



# **WATER DISTRESS IN GROWING CITIES**

## **Issues & Challenges**



Ministry of New and  
Renewable Energy,  
Govt. of India



PRESENTED BY:  
AKASH HINGORANI

**OASIS**  
DESIGNS INC.

# Water crisis looms over India

**DIRTY PICTURE** Despite rapid urbanisation, cities fail to meet growing water demand, treat sewage, finds CSE study

**ht SPECIAL**

Chetan Chauhan

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**NEW DELHI:** Major metros like Delhi and Mumbai face huge water and environmental crises as infrastructure tries to keep pace with the increasing population, says a new study of 71 Indian cities.

The report, *Excreta Matter*, prepared by the Centre for Science and Environment (CSE), comes at a time when India is urbanising at the highest rate in the world and half of all Indians are expected to be living in cities by 2050. "If we do not get the arithmetic of water waste right, it will drown us in its own excreta," said Sunita Narain, CSE's director general.

The study presents the dirty picture of Indian cities' capacity to treat less than half the sewage they generate. Moreover, the dirty sewage generated flows into rivers like Yamuna in Delhi, Mithi in Mumbai and wetlands in east Kolkata. Even a modern city like Bangalore is able to treat just 30% of its sewage.

What is worse, the treated sewage is not even utilised for non-food or non-bathing purposes. "Most cities don't have water management plans," the report says.

The study also points out another major flaw — water loss during distribution. Over 35% of water in Delhi and about 30% in Mumbai is lost because of leakages, the report says.

Delhi extracts around 12% of its supply of 1,824 million litres per day (MLD) from the ground but fails to replenish the same amount by way of water harvesting. The availability of water in certain regions is around 63

## GRAVE SITUATION



File photo of Delhi's Yamuna river. Untreated sewage of the national capital is released into the river

### DELHI

- Existing demand (2011): **4,727 MLD**
- Existing supply: **1,824 MLD**
- Extra supply possible if leakages plugged: **927 MLD**
- Required increase in water supply: **24%**
- Total sewage generated: **4,456 MLD**
- Treatment capacity: **2,330 MLD**
- Treated: **1,478 MLD**
- Disposal: **Yamuna river (untreated)**

### KOLKATA

- Existing demand (2011): **1,049 MLD**
- Existing supply: **790 MLD**



File photo of Mumbai's Mithi river, commonly identified as a drain till the deluge of 2005

### MUMBAI

- Existing demand (2011): **4,500 MLD**
- Existing supply: **2,135 MLD**
- Extra supply possible if leakages plugged: **1,450 MLD**
- Required increase in water supply: **48%**
- Total sewage generated: **2,800 MLD**
- Treatment capacity: **2,284 MLD**
- Treated: **1,186 MLD**
- Disposal: **Arabian Sea and Mithi river**

- Extra supply possible if leakages plugged: **Nil**
- Required increase in water supply: **Nil**
- Total sewage generated: **1,121 MLD**

- Treatment capacity: **173 MLD**
- Treated: **173 MLD**
- Disposal: **East Kolkata wetlands and Hoogly river**

metres below the ground.

Even though the capital's population has increased by 50% since 1994, the increase in water connections is just 3%, the report says, indicating that the Delhi Jal Board has failed to augment water supply in the city.

Mumbai fares no better. Residents of high-rises receive about 220 litres per capita per day whereas those in slums get less than 40 litres. With its population estimated to be 15 million in 2011, it needs about 1,300 MLD to meet the demand.

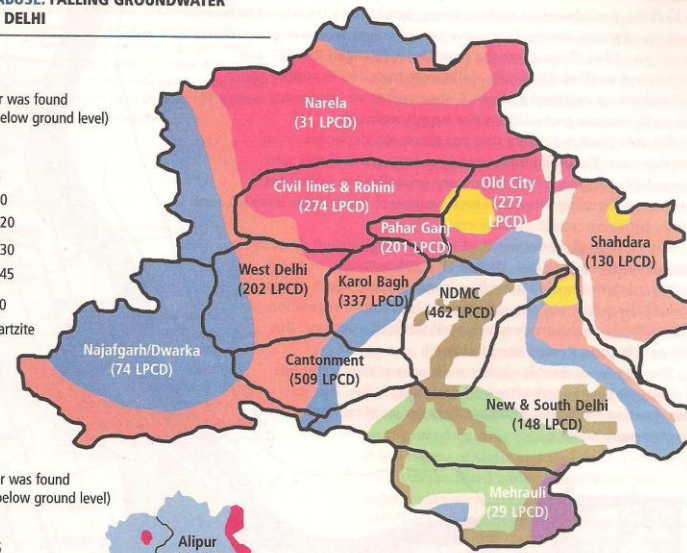
Kolkata is slightly better than the two in meeting its water requirement but may fall in the same trap if its sewage treatment capacity is not increased. From a water-surplus city, Kolkata is turning into a water-deficient city.

## AQUIFER ABUSE: FALLING GROUNDWATER LEVELS IN DELHI

**MAY 2002**

Where water was found (in metres, below ground level)

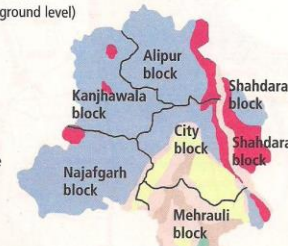
- 0 to -2
- 2 to -5
- 5 to -10
- 10 to -20
- 20 to -30
- 30 to -45
- 45 to 50
- Delhi quartzite



**1960**

Where water was found (in metres, below ground level)

- 0 to -2
- 2 to -5
- 5 to -10
- 10 to -20
- 20 to -30
- Delhi quartzite



Source: CSE

LPCD: Litres per capita daily  
Source: Central Ground Water Board, 2002



# Floods in Guwahati

# When it started.....

One of the first big accounts of urban floods is from July, 2004, when the Brahmaputra River at the peak was flowing at 1.75 meters above the danger mark.

**Source:** Volume 3 Impacts of Floods and Landslides on the Iconic Cultural Heritage of Guwahati, For ASDMA, Government of Assam





# Comparing the Two scenarios. . .

## Case of Guwahati...



Deepor Bil, reduced from 40sq.m. to 4sq.km



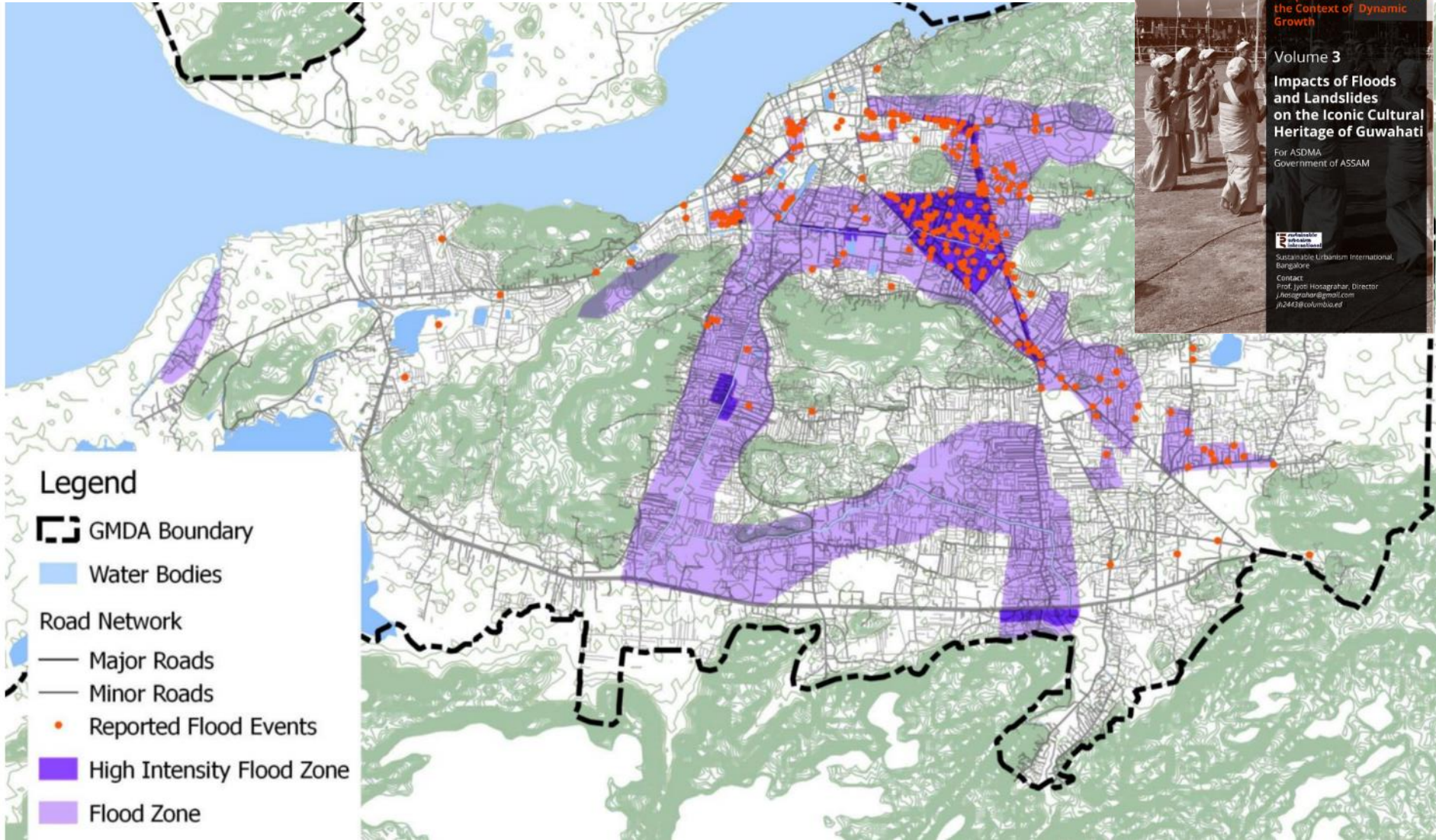
Pallikarainai marshlands, reduced from 250sq.m. to 50sq.km



Case of Chennai...



# The part of city that floods the most. . .



December, 2014

Disaster Risk Reduction  
Including Climate Change  
Adaptation of Guwahati in  
the Context of Dynamic  
Growth

Volume 3

Impacts of Floods  
and Landslides  
on the Iconic Cultural  
Heritage of Guwahati

For ASDMA  
Government of ASSAM

Sustainable Urbanism International,  
Bangalore

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jh2443@columbio.edu



# Flooding

## CURRENT

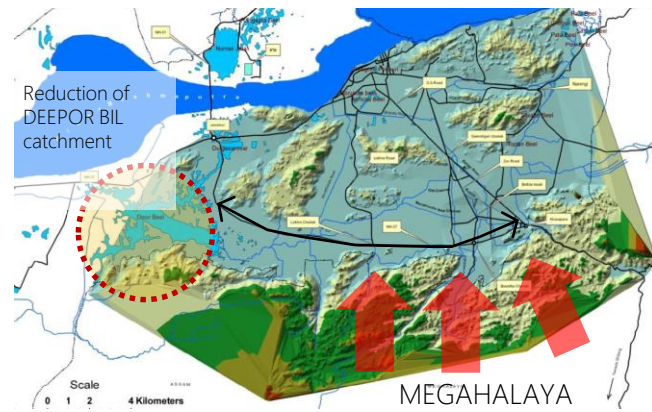
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Source: Volume 3 Impacts of Floods and Landslides on the Iconic Cultural Heritage of Guwahati, For ASDMA, Government of Assam

## Cause For Flooding

**BRAHMAPUTRA RIVER** –Level of Brahmaputra Bed higher than the CITY level

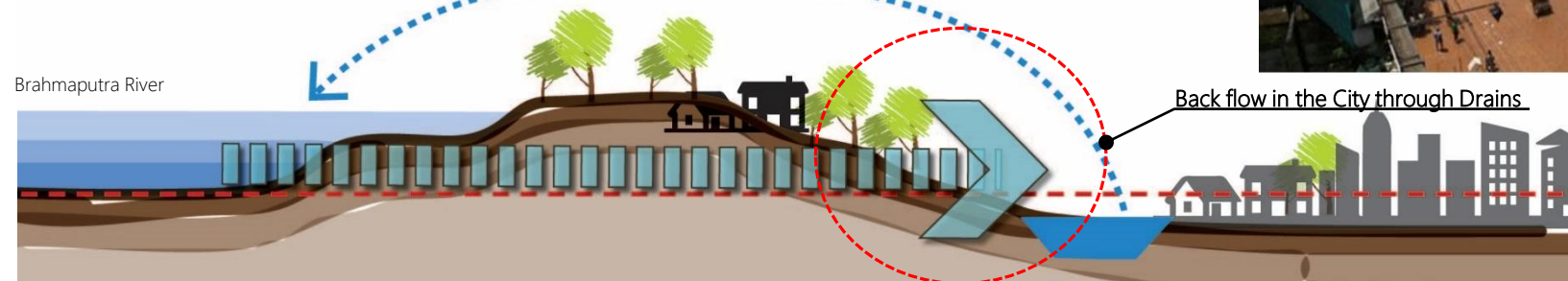
o **RAINWATER FROM MEGHALAYA** –as it is on higher topography



## CONCEPT DEVELOPMENT



City PUMPS it back into the RIVER



o **UNBALANCE IN WATERSHED**

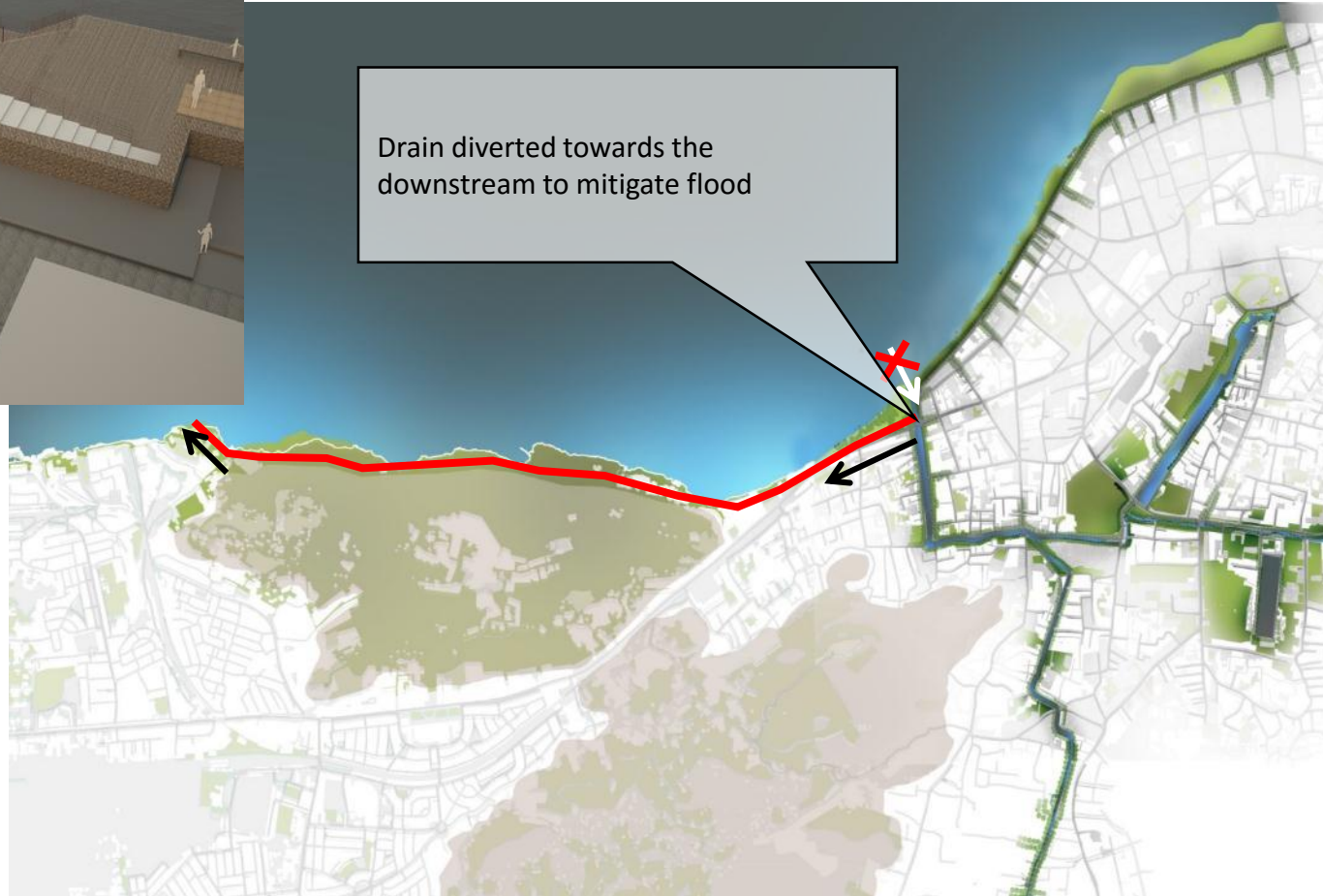


# Back flow from brahmaputra



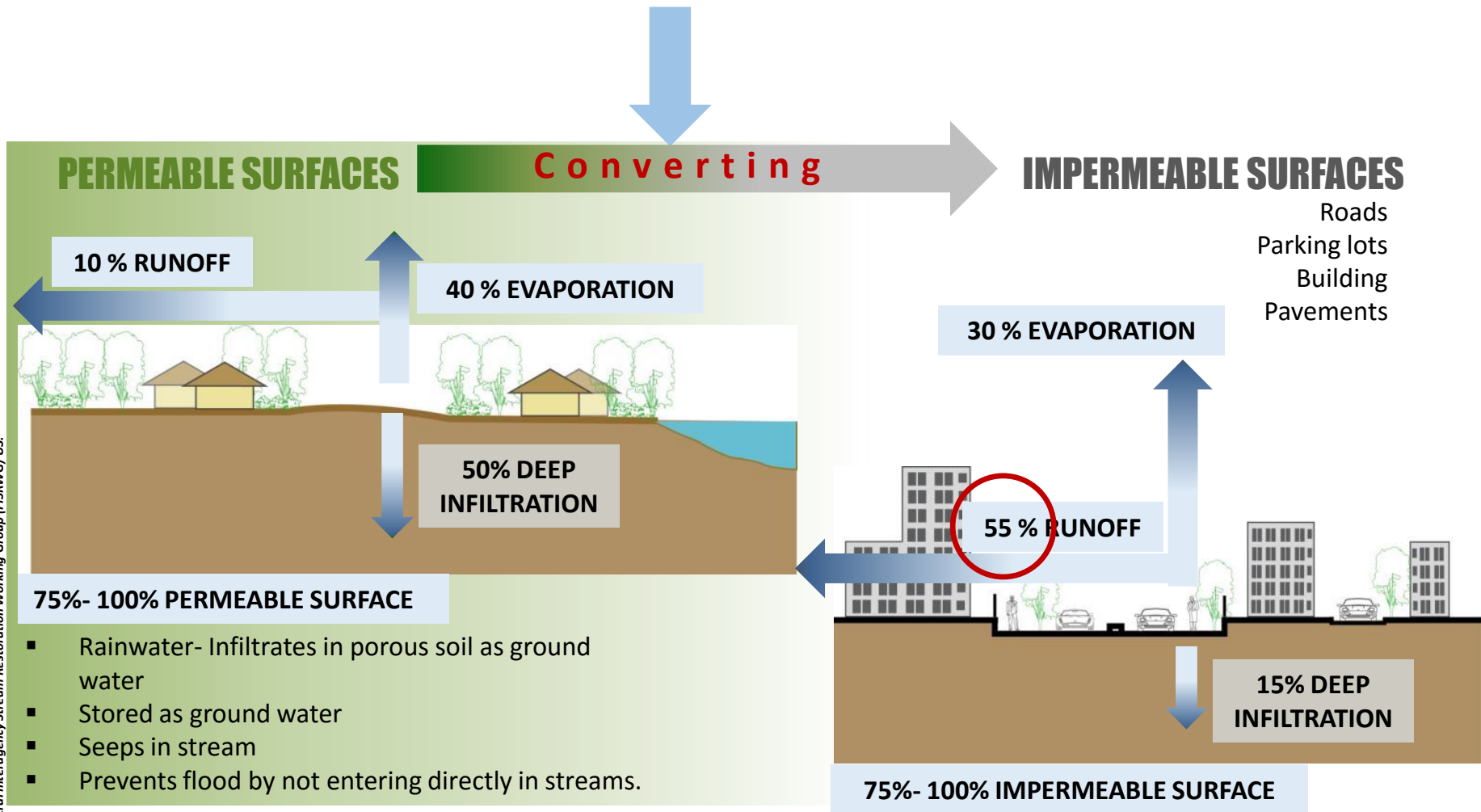
SLUICE GATE TO DIVERT  
WATER & BLOCK BACK  
FLOW FROM RIVER

Water from Guwahati  
backflows into the storm  
water drain when it  
reaches HFL...



Drain diverted towards the  
downstream to mitigate flood

# RAPID URBANIZATION



**INCREASED QUANTITY & INCREASED SPEED**



# Stormwater challenges

## CURRENT

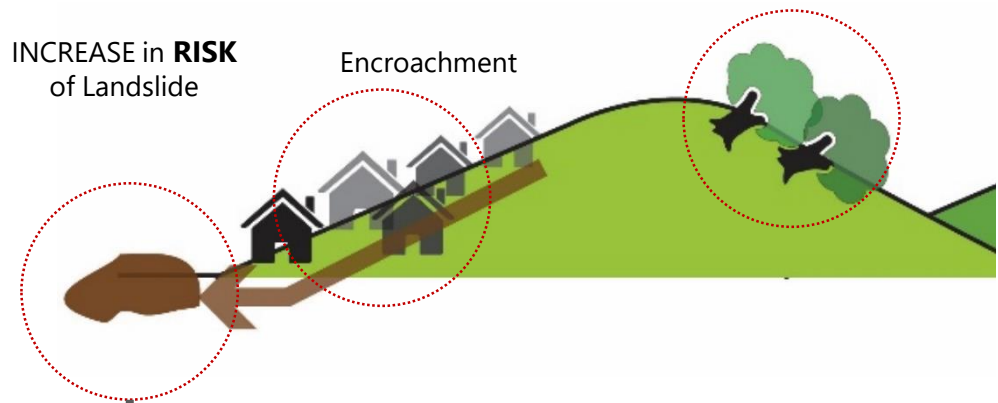
STORMWATER one of the major cause for FLOODING in the city.

### o LAND SLIDE

INCREASE in RISK of Landslide

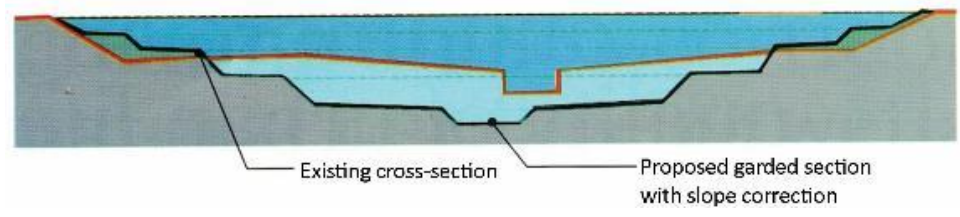
Encroachment

Cutting of Trees

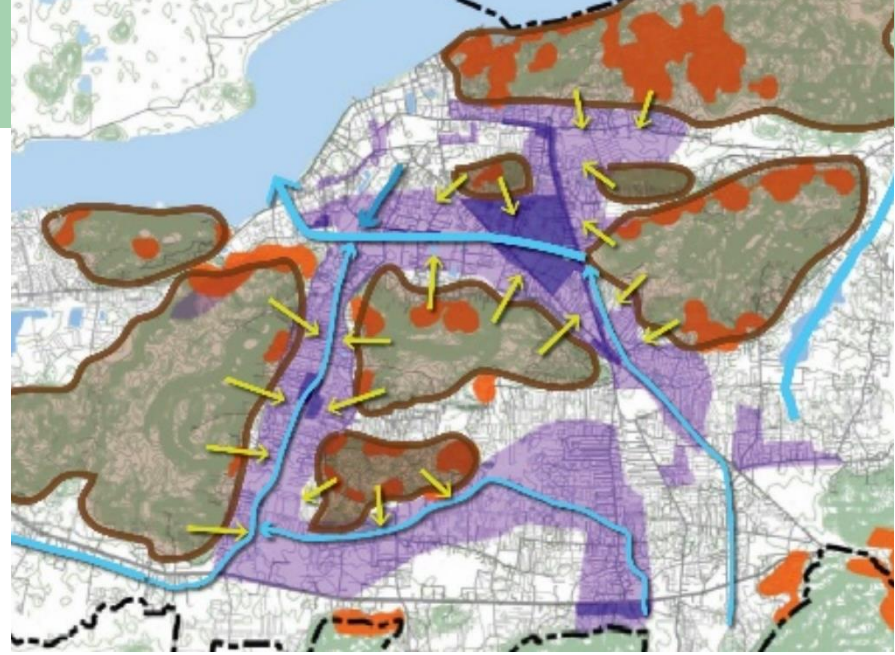


### o SILTATION OF DRAIN

Reducing carrying capacity



**DECREASED CARRYING CAPACITY  
LEADING TO FLASH FLOODS**



Current Techniques to De-silting Nallahs in Guwahati



One of the causes for FLOODING

# Siltation because of slope erosion



Siltation along natural storm water drains in Guwahati, Assam



# Slope stabilization techniques



**Geo-grid**

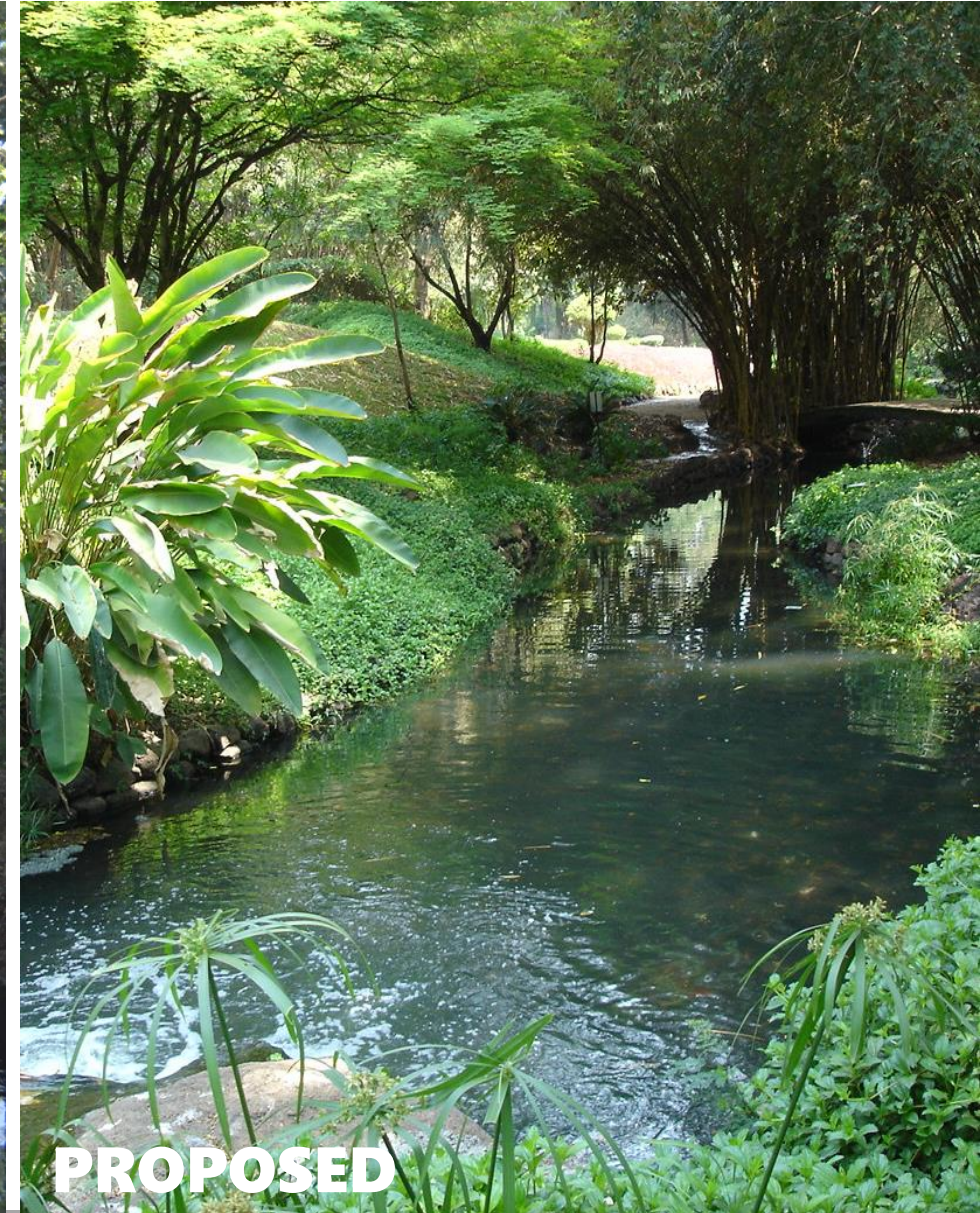
Image Source: [www.grasscrete.com](http://www.grasscrete.com)



**PROPOSED**

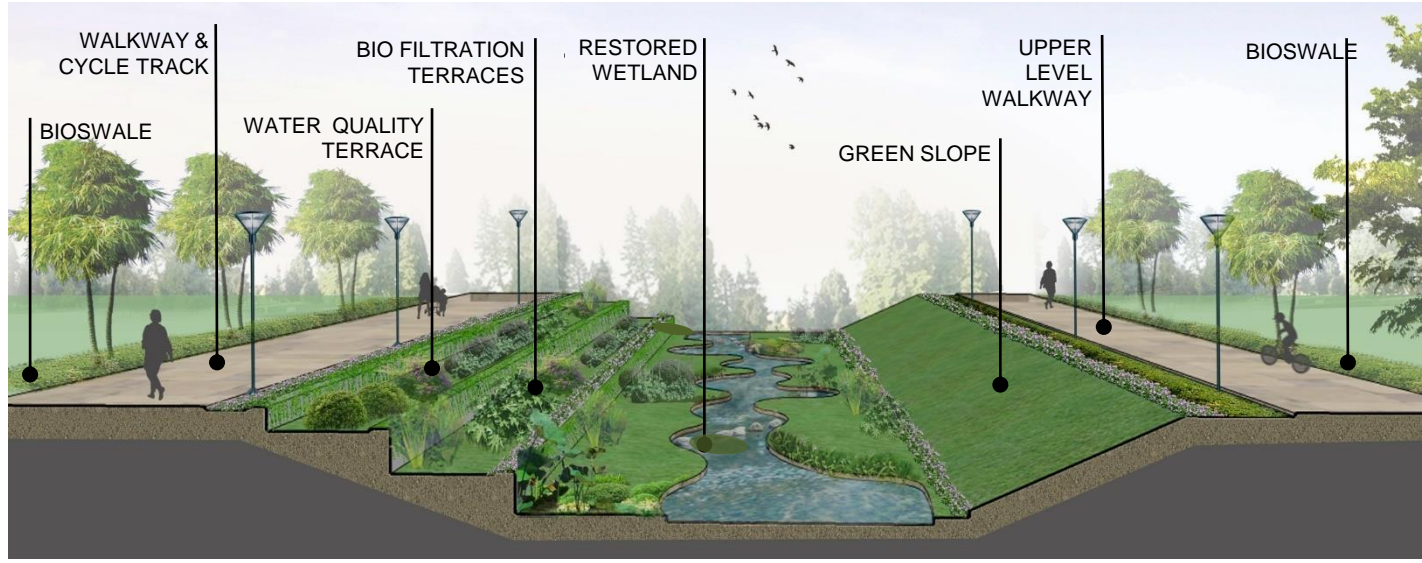
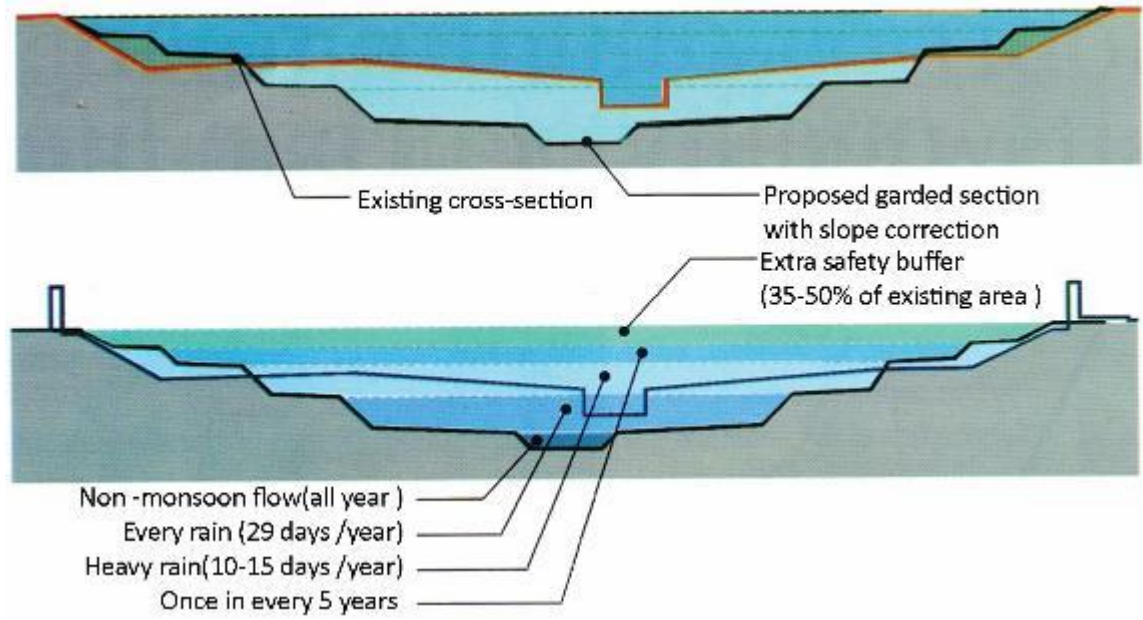


# Natural slope stabilization



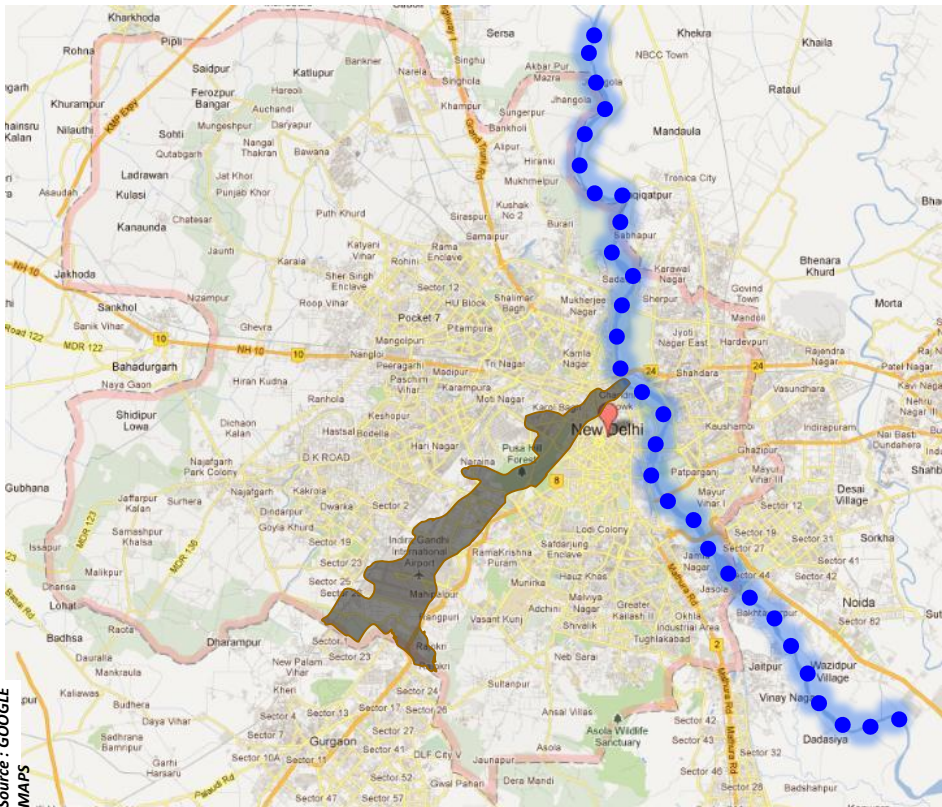
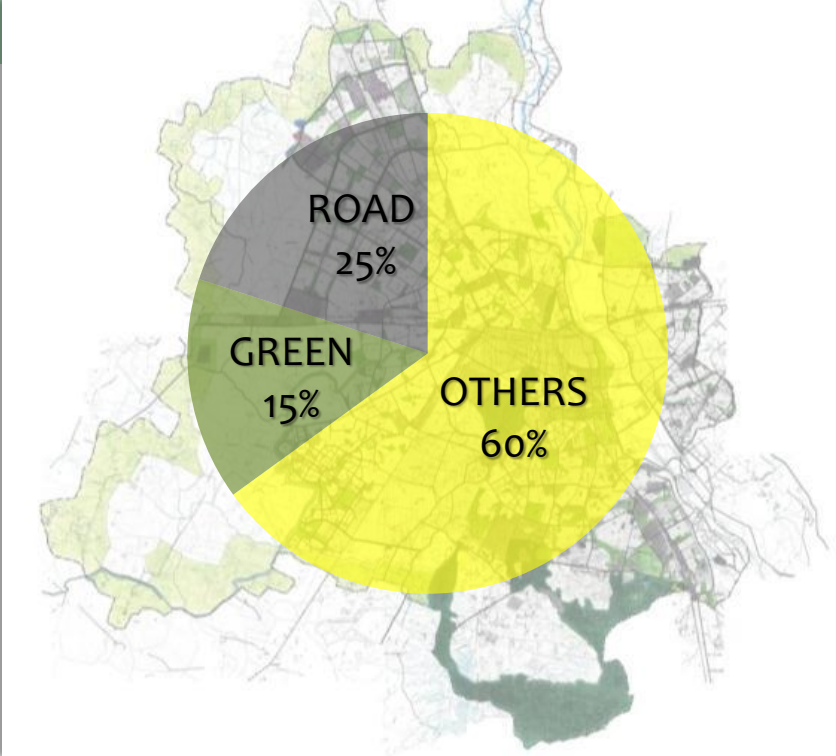


# Cross sectional correction & restoration of riverine ecology



# Case of Delhi - Ridge & the River

Delhi's stormwater drains from the western ridge areas to the river situated in the east. There are 19 major drain outfalls into the River Yamuna.

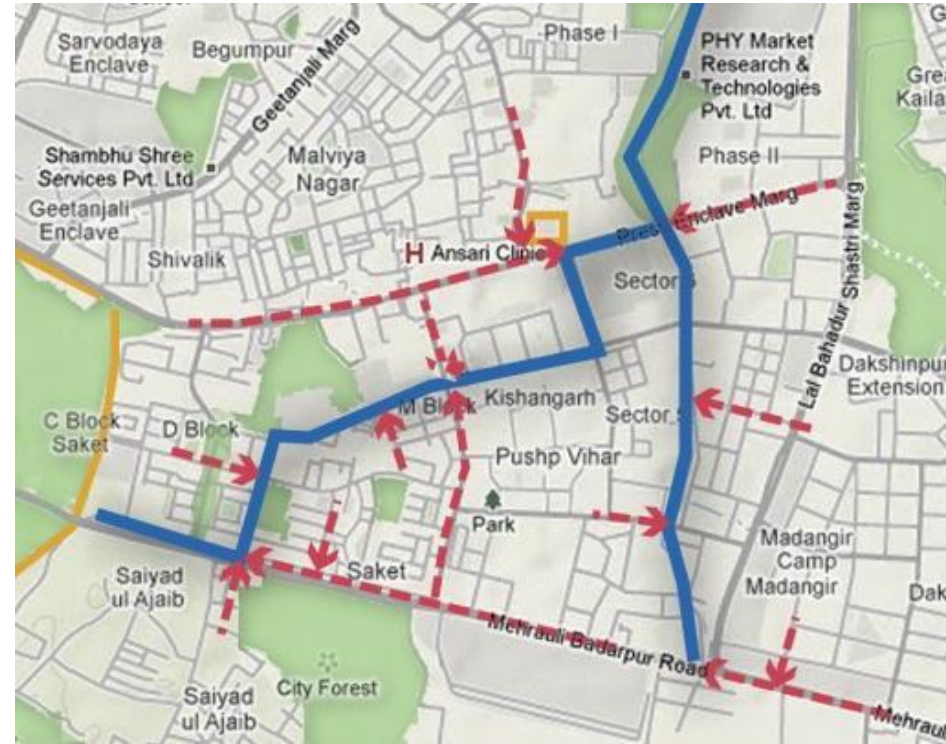


- Rain water falls on green area
  - some quantity soak in.
  - rest goes to near by drain.
- Other areas
  - Some let the rain water go into the near by drain on road
  - Plots above 100 sq. mt. should do rain water harvesting as per building bye laws.
- Roads
  - All water goes to nalla and then to river.
  - No ground water recharge.

Source : GOOGLE MAPS



# One pipe leading to Another



All the stormwater falls on road and it is diverted towards the closest nala or drain.



# Eco system services

All the green areas in the city should be connected and programmed to help in storm water management.

*As per Delhi's MPD 2020*  
**“ZERO RUN OFF  
SHOULD BE ACHIEVED”**

*The Present drainage system targeting*  
**“100% RUN OFF”**





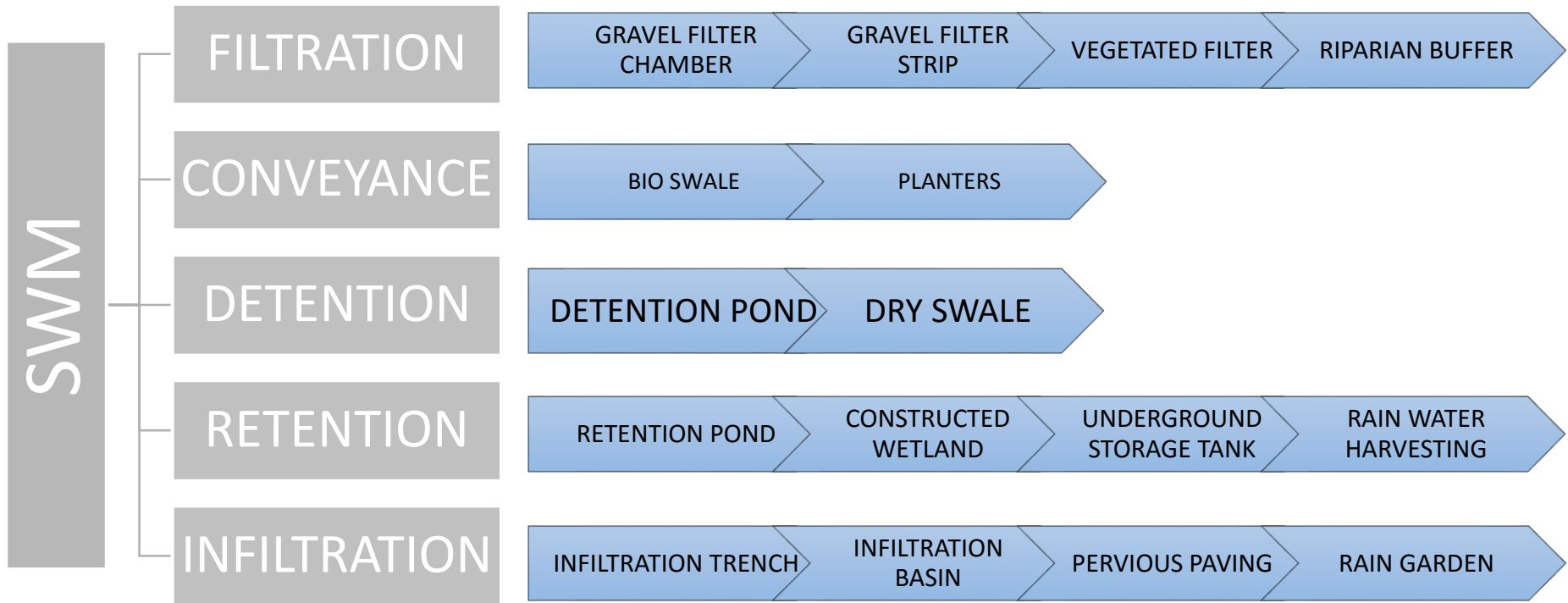
# Design Strategies for sustainable SWM

*MANAGE STORM WATER IN A CITY BY ADOPTING FOLLOWING MEASURES*

- **FILTRATION**
- **CONVEYANCE**
- **DETENTION**
- **RETENTION**
- **INFILTRATION**

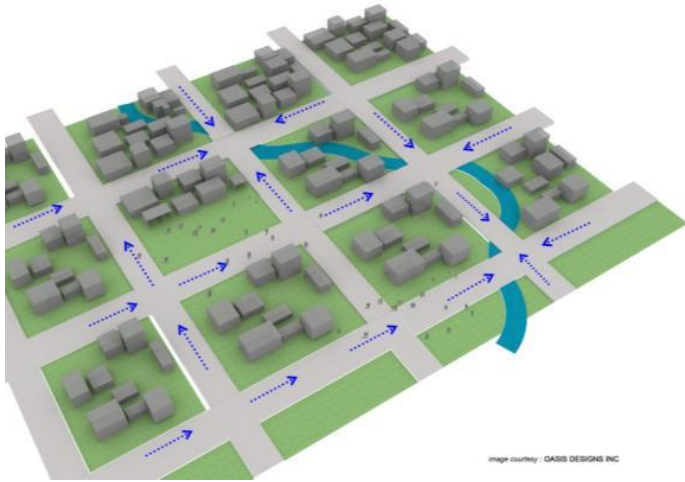


# Storm water management techniques

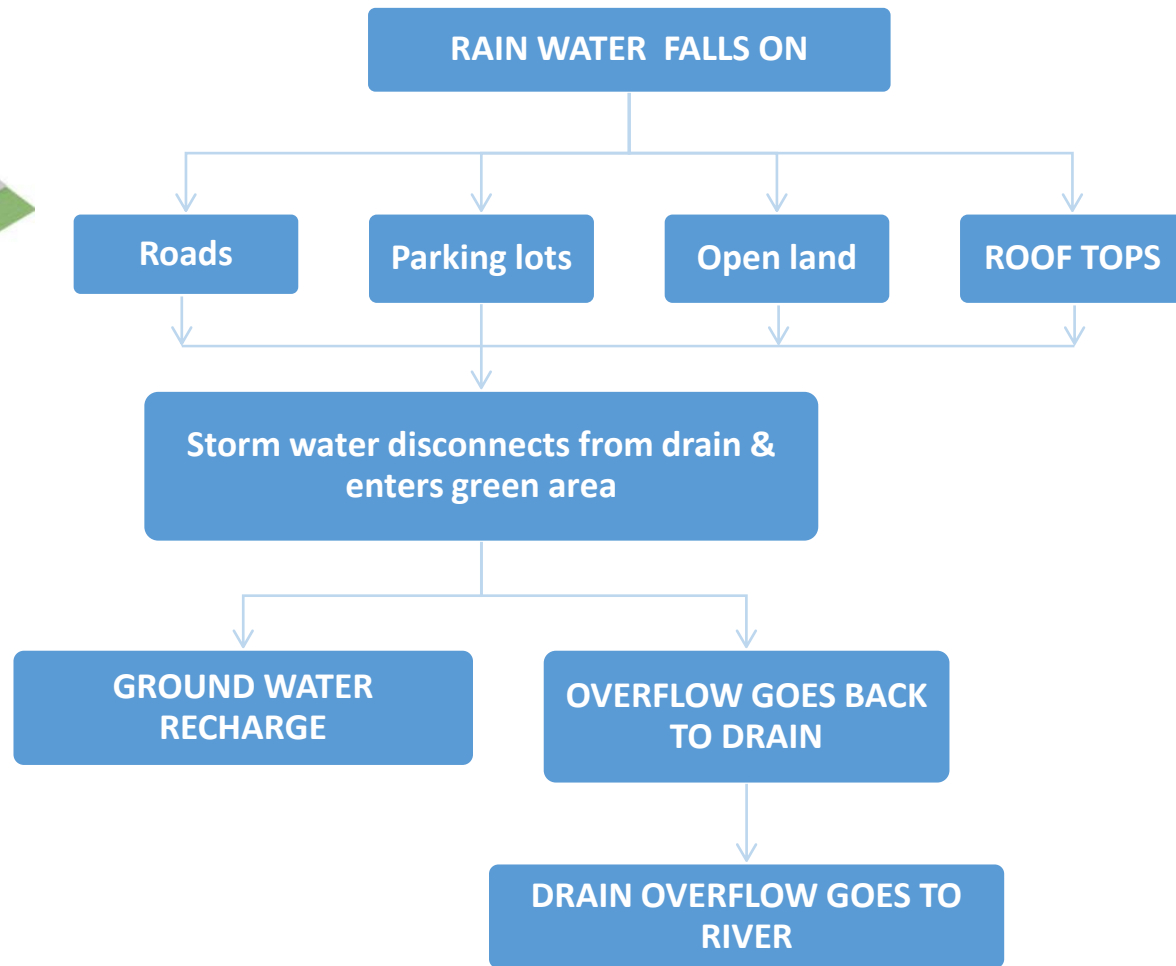




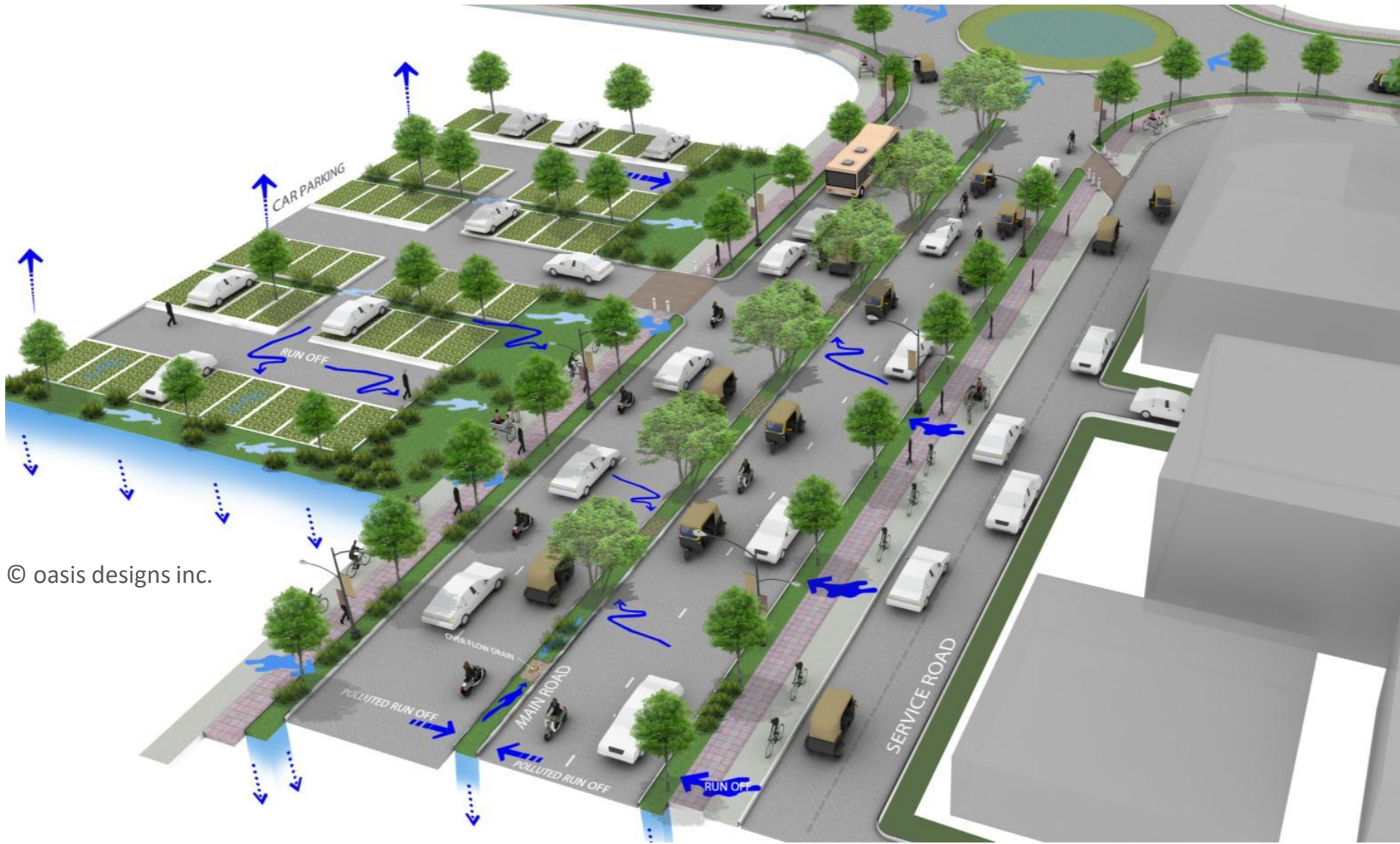
# Storm Water Management Strategy – disconnecting the system



New strategy for disconnecting from the conventional pipe system and using all possible alternate areas for recharge.



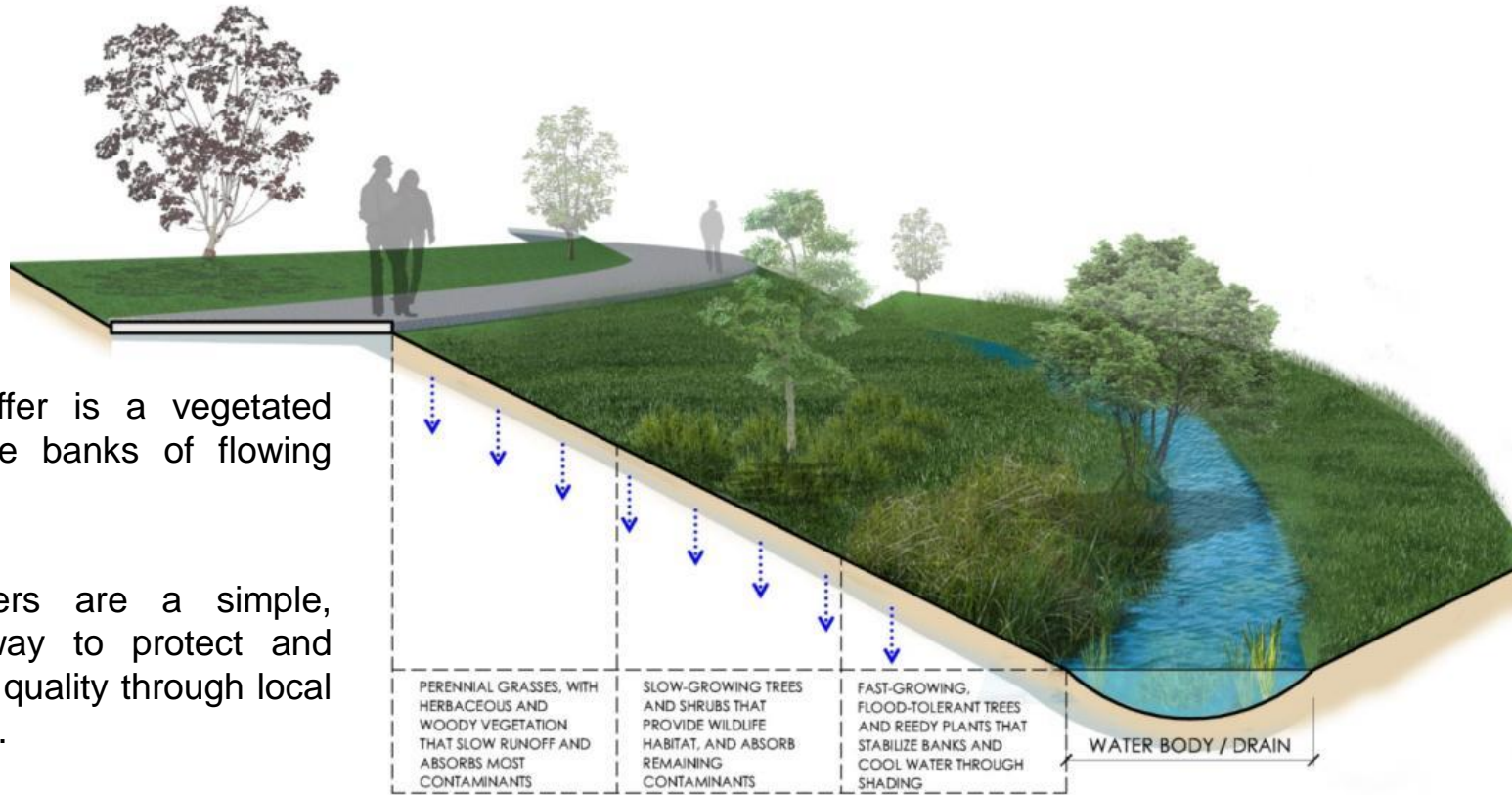
# Storm water facilities that can be put on Road



© oasis designs inc.



# Storm water management filtration – the riparian buffer

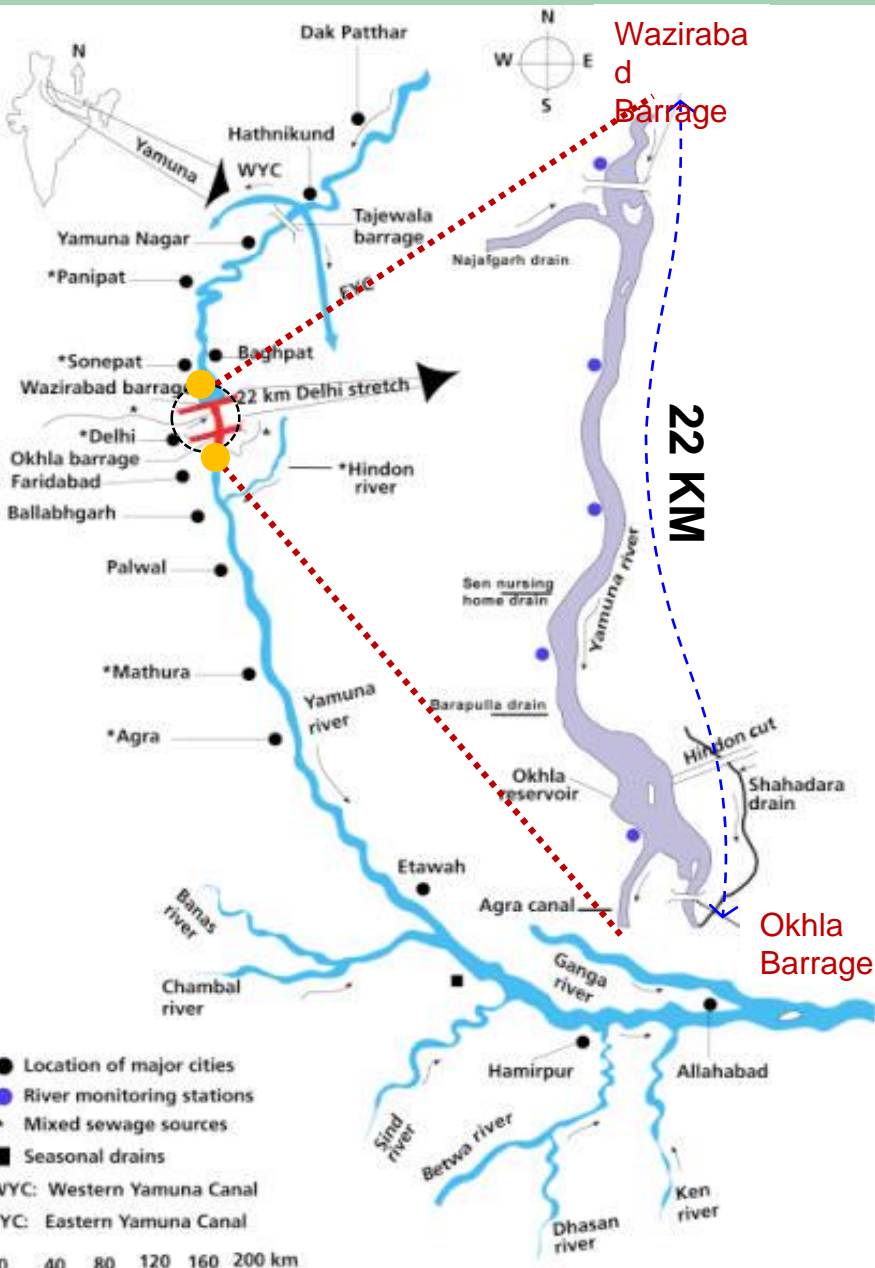


1. A riparian buffer is a vegetated strip along the banks of flowing water body.
2. Riparian buffers are a simple, inexpensive way to protect and improve water quality through local plant materials.
3. Buffer strips structurally stabilize banks and shorelines to prevent erosion. Trees and shrubs provide shade to maintain consistent water temperature necessary for the survival of some aquatic life.

# **SEWAGE WATER IN A CITY**



# River Yamuna in Delhi



22 KM STRETCH IN DELHI

2% OF TOTAL RIVER LENGTH

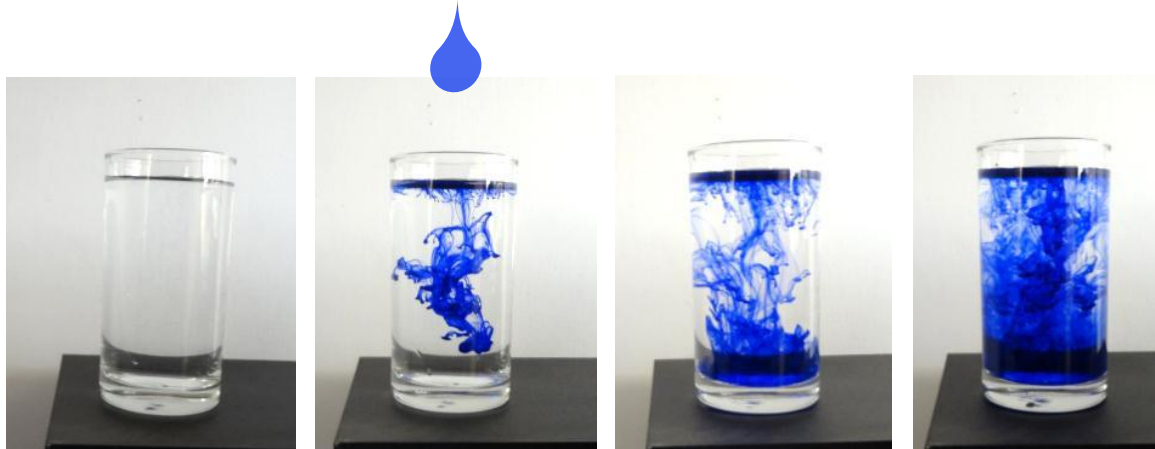
**BUT**

70 % OF TOTAL POLLUTION

LOADED IN YAMUNA IN DELHI

(BOD:>40; COLIFORM: 24MILLIONS)

# Stop the pollution at the source



**Better to catch and treat the pollution at source  
rather than treating the entire polluted water body**

# DECENTRALISED WASTE WATER TREATMENT



# Case study of biological waste water treatment

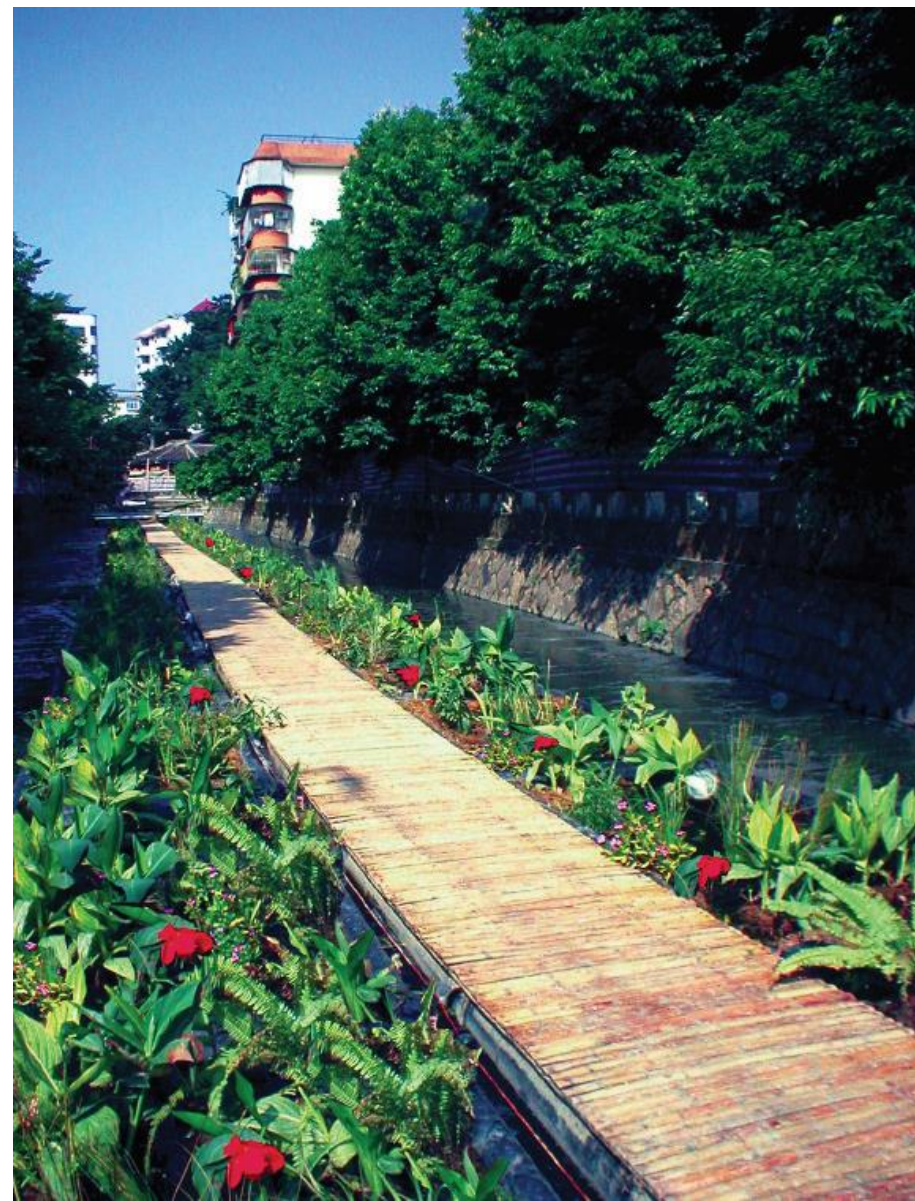
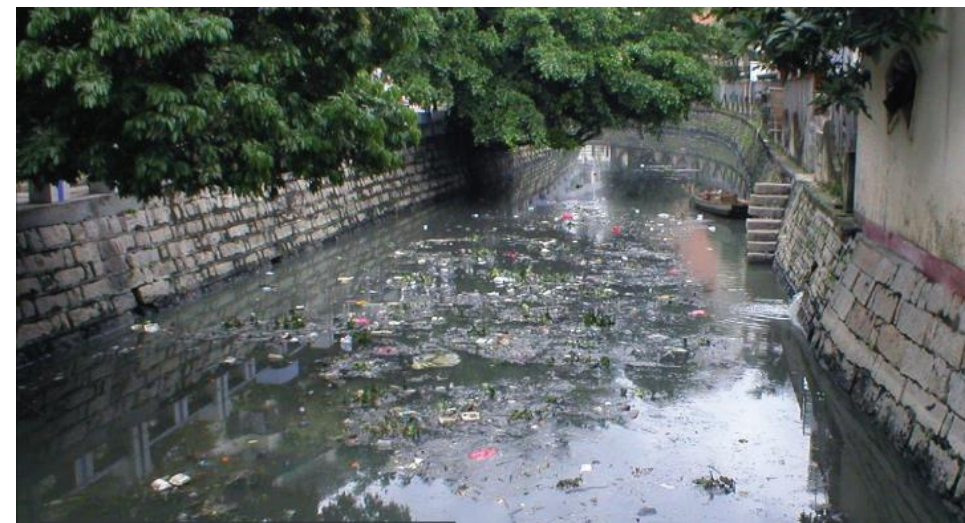


**OSHO PARK, PUNE**



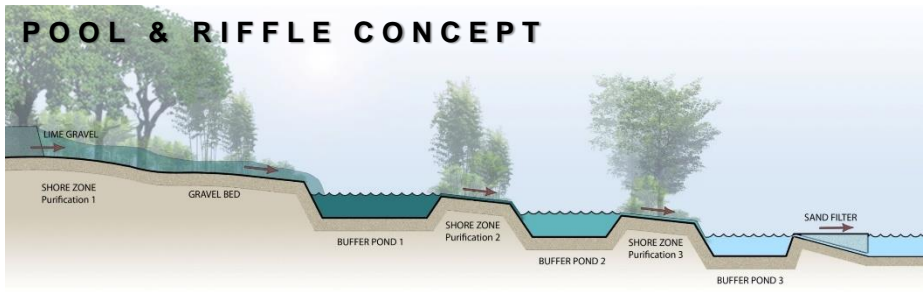
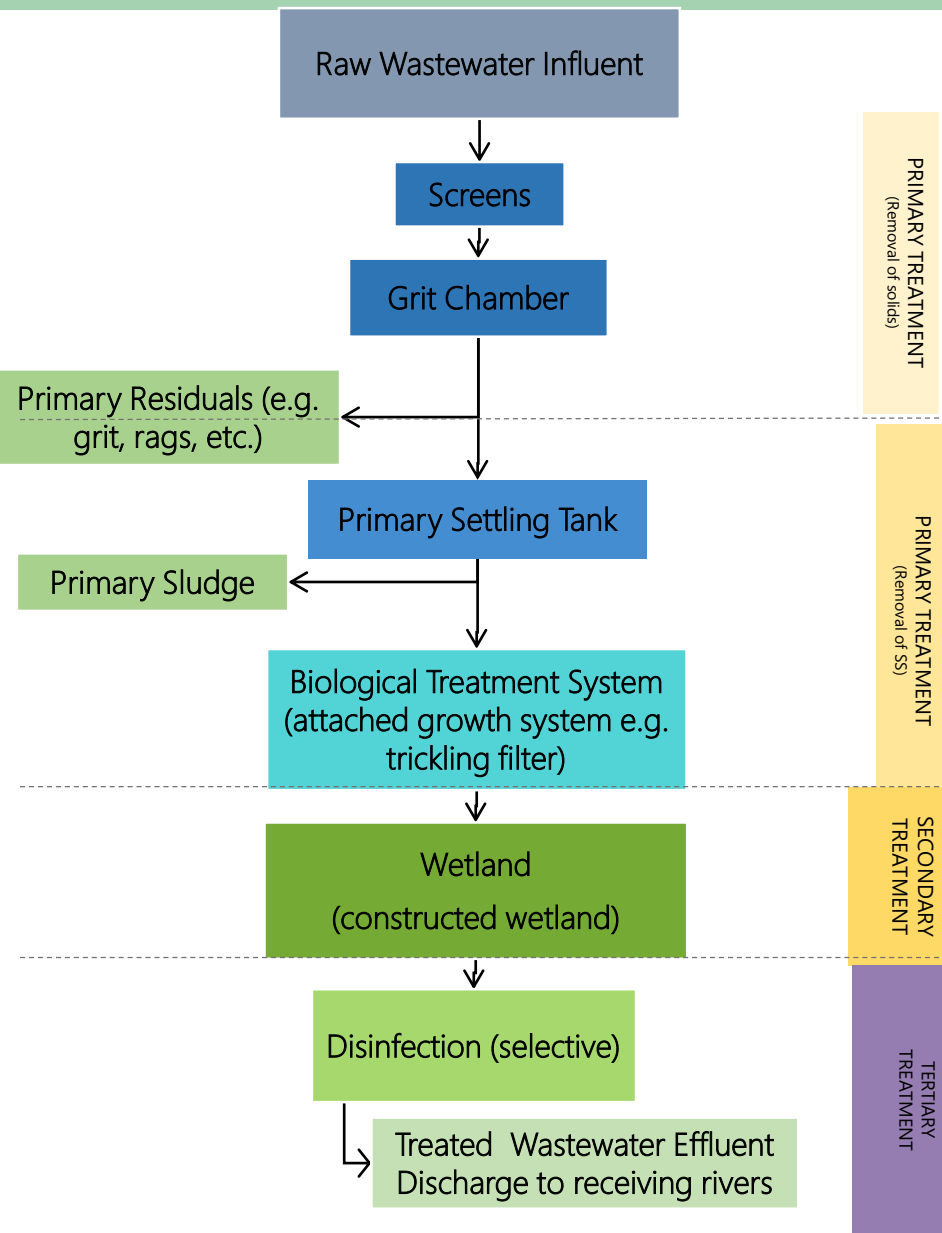
# BAIMA CANAL, Urban Municipal Canal Restorer

Fuzhou, China

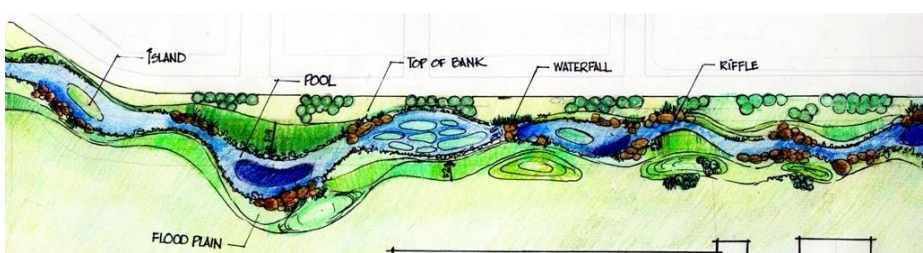




# An overview of sewage treatment strategy



Typical section showing the concept of pool & riffle



## FLOATING ISLANDS



Source: AquaBio Environmental Technologies, Inc. [www.aquabiocleanup.com](http://www.aquabiocleanup.com)



# Wetlands, case study : Hongkong Wetland Park



Natural trails and decks to enjoy the scenic beauty of the place



Role of plants in purification of water

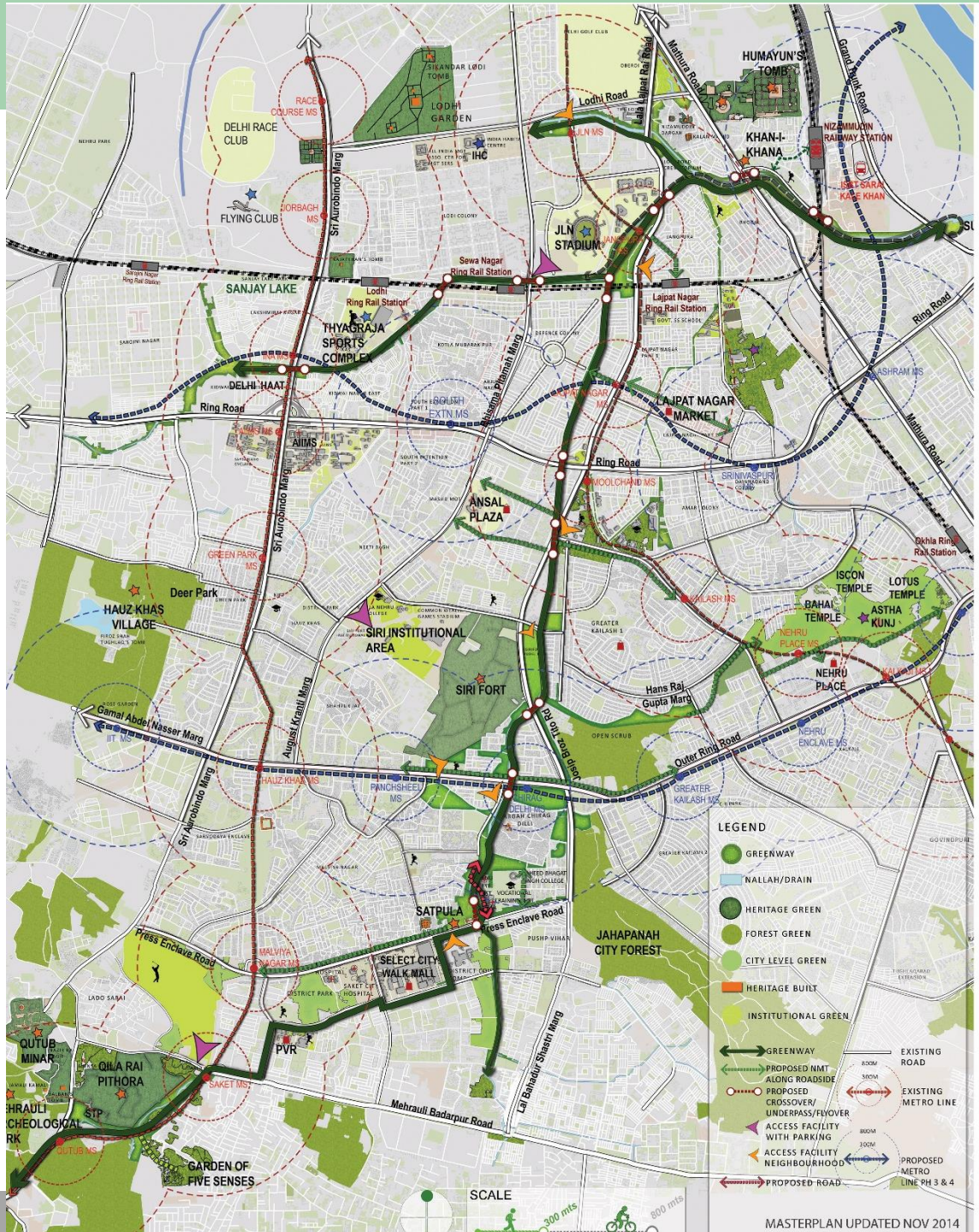




# South Delhi Greenway

## Key elements

1. ECO MOBILITY CORRIDOR
2. MULTI MODAL INTEGRATION
3. ACCESSIBILITY & VISIBILITY
4. OPEN SPACE MANAGEMENT
5. WASTE WATER TREATMENT
6. STORMWATER TREATMENT
7. ECOLOGY-BIO DIVERSITY
8. WORKING LANDSCAPE
9. HERITAGE



**EXISTING**



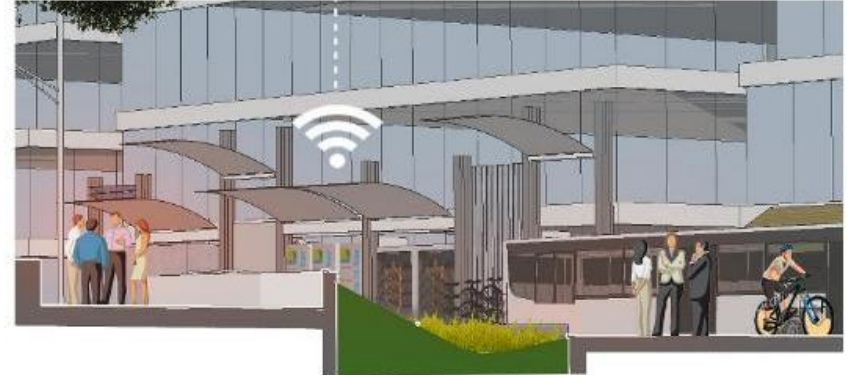
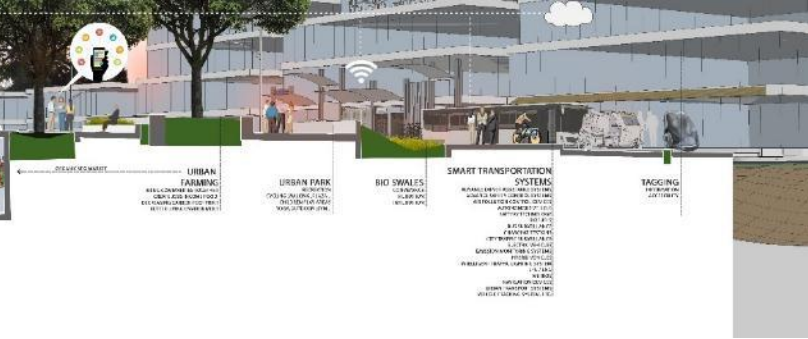


# PROPOSED





# RIVER FRONTS AS DESTINATION SPACE





# STRATEGY FOR BORASILA BIL



CAPTURE +CLEAN  
STORM WATER



PROMOTE NEW  
KIND OF SOCIAL SPACE



SOLAR SHELTERS



CYCLING  
WALKING FACILITY



WATERFRONT  
RESTAURANT



CREATE HABITAT  
FOR WILDLIFE



BIO GARDEN



CULTURAL MARKET

# STRATEGY FOR MORA BHARALU



BAMBOO  
CRAFT SHOPS



SOLAR SHELTER  
FOR ECO CABS



CULTURAL ART



FLOATING MARKET



WATERFRONT  
AMENITES



AMPHITHEATRE



CYCLE TRACK ,PLAZA,FOOTH PATH  
PUBLIC TOILETS



MMI



# SOLAR RIBBON





# CONGRATULATIONS TO THE WINNERS OF INDIA'S FIRST SMART CITIES CHALLENGE!



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# CONGRATULATIONS, GUWAHATI!



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**THANK YOU**

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