Water Woes of a traditionally hydraulic society: ways to become waterwise again

Prof. Hina Zia
Faculty of Architecture & Ekistics
Jamia Millia Islamia
New Delhi

GRIHA Summit
18th Dec, 2017

Let’s figure out the real problem:

- Scarcity or lack of understanding?
- From being frugal to a wasteful ‘modern’ society?

Urban rich are supplied water at a 10^{th} of what it costs the municipality

Photo: Sudipto Das//Sanctuary Photolibrary

Photo: Joydeep Mukherjee/Sanctuary Photolibrary

Our cities cry when it rains, they cry when it does n’t!!

Photo: ABN AMRO

The Mithi River tragedy was human-caused. Have we learned the lessons?

Growing monster

Three years (2014-17), 500 million victims: worst drought spread across geographical regions of India

Affordable sustainable water management solutions for whom?

Cost of water does not reflect cost of production and supply not moderated

City	Production cost Rs/kl	Water charges Rs/kl
Delhi	8.95	2.00
Mumbai	5.74	2.25
Jodhpur	20.00	1.21
Indore	9.50	2.00
Bangalore	13.00	5.60

Why should we save?

City	Own Water Supply Norms of Cities (lpcd)
Ahmedabad	170
Bangalore	140
Kolkata	227
Chennai	110
Delhi	225
Greater Mumbai	240
Lucknow	250
Pune	140

Did you know?

- India has more than **15 lakhs tanks : waterwise society**
- Every **10 fold increase** in catchment area **reduces** average annual **runoff by about 36%**
- One dam with a catchment of 10 ha will collect much less water than 10 dams with 1 ha catchment area each

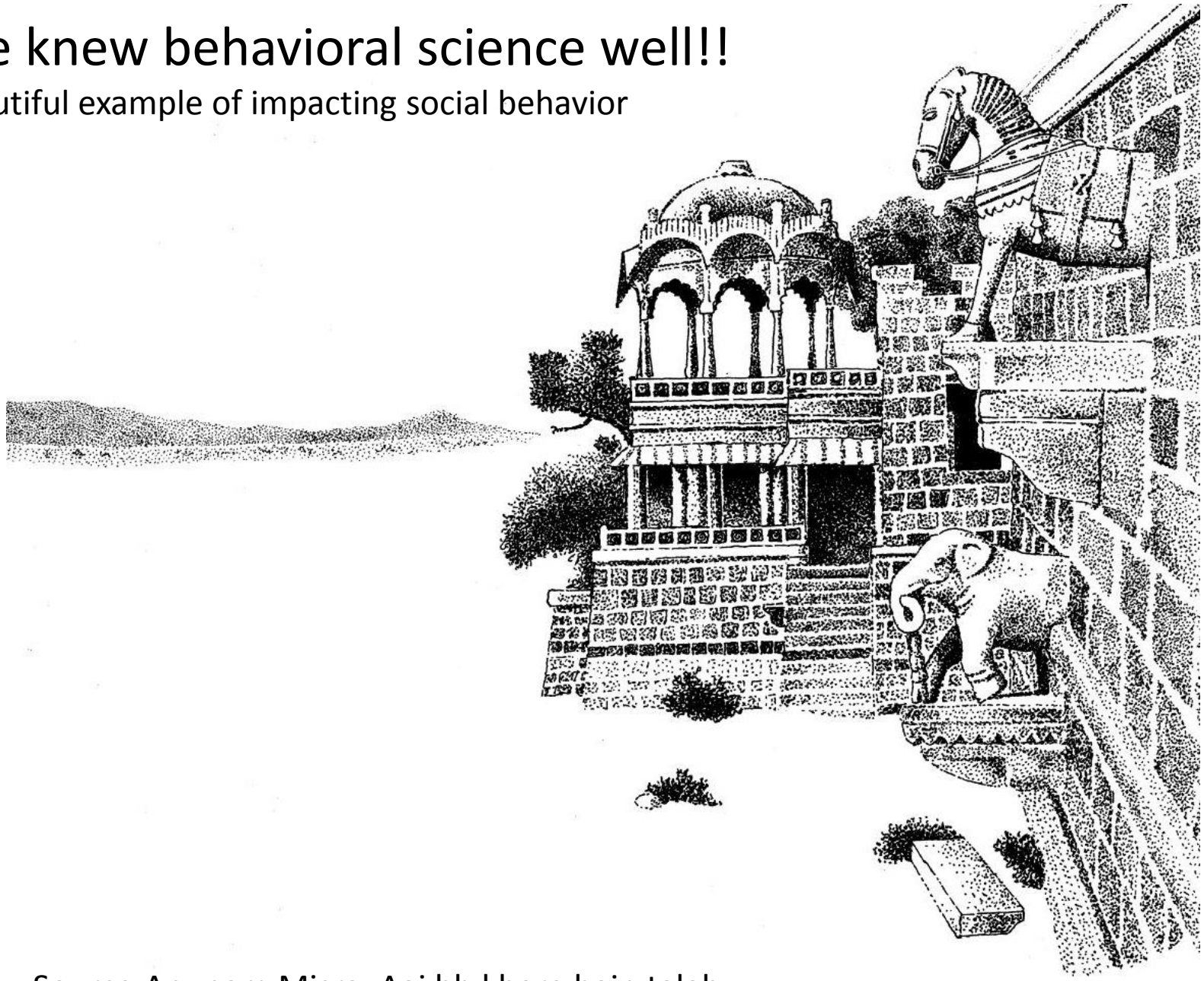
We still feel that our future is secure in building **large dams**

A land of ‘Dying wisdom’!

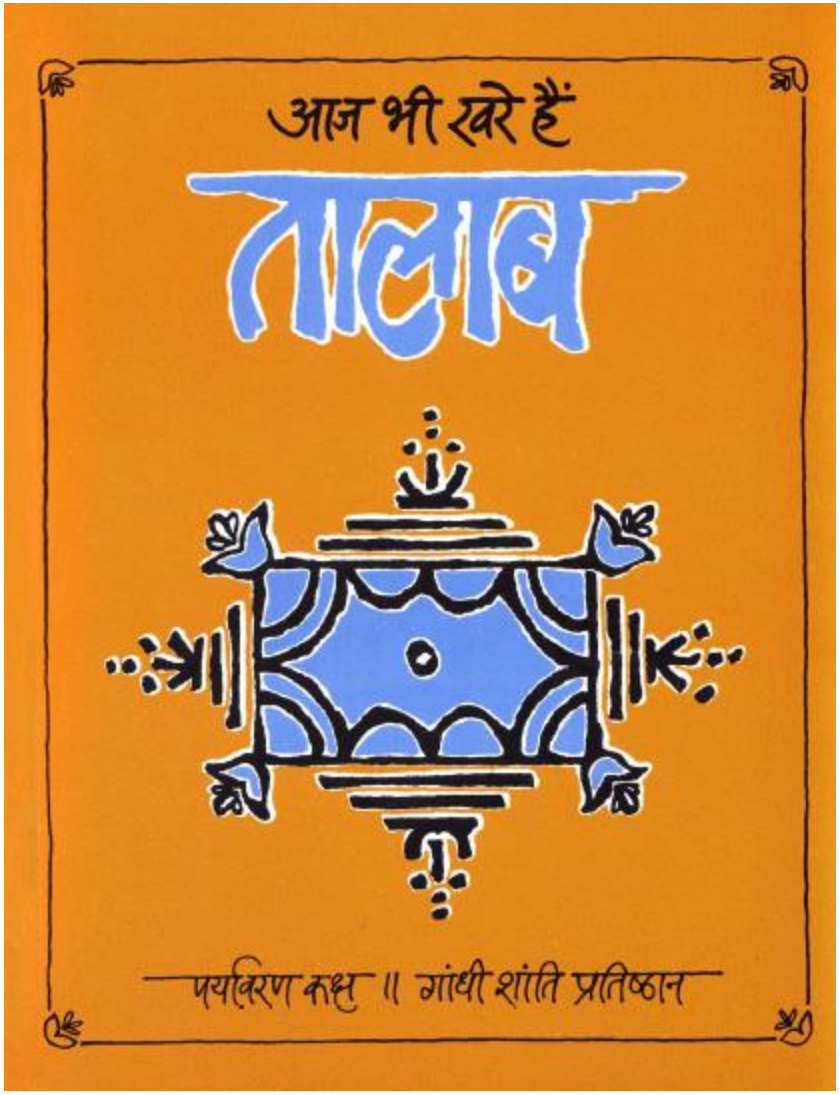
We could catch the precious 100 hrs of rain of the 8760 hours in a year effectively

We knew behavioral science well!!

Beautiful example of impacting social behavior



Source:Anupam Misra, Aaj bh khare hain talab



सैंकड़ों, हज़ारों तालाब
अचानक शून्य से
प्रकट नहीं हुए थे।
इनके पीछे एक इकाई थी
बनवाने वालों की, तो
दहाई थी बनाने वालों की।
यह इकाई, दहाई मिलकर
सैंकड़ा, हज़ार बनती थी।
पिछले दो सौ बरसों में
नए किस्म की
थोड़ीसी पढ़ाई पढ़ गए
समाज ने इस इकाई,
दहाई, सैंकड़ा, हज़ार को
शून्य ही बना दिया।

The most respected lot!

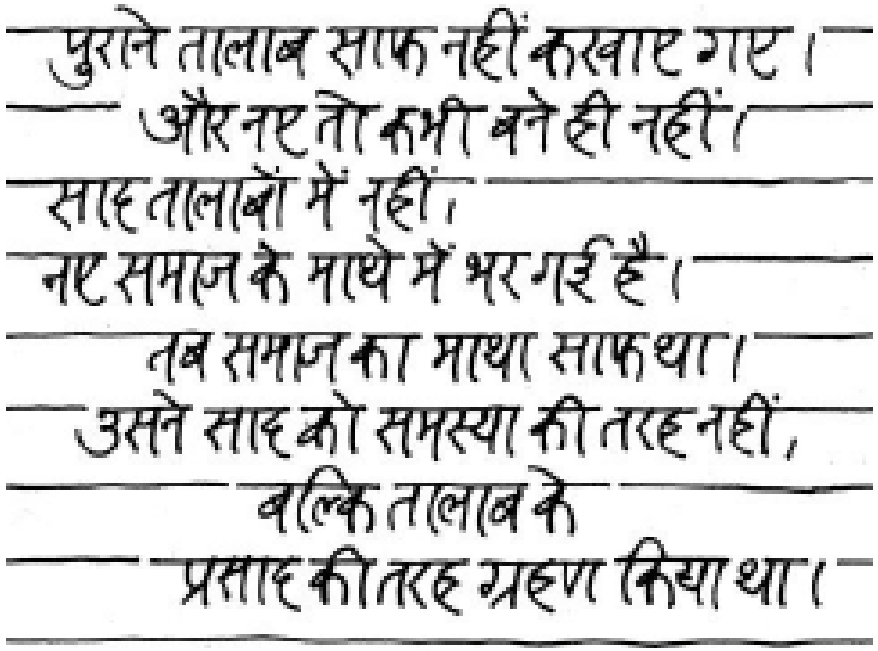
समाज की गहराई
नापते रहे हैं
गजधर

नायकों के साधन
भी पूजनीय बन
जाते हैं

रामनामी : मिट्टी
का काम इनके
लिए राम नाम है

Source:Anupam Misra, Aaj bh khare hain talab

Matrix of developing and maintaining water systems by the society for the society



Sar developed first and settlements followed in the most arid region of the country

Traditional methods to resolve water conflicts

- Example: *Neerkattis* to manage traditional tanks in Karanataka, Tamil Nadu and Andhra Pradesh.

- A neerkatti's role starts much before the onset of monsoon. He decides the date when residents can help desilt the tank and clean the catchment area, and divide up the labour among the tanks' beneficiaries. With the onset of the first downpour, they take stock of the water available and decide per capita allocation, as well as the kind of crops that people should plant. Thus farmers are thwarted from irrigating fields at their own will; and the neerkatti ensures supply to every field on a rotational basis; also give advice on crop management/pest control/etc.

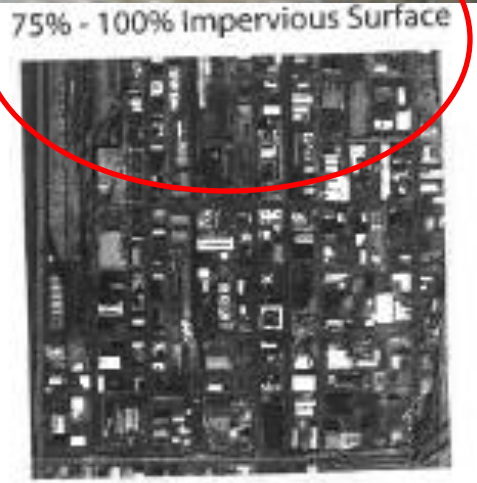
- Neerkatti do not enjoy political power but are given immense administrative power by the Gram Sabha temporarily.


vodafone

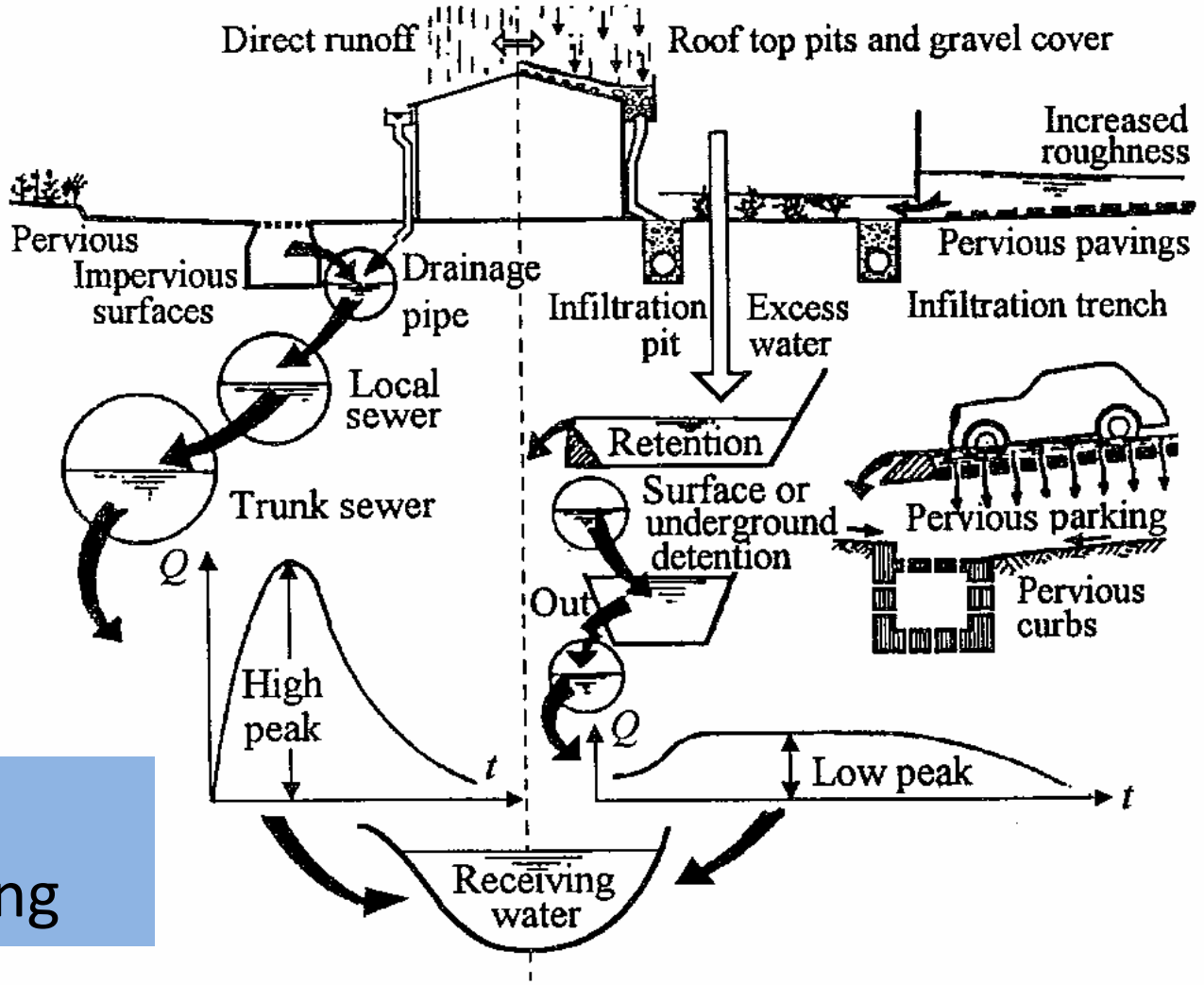

Natural Ground Cover
10%
Runoff
40%
Evapo
transpiration
25%
Shallow
25%
Deep


10% - 20% Impervious Surface
20%
Runoff
38%
Evapo
transpiration
21%
Shallow
21%
Deep


35% - 50% Impervious Surface
30%
Runoff
35%
Evapo
transpiration
20%
Shallow
Infiltration
15%
Deep
Infiltration


75% - 100% Impervious Surface
55%
Runoff
30%
Evapo
transpiration
10%
Shallow
Infiltration
5%
Deep
Infiltration

Comparison of Urban Storm water Drainage– Direct runoff vs. Source



Urban flooding

Source: Maksimovic, C., 1996, Measurements of Water Quantity in Urban Areas

How did the transition happen?

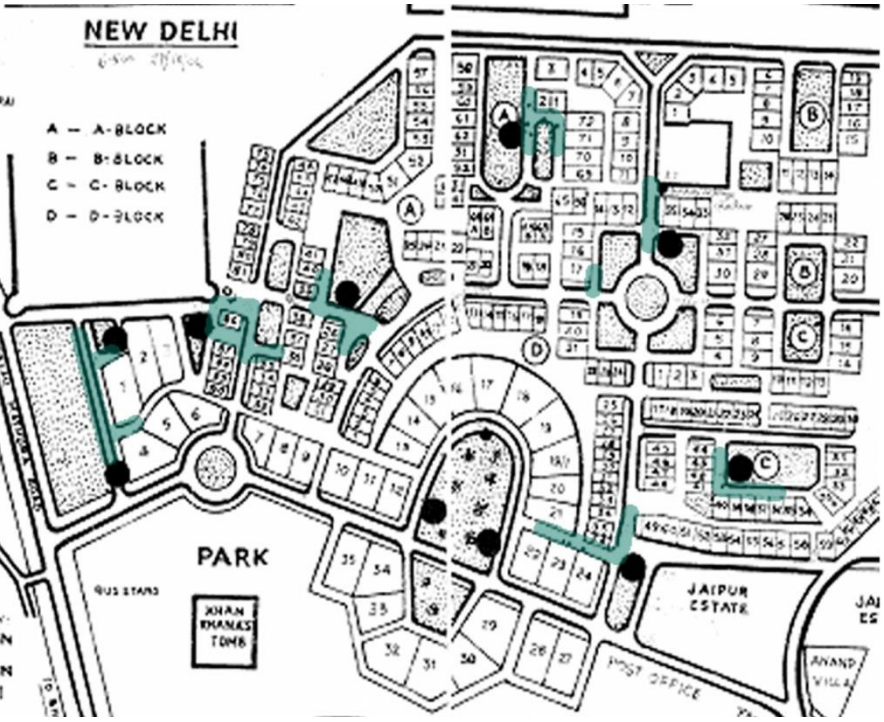
Is there a way for ‘Dying wisdom’ to ‘reviving wisdom’?

Possible mitigation strategies

- Think holistically; macro to micro scales
- Acknowledge that 80% of our demand is met from GW; need to restore the sources and manage the demand
- Revive the existing (obsolete/dead) man-made/artificial network of water bodies which often also function as sponges for any settlement/village/city
- RWH(for recharging)-site specific and not blanket rule irrespective of the hydro-geology of the place
- Promote SUDS at all scales

WATER LOGGING PROBLEM SOLVED THROUGH LOCATING RECHARGE STRUCTURE WHERE WATER TENDS TO COLLECT NATURALLY

Nizamuddin East, Delhi



Source: VANDANA MENON ARCHITECTS

Possible strategies to manage stormwater in urban context

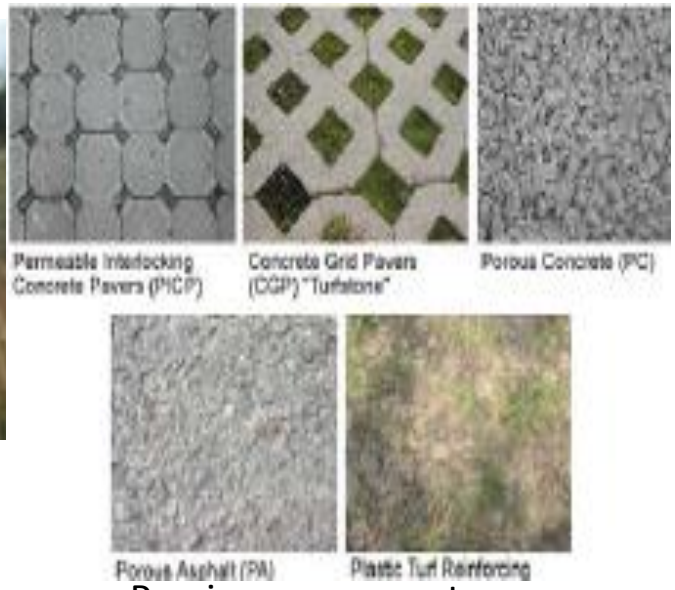
Rainwater harvesting

Green roof

Detention basin

Swales

Wetlands



Pervious pavements

Ecological Goals:

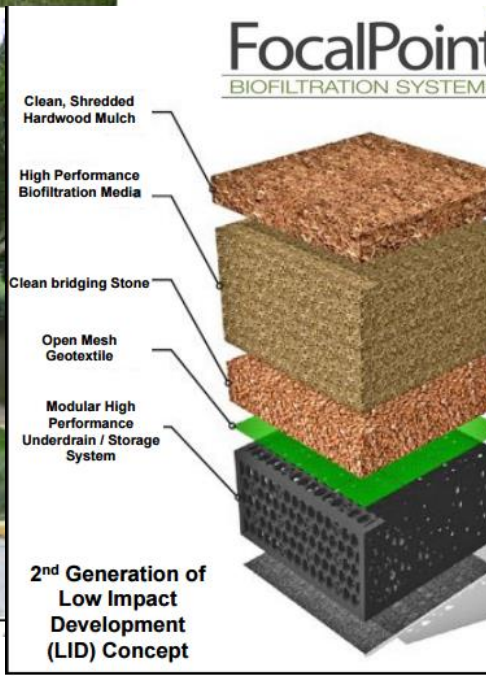
Reduce heat island effect & aid storm water management.

To reduce urban Heat Island Effect and aid natural storm water management:

Decrease impervious surfaces through permeable paving, tree planting zones, etc. to increase ground water infiltration & prevent seasonal flooding.

Integrate Natural Storm Water filtration and absorption into street design through bio-filtration beds, swales and detention ponds.

Decrease Heat Island Effect (HIE) by increasing greenery, planting trees, using reflective paving, etc.



Source: Street Design Guidelines, UTTPEC, DDA, 2009

Current Situation

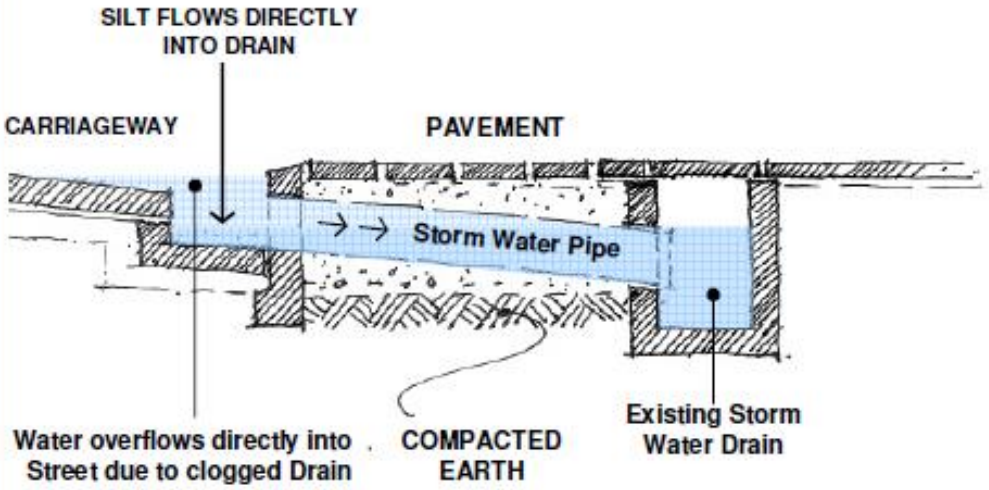
Silted Open Drain, Tughlaqabad Institutional Area

Overflowing Storm Water Inlet, ITO

Natural Storm Water Management can be incorporated along Planting Strips of Roads.

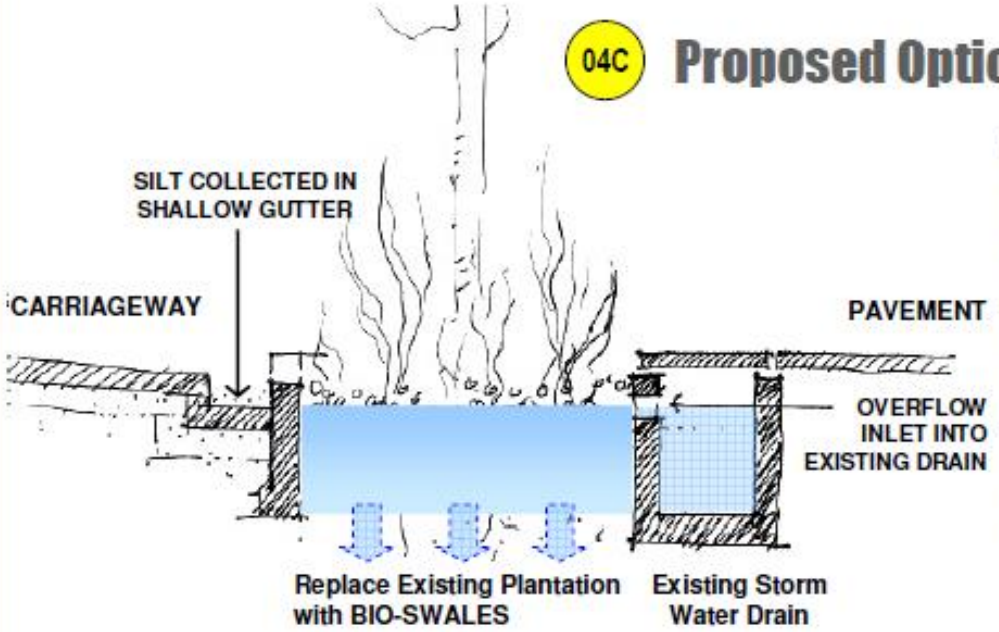
Planting Strip with Storm Water Management

Current:



- Storm Water and Silt flows directly into the S.W. rain, carrying all pollutants with it.
- Slope of S.W. Pipe prevent rain from being used to pull capacity.

04C Proposed Option: Bioswale



- Storm Water flows directly into a Bio-filtration or Bio-retention Swale.
- Water is retained and infiltrated in the bio-swale.
- In heavy rains, extra stormwater overflows into the existing S.W. Drain.

Source: Street Design Guidelines, UTTPEC, DDA, 2009

Permeable Pavement Types

A

Permeable Asphalt

Fundamentally the same as regular asphalt, but it does not contain the fine particles that asphalt does, hence, creating porosity.

- **Need to be cleaned 2 to 4 times a year to avoid build-up of debris**. But some research has found that even with 99% clogging the infiltration rate can be up to 10 inches/hr.
- It **does not require special training** and can easily be supplied by conventional asphalt batch plants

B

Permeable Concrete

This is a variation of traditional concrete, but without the fine particles in the mix.

- Installation is quite different from the traditional method, and **requires experienced installers** both in the mixing and laying of the product.
- Proper maintenance includes periodic vacuuming of the surface to **prevent clogging with sediment or organic material.** With proper maintenance it can last a minimum of 20 years.

C

Interlocking Concrete Pavers

Themselves are not always permeable, but they are typically installed with gaps between them to allow infiltration into the subsurface. The gaps, typically 10% of the surface area, are filled with a permeable material, usually small clean stone.

- **They have a long useable life, are relatively easy to install** and provide good infiltration.
- However, they are **sensitive to deformation** in the base and do require a thick base to prevent "heaving."

D

Open-Celled Paving Grid with Vegetation

Open-celled paving grids consist of a rigid grid composed of concrete or a durable plastic that is filled with a mix of sand, gravel, and topsoil for planting vegetation.

- The plastic grid pavers are also **flexible, allowing them to be used on uneven sites.**
- They do not require another drainage facility and are **competitively priced to asphalt and concrete paving**, when their required drainage costs are factored in.

E

Open-Celled Paving Grid with Gravel

The same open-celled grid structure is employed but the voids in the rings are filled with a mix of gravel.

- With the gravel in place this grid system does **provide additional structural support.** And since most grid-cell material is plastic, hence flexible, it can adapt well to shrink/swell and freeze/thaw conditions.
- Most commercially available geocell material is made from recycled material, an added environmental plus.

Source: Street Design Guidelines, UTTPEC, DDA, 2009

- These are known but why this is not adopted?
- Where are examples of Water sensitive design?

- Can we together revive our traditional wisdom and create our own ‘hybrid’ modern version of water future?

Possible strategies

Holistic planning

- Deal with the issues at macro (city level) and micro level (buildings etc)
- Plans as per urban ecology (regional and local scales)

Regulatory

- Introduce regulations/codes and standards that help plan climate resilient infrastructure
- Revise existing codes to reflect requirement for efficiency upgrade
- Implementation needs to be strengthened

Technology and Design

- Apply integrated approach to an efficient design
- Technology upgrade (fixtures/equipment/plumbing) that are cost competitive

Social and environmental

- Introducing mindset changes through proper awareness (on reuse of treated water for flushing etc)
- Ensure health and hygiene standards (issue of inequity to addressed/proper harvesting of rain water)

Pricing

- Depoliticise pricing: Pricing of water should reflect actual cost to the supplier

Monitoring and maintenance