Spatial Approach to CWIS Planning

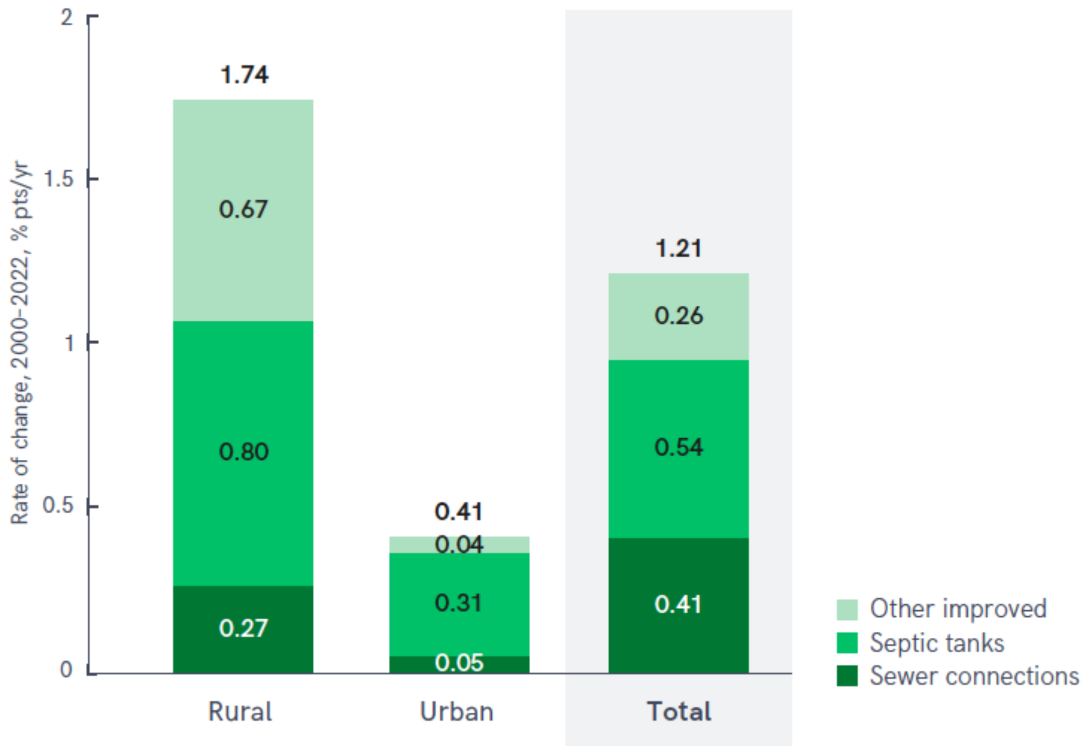
Hypothesis: Is Wastewater Management Tied to Sewerage Coverage?

Current Scenario: Only 53% of South Asia's urban households are connected to sewers. Striving for full coverage.

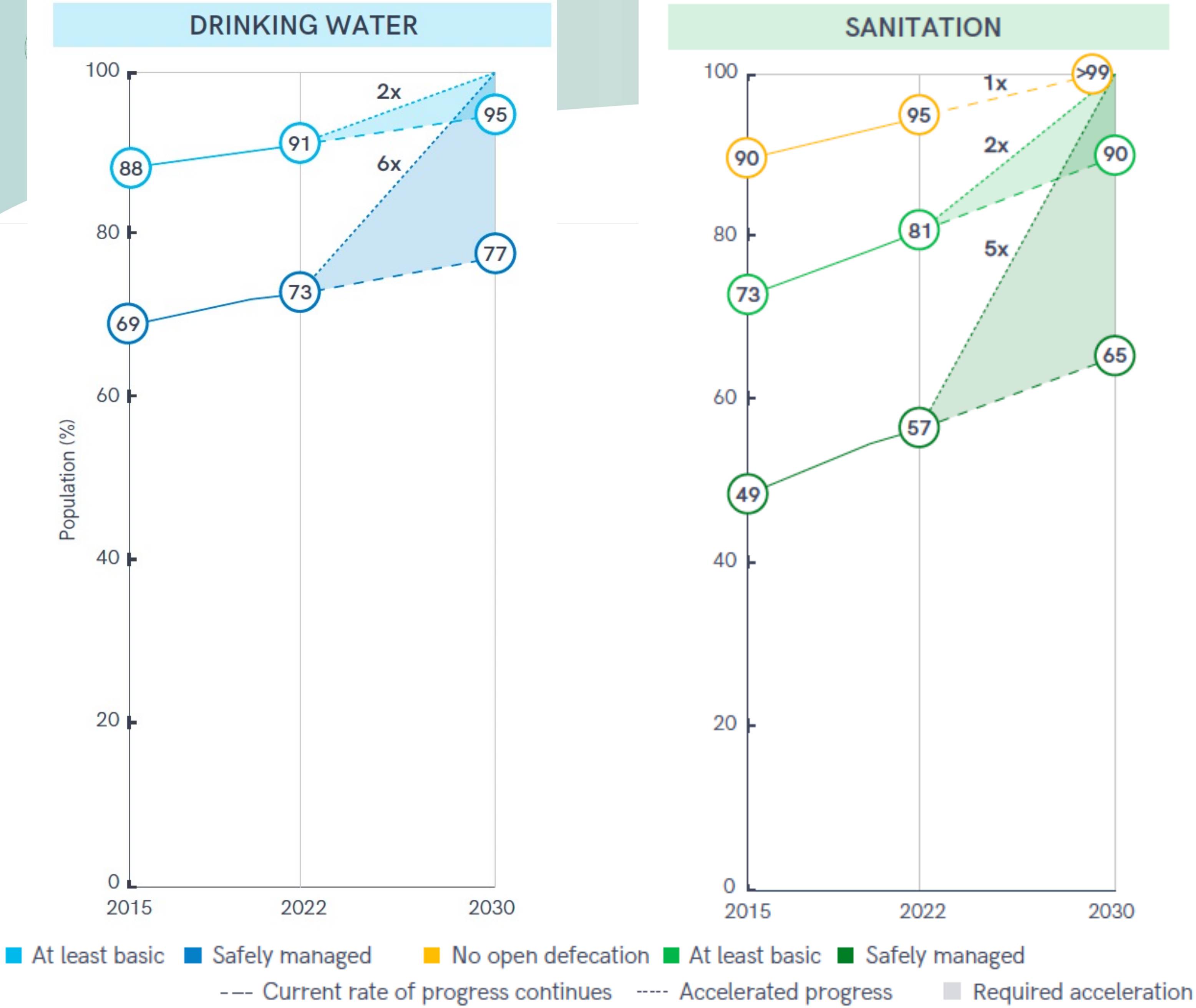
Shift to On-Site Systems: The urban population increased by 59%, with improved sanitation access expanding from 3.8 to 7 billion people, where 3 out of 5 i.e. 1.9 billion served by onsite sanitation systems like septic tanks and latrines compared to sewer connections (2000 to 2022).

Beyond Sewers: Large non-sewered population have limited treatment options, predominantly for black water (3% black, 97% grey).

Since 2000, on-site sanitation has increased faster than sewered sanitation in both rural and urban areas



Progress on household drinking water, sanitation and hygiene 2000–2022: special focus on gender. New York: United Nations Children's Fund (UNICEF) and World Health Organization (WHO), 2023.



Progress on household drinking water, sanitation and hygiene 2000–2022: special focus on gender. New York: United Nations Children's Fund (UNICEF) and World Health Organization (WHO), 2023.

Significant strides in achieving safely managed sanitation have been made by **low-income and lower-middle-income**

https://swarajya.gumlet.io/swarajya%2F2023-03%2F3ba7271d-6266-414b-9318-c39ac02ea1c0%2Funequal_scenes_1.jpg?q=75&auto=format%2Ccompress&format=webp&w=640&dpr=2.0

Dharavi, Mumbai

56% of subsidies end up in the pockets of the richest 20% but only 6% of subsidies find their way to the poorest 20%.

Source: https://www.worldbank.org/en/topic/water/publication/smarter-subsidies-for-water-supply-and-sanitation

CWIS Spatial Planning Approach

Geo-spatial based approach to designing a climate responsible, pro-poor and smart sanitation plan for urban areas

Guided by Ms. Neelima Thota

7 different Stages for CWIS Planning across Sanitation Value Chain

Equity	• Urban Poor • Climate and environment risk
Safety	• Safety across sanitation value chain • Safe containment - one solution will not fit for all ?
Sustainability	• Environmentally • Financially
Responsibility	• Managed through sound regulatory system • Mechanisms for enforcement
Accountability	• Service level benchmark • Performance monitoring indicator
Resource Planning	• Smart management • Evidence based planning and management

1 Organizing Geo-Spatial Database

2 Develop a Composite Risk-Map

3 Safe Containment Plan for All

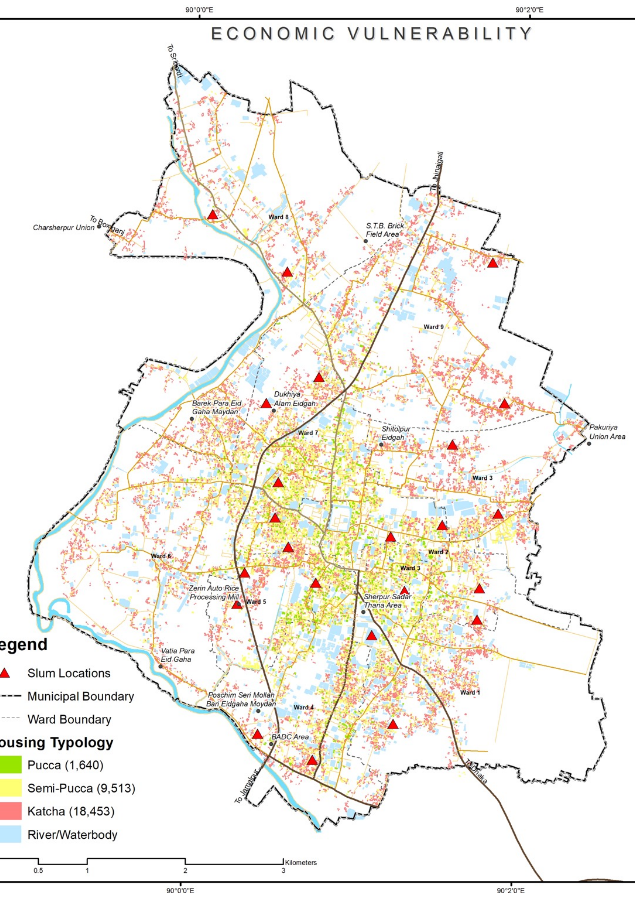
4 Adequate Public Toilet Coverage to Users

5 Safe Collection & Transportation Plan for All

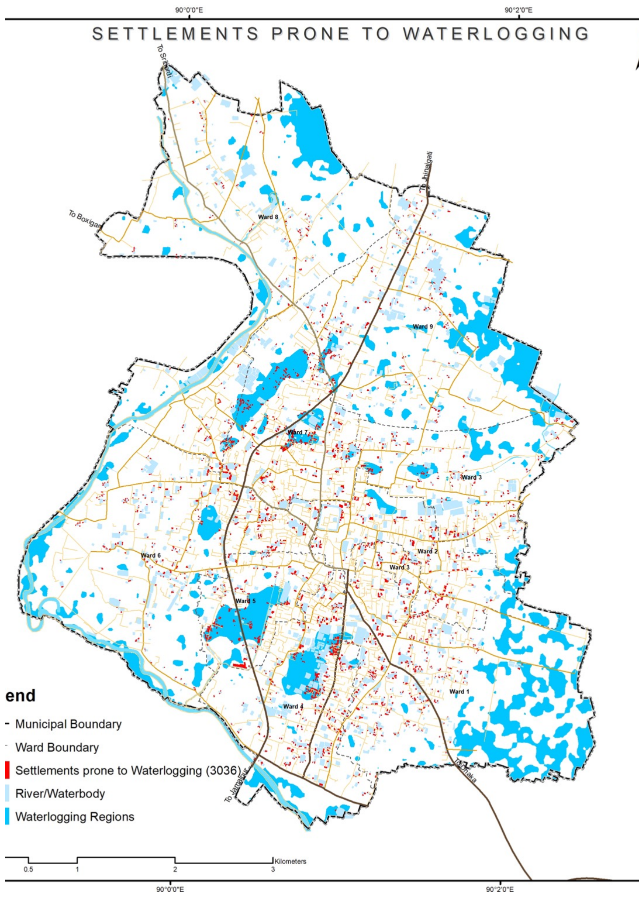
6 Settlement Proximity from FSTP

7 Ground Truthing and Validations

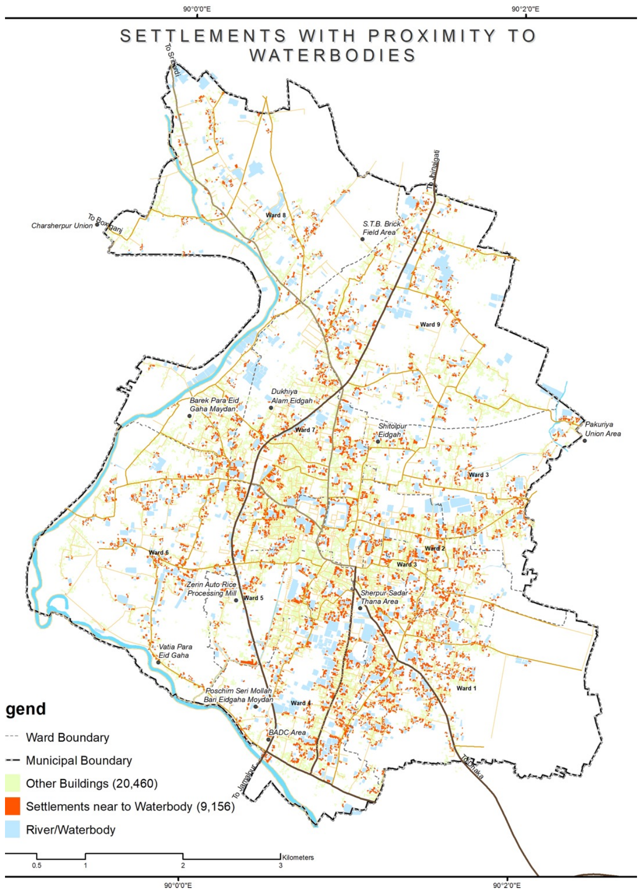
Taking Vulnerabilities into Considerations



Housing structure typology - pucca and kacha houses



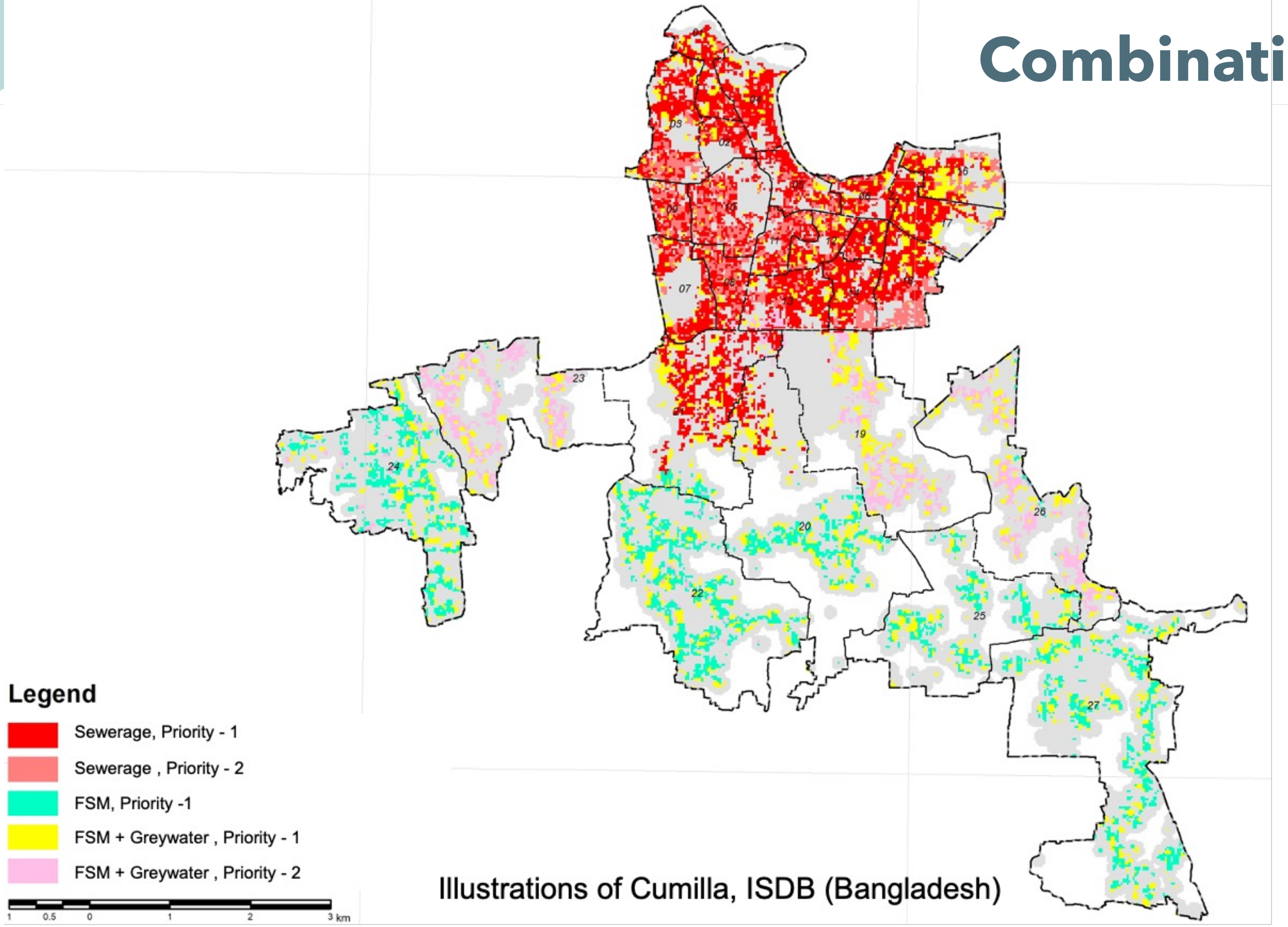
Natural drainage density and municipal drainage network



100-meter buffer from the river and 30 meters from other waterbodies

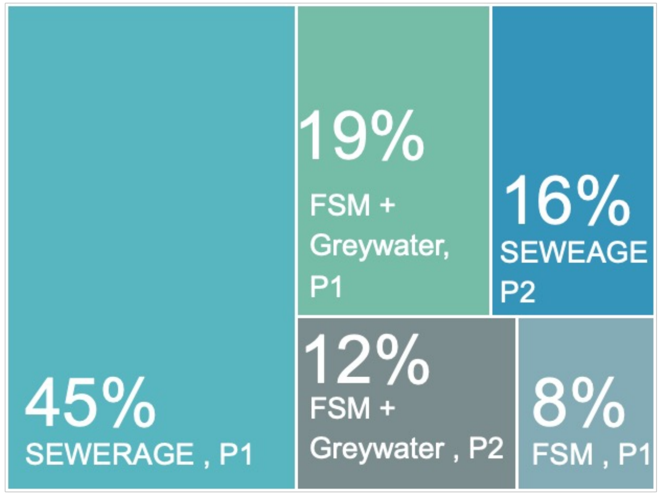
Road network maps with width details and settlement areas

Combinations of SS and NSS



Illustrations of Cumilla, ISDB (Bangladesh)

Recommendations provide based on potential combinations of sanitation interventions

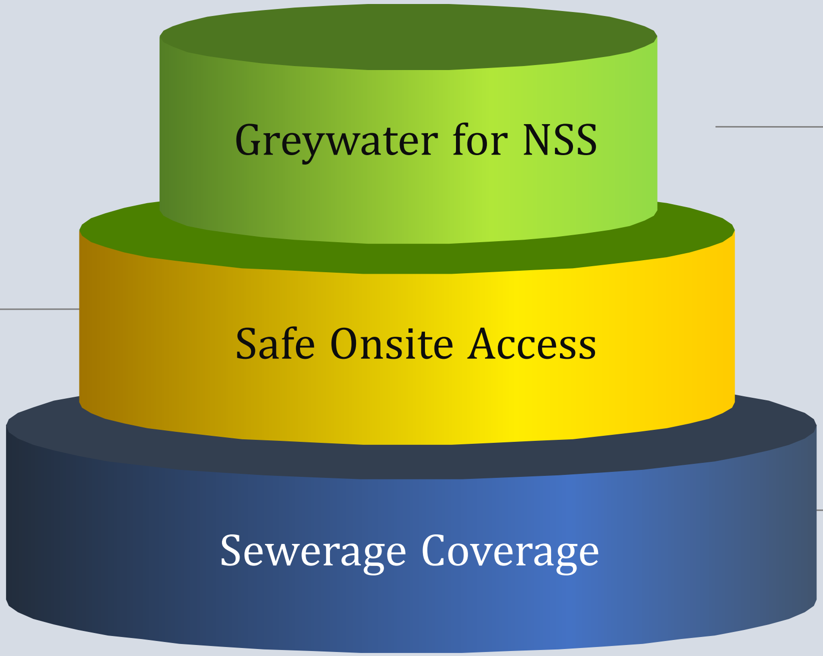


Completeness of **Citywide Inclusive Wastewater Management**

Safe Containment

Don't Forget the Greywater!

Contextual to the existing situations



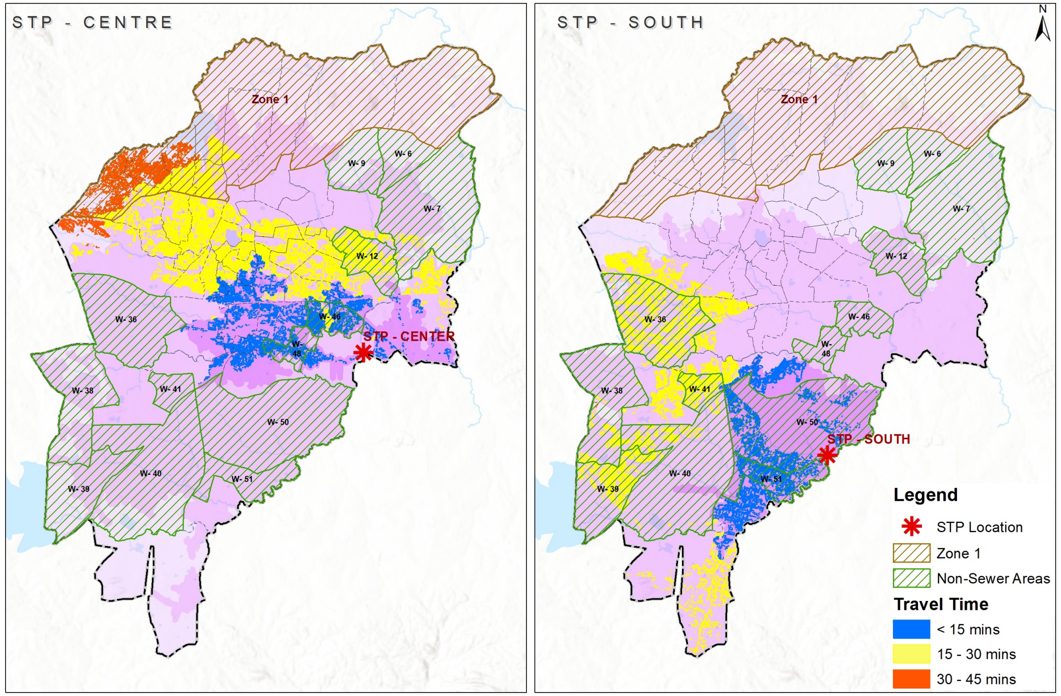
Separate Greywater system along with Blackwater

Combined wastewater management

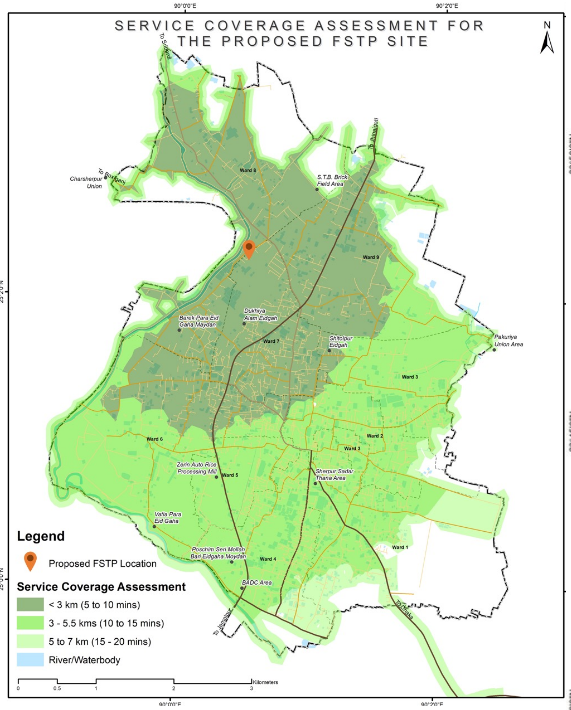
Ladder of holistic wastewater management in CWIS planning

Resource Optimization: Defined Emptying Zone and Service Proximity

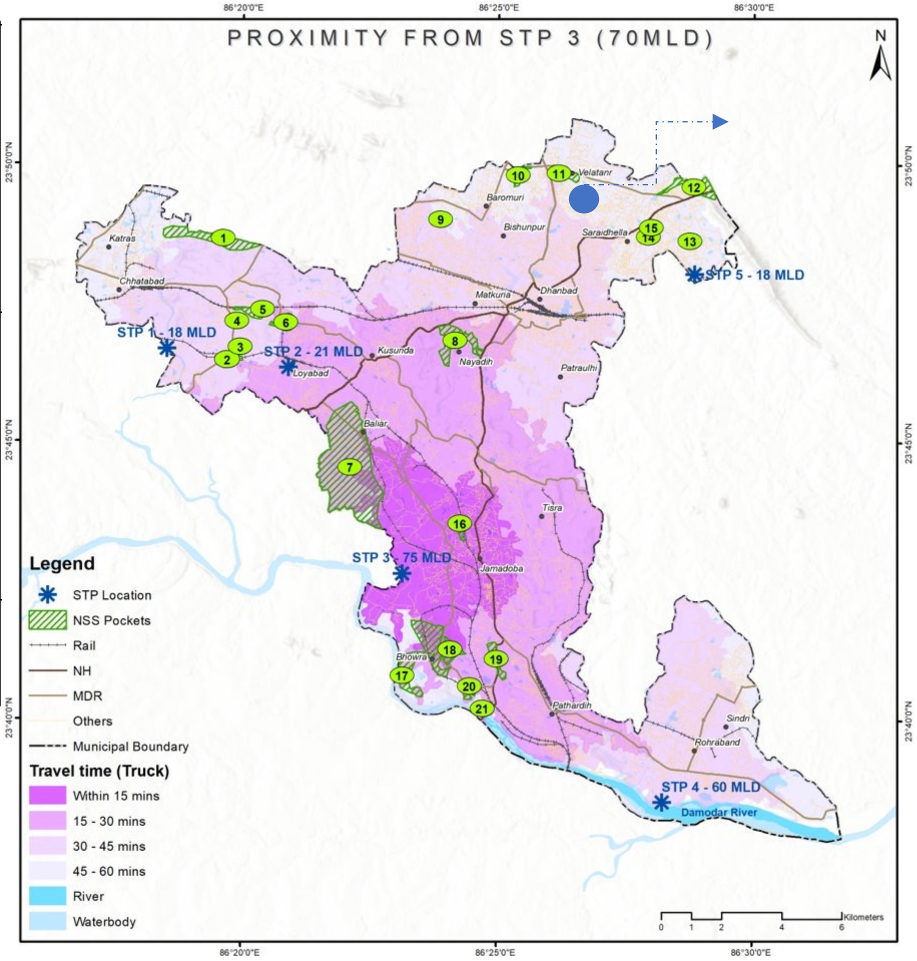
Define zones for regulated sludge emptying and co-treatment



Optimize treatment facility locations



Identifying needs for additional infrastructure



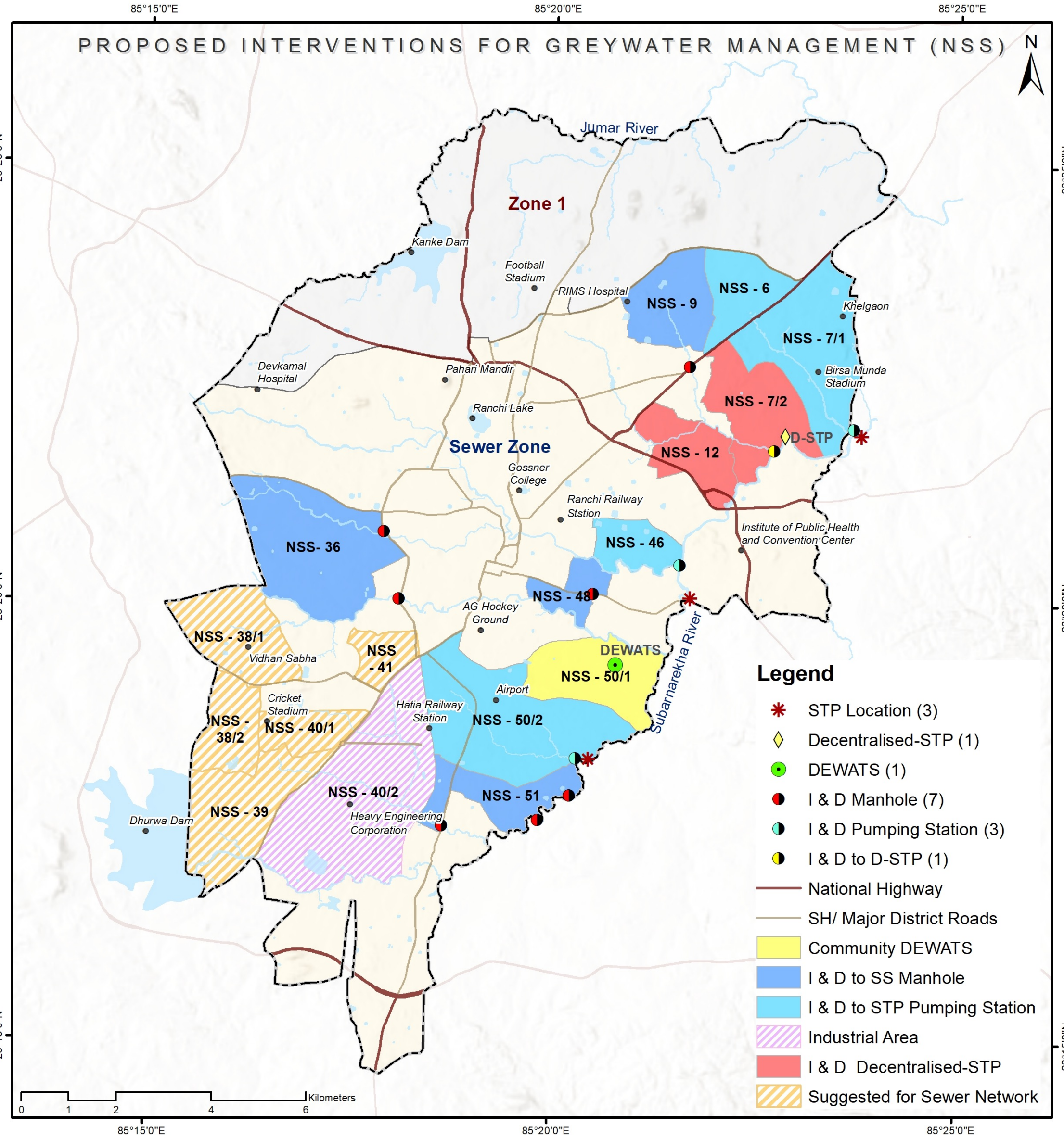
Define zones for regulated sludge emptying, integrating with co-treatment facilities.

Optimize treatment facility locations, identifying needs for additional infrastructure.

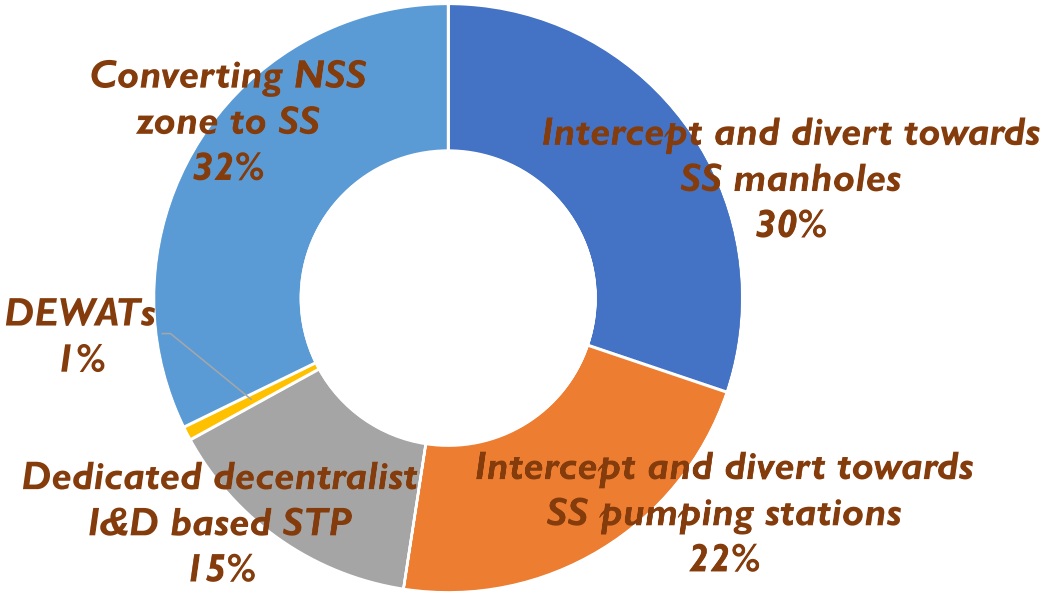
Align area coverage for population with co-treatment at existing/proposed STPs, considering distance.

Build on existing/planned infrastructure, integrating further recommendations.

Resource Optimization: Greywater Intervention



Expanding Greywater Coverage Strategically



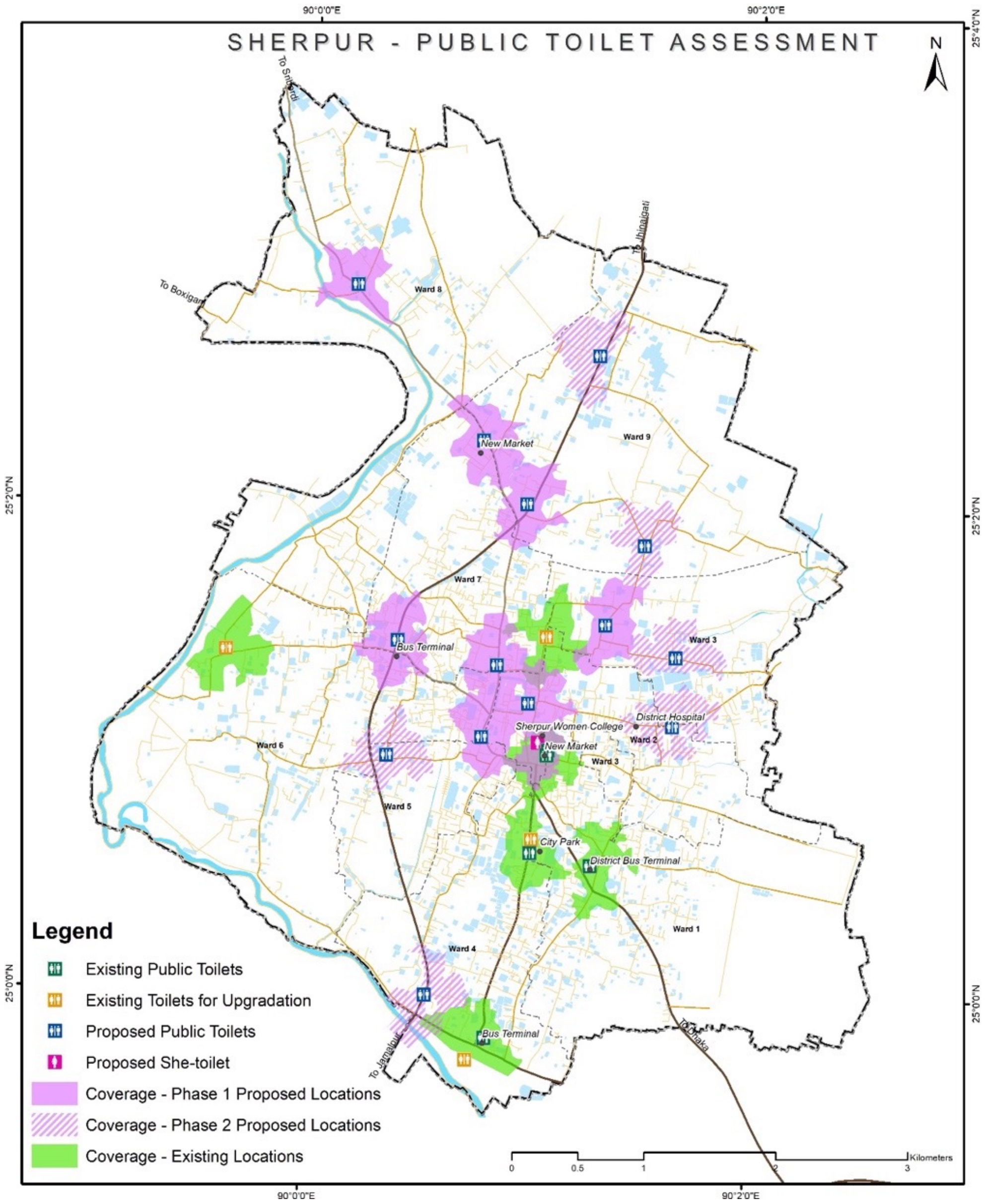
Cost-Effective: ~$20 per capita

Adequate Public Toilet Coverage to Users

Inputs – Commercial unit's location and area, non-residential land use, location and details of existing toilets, floating population

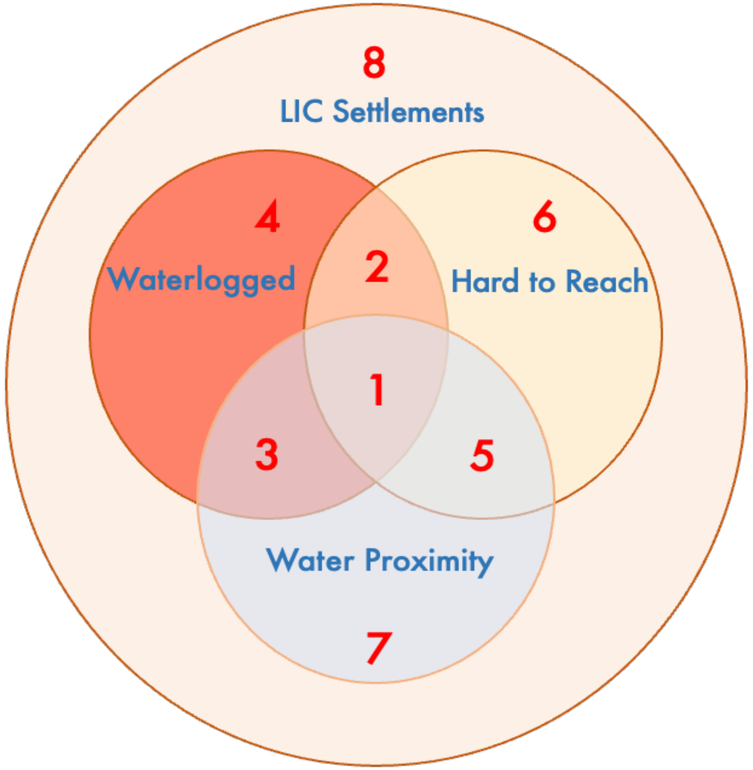
Process – Ward wise demand is calculated and compared with standards to understand gaps. Gaps are reviewed spatially, and recommendation are made .

Application – Applying and adopting the recommendations would help to have adequate distribution and coverage of public toilet services.

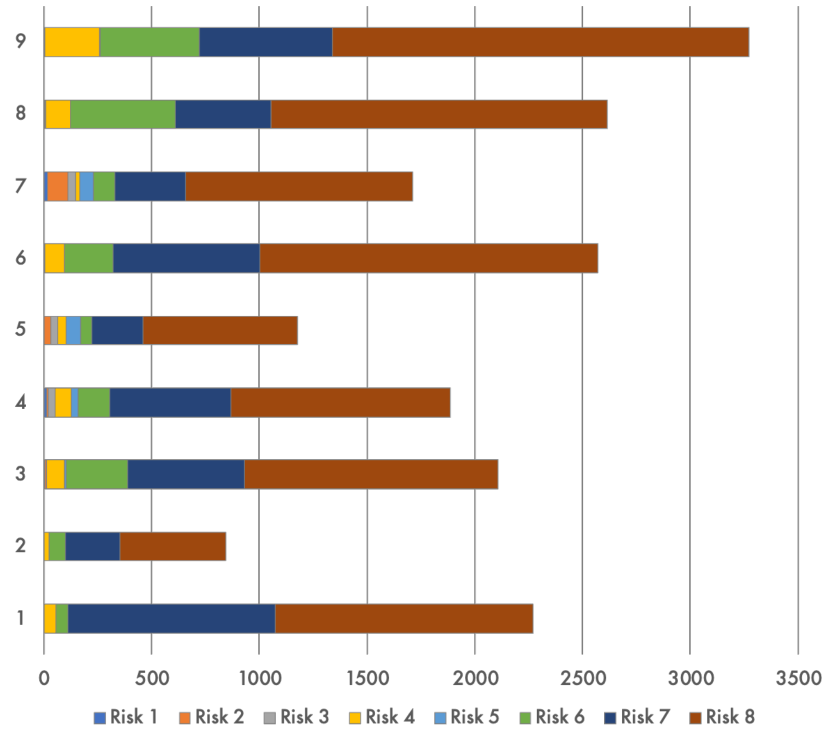


Planning Translates into Financial Figures

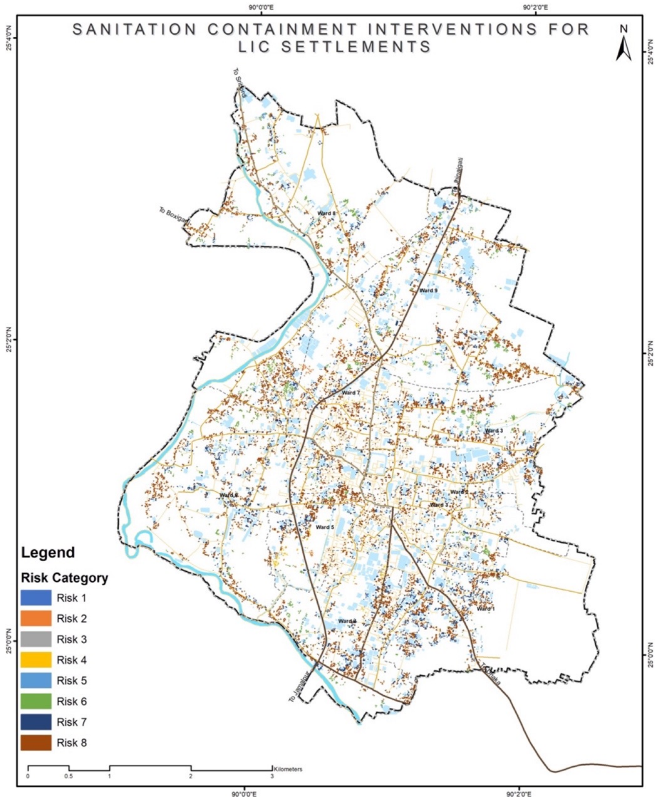
Decision Support Framework for Containment Improvement



Suitable toilet technology (contextual) for each of risk typology



Exact number of beneficiaries with locations with degree of vulnerability and their implementation priority



Investment estimations and Inputs in designing containment regulations

Developing Safe Containment Plan for All

Risk Ranking/ Category	Risk Typology within LIC Settlements	Suggested Interventions (Community/Individual scale)	Interventions	Estimated Investments (USD)
1	Waterlogged + Hard to reach + Water Proximity	Community – DEWATs Individual - Raised/Bermed Twin Pits	Total – 36 HHs, DEWATS – 2 units (19 HHs), Individual Containment – 17	= 16000 + 3825 = 19825
2	Waterlogged + Hard to reach	Community - DEWATs Individual - Raised/Bermed Twin Pits	Total – 148 HHs, DEWATS – 5 units (102 HHs), Individual Containment – 46 HHs	= 50000 + 10350 = 60350
3	Waterlogged + Water proximity	Community - DEWATs Individual - Raised - Septic Tank & Soak Pits	Total – 102 HHs, DEWATS – 4 units (53 HHs), Individual Containment – 49 HHs	= 32000 + 19600 = 51600
4	Remaining waterlogged settlements	Community - DEWATs Individual - Raised - Septic Tank & Soak Pits	Total – 175 HHs , DEWATS – 2 units (63 HHs), Individual – 112 HHs containment	= 20000 +44800 = 64800
5	Hard to reach + Water proximity	Individual - Raised/Bermed Twin Pits	Total – 2187 HHs	= 492075
6	Remaining hard to reach settlements	Individual - Twin Pits	Total – 4771 HHs, Individual Containment – 4771 HHs	=1073475
7	Remaining water proximity settlements	Individual - Plastic septic tank and soak-pit	Total – 2999 HHs, Individual Containment - 2999 HHs	= 899700
8	Remaining LIC settlements	Individual - Twin Pits / Plastic septic tank and soak-pit	Total – 7558 HHs, Individual Containment - 7558 HHs	= 2267400

Developing Safe Collection and Transportation plan for All

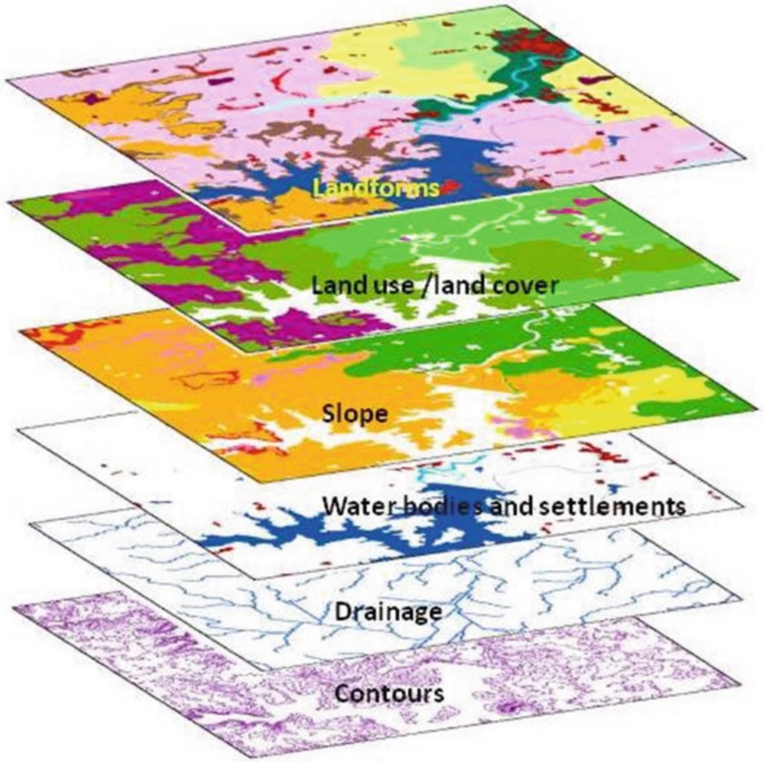
Sl.	Category of Sludge Collection	Description	Eligible (HHs)	%	Sludge Volume/d (wrt. to proposed FSTP of 18 KL)	Existing truck volume	Expected volume coverage	Existing volume gaps	Proposed truck volume to fill the demand gaps
1	Containments that are accessible by big vacuum trucks	Settlements along the wider road (more than 3.5 meters) within 100 feet distance from a large vacuum truck	7388	25%	7KLD	3 KL (1 Nos)	9 KLD	0	0
2	Containments that are not accessible by big vacuum trucks but are accessible by pickup trucks (small capacity trucks)	Settlements along narrow roads (between 2 to 3.5 meters) within 100 feet distance from a small vacuum truck	12364	42%	12KLD	2 KL (1 Nos)	6 KLD	6 KLD	2 KL (1 Nos)
3	Containments that are remotely located for motorized vehicle access and that require extended pipe length with additional electric pump	In-accessible settlements (less than 2 meters) and between distances of 100 to 200 feet from a vacuum truck	6434	22%	6KLD	1.5 KL (1Nos)	4.5 KLD	1.5 KLD	1.5 KL (1 Nos)
4	Containments that are not accessible by motorized vehicle and will require electric carts for desludging and transportation	In-accessible settlements (less than 2 meters) and beyond the distance of 200 feet from a vacuum truck	3430	11%	3KLD	None	None	3 KLD	0.5 KLD (2 Nos)

Having Data is critical !

Data utilization within CWIS Spatial Planning Approach

Data Collection
Collected from different sources: Primary and Secondary
Focus on the use of open-source datasets (example: Google Open Buildings, Open street datasets, SRTM/ASTER DEM)

Data Generation
Some datasets are generated from existing other available datasets through GIS analysis techniques (example: drainage density of rivers generated from DEM for delineation of waterlogging area)



Important aspects considered before data use: data cleaning, checking for geometry, outliers, redundancy, projection system, data format, data copyright, data quality, data version

Geo-Spatial database sources and generation techniques

CWIS TECHNICAL ASSISTANCE HUB

Output maps	Data Layer	Data generation Techniques
1.Base Map	Administrative boundary	Secondary sources (Mainly from Government Authorities)
	Water bodies	Secondary sources (example: Government prepared dataset, ESRI Sentinel 10m LULC dataset), Remote sensing
	Road/Rail network	Open Street Maps, High Resolution Imageries, LiDAR
	Land use	Secondary sources (example: Government Prepared Dataset, ESRI Sentinel 10m LULC dataset), Remote sensing
	Building footprint	Open Street Maps, High Resolution Imageries, LiDAR, Other secondary sources (GlobalMLBuildingFootprints: Bing maps, Google Open Buildings)
	Building Uses	Secondary sources
	Ward Wise Population	Secondary sources
2. Waterlogged Risk Mapping	Elevation profile	DEM (SRTM, ASTER), LiDAR
	Natural Drainage Density	DEM (SRTM, ASTER), LiDAR
	Storm Water Drainage Network	High Resolution Imageries, LiDAR
3. Flood risk mapping	Highest Flood Level (HFL) of Nearby river	Secondary sources
	Elevation Profile	DEM (SRTM, ASTER), LiDAR
4. Water Proximity settlements mapping	Buffer of water bodies	GIS analysis
5. Hard to reach settlements	Applying buffer on different road width	GIS analysis
	In-accessible settlements	GIS analysis
	Building footprints	High Resolution Imageries, LiDAR (GlobalMLBuildingFootprints: Bing maps, Google Open Buildings)
6. LIC settlements	Building footprints Building structure type	High Resolution Imageries, LiDAR, Other secondary sources
7. Public toilets (upgradation and new units)	Location of all existing toilets	Secondary sources
	No. of seats (male and female) with each toilet block	Secondary sources
8. FSTP proximity	Building footprints	High Resolution Imageries, LiDAR
	Road network	Open Street Maps, High Resolution Imageries, LiDAR
	Road width	Open Street Maps, High Resolution Imageries, LiDAR, Survey
	Location of FSTP	Secondary sources

Thank You