SCHOOL OF WATER AND WASTE AAETI

THE POLICY & PRACTICE FORUM 2023

Session 9: Climate Change and Resilience: Framing of Water Sensitive and Water-Wise Cities in the Climate Change Context

MAINSTREAMING NATURE-BASED SOLUTIONS IN INDIA'S CITIES

April 25 - 27, 2023

WATER RESEARCH COMMISSION · NFSSM Alliance · giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH · FSMA faecal sludge management alliance · COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK · IWA the international water association

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Structure of Presentation

Contents…

- **OBJECTIVE & VISION:** Addressing climate change through nature-based solutions
- **THEORY OF CHANGE:** How we are integrating nature-based solutions through planning, design and advocacy projects across multiple scales
- **OUR CURRENT EFFORTS AND PROJECTS**
- **KEY TAKEAWAYS AND WAY FORWARD**

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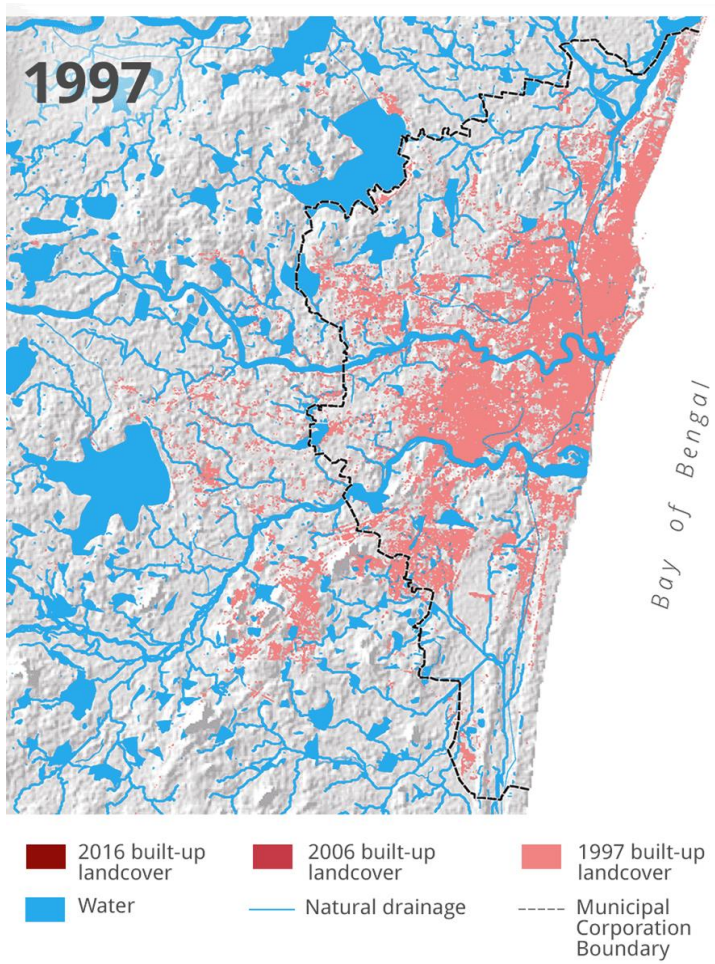
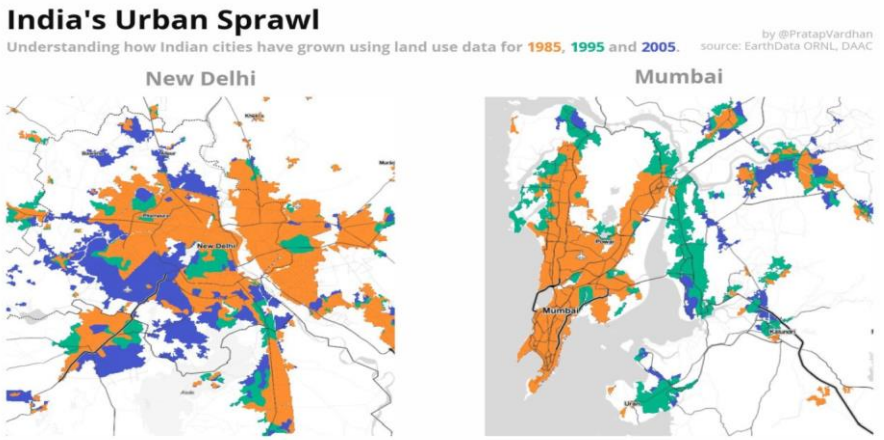
OBJECTIVE

Key Climate risks in India

Exacerbating risks due to the nature of urbanization in India





To mainstream NBS approaches to promote climate resilience in India

VISION

Key Principles

1. Protect

Green Ecosystems and Water Bodies from Encroachment or Pollution

2. Restore

Ecological Functions of Degraded or Polluted Landscapes

3.Enhance

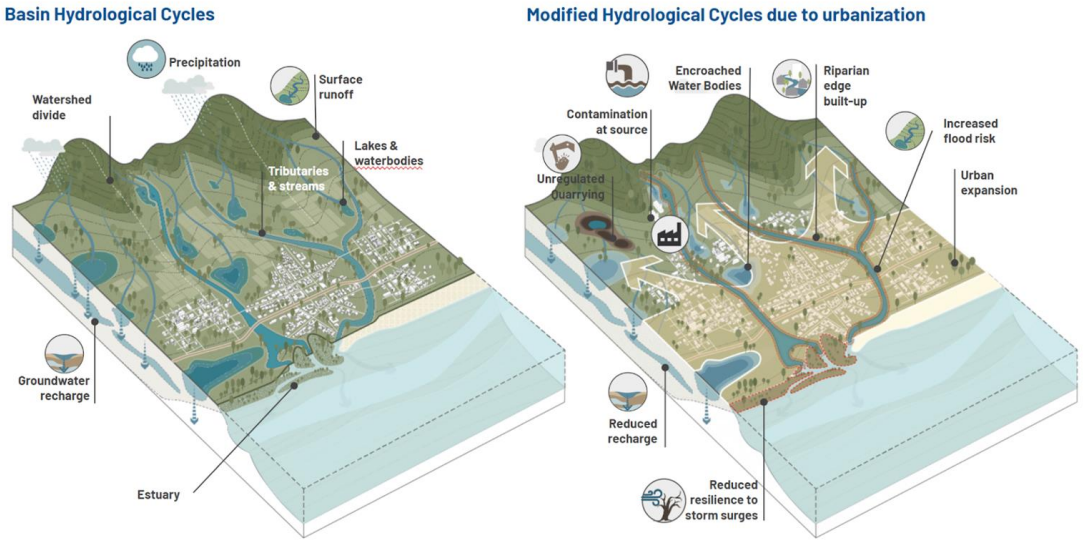
Coastal, Riparian, Wetland Ecosystems with Hybrid Infrastructure

4. Construct

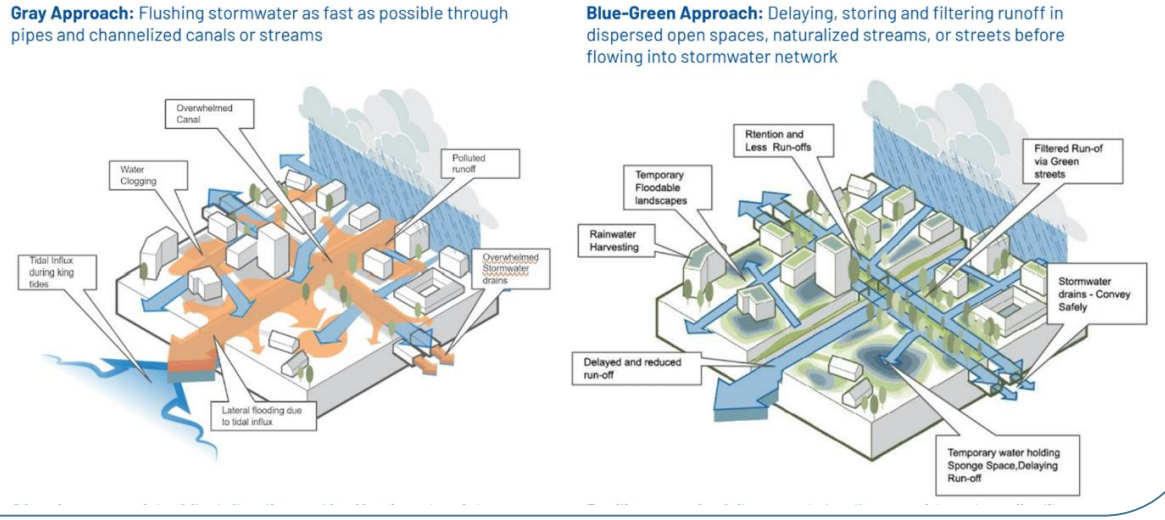
Blue-Green Infrastructure in open spaces, streets, and buildings

Key Approaches

By promoting strategic basin planning and water-sensitive urban design



By mainstreaming blue-green infrastructure planning and implementation in Indian cities



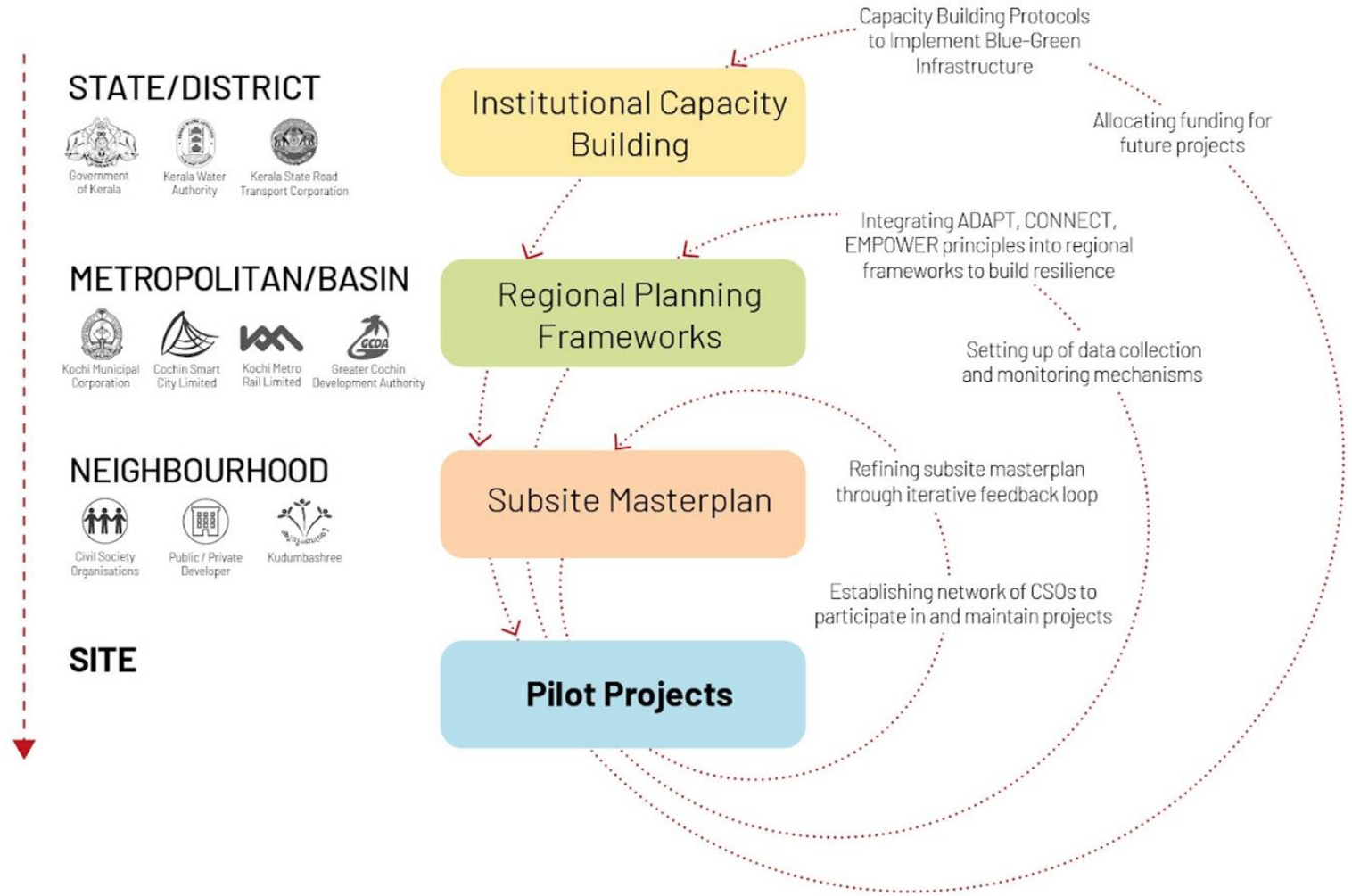
THEORY OF CHANGE

Sponge Handbook: Chennai

Chennai Third Vision Masterplan, CMDA
Theme: Sponge City And Climate Resilience
Adyar River Basin Vision

Sponge City: Detailed Feasibility Study In Kosasthalaiyar Basin - Integrated Stormwater Design

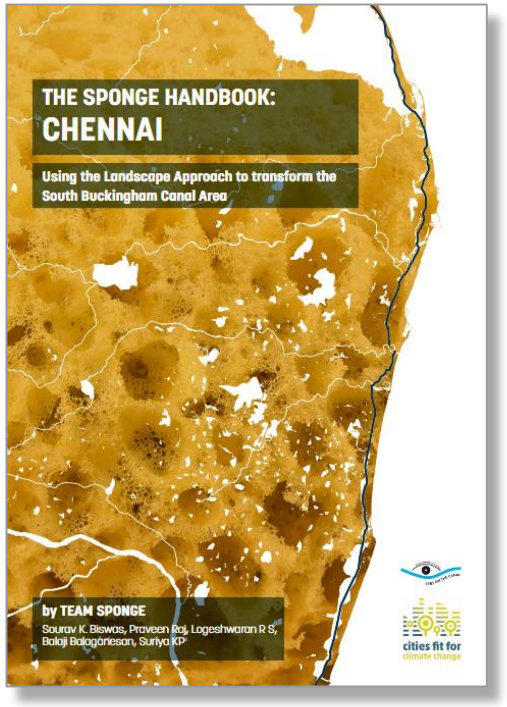
Sponge City Park: Pilot Project



INSTITUTIONAL SCALE: SPONGE HANDBOOK

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

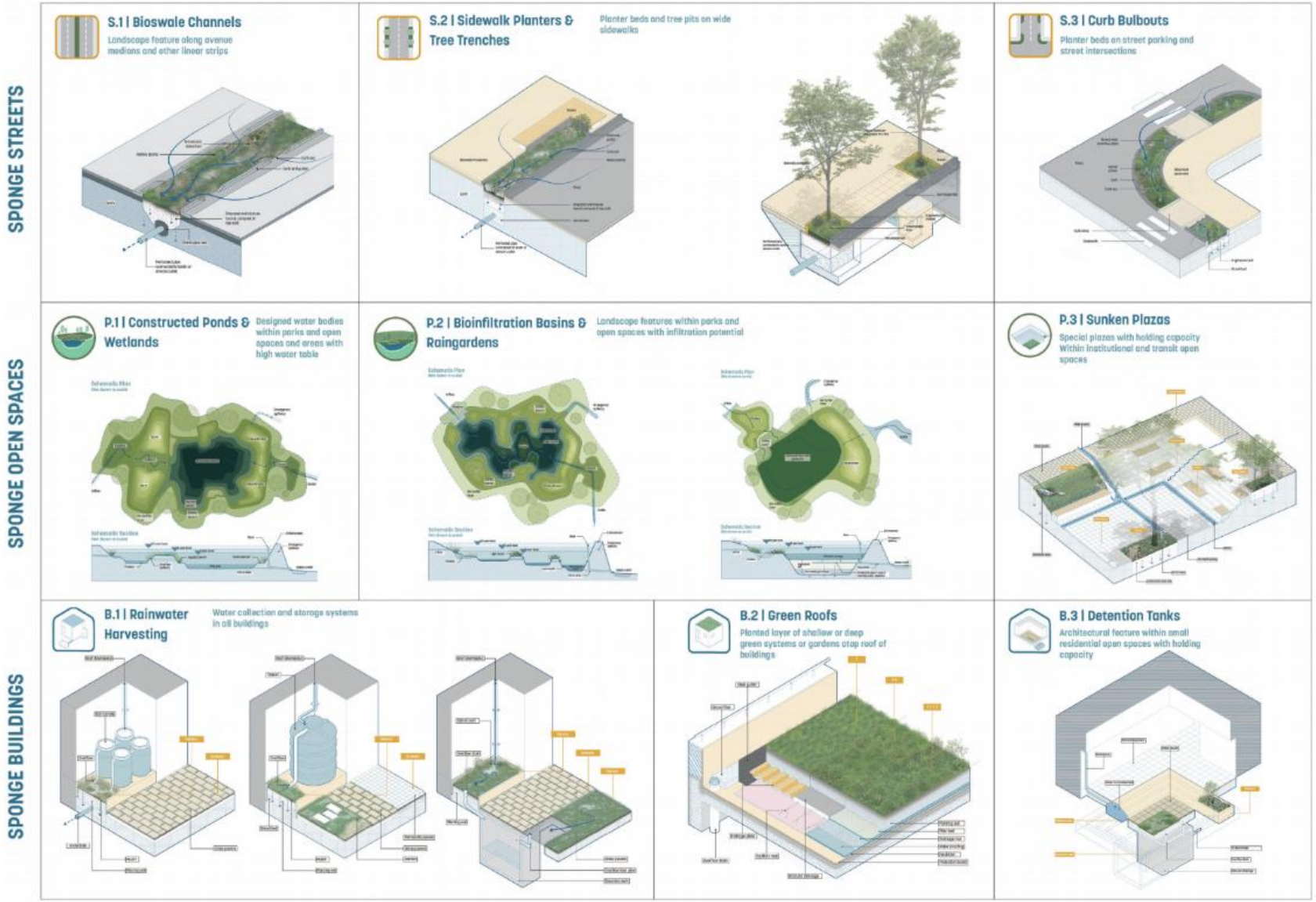
Greater Chennai Corporation



SPONGE HANDBOOK: CHENNAI
https://issuu.com/skb347/docs/team_sponge_sponge_handbook-chennai

CLIENTS

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) | Gov't Departments of TN



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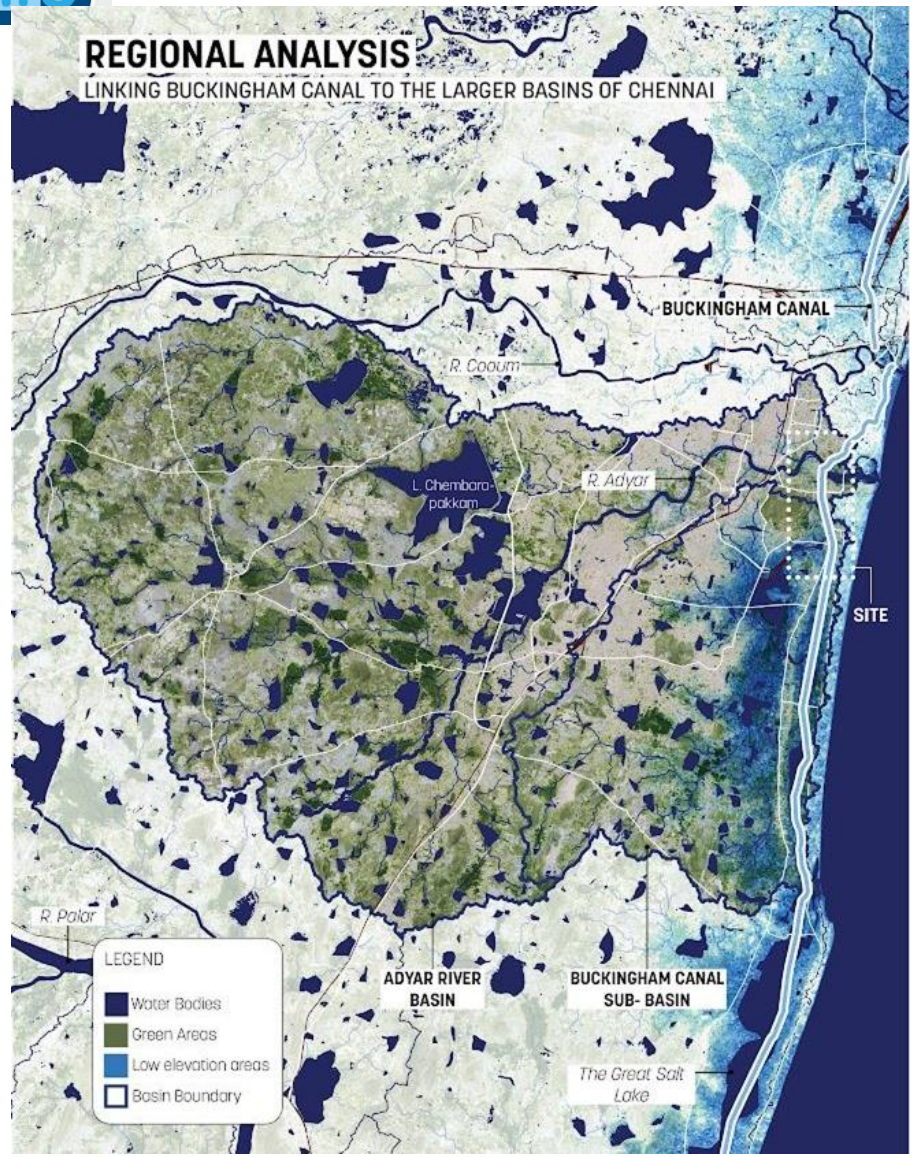
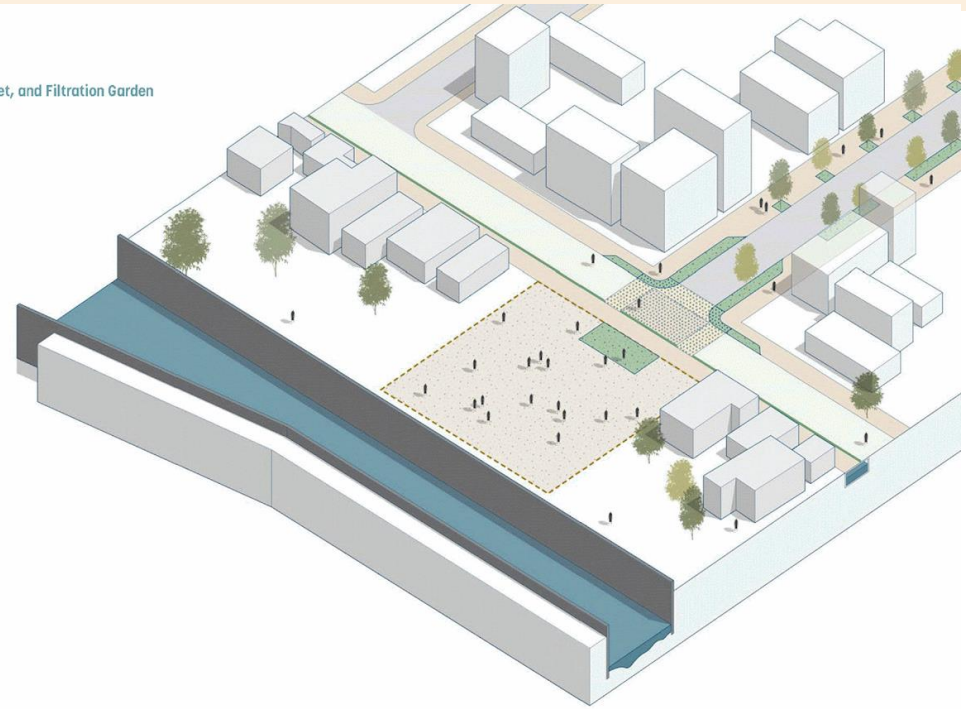
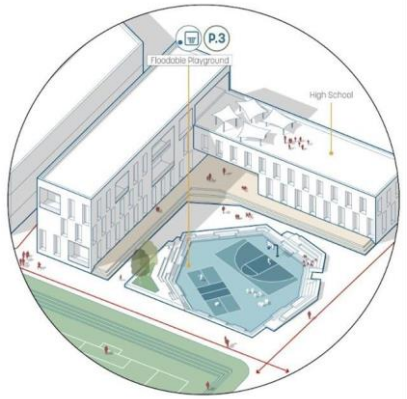
INSTITUTIONAL SCALE: SPONGE HANDBOOK

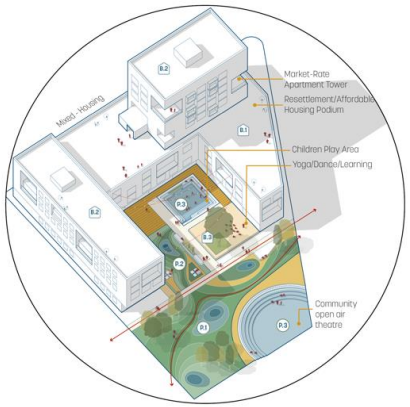




Regrading an Existing Park to a Sponge Park



Redesigning a school playground to a sponge playground



Sponge Open Spaces within Residential Courtyards

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OUR CURRENT EFFORTS

Greater Chennai Corporation plans to set up 'sponge park'

TNN / Updated: Sep 2, 2021, 10:18 IST

ARTICLES

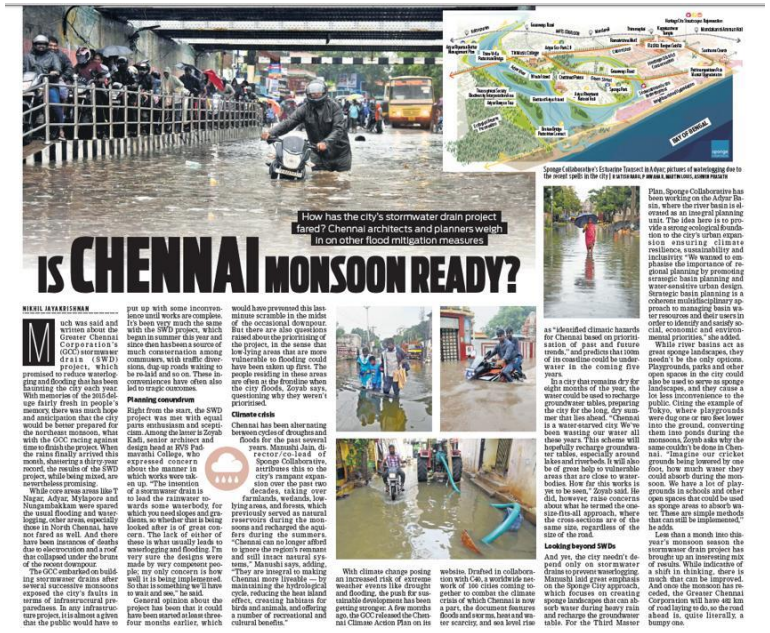
- Greater Chennai Corporation plans to set up 'sponge park'
- Chennai dengue menance: Poor infrastructure will worsen situation
- 12 lakh get Covid-19 jab in 50,000 centres across Tamil Nadu
- PIL says more seats for women in Greater Chennai...

Greater Chennai Corporation (File photo)

CHENNAI: To improve the groundwater table and prevent flooding, the city corporation has proposed to set up a 'sponge park' with artificial pond and rain gardens at the Kargil Nagar flood water pumping station in Manali zone.

HOW SUCH A PARK WORKS

- **A sponge park is an urban space constructed to collect,** filter and store the run-off during heavy rainfall
- **A tank with several layers of filters using gravel, sand, and biofilters is set up at the centre of the park.** It is an artificial wetland structure without any concrete flooring but water infiltration blocks
- Several layers of pond zones are **created around it to store water**
- Around these pond structures, a rain garden using native species of trees and a top layer of sand and compost is **set up to allow faster water infiltration and percolation**
- During dry months, **the space can be used as a park or recreation area**



How has the city's stormwater drain project fared? Chennai architects and planners weigh in on other flood mitigation measures

IS CHENNAI MONSOON READY?

NIKHIL JAYAKRISHNAN

Much was said and written about the Greater Chennai Corporation's (GCC) stormwater drain (SWD) project, which promised to reduce waterlogging and flooding that has been haunting the city each year. With memories of the 2015 deluge fairly fresh in people's memory, there was much hope and anticipation that the city would be better prepared for the northeast monsoon, what with the GCC racing against time to finish the project. When the rains finally arrived this month, shattering a thirty-year record, the results of the SWD project, while being mixed, are nevertheless promising.

While core areas areas like T Nagar, Adyar, Mylapore and Nungambakkam were spared the usual flooding and waterlogging, other areas, especially those in North Chennai, have not fared as well. And there have been instances of deaths due to electrocution and a roof that collapsed under the brunt of the recent downpour.

The GCC embarked on building stormwater drains after several successive monsoons exposed the city's faults in terms of infrastructural preparedness. In any infrastructure project, it is almost a given that the public would have to put up with some inconvenience until works are complete. It's been very much the same with the SWD project, which began in summer this year and since then has been a source of much consternation among commuters, with traffic diversions, dug-up roads waiting to be laid and so on. These inconveniences have often also led to tragic outcomes.

Planning conundrum

Right from the start, the SWD project was met with equal parts enthusiasm and scepticism. Among the latter is Zoyab Kadi, senior architect and design head at RVS Padmavathi College, who expressed concern about the manner in which works were taken up. "The insertion of a stormwater drain is to lead the rainwater towards some waterbody for which you need slopes and gradients, so whether that is being looked after is of great concern. The lack of either of these is what usually leads to waterlogging and flooding. I'm very sure the designs were made by very competent people, my only concern is how well it is being implemented. So that is something we'll have to wait and see," he said.

General opinion about the project has been that it could have been started at least three-four months earlier, which would have prevented this last-minute scramble in the midst of the occasional downpour. But there are also questions raised about the prioritising of the project, in the sense that low-lying areas that are more vulnerable to flooding could have been taken up first. The people residing in these areas are often at the frontline when the city floods, Zoyab says, questioning why they weren't prioritised.

Climate crisis

Chennai has been alternating between cycles of droughts and floods for the past several years. Manushi Jain, director/co-lead of Sponge Collaborative, attributes this to the city's rampant expansion over the past two decades, taking over farmlands, wetlands, lowlying areas, and forests, which previously served as natural reservoirs during the monsoons and recharged the aquifers during the summers. "Chennai can no longer afford to ignore the region's remnant and still intact natural systems," Manushi says, adding, "They are integral to making Chennai more liveable — by maintaining the hydrological cycle, reducing the heat island effect, creating habitats for birds and animals, and offering a number of recreational and cultural benefits."

With climate change posing an increased risk of extreme weather events like drought and flooding, the push for sustainable development has been getting stronger. A few months ago, the GCC released the Chennai Climate Action Plan on its website. Drafted in collaboration with C40, a worldwide network of 100 cities coming together to combat the climate crisis of which Chennai is now a part, the document features floods and storms, heat and water scarcity, and sea level rise as "identified climatic hazards for Chennai based on prioritisation of past and future trends," and predicts that 10cm of its coastline could be underwater in the coming five years.

In a city that remains dry for eight months of the year, the waser could be used to recharge groundwater tables, preparing the city for the long, dry summer that lies ahead. "Chennai is a water-starved city We've been wanting our water all these years. This scheme will hopefully recharge groundwater tables, especially around lakes and riverbeds. It will also be of great help to vulnerable areas that are close to waterbodies. How far this works is yet to be seen," Zoyab said. He did, however, raise concerns about what he termed the one-size-fits-all approach, where the cross-sections are of the same size, regardless of the size of the road.

Looking beyond SWDs

And yes, the city needn't depend only on stormwater drains to prevent waterlogging. Manushi laid great emphasis on the Sponge City approach, which focuses on creating sponge landscapes that can absorb water during heavy rain and recharge the groundwater table. For the Third Master Plan, Sponge Collaborative has been working on the Adyar Basin, where the river basin is elevated as an integral planning unit. The idea here is to provide a strong ecological foundation to the city's urban expansion ensuring climate resilience, sustainability and inclusivity. "We wanted to emphasise the importance of regional planning by promoting strategic basin planning and water-sensitive urban design. Strategic basin planning is a coherent multidisciplinary approach to managing basin water resources and their users in order to identify and sustainably social, economic and environmental priorities," she added.

While river basins act as great sponge landscapes, they needn't be the only options. Playgrounds, parks and other open spaces in the city could also be used to serve as sponge landscapes, and they cause a lot less inconvenience to the public. Citing the example of Tokyo, where playgrounds were dug one or two feet lower into the ground, converting them into ponds during the monsoons, Zoyab asks why the same couldn't be done in Chennai. "Imagine our cricket grounds being lowered by one foot, how much water they could absorb during the monsoon. We have a lot of playgrounds in schools and other open spaces that could be used as sponge areas to absorb water. These are simple methods that can still be implemented," he adds.

Less than a month into this year's monsoon season the stormwater drain project has brought up an interesting mix of results. While indicative of a shift in thinking, there is much that can be improved. And once the monsoon has receded, the Greater Chennai Corporation will have its hands of road laying to do, so the road ahead is, quite literally, a bumpy one.

Chennai Corporation to develop sponge parks at 10 locations

The estimated cost of the sponge parks is ₹1.06 crore; the work will start this month and is expected to be completed in six months, ahead of the onset of the northeast monsoon, say officials

February 11, 2023 09:48 pm | Updated 09:48 pm IST – CHENNAI

THE HINDU BUREAU

COMMENTS SHARE READ LATER

The Corporation proposes to build artificial ponds and rain gardens in select parks. | Photo Credit: M. KARUNAKARAN

Mainstreaming nature-based solutions among urban local bodies, government institutions, and academia

METROPOLITAN SCALE: THIRD MASTERPLAN VISION, CMDA

Metropolitan Diagnostic

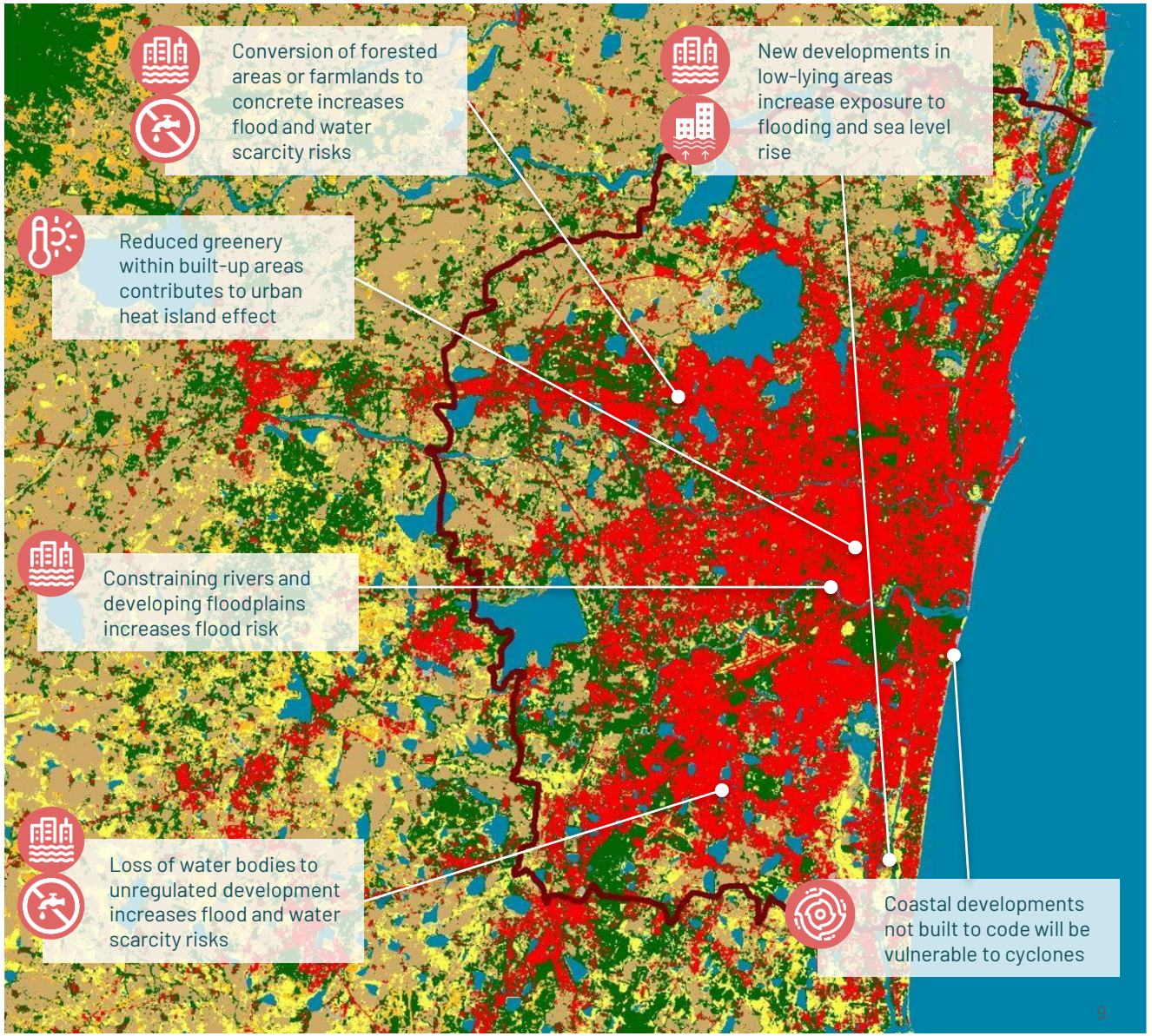
Climate Risks and Urban Development

- Urban areas are exposed to elevated flood risks because of impervious catchments that lead to increased runoff.
- Lack of aquifer recharge due to imperviousness increases risk of water scarcity.
- Built-up areas also contribute to urban heat island effect increasing the risk of heat-related fatalities.
- Increased blue-green areas can mitigate some risks. But only 2% of Chennai city are declared parks (SMP) ; 24 km^2 of declared forest in CMA (SMP) and 91.31 km^2 of water bodies present in CMA (C&AG, 2017)

Land Cover

- Built-up
- Bare / Sparse Veg.
- Croplands
- Shrublands
- Grasslands
- Tree Cover
- Wetlands and Waterbodies

Source: Challenges in Chennai City to Cope with Changing Climate
Map Data: ESA World Cover with Global Human Settlement Layer



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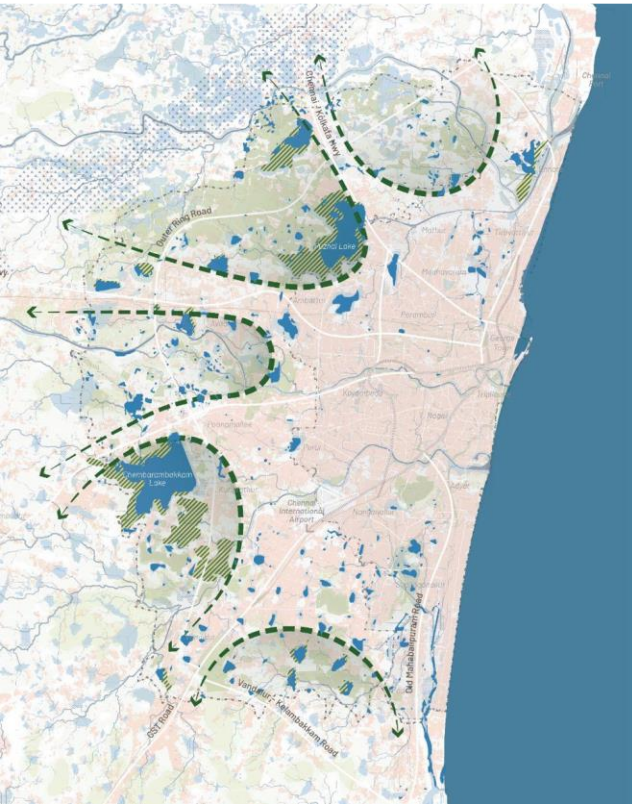
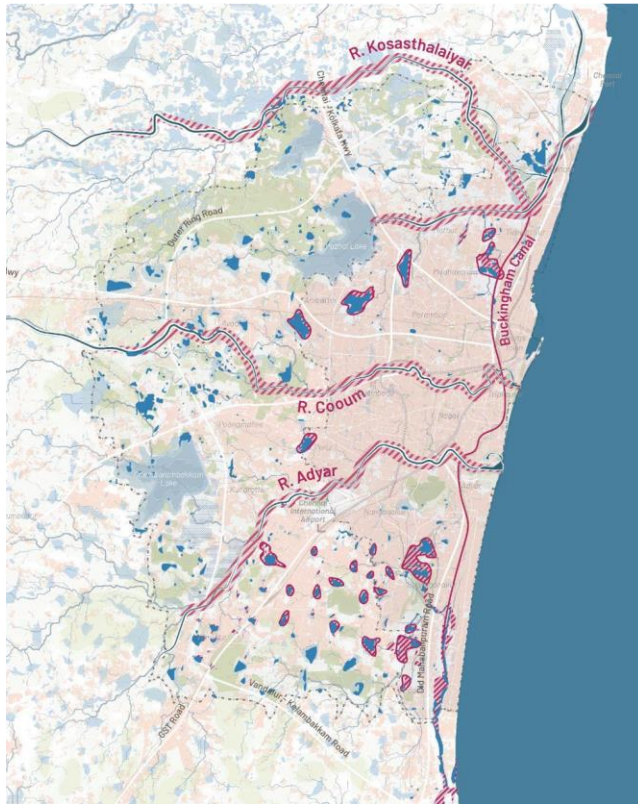
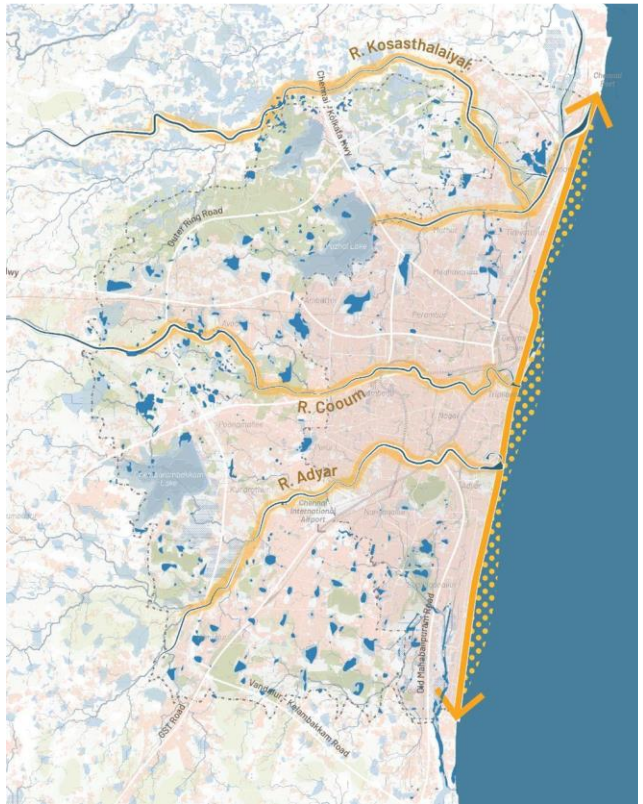
METROPOLITAN SCALE: THIRD VISION MASTERPLAN, CMDA

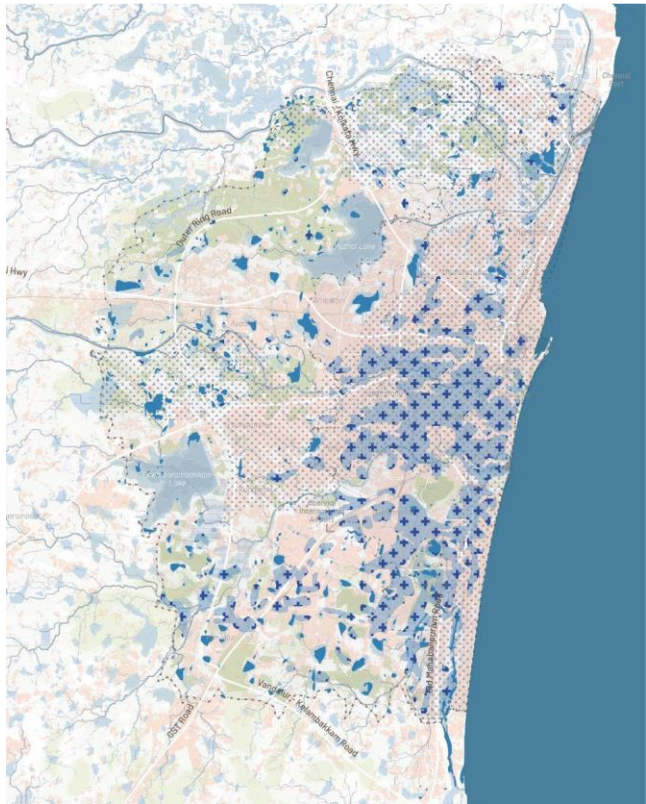
Sponge City Ecological Framework

- **PROTECT** Ecosystems and water bodies from encroachment or pollution **(P)**
- **RESTORE** Ecological functions of degraded or polluted landscape **(R)**
- **ENHANCE** Coastal, riparian, and wetland areas to withstand climate change **(E)**
- **CONSTRUCT** Blue-green infrastructure in urban open spaces, streets, and buildings to replicate natural systems **(C)**









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METROPOLITAN SCALE: THIRD MASTERPLAN VISION, CMDA

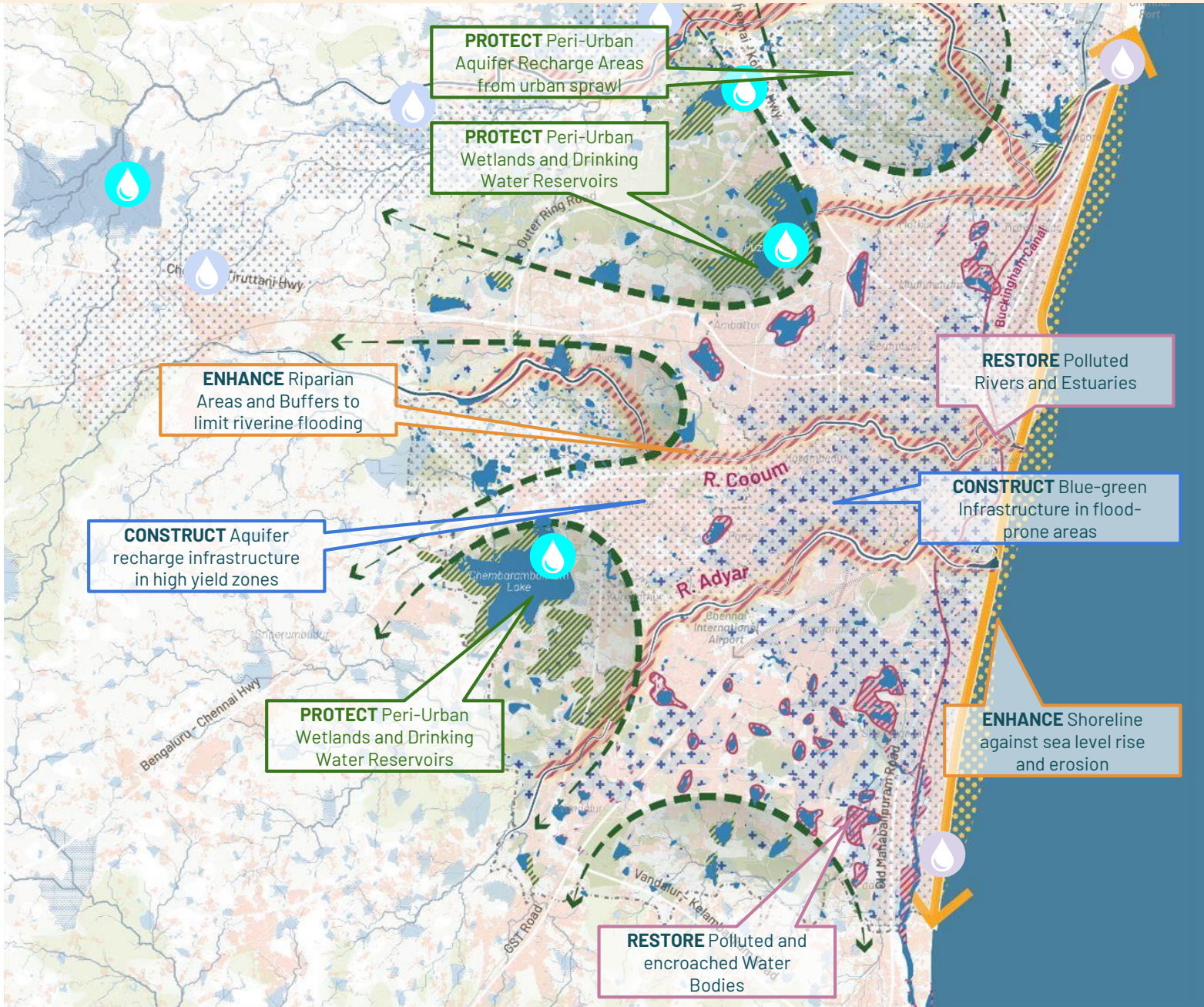
Sponge City Chennai

Where and how should Chennai prioritize the following nature-based solution actions?

- **PROTECT** Ecosystems and water bodies from encroachment or pollution **(P)**
- **RESTORE** Ecological functions of degraded or polluted landscape **(R)**
- **ENHANCE** Coastal, riparian, and wetland areas to withstand climate change **(E)**
- **CONSTRUCT** Blue-green infrastructure in urban open spaces, streets, and buildings to replicate natural systems **(C)**

Stick notes on the map with your comments following the color code

P R E C



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METROPOLITAN SCALE: THIRD MASTERPLAN VISION, CMDA

Resilient City Chennai

Where and how should Chennai prioritize the following urban development actions?

- **STRUCTURE** Urban expansion through risk-sensitive land use planning **(S)**
- **CONNECT** Transit-oriented Developments with sustainable mobility networks **(C)**
- **PROMOTE** Mixed-use economic nodes as climate-resilient cities **(P)**
- **IMPROVE** Service delivery and housing in vulnerable areas **(I)**

Stick notes on the map with your comments following the color code

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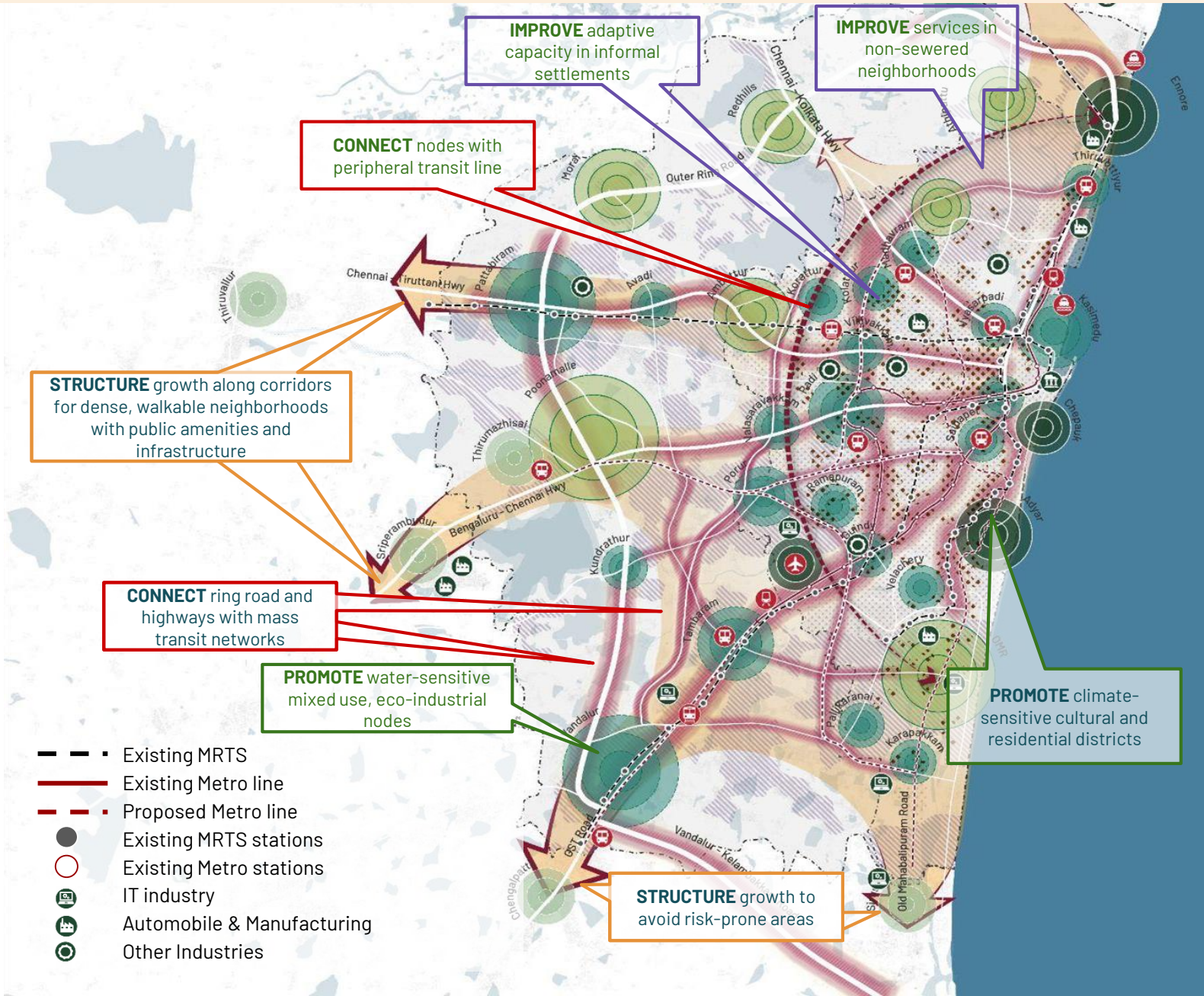

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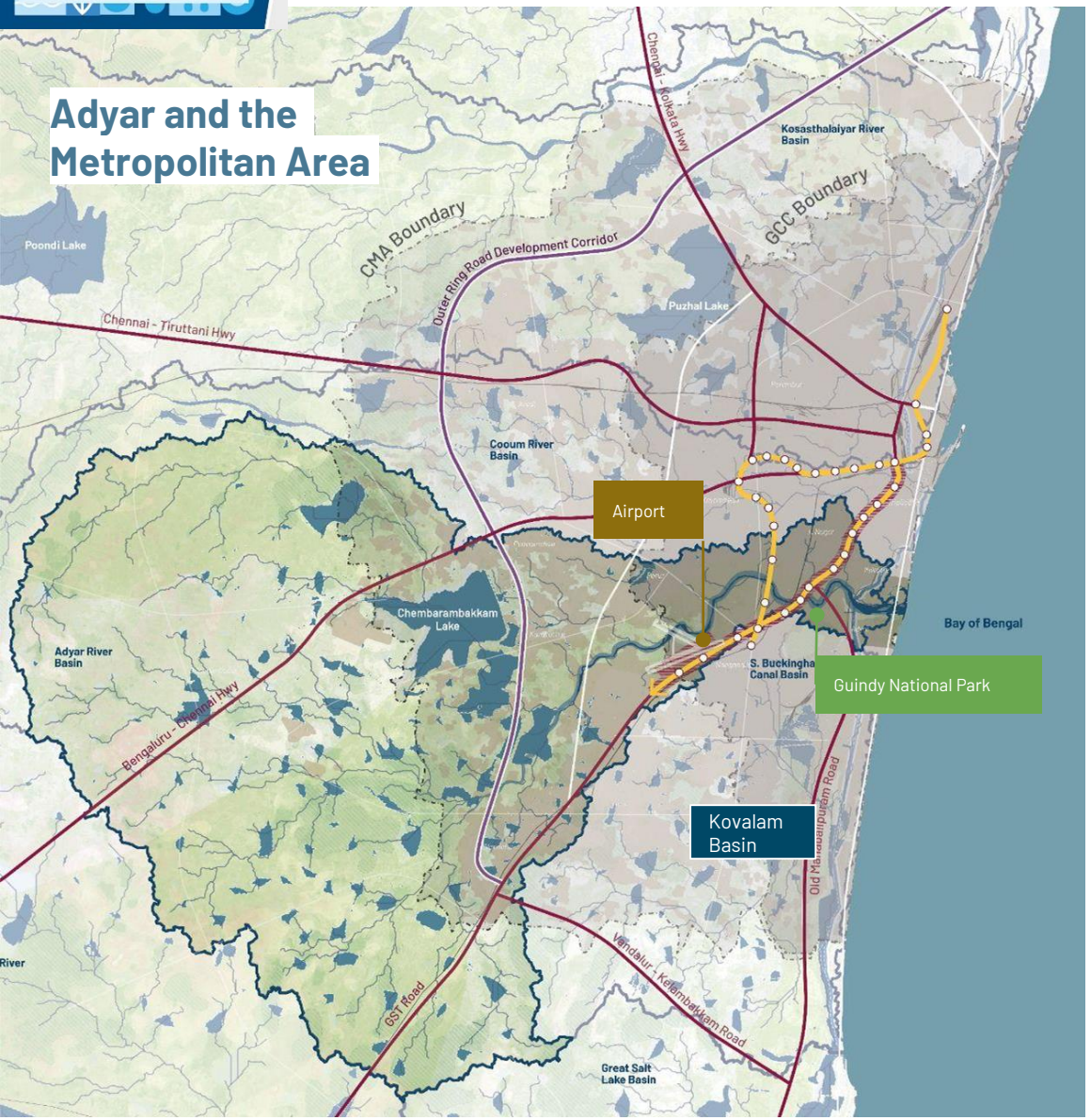
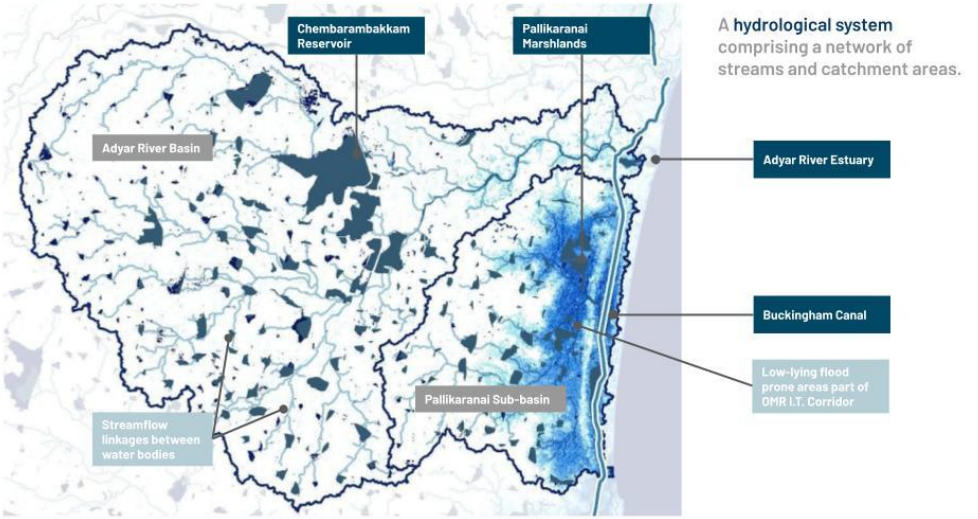
METROPOLITAN SCALE: ADYAR BASIN VISION



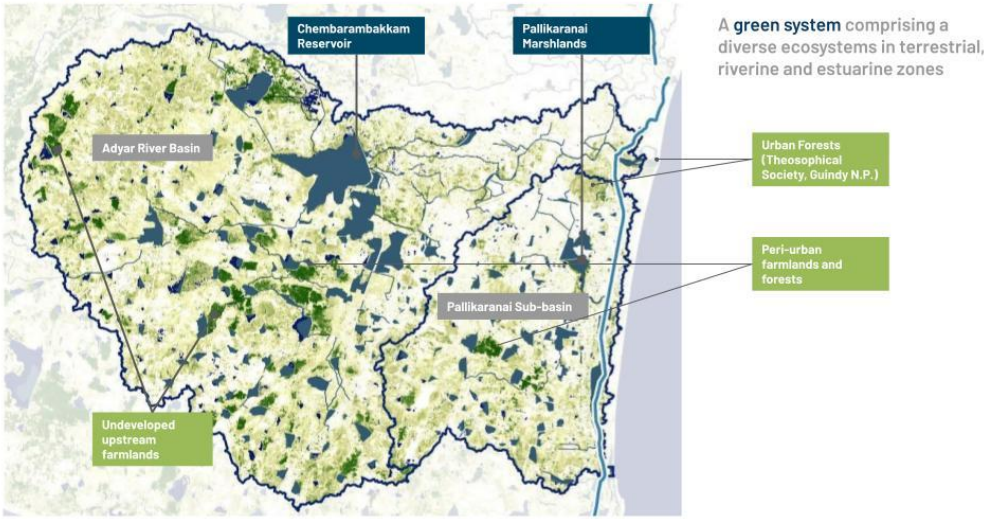
- Adyar basin is the southernmost of the three major river systems within Chennai city extents
- The riverine transect encompasses urban, peri-urban and rural contexts of the Chennai Metropolitan Area
- The Adyar Basin has the river as a major ecological corridor and three development corridors (ORR, GST Road, Bengaluru-Chennai highway)

Mapping Land-water Linkages in Adyar Basin



A **hydrological system** comprising a network of streams and catchment areas.

Recognizing Terrestrial, Riverine, and Estuarine Ecosystems in Adyar Basin



A **green system** comprising a diverse ecosystems in terrestrial, riverine and estuarine zones

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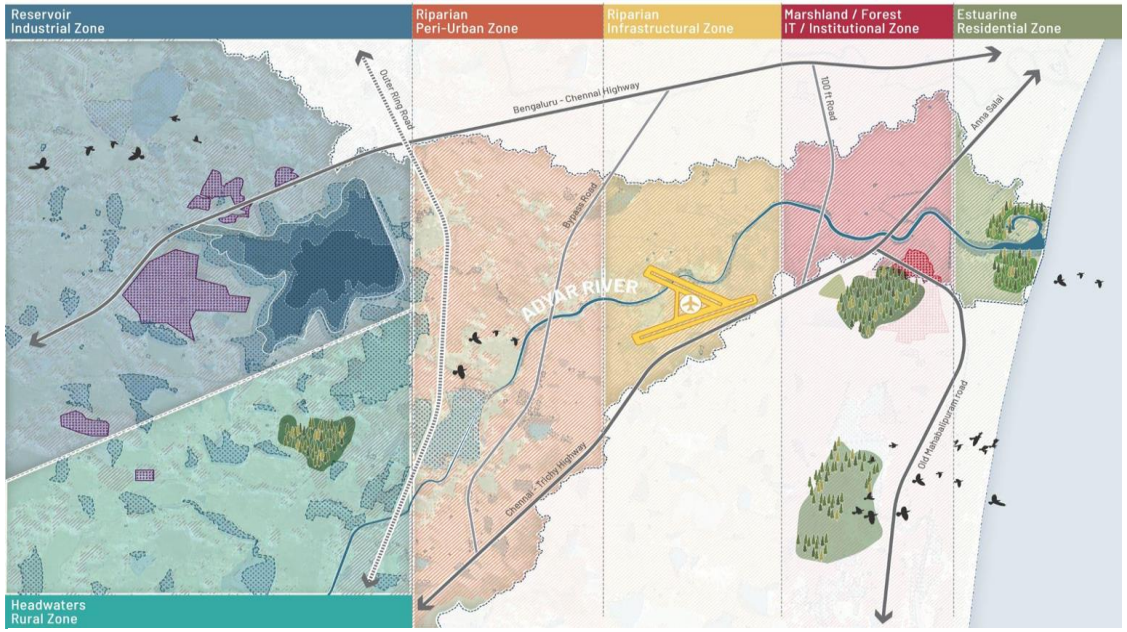
METROPOLITAN SCALE: ADYAR BASIN VISION



[Left to Right]: 1) Estuarine Residential Zone, 2) Forested Institutional Zone, 3) Riparian Infrastructural Zone, 4) Riparian Peri-urban Zone, 5) Reservoir Industrial Zone, 6) Headwaters Rural Zone

Economic nodes and land use

Groundwater systems

Infrastructure and Risk

Culture and Livelihoods

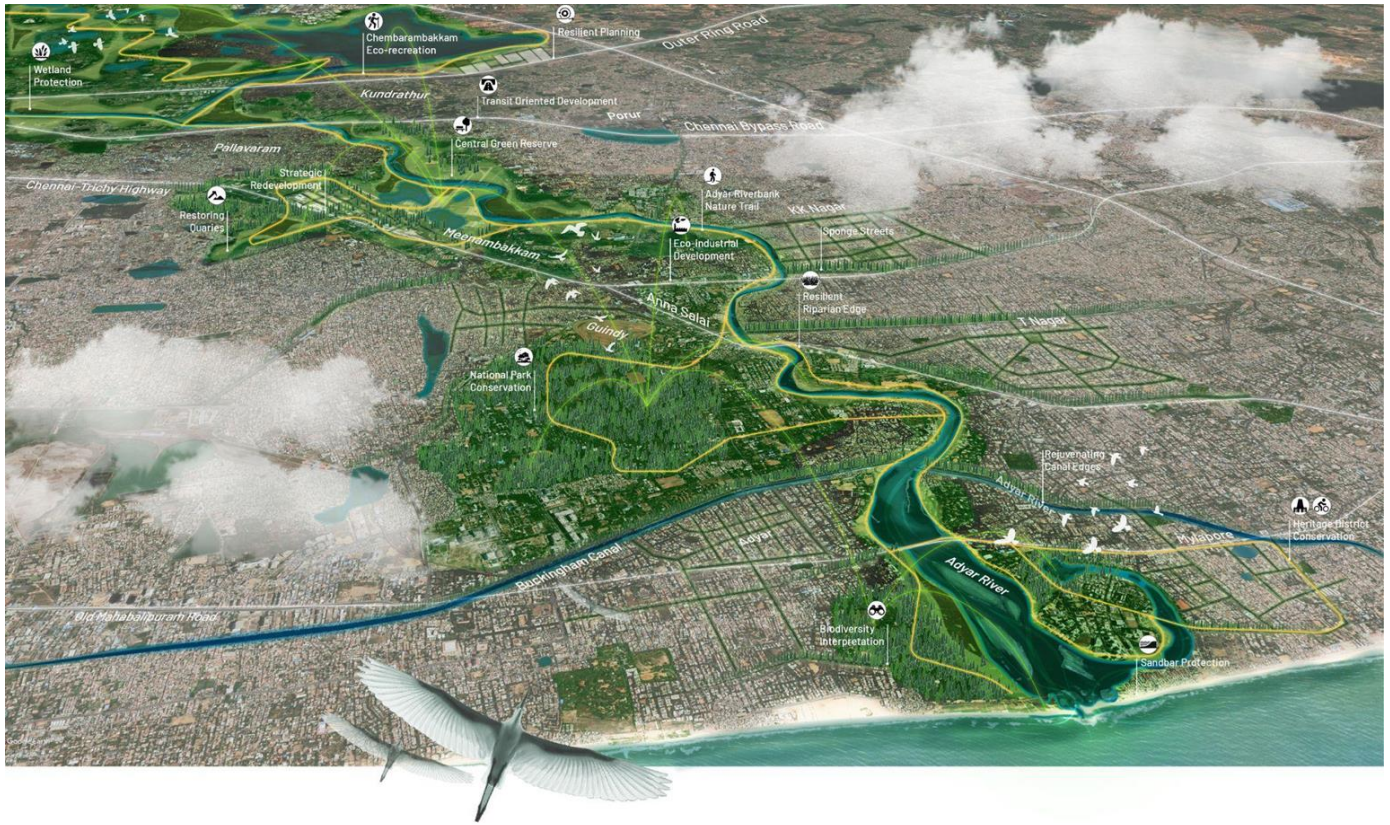
Land and Water

A Strategic Planning River-sensitive framework

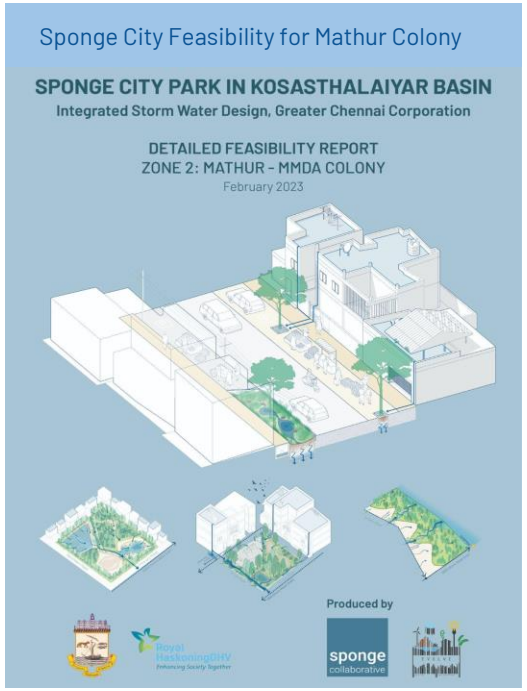
METROPOLITAN SCALE: ADYAR BASIN VISION

Estuarine zone

Institutional zone



NEIGHBORHOOD SCALE: SPONGE CITY FRAMEWORK



SPONGE CITY FEASIBILITY AND PILOT PROJECT

Detailed Feasibility and Project Report for Blue-green Infrastructure

COLLABORATORS

CARE Earth, IIT Madras, EVOLVE Engineering

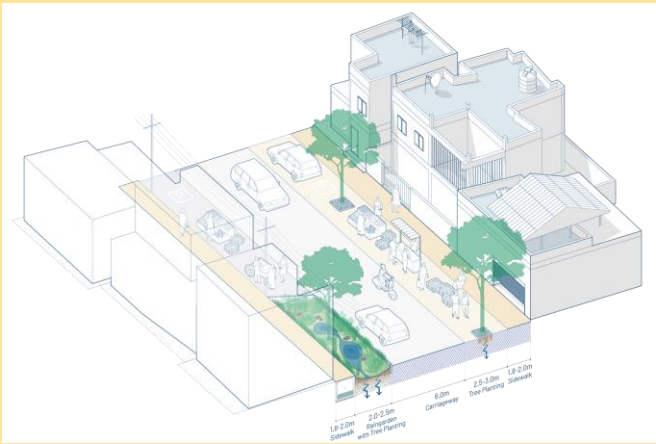
CLIENTS
Royal HaskoningDHV for GCC

1 Land Cover Mapping and Street Surveys

- Using GIS, CAD, field visit and reconnaissance to accurately represent land cover, street widths and feasibility of blue-green infrastructure

2 Siting Sponge Street and Open Space Interventions

- Designing blue-green infrastructure for streets and open spaces based on spatial, land-use, and hydrological opportunities



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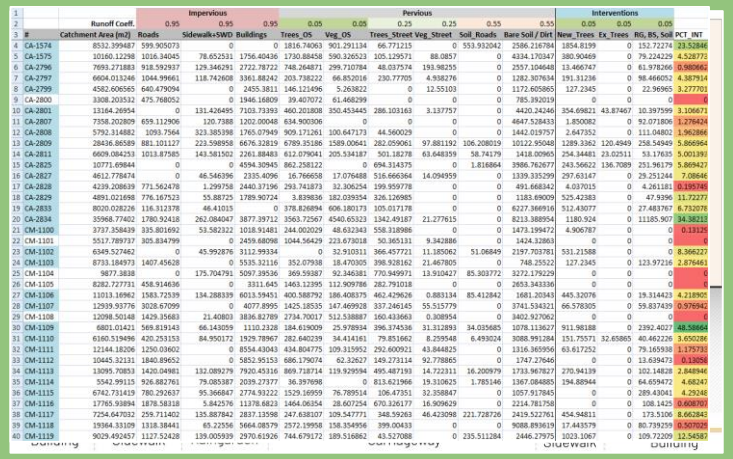
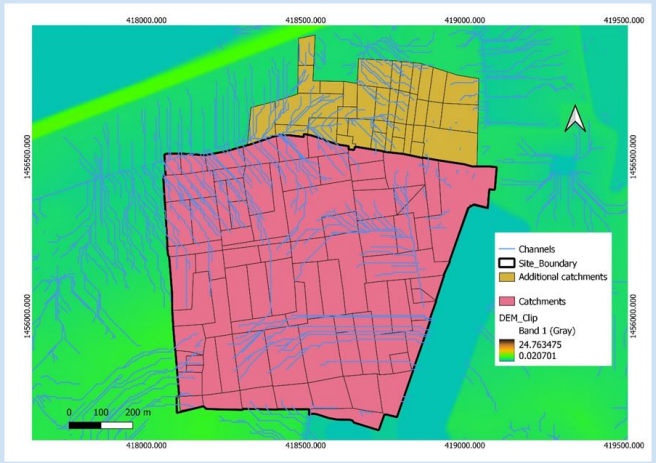
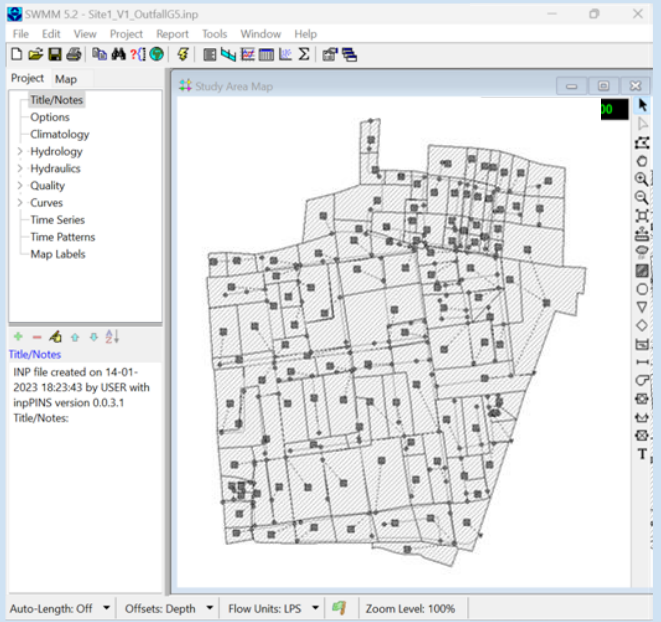
NEIGHBORHOOD SCALE: SPONGE CITY FRAMEWORK

3 Quantifying Impact of Sponge Network on Flood Mitigation and Aquifer Recharge

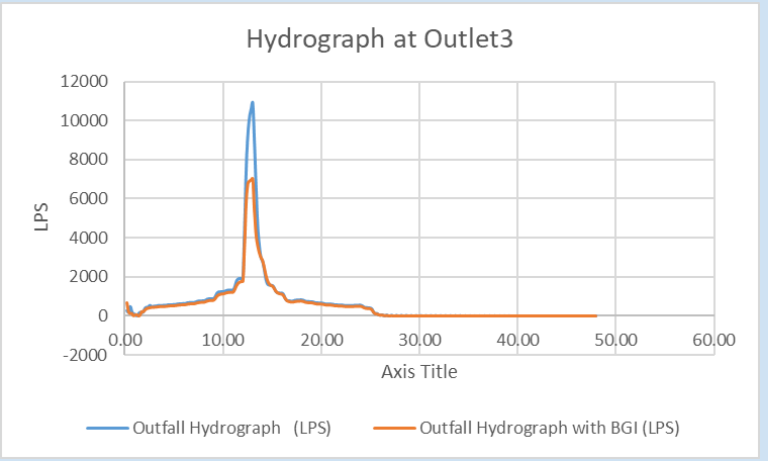
- Evaluating the impact of proposed blue-green infrastructure network on runoff volume reduction and infiltration increase for specific storm return periods







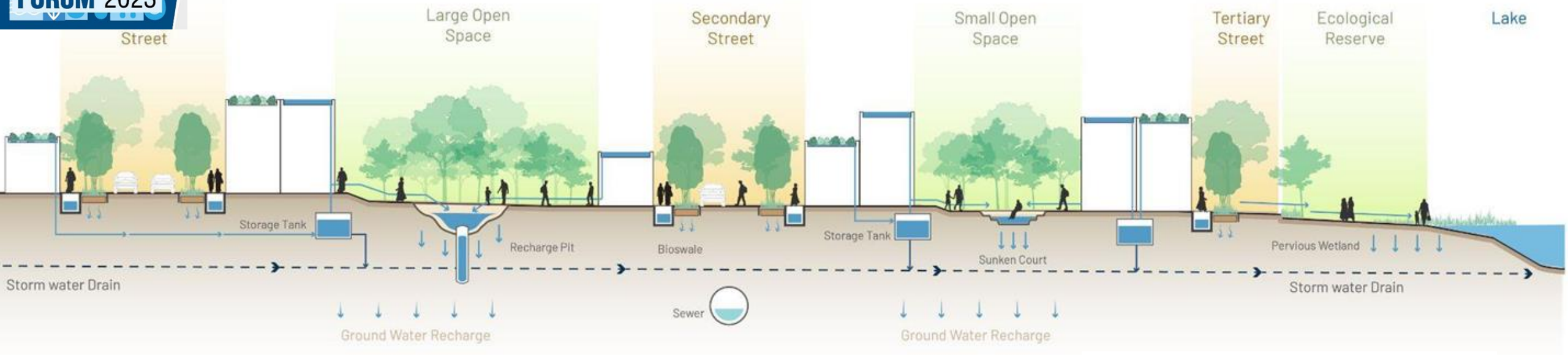
Dynamic Hydrological Modeling



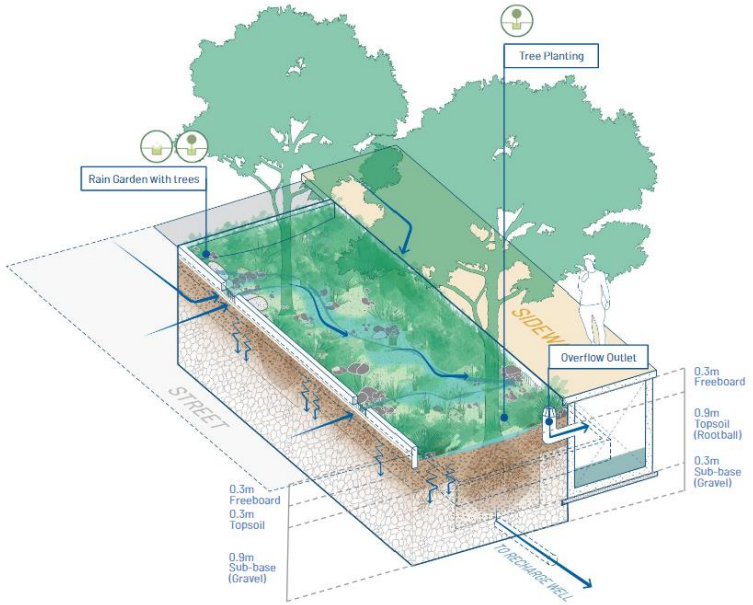
Without LID			With LID					
Subcatch ID	Area	Total Infiltration in million litre	Subcatch ID	Area	Total Infiltration in million litre through native soil	Infiltration final soil storage (mm)	Infiltration initial soil storage (mm)	Soil storage in milllion litre	Total Infiltration in million litre
1	0.7676	0.42	SC_68	0.38	0.08	470.08	32.62	1.64	1.72
2	0.6674	0.53	SC_59	0.17	0.04	844.60	32.62	1.38	1.42
3	0.4583	0.57	SC_58	0.26	0.05	822.25	32.62	2.04	2.09
4	0.3308	0.24	RG_9	0.00	0.04	0.00	0.00	0.00	0.04
5	1.3156	0.73	RG_8	0.08	0.33	0.00	0.00	0.00	0.33
6	0.736	1.03	RG_74	0.04	0.24	270.00	90.75	0.07	0.30
7	0.5748	0.78	RG_73	0.00	0.02	270.00	90.75	0.00	0.02
8	2.9821	5.10	RG_70	0.00	0.04	270.00	90.75	0.01	0.05
9	0.6748	0.37	RG_69	0.03	0.07	270.00	90.75	0.06	0.13
10	1.1314	0.62	RG_68	0.00	0.00	270.00	90.75	0.01	0.01
11	0.4683	0.26	RG_62	0.03	0.38	270.00	90.75	0.04	0.42
12	0.4479	0.29	RG_61	0.11	1.24	270.00	90.75	0.20	1.44
13	0.5481	0.30	RG_58	0.05	0.07	270.00	90.75	0.09	0.15
14	0.8013	2.12	RG_52	0.09	0.32	270.00	90.75	0.16	0.49
15	3.6849	10.50	RG_50	0.03	0.46	90.00	79.66	0.00	0.46
16	0.8413	2.15	RG_5	0.01	0.02	0.00	0.00	0.00	0.02
17	1.0428	1.88	RG_48	0.01	0.13	270.00	90.75	0.02	0.15
18	0.2872	0.16	RG_47	0.01	0.09	270.00	90.75	0.01	0.10
19	0.5613	0.31	RG_44	0.01	0.21	270.00	90.75	0.02	0.23
20	0.6242	0.34	RG_43	0.03	0.35	270.00	90.75	0.05	0.40
21	0.8594	0.48	RG_41	0.02	0.36	270.00	90.75	0.04	0.40
22	0.9984	0.55	RG_39	0.03	0.48	270.00	90.75	0.05	0.54
23	0.7982	0.44	RG_38	0.01	0.10	270.00	90.75	0.01	0.11
24	1.1005	0.84	RG_37	0.03	0.34	270.00	90.75	0.05	0.39
25	1.3037	0.72	RG_36	0.09	0.53	0.00	0.00	0.00	0.53
26	1.2096	1.16	RG_35	0.03	0.27	0.00	0.00	0.00	0.27
27	0.681	1.38	RG_34	0.02	0.11	0.00	0.00	0.00	0.11
28	0.6334	0.35	RG_31	0.04	0.21	0.00	0.00	0.00	0.21
29	1.1799	0.62	RG_28	0.00	0.03	0.00	0.00	0.00	0.03
30	1.0285	0.74	RG_27	0.01	0.07	0.00	0.00	0.00	0.07
31	1.40044	1.07	RG_24	0.04	0.43	0.00	0.00	0.00	0.43
32	0.5616	0.52	RG_22	0.00	0.05	0.00	0.00	0.00	0.05

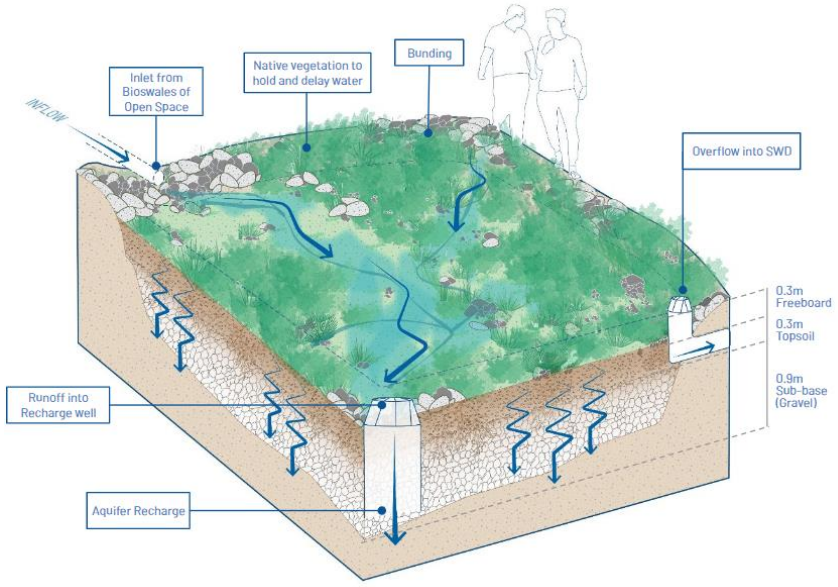
Simulation results from 5, 10, 25 year R.P storms with and without blue-green infrastructure

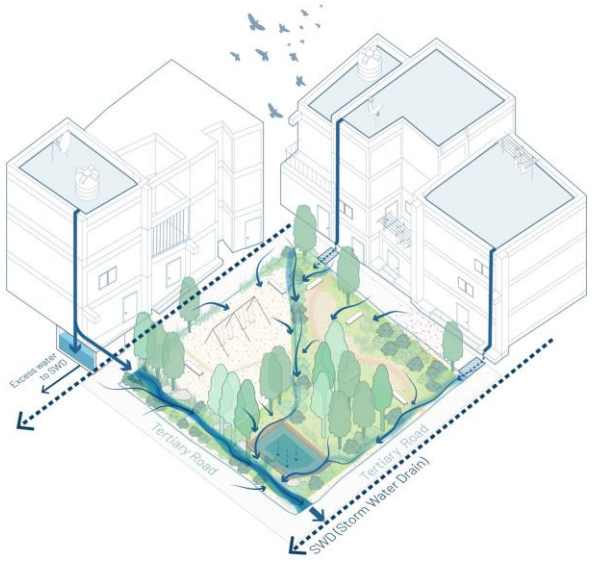
NEIGHBORHOOD SCALE: SPONGE CITY FRAMEWORK



Sponge Street Intervention







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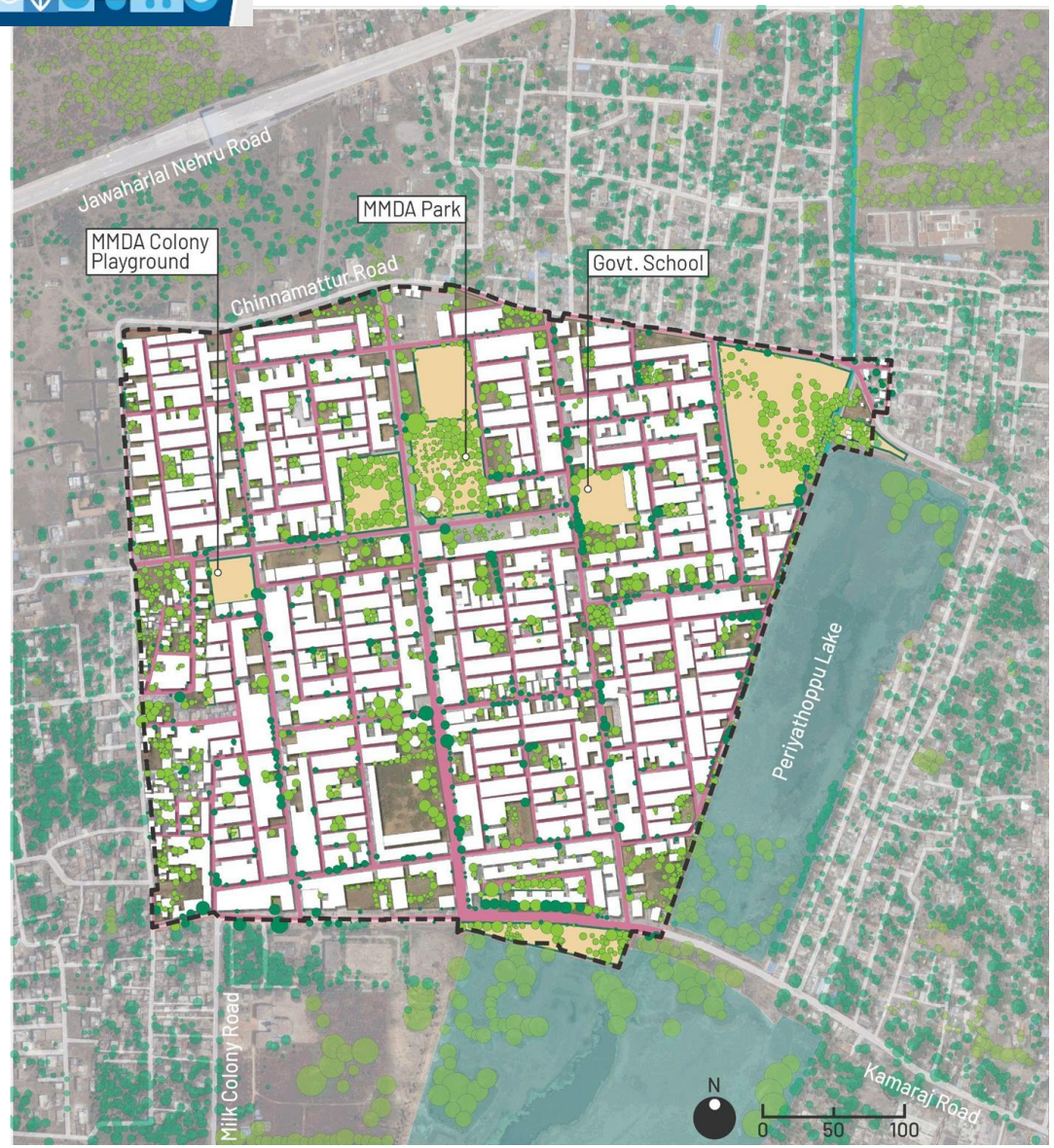
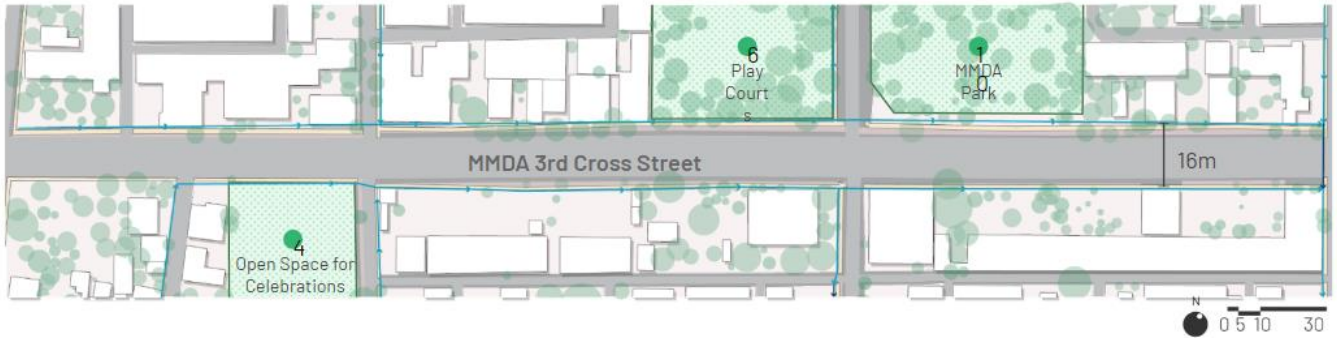
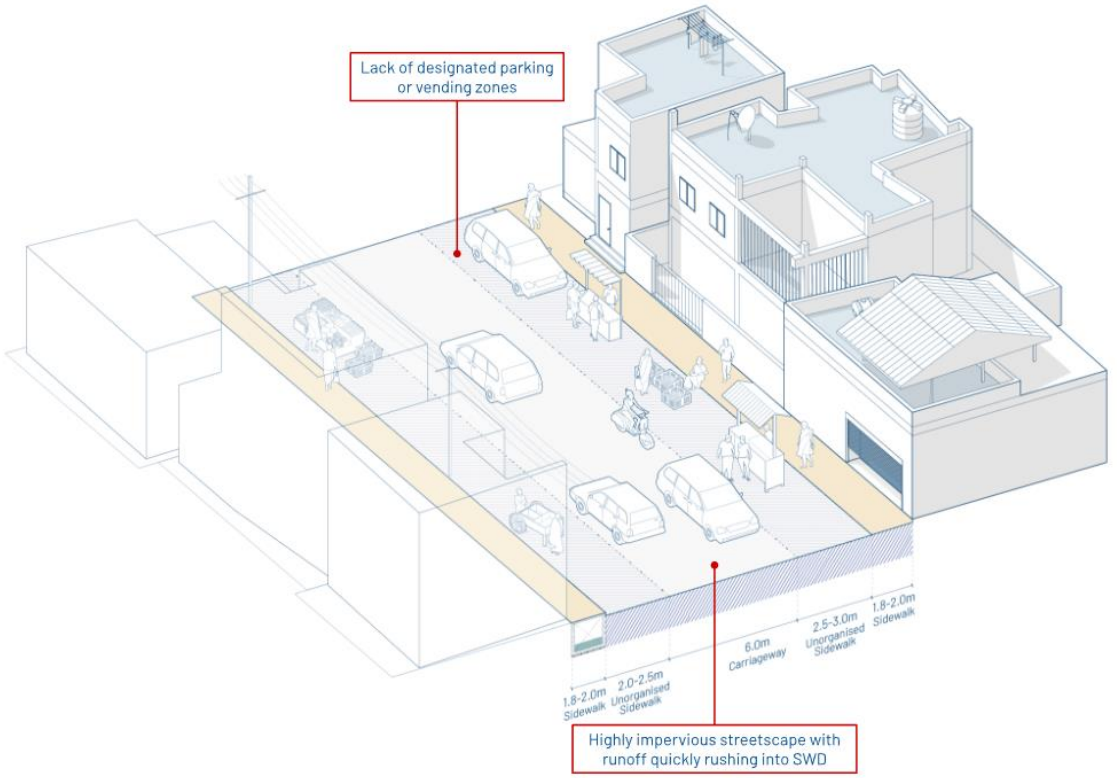
NEIGHBORHOOD SCALE: SPONGE CITY FRAMEWORK

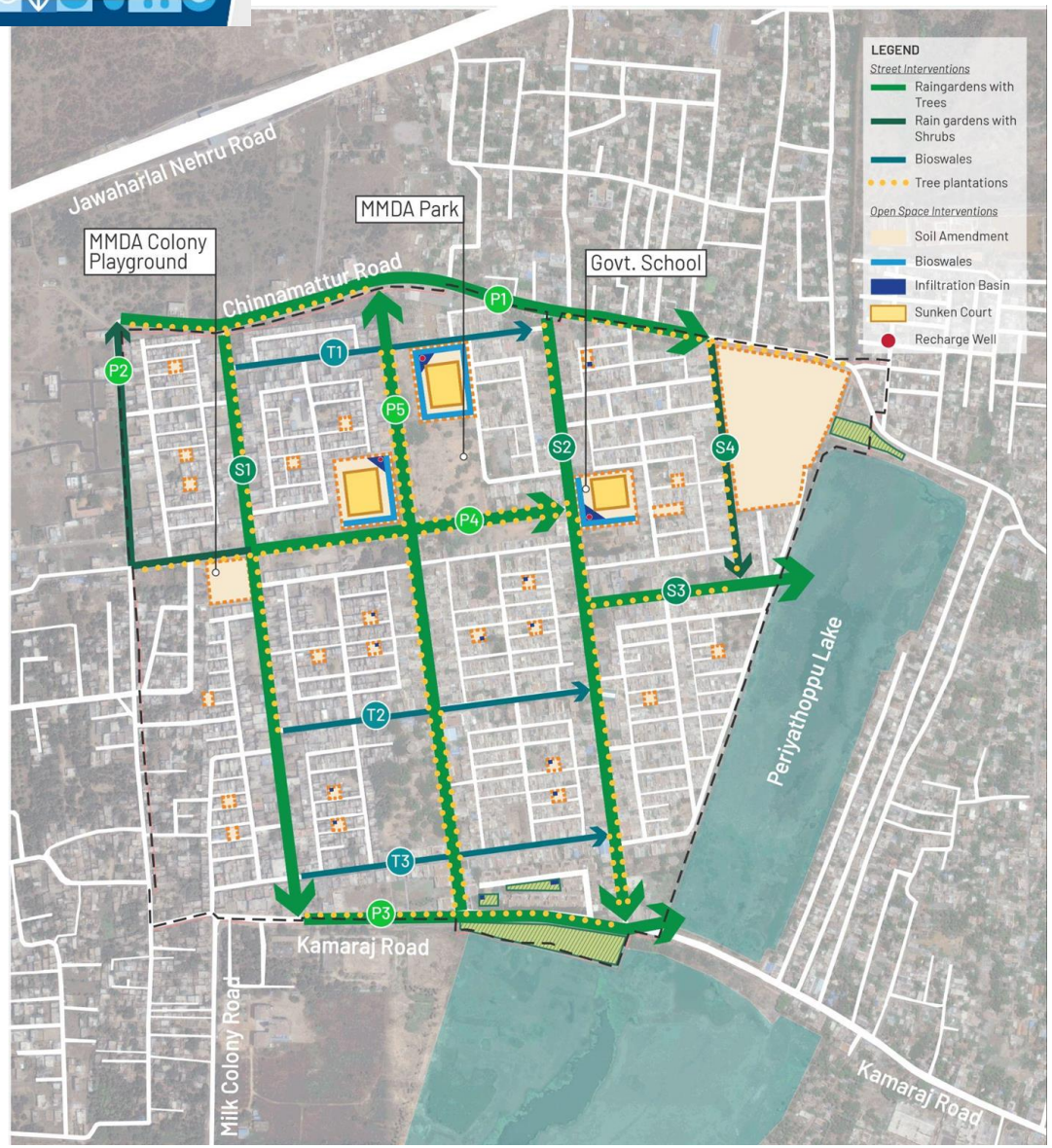


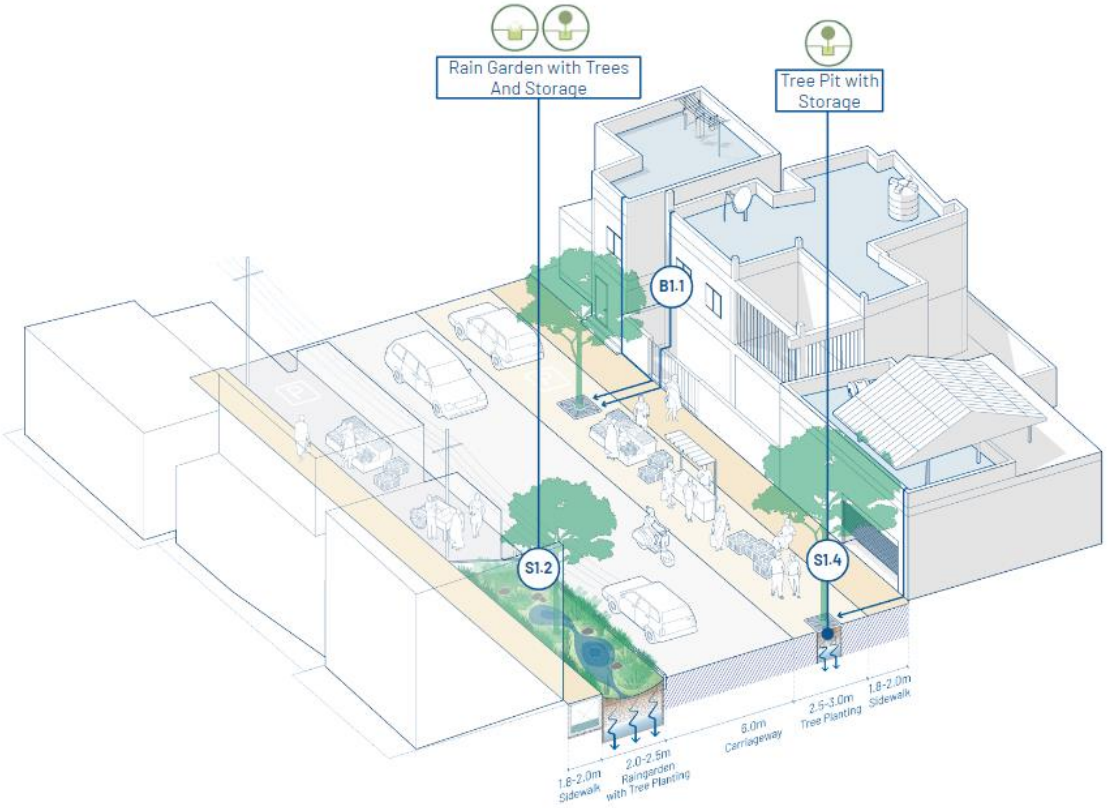




THE POLICY & PRACTICE FORUM 2023

NEIGHBORHOOD SCALE: SPONGE CITY FRAMEWORK





PILOT SCALE: SPONGE PARK

Neighbourhood Commons for Vibrant Social Life

Green Park for Healthy Living

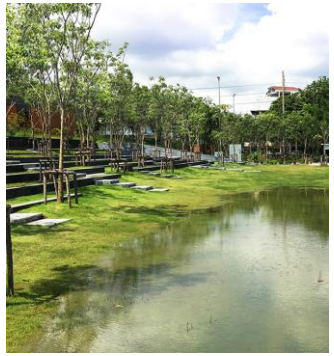
Infrastructure to Reduce Flooding and Raise Aquifers

Habitat for Flora and Fauna

PILOT SCALE: SPONGE PARK

Forebay

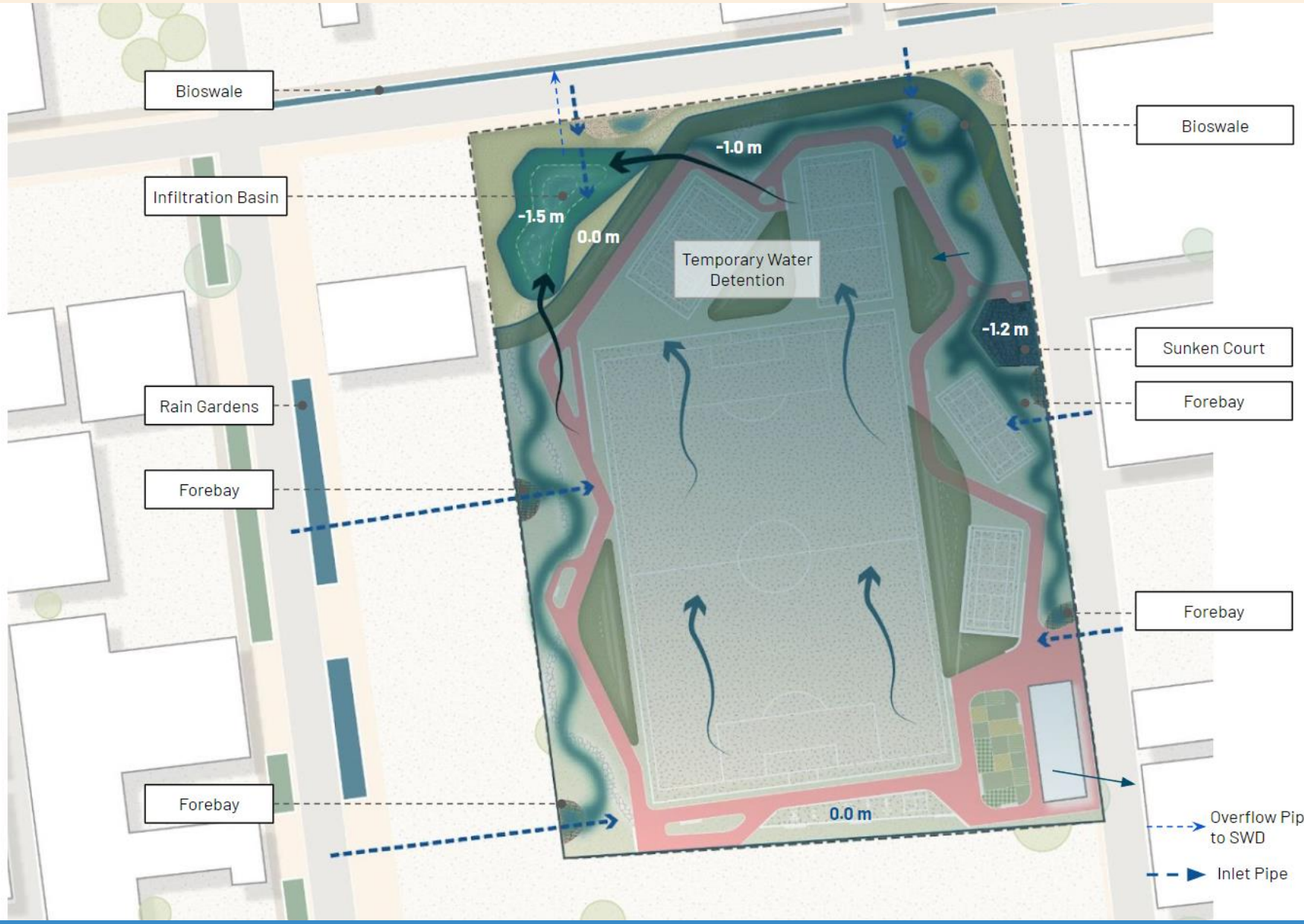
Infiltration Basin



Bioswale

Recharge Well

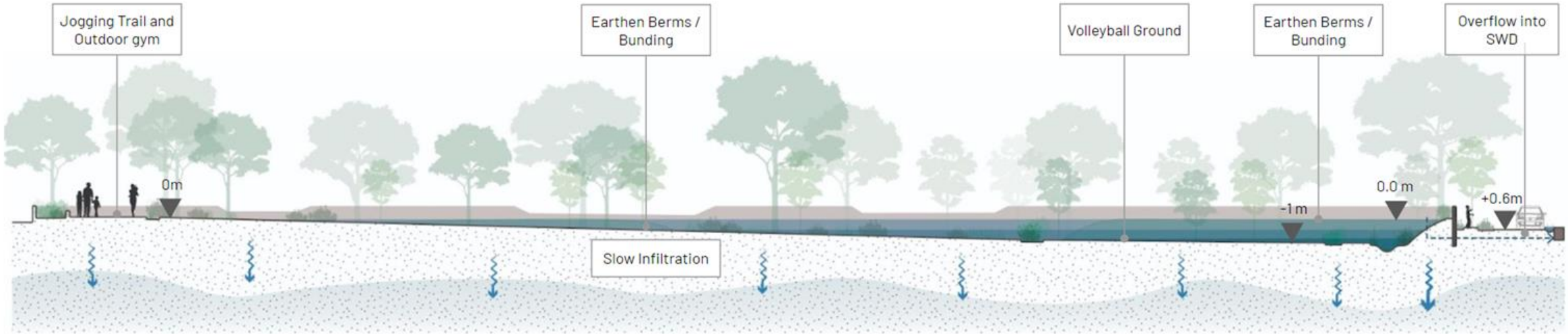
Cistern for Water Harvesting



PILOT SCALE: SPONGE PARK

During Dry Periods

During Storms



Section 1-1

THE POLICY & PRACTICE FORUM 2023

PILOT SCALE: SPONGE PARK

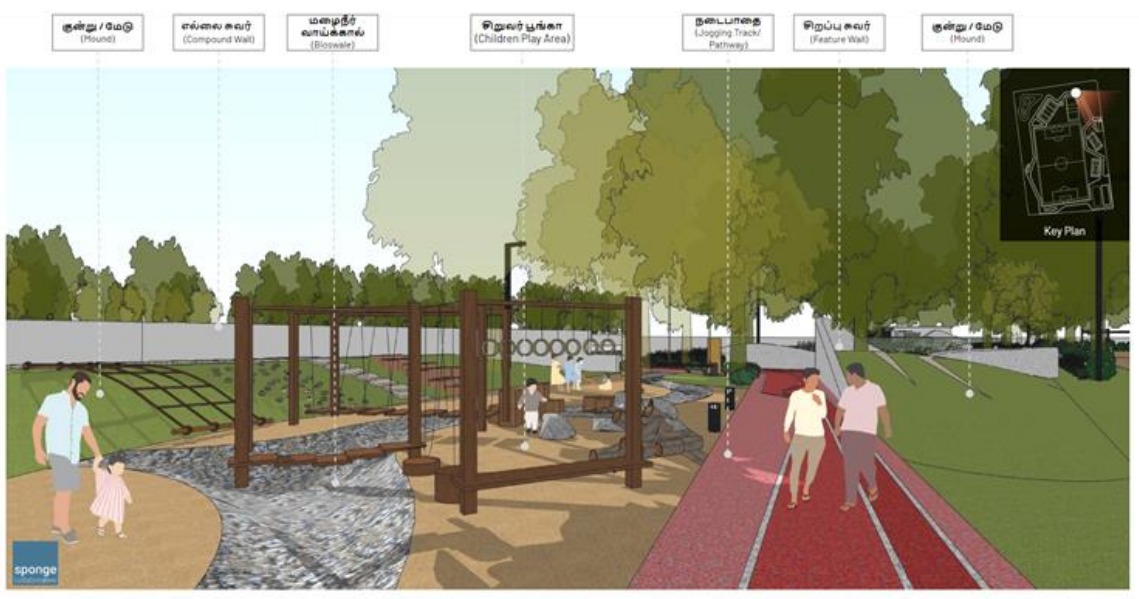
THE POLICY & PRACTICE FORUM 2023

PILOT SCALE: SPONGE PARK

> **Happy to see a park like this in our community which has no breathing space for old people and women like us**
>
> -Elderly man & Woman from the RWA

THE POLICY & PRACTICE FORUM 2023

PILOT SCALE: SPONGE PARK



LEARNINGS SO FAR…

- **Compelling visuals and storytelling** can be a powerful political tool to communicate risks and co-benefits of bundling nature-based solutions into infrastructure delivery
- **Integration of high-level visions with strategic pilot projects** that touch upon multiple priority areas are necessary for key stakeholders
- **Integrating spatial and non-spatial approaches** : Policymakers, planners, urban designers and engineers need to collaborate to integrate guidelines, plans, and infrastructure projects
- **Institutional Reform:** Design Manuals and Standards at National Level (CPHEEO), Regulations and Bylaws at Local Level
- **Capacity Building:** Updating Engineering Curriculum at National Level, Training for Municipal Engineers and Maintenance Personnel at Local Level
- **Inter-governmental and multi-scalar Coordination:** of blue-green infrastructure strategies and investments at metropolitan, municipal, and ward levels. **Inter-departmental Coordination:** for the integration of multiple systems for implementation and maintenance of blue-green infrastructure.
- **Procurement Reform:** Prohibitive qualifications for Municipal and Multilateral procurement for innovative firms in blue-green space competing against firms with decades of gray infrastructure experience.
- **Green-Blue Financing:** Unlocking new finance models including blended finance, public-private collaborations to finance the planning, design, implementation and maintenance of blue-green infrastructure

Thank you !

Manushi Ashok Jain
Co-founder & Director (Business Development, Operations and Design)
Sponge Collaborative | Chennai, Bengaluru & Lyon, France
Email: manushi@spongecollaborative.com