus must now shift from coverage to improving service quality, resilience, and sustainability to safeguard long-term water security.



Tracing Water Flows in Baramulla



Leh's Silent Winter Crisis



Source: Ladakh Ecological Development Group

In Leh, winter doesn't just bring cold; it halts daily life. From October to March, sub-zero temperatures freeze pipelines, shutting down water supply altogether. Unlike other small towns where flow slows but continues, taps in Leh stay dry for months.

Households store water in large barrels before winter, while tankers serve as backup. But icy roads often delay supply, forcing families to ration. Even in summer, the Public Health Engineering Department provides around 5 MLD, yet leakages and illegal connections drain much of it before reaching households.

In Leh, winter turns off the taps, pipelines freeze, sanitation stalls, and life slows without a plan for continuity.

Sanitation suffers equally. The town's 12 KLD Faecal Sludge Treatment Plant shuts in winter, unable to function in freezing conditions. Over half of households rely on (un)scientific septic tanks and pit latrines and frozen ground leads to overflows. Dry toilets, once climate-suited, have largely vanished, leaving no reliable alternatives.

The deeper issue lies in the absence of winter continuity planning. Infrastructure designed for the plains cannot withstand Himalayan extremes, yet national schemes continue to replicate the same models. This mismatch leaves residents navigating months of shortage and heightened health risks. For towns like Leh, resilience demands decentralised solutions, context-specific technologies, and greater recognition of local knowledge in planning.

Jhelum – Source of Life, Sink of Waste



Source: Basit Khan, Pexels

Baramulla's lifeline, the Jhelum, is being choked by unchecked waste and weak coordination between institutions.

Every evening, as the sun sets behind the Pir Panjal, the Jhelum River in Baramulla shimmers gold. Yet beneath the beauty lies a silent crisis. Along the banks in Jetty Khawaja Bagh, plastic bags flutter from trees, discarded syringes litter the ground, and the air reeks of untreated waste.

The Jhelum, once Baramulla's lifeline, still supplies over 6 million gallons of water daily. But in the absence of a sanitary landfill or designated dumpsite, much of the town's waste ends up on its banks. Municipal trucks collect garbage, yet with nowhere to take it, informal disposal has become routine, dangerously close to homes and markets. Household refuse mixes with slaughter waste and biomedical litter, seeping into the same river that flows back into taps after only minimal treatment.

"*The Jhelum is everything here - water, heritage, culture. Protecting it must be a shared priority,*" says a regional expert.

The problem is not just infrastructure but governance. While waste management lies with the Urban Local Body, the riverbank is controlled by the irrigation and flood control department, leaving gaps in accountability. Ward-level cleanups and ad hoc measures provide some relief but fail to address the systemic issue.

Baramulla stands at a crossroads. Without inter-departmental collaboration, monitoring, and enforcement, the river's decline will accelerate. Decentralised waste management and safer transfer points could be first steps, but lasting solutions require community ownership and political will. For a town so closely tied to its river, safeguarding the Jhelum is central to safeguarding Baramulla itself.

Kargil

Town Area (sq.km)	Population	Agro-climatic Zone
2.14	~ 17,122 (2024 est.)	Mountain, Cold Arid

Flow Snapshots:

Predominantly sourced from the **Suru and Dras rivers** with additional supply from springs and minor groundwater use

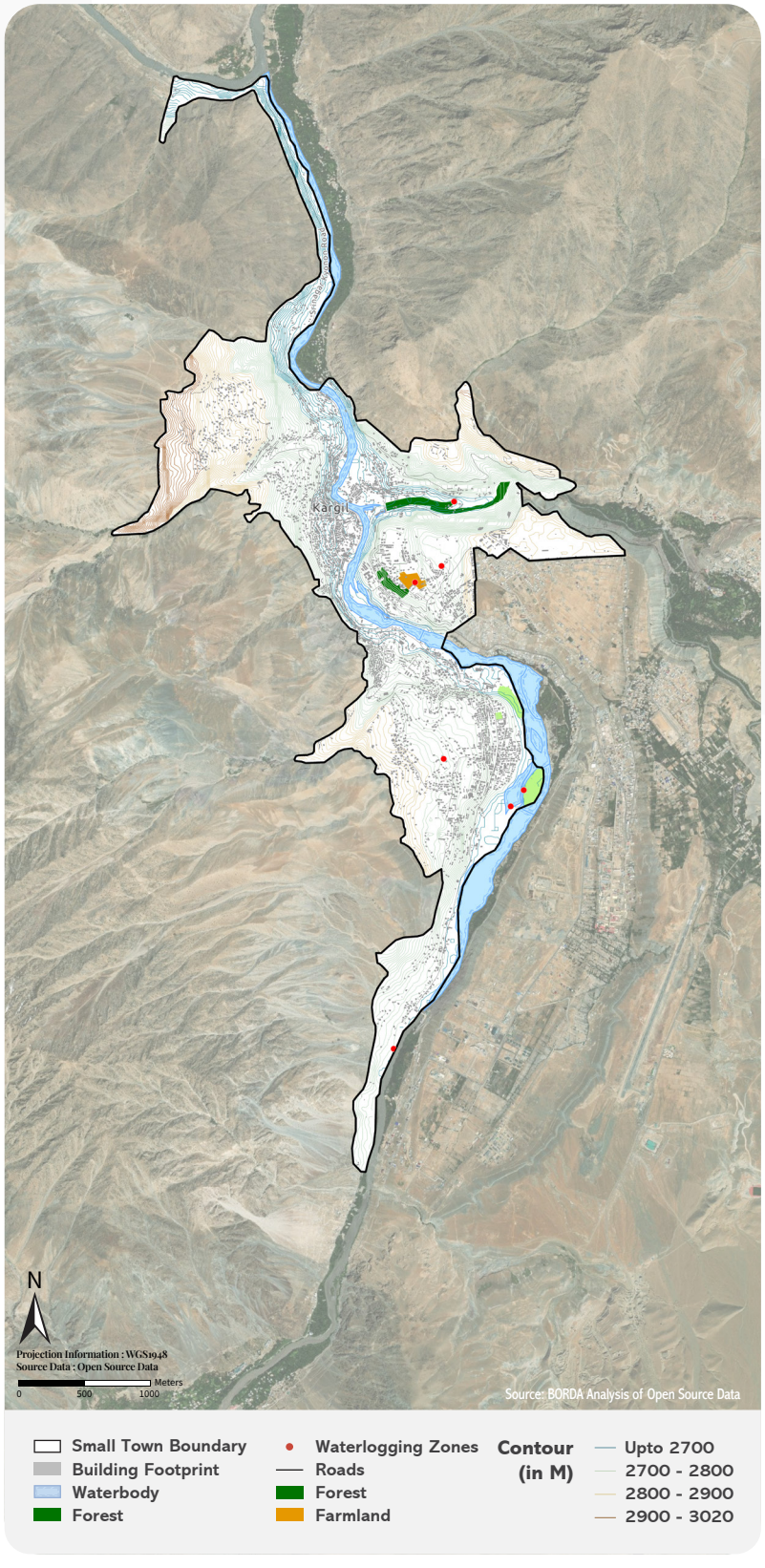
260 KLD treated before distribution against **~4.1 MLD demand** (100–120 LPCD)

98% of water is supplied via piped distribution

IHHL coverage at 92%, with only **45% of used water** safely contained in (un)scientific septic tanks and single pits, emptied by vacuum trucks (limited PPP involvement)

About 4 MLD of used water generated daily; While FSTP exists, all used water remains untreated due to non-functional FSTP, absence of UGD network despite desludging efforts.

Resulting risk of contamination to SURFACE and GROUND WATER





Source: Ladakh Ecological Development Group

Losing Dry Toilets, Losing Climate Wisdom

The shift from dry toilets to septic tanks in Kargil is turning a climate-adapted practice into a sanitation crisis.

In Kargil, a high-altitude Himalayan town, traditional dry toilets are rapidly disappearing from homes in areas like Lankerchey, Poyen, and Goma Kargil. Replaced by water-based septic systems, these changes overlook the realities of extreme winters and water scarcity.

For nearly half the year, sub-zero temperatures cause septic tanks to freeze or overflow, making desludging impossible and creating unsafe conditions for sanitation workers. Unlike dry toilets, which required no water and allowed natural composting, the new systems are prone to breakdowns and increase environmental and occupational risks.

The Ladakhi dry toilet was inherently climate-responsive, but schemes like Swachh Bharat and housing policies have promoted septic tanks as the default "upgrade," erasing local wisdom. With no provision for dry toilets in building regulations, a one-size-fits-all approach is being applied in a context where it does not work.

A recent survey in Kargil revealed unsafe conditions for sanitation workers managing frozen septic systems, highlighting the urgent need for retrofitting guidelines and operational protocols for dry toilets. Experts argue that rather than phasing them out, policies must modernise dry toilets, ensuring safety, dignity, and alignment with ecological conditions.

Kargil's experience demonstrates a larger lesson: national sanitation goals must adapt to diverse geographies. Retaining and upgrading traditional systems, rather than replacing them outright, offers a pathway to solutions that are sustainable, safe, and contextually relevant.


I ♥ LEH

Following Ladakh's J&K's Flows

Water source

Groundwater in Ladakh and rivers like the Jhelum in J&K, supported by glacial melt, are lifelines but face stress from climate change, waste dumping, and pollution.

Water supply

In Ladakh, frozen pipes in winter mean barrels and tankers, while in summer, tourism drives demand beyond supply. In J&K, piped networks exist but remain unreliable, keeping many households dependent on tankers.

UW generation

Seasonal surges from markets and tourist hubs overwhelm systems built for residents, leaving little room to manage used-water from the floating population.

UW containment & conveyance

Traditional dry toilets, one adapted to winters, lie abandoned. (Un)scientific septic tanks and desludging trucks dominate, but poor practices lead to frequent dumping into open areas and rivers.

UW treatment

FSTPs exist but often falter in winters, while non-functional plants and weak oversight see untreated sludge dumped on land and into water bodies.

Reuse and closing the loop

Wastewater reuse is absent across both regions, leaving untapped potential to strengthen water security and reduce pollution.



Source: Abdul Kayum, Pexels

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NEPAL



Regional Flowscape

Nepal's emerging urban centres are shaped by rugged topography, dispersed growth patterns, and fragile ecosystems. While urbanisation is still relatively modest compared to neighbouring countries, these municipalities are rapidly becoming nodes of migration, trade, and services, linking rural hinterlands with national markets. Yet water, sanitation, and hygiene (WASH) services remain underdeveloped, with climate risks and institutional gaps compounding the challenge.

Water supply is drawn primarily from springs, streams, and shallow aquifers. Many networks are community-managed, conveying water over long distances before treatment through slow sand filters and basic chlorination. Piped coverage has expanded, but only a fraction of households receive reliable, safe, and continuous supply. In dry seasons, depletion of sources and rising groundwater dependence intensify stress, while extreme rainfall and landslides damage fragile transmission lines. Informal private vendors and tanker markets fill gaps, but at high cost to low-income families.

Sanitation is dominated by on-site systems such as pit latrines and septic tanks, often without proper lining or regular desludging. Sewerage networks exist only in a few larger municipalities, and fecal sludge treatment plants are rare, with most septage disposed untreated in open lands or drains. Usedwater management is almost absent, with less than 5% of flows treated nationally. This fragmented sanitation chain leaves settlements vulnerable to contamination of both surface and groundwater, with visible health and environmental risks.

Responsibility for water supply lies primarily with municipal governments, supported by the Department of Water Supply and Sewerage Management (DWSSM). Sanitation governance remains fragmented across ministries, municipalities, and informal operators. Policy frameworks such as the Municipal Water, Sanitation and Hygiene (MWIS) Plan and the Waste Management & Plastic Ban Guidelines (2075) provide opportunities to steer cities toward safer practices. Building resilience will require formalising service chains, strengthening municipal capacity, and embedding climate-linked strategies for sustainable and inclusive WASH outcomes.

Kirtipur

Town Area (sq.km)	Population	Agro-climatic Zone
14.76	81,578	Hilly, Kathamandu Valley

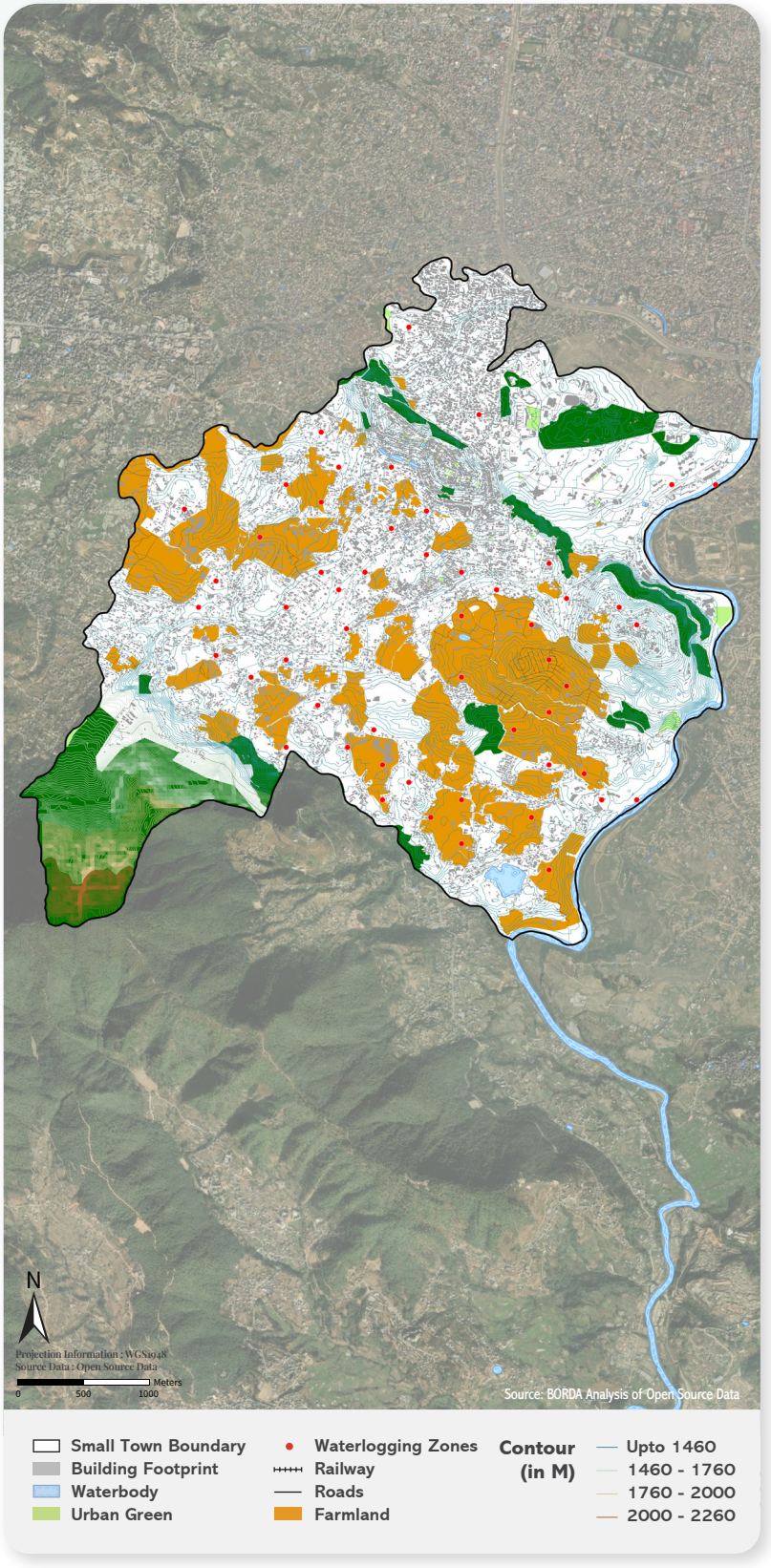
Charting the Flow : Kirtipur in Focus

Kirtipur, located on the southwestern edge of the Kathmandu Valley, is shaped by a mix of historic water systems and limited municipal infrastructure. While household sanitation access has expanded, safely managing water and waste remains a critical challenge.

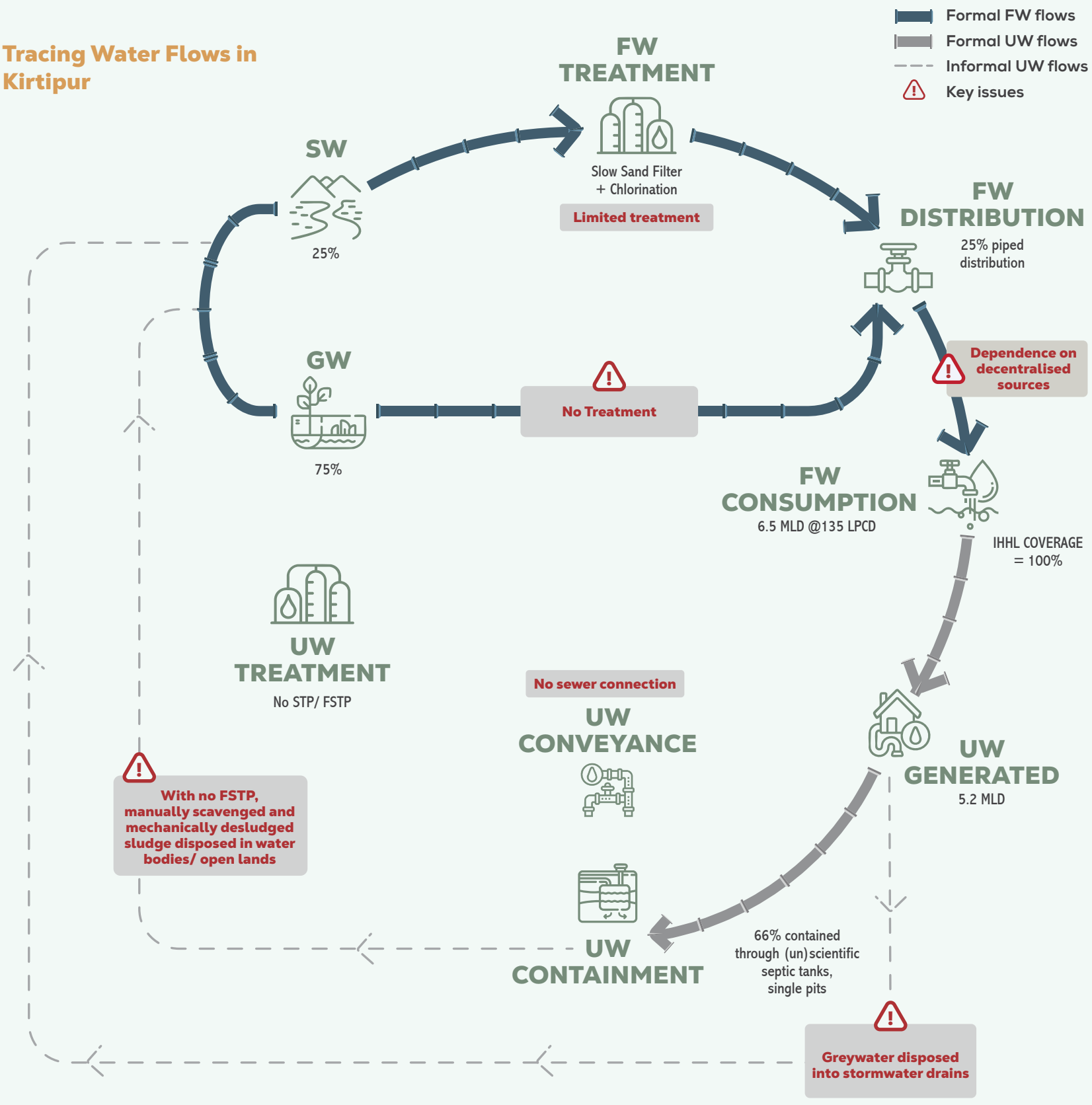
Water supply is split between groundwater and surface sources. Nearly three-quarters of households rely on wells and spouts, many of which were once community-managed and are now used at an individual level. The remaining quarter is drawn from surface sources, primarily the Dudh Pokhari and Sim Pokhari ponds, which feed service reservoirs before being chlorinated, sand filtered, and piped. Only about 25% of households receive piped supply, with water delivered just two to three times a week for less than an hour. For many, tanker water remains an expensive but necessary backup, costing ₹4,000–₹5,000 per delivery in times of scarcity. Groundwater dependence, limited recharge areas, and climate variability heighten the risks of depletion and contamination.

Sanitation is dominated by on-site systems. About 66% of households use septic tanks or pit latrines, with no sewerage, faecal sludge treatment plant, or sewage treatment facility in place. Desludging is carried out by vacuum trucks on demand, though manual emptying still occurs, exposing both workers and the community to health hazards. Greywater and untreated effluent typically drain into surface channels, ultimately flowing into the Bagmati River.

Recurring hazards such as flooding, landslides, earthquakes, and growing urban demand have exposed the fragility of these systems. Strengthening resilience will require improving water quality treatment, formalising desludging with safe endpoints, piloting decentralised treatment options, and protecting groundwater and surface sources that remain the lifeline of the city.



Tracing Water Flows in Kirtipur



The Fragile Promise of Piped Water



Source: Environment and Public Health Organisation

The true cost of water lies not in pipes, but in the burden on users.

In the hillside towns of Kirtipur and Godawari, pipes have reached most homes, yet every kitchen still keeps a 20-litre jar on the shelf. The jar is more than a convenience – it is a quiet symbol of mistrust. Piped supply, though widespread, comes only once every two to four days. When taps run dry, households turn to jars, dug wells, or tankers that weave through narrow lanes, their coloured stickers, blue for drinking, green for domestic use, serving more as labels than guarantees.

In the older cores of town, families juggle between piped water, purchased jars, and bottled filters. On the fringes, wells remain common, even where iron stains mark the water as unsafe. Community-led Water User Committees, often born of donor projects, fill the gaps with small sand filtration units, but when those systems break down, there are rarely funds for repairs. Large national projects like Melamchi have focused on extending reach through more pipes, but water quality, reliability, and trust remain elusive.

A provincial water official captured the dilemma: "*Infrastructure has reached, yes, but reliability and quality haven't.*"

For residents, the burden of making water safe through boiling, filtering, buying, or hauling falls squarely on their shoulders. The system may have expanded, but until governance improves and trust is rebuilt, the jar on the kitchen shelf will remain, silently telling the story of water in these towns.



Source: Hasmat Safi, Pexels

Godawari

Town Area (sq.km)	Population	Agro-climatic Zone
17.5	~ 97,633 (2024 est.)	Hilly/Riverine, Middle Mountain

Flow Snapshots:

19% reliance on surface water, with the remaining demand met through groundwater, tube-wells, and traditional spouts

30% of supply treated by KUKL through slow sand filtration and chlorination against a **~7.8 MLD demand**

Only **30%** of households covered through piped distribution, with high dependence on decentralised and private sources

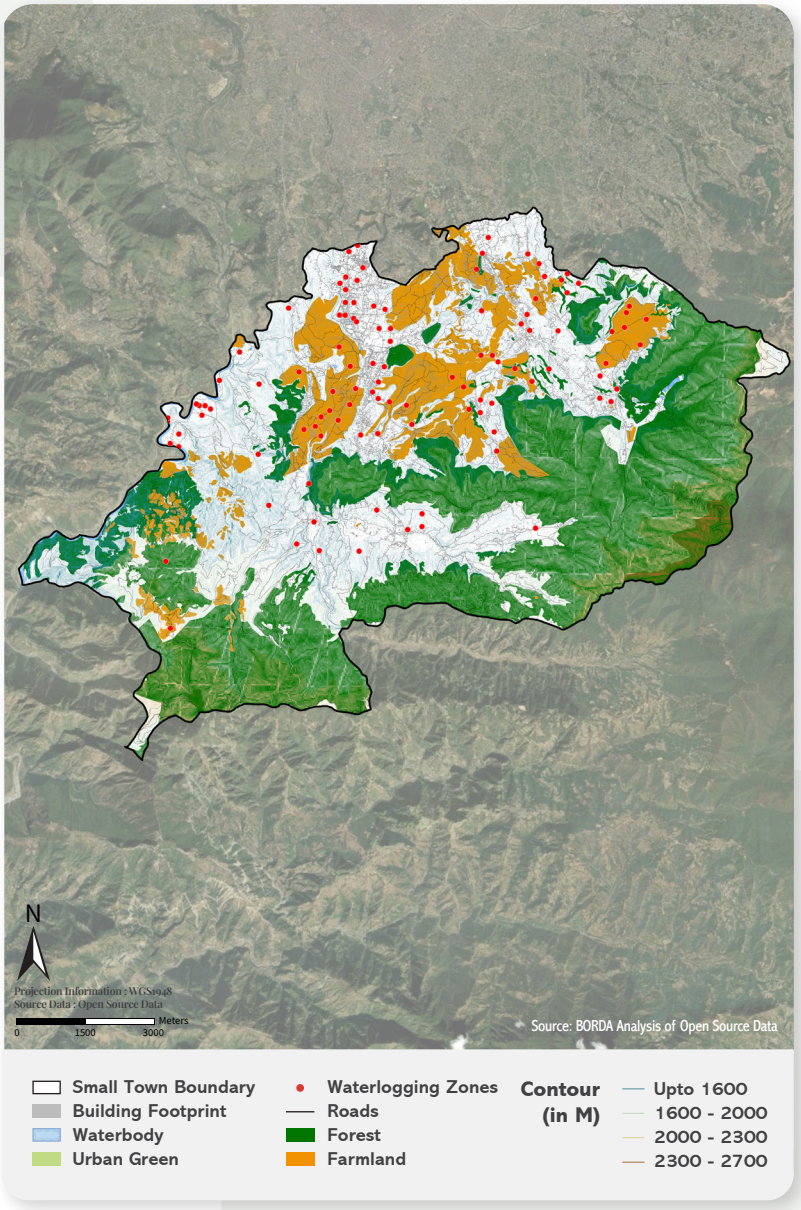
IHHL coverage at 100%, but only 4% of used water safely contained in

(un) septic tanks and single pits

widespread reliance on unsafe containment, manual scavenging, and instances of open defecation

About 6.24 MLD of used water generated daily, with no centralized sewerage network, no STP/FSTP, and minimal desludging practices

High risk of contamination of SURFACE and GROUND WATER



> **In small towns of Nepal, underutilised rainwater harvesting and blocked recharge zones turn abundant rainfall into flood risks, highlighting gaps in planning and enforcement.**

From Relic to Resource

In the hill town of Kirtipur, locals say the monsoon truly begins when the old stone spout near the town square starts to gurgle again. Once dry for years, it now flows softly, a reminder of water once central to daily life. Similar revivals are appearing in neighbouring Godawari, where traditional dhunge dharas, the stone waterspouts long treated as relics are returning to use. Historically fed by shallow aquifers and natural gravity, these spouts had withered under unchecked urbanisation, concretisation, and declining recharge. In many towns they were fenced off as cultural artefacts rather than community utilities. Their revival has been led by NGOs and municipalities, which have re-mapped fractured springs, restored channels, and repaired old masonry so that water can flow again.

The quiet trickle of stone spouts signals resilience rooted in tradition.

Once restored, the community keeps them alive. Each year, households join in the Sithi Naka festival to clean ponds, wells, and spouts before the rains. Families sweep away silt, clear weeds, and repaint shrines, turning maintenance into both ritual and responsibility. The results are modest but meaningful. During the monsoon, water once again trickles through spouts that residents filter with lime or sand and use for drinking, cooking, and rituals. For households facing unreliable piped supply, these sources ease scarcity, reducing the need for tankers and offering quick relief during shortages. With rainfall in the Valley averaging 1,600 mm, and piped systems still inconsistent, the return of stone spouts shows how formal restoration and community care together can provide small towns with resilience, answers lying just beneath their feet in stone and in the quiet trickle of water.



Source: Environment and Public Health Organisation



Following Nepal's Flows

Water source

Rivers and stone spouts (dhunge dharas) once shaped Kathmandu Valley's supply, but most now run dry or are polluted, though some are being rejuvenated. Groundwater extraction fills gaps, though aquifers are under stress.

Water supply

Intermittent municipal pipelines are supplemented by colour-coded tankers (blue for potable, green for non-potable). Many households still store and ration water daily in jars and containers.

UW generation

Dense settlements, households, and markets generate significant used water, with monsoon flooding worsening untreated discharges into rivers.

UW containment & conveyance

Household single pits and (un)scientific septic tanks dominate. Desludging trucks operate irregularly, with poorly maintained systems heightening risks.

UW treatment

Treatment is minimal. Desludging trucks often dump untreated septage into rivers, adding to already high pollution loads.

Reuse and closing the loop

Reuse of wastewater and sludge is negligible, leaving opportunities to improve water security largely untapped.



Source: Tanin Ahmed, Pexels

বাংলাদেশ

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Regional Flowscape

Bangladesh's emerging urban centres are becoming pivotal hubs for migration, trade, and services, linking rural regions with national markets. Nearly 40% of the population now resides in urban areas, with small and medium towns such as Kushtia, Haragach, and Parbatipur playing a growing role in absorbing population pressures from megacities like Dhaka and Chattogram. These towns support regional economies yet face unplanned growth, weak municipal capacity, and heightened exposure to climate-induced risks including flooding, salinity intrusion, and riverbank erosion.

Water supply in these centres is largely dependent on groundwater, with limited diversification to surface water. Kushtia has partial piped networks and basic treatment units, but Haragach and Parbatipur rely almost entirely on private borewells without tariffs, systematic quality testing, or formal management. Seasonal shortages, arsenic and iron contamination, and inadequate reuse or rainwater measures constrain reliable supply. Cost recovery remains weak even where municipal systems exist, and marginalised populations often lack equitable access.

Sanitation is dominated by on site-systems such as (un)scientific septic tanks and pit latrines, where sewerage networks are absent outside larger cities. Kushtia operates a faecal sludge treatment plant with limited mechanical desludging services, but informal dumping of untreated waste persists. Haragach and Parbatipur rely on manual desludging by untrained workers, with 100% of wastewater discharged untreated into drains or lowlands. Public toilets are scarce and lack menstrual hygiene facilities, while flooding frequently damages containment systems.

Governance is primarily under urban local bodies guided by national strategies such as the National Strategy for Water Supply and Sanitation (2014/2021) and the FSM Action Plan (2020). However, fragmented planning, financing gaps, and absence of climate-linked approaches hinder resilience. Strengthening municipal systems, formalising service chains, and embedding integrated, climate-adaptive WASH planning are critical for these emerging centres to develop sustainably.

Kushtia

Town Area (sq.km)	Population	Agro-climatic Zone
42.78	~ 2,27,743 (2024 est)	Plain / Riverine

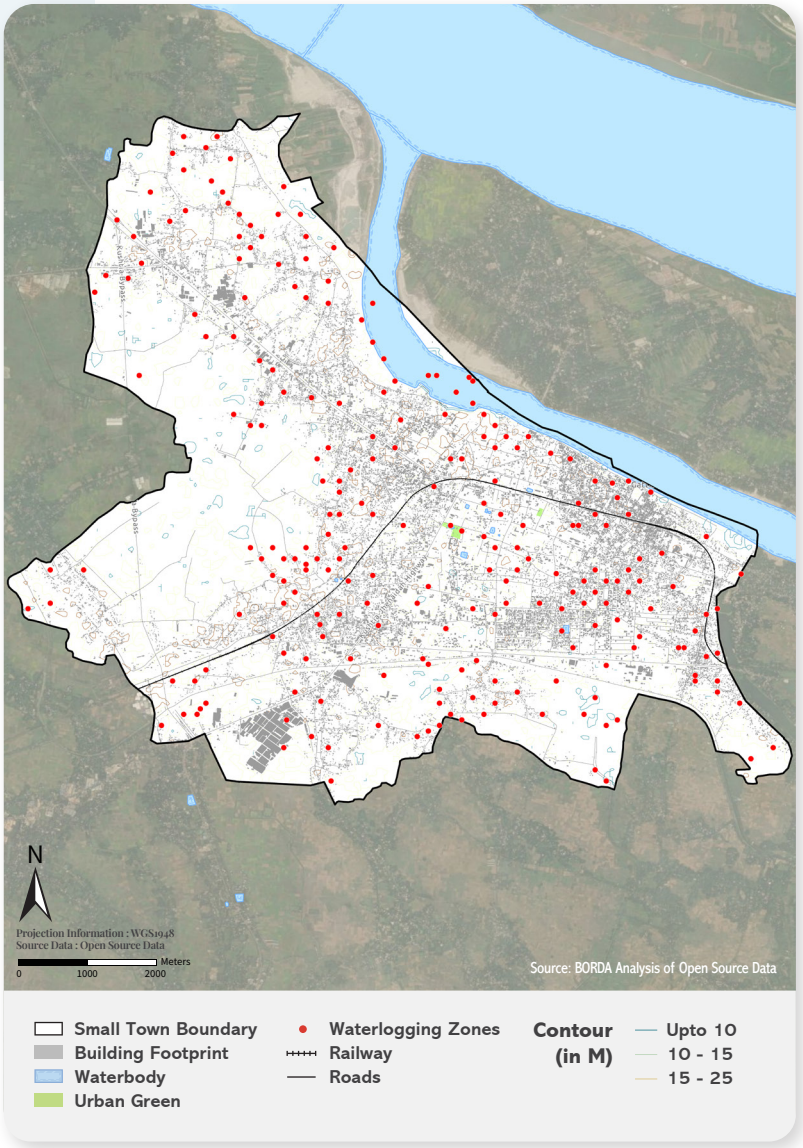
Charting the Flow : Kushtia in Focus

Kushtia, a medium-sized town in southwestern Bangladesh with a population of around 2,27,700 relies predominantly on groundwater, with nearly 77% of supply drawn from untreated municipal and private tubewells and handpumps. Only 23% comes from surface water, treated at a 14 MLD plant, with piped distribution reaching just 23% of households. Daily consumption is high at 41 MLD (185 LPCD), intensifying pressure on arsenic-contaminated aquifers. Seasonal shortages are common, and rainwater harvesting or reuse measures remain limited. Water management is shared between Kushtia Municipality, the Department of Public Health Engineering (DPHE), and the Bangladesh Water Development Board (BWDB).

Sanitation coverage is 82% with individual household latrines (IHHL), though open defecation persists among transient populations. Most households rely on unscientific on-site containment such as (un)scientific septic tanks and pit latrines that often overflow or discharge into drains and land, polluting nearby water bodies. Blackwater and greywater remain largely unmanaged as the town lacks a sewerage network.

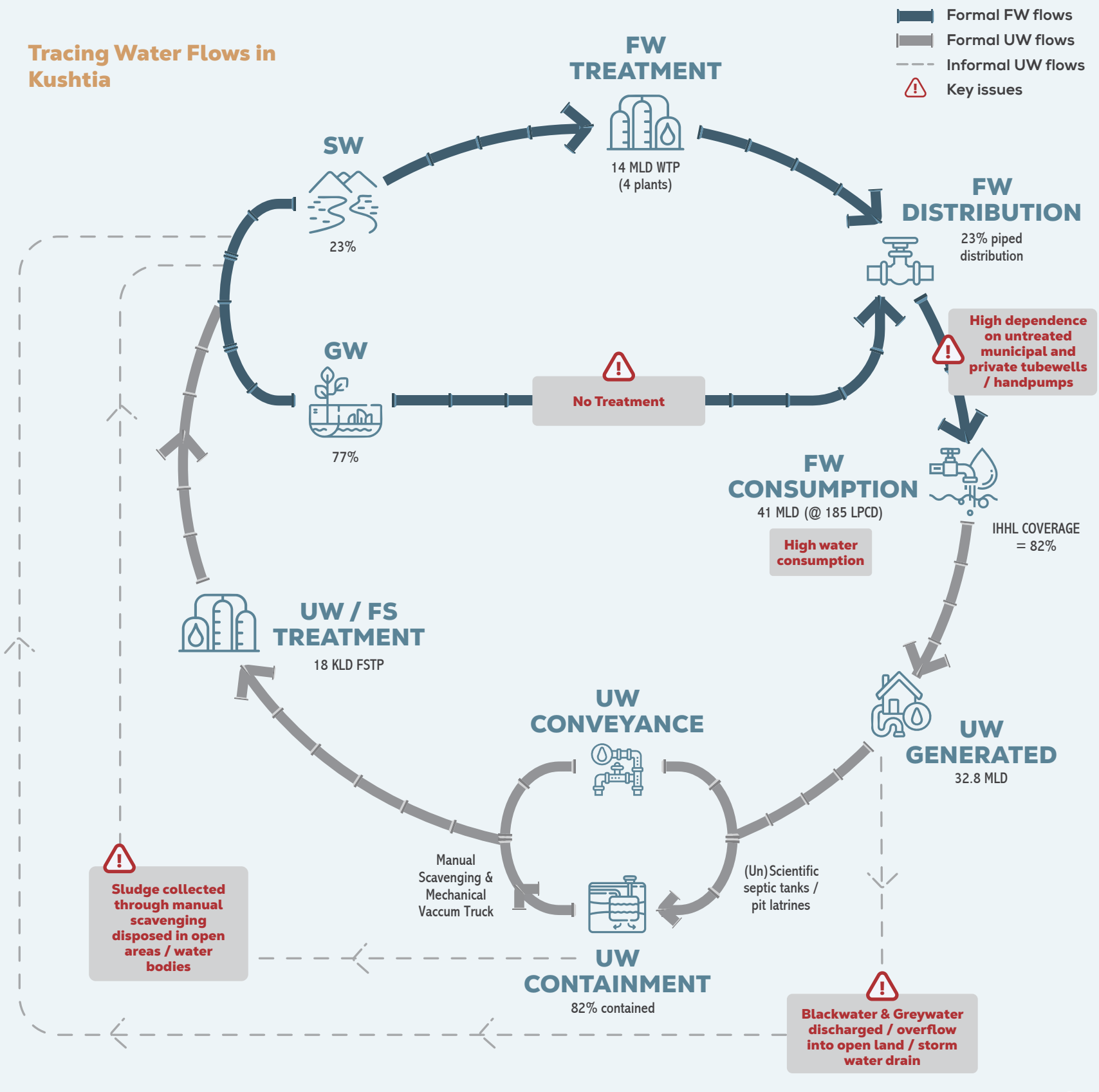
Faecal sludge management is partly established, with manual scavenging and vacuum trucks, but only a fraction reaches the 18 KLD FSTP, while large quantities are dumped illegally into open areas or waterways.

Kushtia is vulnerable to flash floods, agricultural flooding in Daulatpur, and overflows from the Gorai River, which damage sanitation infrastructure and worsen contamination risks. Expanding piped coverage, protecting groundwater, improving sludge treatment, and integrating flood risk management are essential to enhance resilience.



> **Households depend on water kiosks selling 20L jars, which are often carried home on foot or two-wheelers, reflecting gaps in safe and reliable drinking water supply.**

Tracing Water Flows in Kushtia



Haragacch

Town Area (sq.km)
16.32

Population
~ 61,425 (2024 est)

Agro-climatic Zone
Plain / Riverine

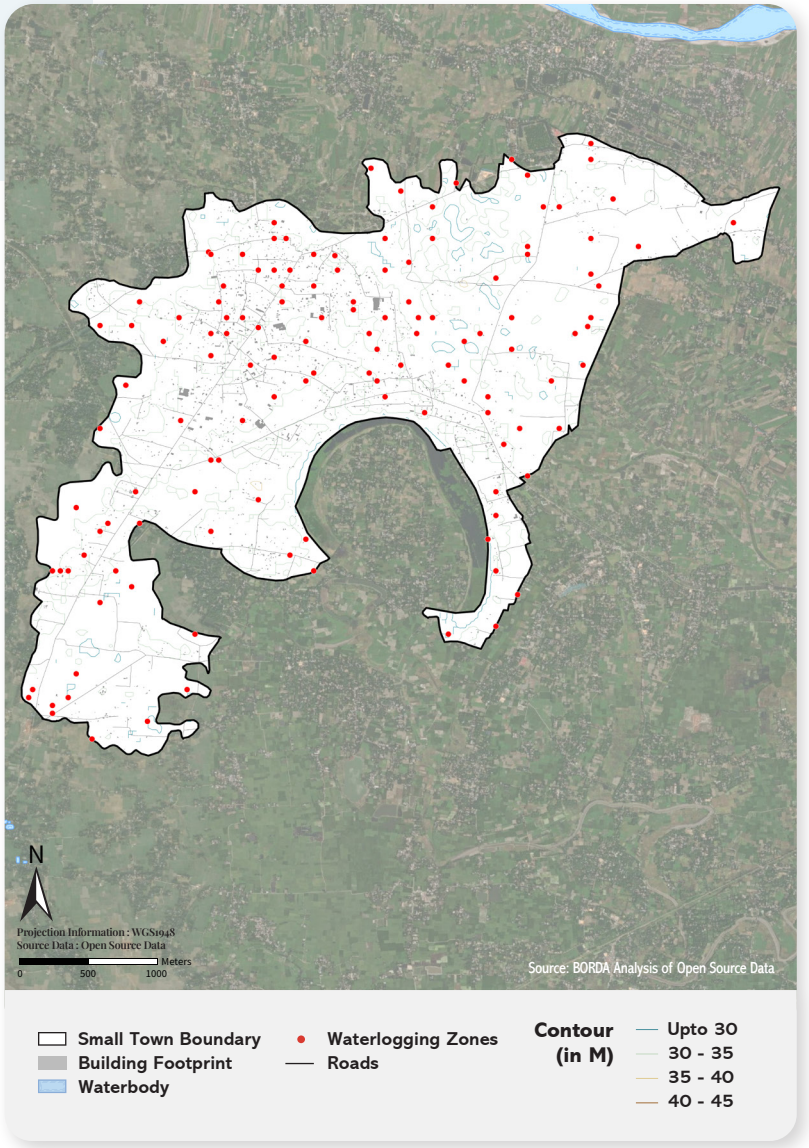
Charting the Flow : Haragacch in Focus

Haragacch, a small emerging urban centre in northern Bangladesh with a population of 61,424, faces acute water and sanitation challenges with no formalised infrastructure. The town has no surface water source, no treatment plant, and no piped distribution network. Its entire supply depends on untreated groundwater drawn from private borewells and handpumps, with daily consumption of 0.92 MLD (150 LPCD). This reliance raises risks of over-extraction and contamination, particularly without systematic water quality monitoring or treatment.

Sanitation coverage is low, with only 65% of households equipped with individual latrines (IHHL). Open defecation remains widespread, posing serious health risks. Most existing systems are rudimentary, with (un)scientific septic tanks and pit latrines that frequently overflow or discharge into stormwater drains and open land, contaminating the environment. Blackwater and greywater management is virtually non-existent.

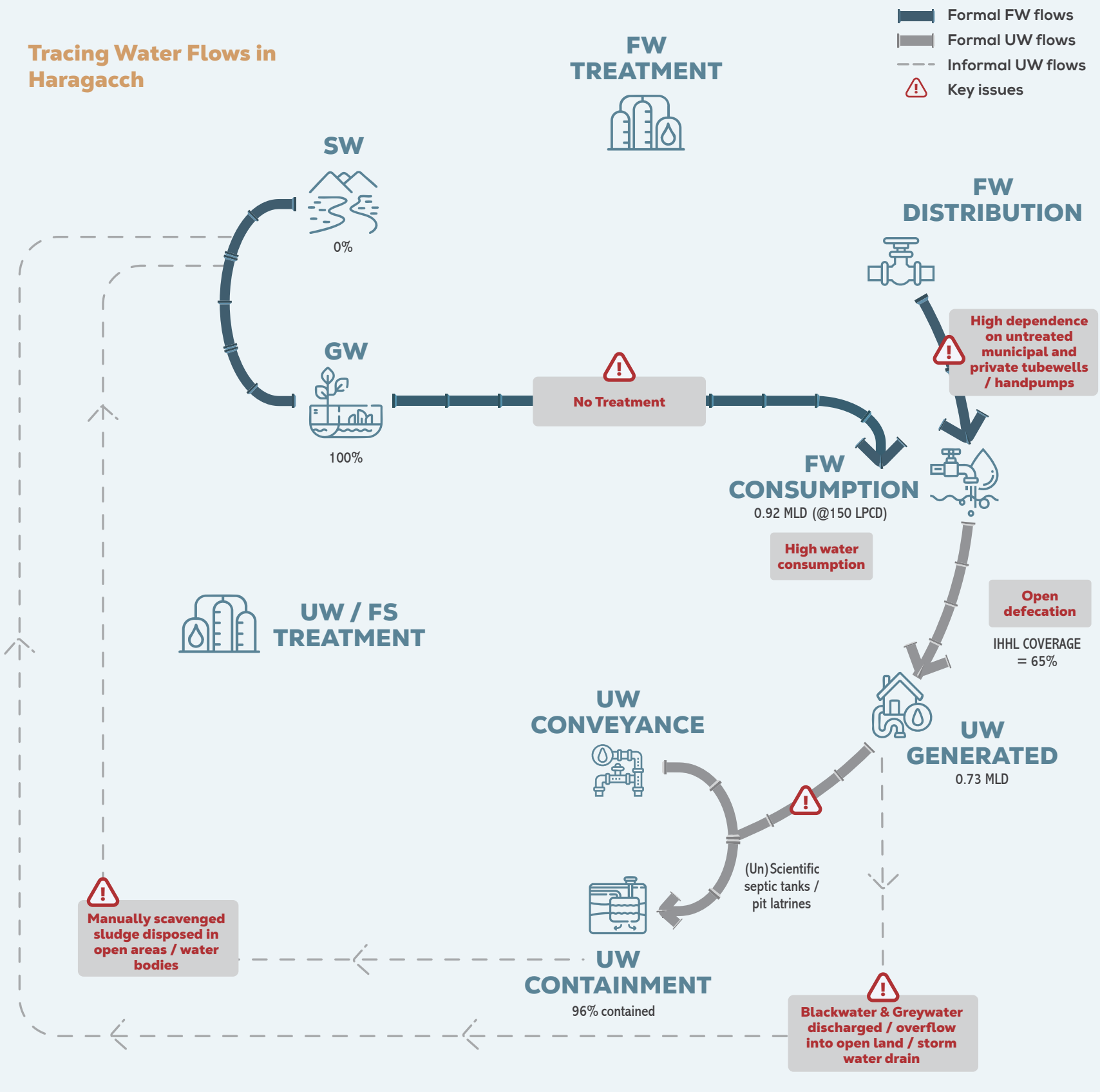
Faecal sludge management is entirely manual, with workers forced into hazardous manual scavenging under unsafe, undignified conditions. Sludge is typically dumped untreated into open areas and nearby water bodies, further degrading the environment and exposing the community to hazards.

Haragacch is highly prone to flash floods and frequent waterlogging during monsoons, which worsen the sanitation crisis by spreading untreated waste across residential areas. With no treatment systems, no reuse measures, and minimal institutional capacity, the town's water and sanitation conditions remain dire, demanding urgent interventions for safe water access, dignified sanitation, and climate-resilient infrastructure.



> **Small towns in Bangladesh are increasingly hit by flash floods that submerge homes and markets, disrupting water supply and crippling fragile sanitation systems.**

Tracing Water Flows in Haragacch



Red and Green – The Colors of Survival



Source: NGO Forum

Across Bangladesh, families still walk past red-marked wells each day, forced to choose between thirst and arsenic-contaminated water.

At dawn, people gather with empty pitchers in hand, walking past a row of handpumps. Most are marked with red paint, faded yet striking. Only one, at the far end of the lane, is green. Children wait in line, shifting from foot to foot, as mothers fill their buckets quickly before heading home.

The red wells are closer, more convenient. But they hide an invisible threat: arsenic. For years, families drank from them unknowingly, believing the water to be pure because it was clear and cool. Slowly, signs appeared as dark spots on the skin, chronic weakness, unexplained illnesses. When officials painted the pumps red, the warnings came without alternatives.

Today, water is both near and far: a poisoned convenience beside a distant lifeline. The green well often runs dry under the weight of the entire neighborhood's demand. Some still use the red pumps in secret, hoping a few cups won't matter.

What seems like a simple walk for water is, in truth, a daily negotiation between health and necessity. There are too few safe sources, no affordable filters, and no reliable supply network. Groundwater remains the only source, yet its safety is left to painted colors and personal risk.

The red and green marks are more than signs; they are symbols of a nation forced to choose between thirst and danger, where survival is measured by the color of a pump.

Toilets Without Safety

In the back lanes of a bustling Bangladeshi small town, rows of toilets stand behind houses with new doors and fresh paint. From the outside, it looks like progress. But just a few steps away, shallow pits lie uncovered, brimming after the last rain. Waste seeps silently into the soil, disappearing beneath the same ground that holds the wells people drink from.

Families use these toilets proudly, believing they have left open defecation behind. Coverage statistics agree: over three-fourths of households have access to latrines. Yet when the monsoon comes, the pits overflow. Wastewater mixes with rain, running into drains, flooding courtyards, and coating ponds where children splash and women wash rice.

There is no sewer to carry the waste away, no treatment plant to make it safe, no regulated service to empty it properly. Some pits are dug so close to handpumps that a single storm is enough to contaminate a family's drinking water for weeks.

Sanitation here is built to be counted, not contained. It offers the comfort of a closed door but not the safety of a closed system. What flows beneath those doors—quiet, unseen—spreads disease far faster than it is removed.

Until toilets are paired with safe containment, regular desludging, and proper treatment, the promise of sanitation will remain half-built, and the ground itself will continue to carry the burden.

Sanitation coverage is rising, yet untreated waste silently pollutes the water beneath communities.



Source: NGO Forum

Parbatipur

Town Area (sq.km)	Population	Agro-climatic Zone
9.73	~ 44,726 (2024 est.)	Plain

Flow Snapshots:

100% groundwater dependence through private borewells and handpumps with no treatment or piped distribution.

Predominantly unscientific

- (un)scientific septic tanks
- pit latrines

frequent overflow into drains and open lands.

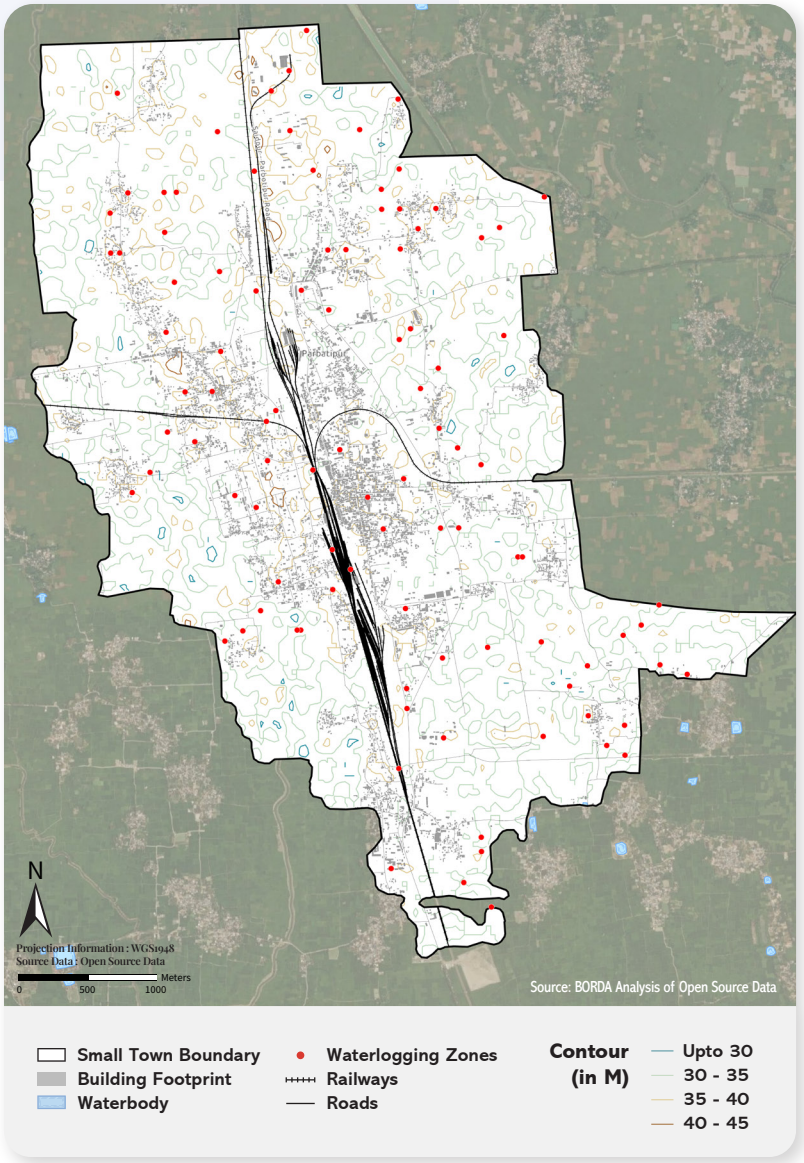
74% IHHL coverage; open defecation persists.

0.67 MLD daily water use (150 LPCD), entirely untreated and unregulated.

No FSTP/STP; only manual scavenging for sludge removal, with unsafe disposal in open areas and water bodies.

Excessive **Untreated Black Water • Grey Water Discharge**

Resulting risk of contamination to **SURFACE and GROUND WATER**



> **Groundwater in Bangladesh is extracted freely through millions of tubewells, with no regulation on quantity or quality, leaving aquifers stressed and unsafe.**

The Cost of Unchecked Extraction

Morning begins with the clank of iron rods against stone as a new handpump takes shape in a small town in Bangladesh. By noon, it will draw water from deep underground, just like the others lining the dusty lanes. No one asks whether the aquifer can keep up. No one tests what the water carries. It is enough that it flows.

Here, there is no piped supply, no surface water treatment, no municipal oversight. Every family depends on its own borewell or one shared with neighbors. When a pump runs dry, another is drilled, often deeper, always without a plan.

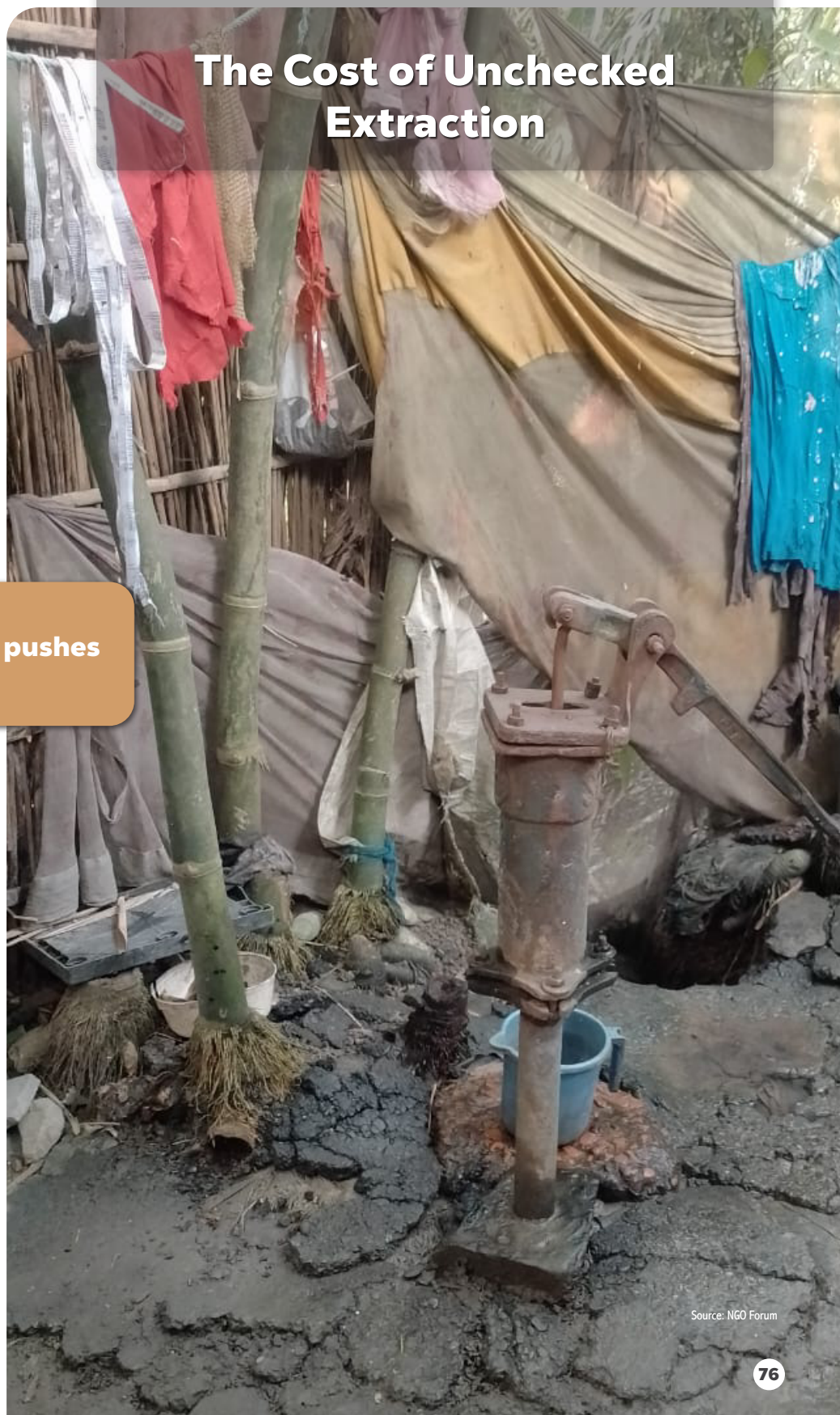
Water seeps back into the ground in ways it should not. Greywater from kitchens trickles into open drains. Blackwater from pits and septic tanks leaks slowly into soil. During the monsoon, floods wash it all over, sending it back underground, unfiltered, untreated.

Every private handpump drilled today pushes the town closer to scarcity tomorrow.

People drink what they can find. Some wells taste of iron; others carry a bitter tang. In many areas, handpumps and tubewells have arsenic concentrations above the national limit of 50 µg/L. According to surveys, nearly 27% of shallow tubewells in Bangladesh exceed this standard, and about 57 million people are exposed to levels higher than the World Health Organization's guideline of 10 µg/L.

When deep wells are scarce or unaffordable, families use what they trust or what's closest. They cannot be sure what they drink is safe. The crisis is quiet but growing.

Borewells appear overnight, each one a private answer to a shared problem. Together they draw more water than the earth can give back. Meanwhile, waste continues to seep in. Groundwater, once seen as a gift without end, is being drained, polluted, and left unattended, while the next pump is already being built.



Source: NGO Forum



Following Bangladesh's Flows

Water source

Settlements along the Ganga and Teesta floodplains rely on shallow handpumps (often arsenic-contaminated) and deep borewells, with growing aquifer stress from over-extraction.

Water supply

Negligible piped networks force households to buy 20L bottled water from kiosks, often carried on foot or two-wheelers in towns like Haragachh and Parbatipur.

UW generation

Dense settlements produce large volumes of used water, which frequently mixes with floodwaters during monsoons.

UW containment & conveyance

(Un)scientific septic tanks and pit latrines dominate but often overflow, while blackwater is discharged into open drains, polluting local environments.

UW treatment

Treatment is minimal. Pits are often emptied manually, while trucks frequently dump untreated sludge into rivers and ponds, compounding risks for communities downstream.

Reuse and closing the loop

Reuse of wastewater or sludge is virtually absent, though agricultural application could provide opportunities if safe systems are developed.

Flowing Forward

Emerging urban centres across South Asia sit at the heart of a region's water and sanitation challenge and its opportunity. They are where the Sustainable Development Goals (SDGs) for clean water, sanitation, and resilient cities will be won or lost. Yet, across geographies, 'Following the Flows' reveals a shared reality - fragmented systems, weak coordination, and the absence of a complete service chain. In Chikkaballapura, underground drainage networks and septic tanks operate side by side, yet limited coverage, irregular desludging, and overstretched treatment systems leave the town's water flows vulnerable and incomplete. In Koyilandi, life runs on groundwater drawn from fragile aquifers, water that is increasingly saline and contaminated, as used water continues to flow untreated into canals and backwaters. In Kirtipur, the promise of piped supply fades each dry season, forcing households to rely on costly jars and private vendors, turning water into a daily expense rather than a right. And in Haragacch, where no treatment exists, neither before consumption nor after use, contamination flows unchecked, sending the region's waters into a slow spiral of decline, blurring the line between resource and risk.

To move forward, planning must connect infrastructure with governance, land use, and finance. Strengthening local government capacities and fostering inter-departmental coordination are essential to make assets functional and sustainable. Closing the loop is central to this transformation. Sanitation cannot end with a toilet, nor water supply with a tap. A complete loop - from containment and conveyance to treatment and reuse - must replace today's broken chain. The WASH Climate Action Plan for Chintamani, building on insights from this study, is one such step toward embedding water and sanitation resilience within broader urban strategies.

Every geography tells a different story. Frozen pipes in Ladakh, saline intrusion in Kerala, drought in Karnataka, and landslides in Himachal Pradesh all reveal why one-size-fits-all schemes inevitably fall short. Building resilience requires context-sensitive, climate-adapted designs - solutions rooted in local wisdom, traditional practices, and lived realities. Equally vital is reuse: transforming treated used water into a dependable resource for agriculture, industry, aquifer recharge, and urban greening. This not only relieves pressure on fragile groundwater reserves but also closes the loop in urban water management. The ongoing Reuse Readiness Assessments across few small towns in Karnataka are now shedding light on both the low-hanging opportunities and the longer-term structural shifts needed to mainstream reuse in emerging urban centres.

Finally, inclusion must anchor every reform. Access is meaningful only when it is reliable, safe, and equitable. Empowering women, informal workers, and vulnerable communities to participate in planning can turn fragmented projects into living systems of accountability and care.

Small towns are not transitional spaces, they are vital nodes of resilience. By closing loops, aligning institutions, embracing climate-sensitive design, and investing in reuse, these emerging urban centres can lead South Asia toward a water-secure, inclusive, and climate-resilient urban future.



Source: JJ Wins, Pexels

Flow Guide

Faecal Sludge Treatment Plant (FSTP)	A facility designed to treat sludge collected from septic tanks and pit latrines, reducing pathogens and making it safe for disposal or reuse.
Freshwater consumption	The volume of freshwater used daily for domestic, commercial, and public purposes.
Freshwater source	The origin of water used for human consumption and other purposes, including rivers, lakes, springs, and groundwater.
IHHL (Individual Household Latrine)	A toilet facility located within a household, ensuring private sanitation access.
ODF (Open Defecation Free)	A status indicating that a community or area has eliminated open defecation, with all households using toilets or latrines.
Pit Latrine	A simple sanitation facility where human excreta is collected in a pit, often covered by a slab or structure for privacy.
Safe Containment	The secure storage of used water or sludge in tanks, pits, or other structures to prevent contamination of the environment and groundwater.
Septic Tank	An underground tank used to store and partially treat wastewater from households; solids settle at the bottom, and liquids drain out for further disposal or treatment.
Sewage Treatment Plant (STP)	A facility where wastewater (used water from households, industries, and other sources) is treated to remove contaminants before being safely discharged into the environment.
Sewerage	The infrastructure (pipes, drains, pumping stations) used to collect, transport, and dispose of wastewater from homes, industries, and public spaces.
Treated Used Water (TUW)	Wastewater that has undergone treatment to remove contaminants and is safe for reuse or discharge.
Underground Drain (UGD)	A system of pipes or channels that carries used water (sewage) from households or other sources to a treatment plant or safe disposal point.
Used Water Generation	The volume of wastewater produced daily from households, industries, and other sources.
Vacuum Tanker	A vehicle used to empty septic tanks or pit latrines and transport faecal sludge safely to a treatment facility.
WASH (Water, Sanitation, and Hygiene)	An integrated approach to ensuring access to safe water, proper sanitation, and hygiene practices to protect public health.
Water Treatment Plant (WTP)	A facility where freshwater is treated to remove impurities and pathogens, making it safe for drinking and domestic use.

Flow Key

ABBREVIATION	FULL FORM
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BORDA	Bremen Overseas Research and Development Association
CRZ	Coastal Regulation Zones
DMA	Directorate of Municipal Administration
ENPHO	Environment and Public Health Organization
FS	Faecal Sludge
FSTP	Faecal Sludge Treatment Plant
FW	Fresh Water
GIS	Geographic Information System
GW	Groundwater
HN valley	Hebbal and Nagavara Valley
IHHL	Individual Household Latrines
IEC	Information, Education and Communication
KLD	Kilo Litres per Day
KUWSDB	Karnataka Urban Water Supply and Drainage Board
KUIDFC	Karnataka Urban Infrastructure Development and Finance Corporation

ABBREVIATION	FULL FORM
KUKL	Kirtipur Urban Water Supply and Sewerage Limited
LEDeG	Ladakh Ecological Development Group
LPCD	Litres per Capita per Day
MLD	Million Litres per Day
MWIS	Municipal Water and Sanitation Plan
NAMASTE scheme	National Action for Mechanised Sanitation Ecosystem
NGOF	NGO Forum for Public Health
ODF	Open Defecation Free
RO	Reverse Osmosis
STP	Sewage Treatment Plant
SW	Surface Water
TUW	Treated Used Water
UGD	Underground Drain
ULB	Urban Local Body
UW	Used Water
WASH	Water, Sanitation and Hygiene

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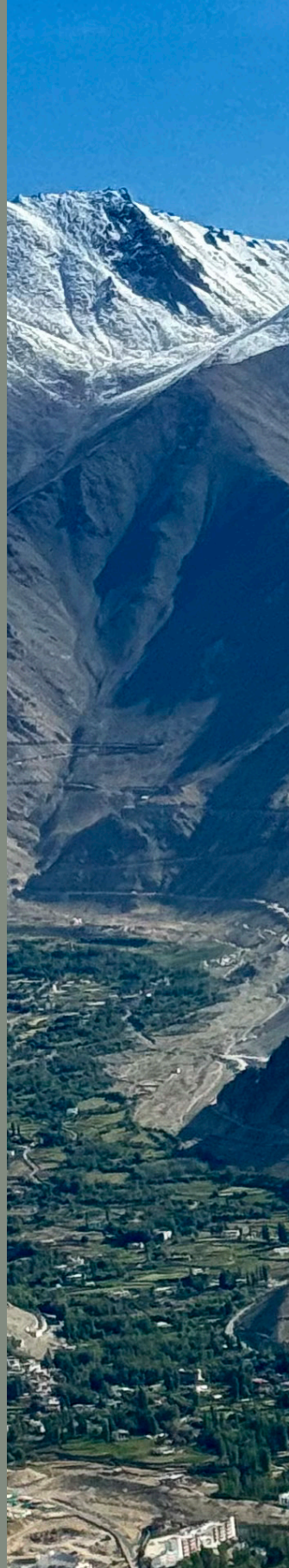
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Annexure

Access detailed annexures including questionnaires, analysis, and KII notes by scanning or clicking this QR code

Access our complete set of publications and insights by scanning or clicking this QR code





Source: BORDA South Asia

As every loop closes and every flow finds its way back -restoring, not depleting, South Asia's emerging urban centres will stand as the architects of a resilient and regenerative future.








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