Storm water drainage of Chennai

- Lacuna, Assets, and Way Forward

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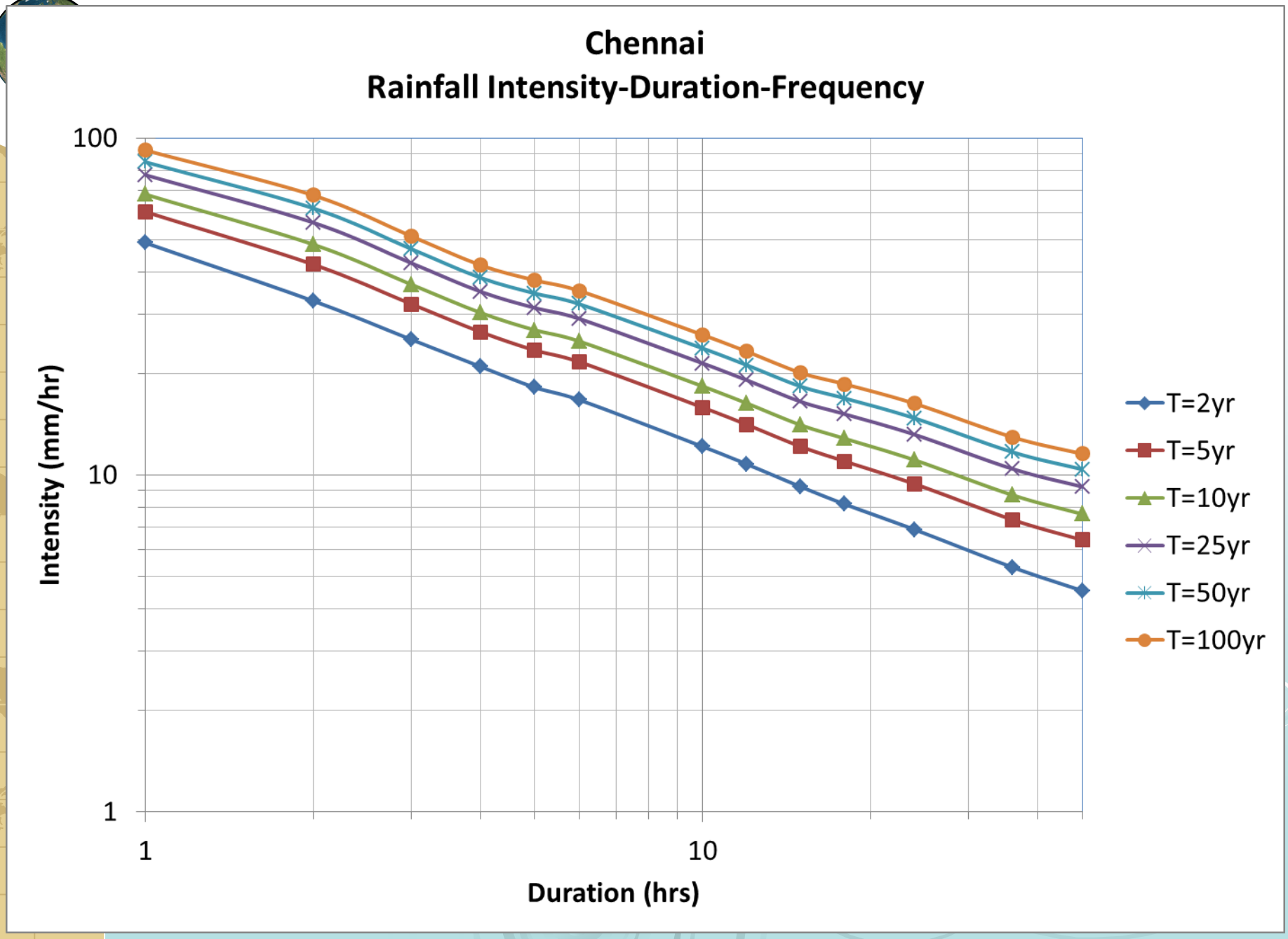
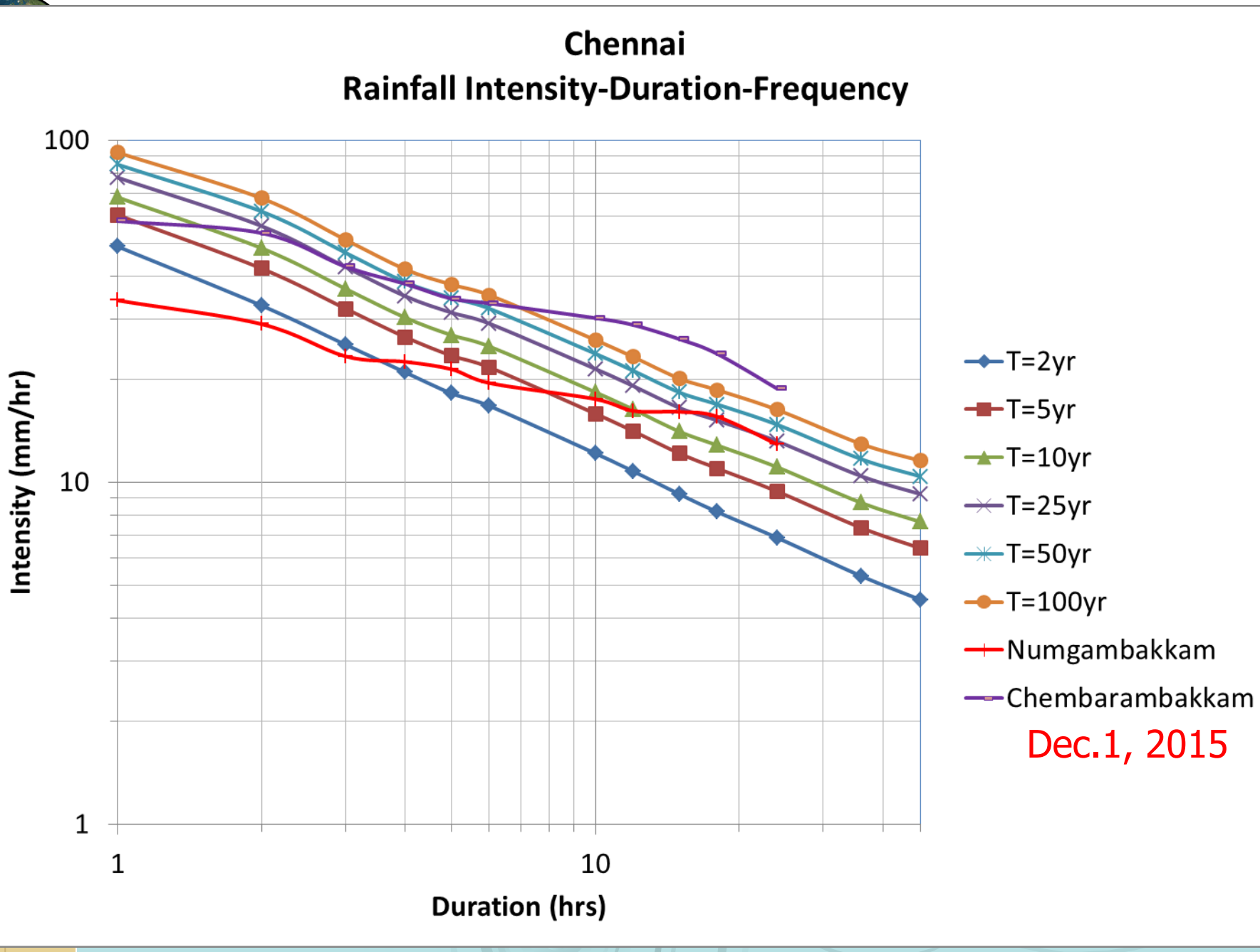
Outline

- Chennai Rainfall
  - Historic Intensity – Duration – Frequency curve
  - A perspective of Dec.1, 2015 rainfall
    - Chembarambakkam reservoir release
- Lacuna
- Assets
- Way Forward
  - Sustainable Urban Storm water Drainage System (SUDs)
  - GIS based data management and modelling system


Chennai
Rainfall Intensity-Duration-Frequency
100
10
1
Intensity (mm/hr)
1
10
Duration (hrs)
T=2yr
T=5yr
T=10yr
T=25yr
T=50yr
T=100yr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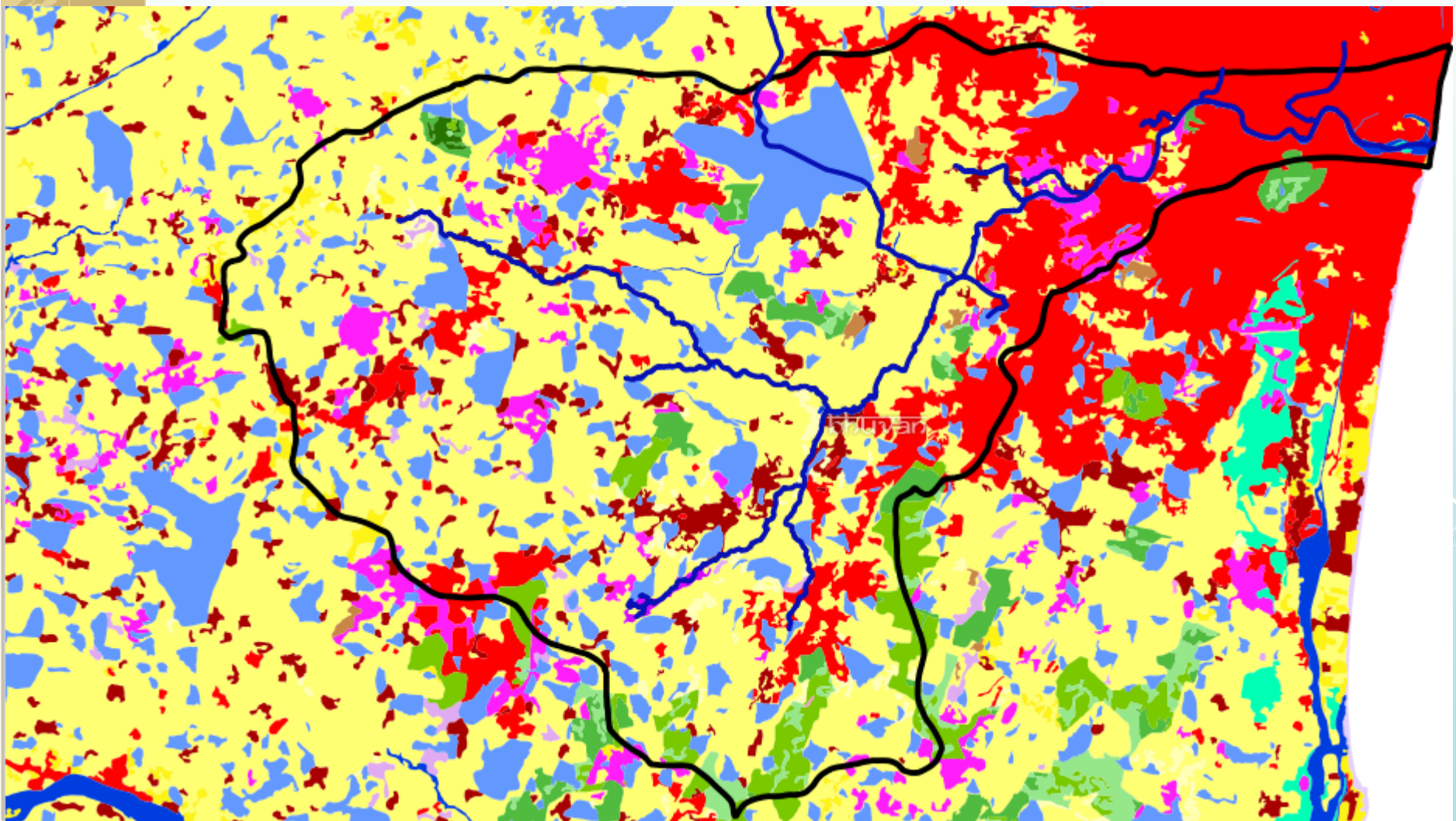
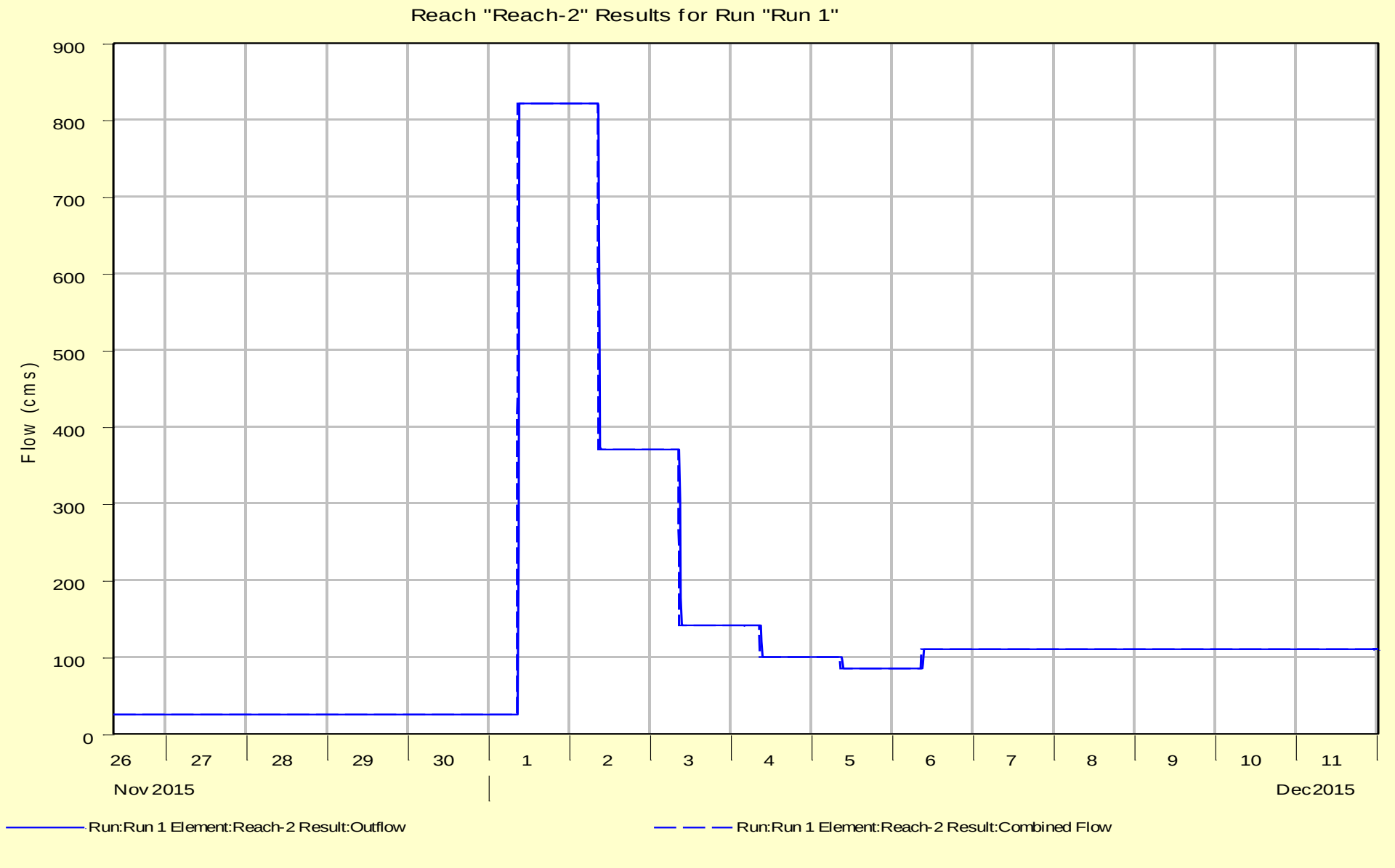
Numgambakkam
Chembarambakkam
Dec.1, 2015

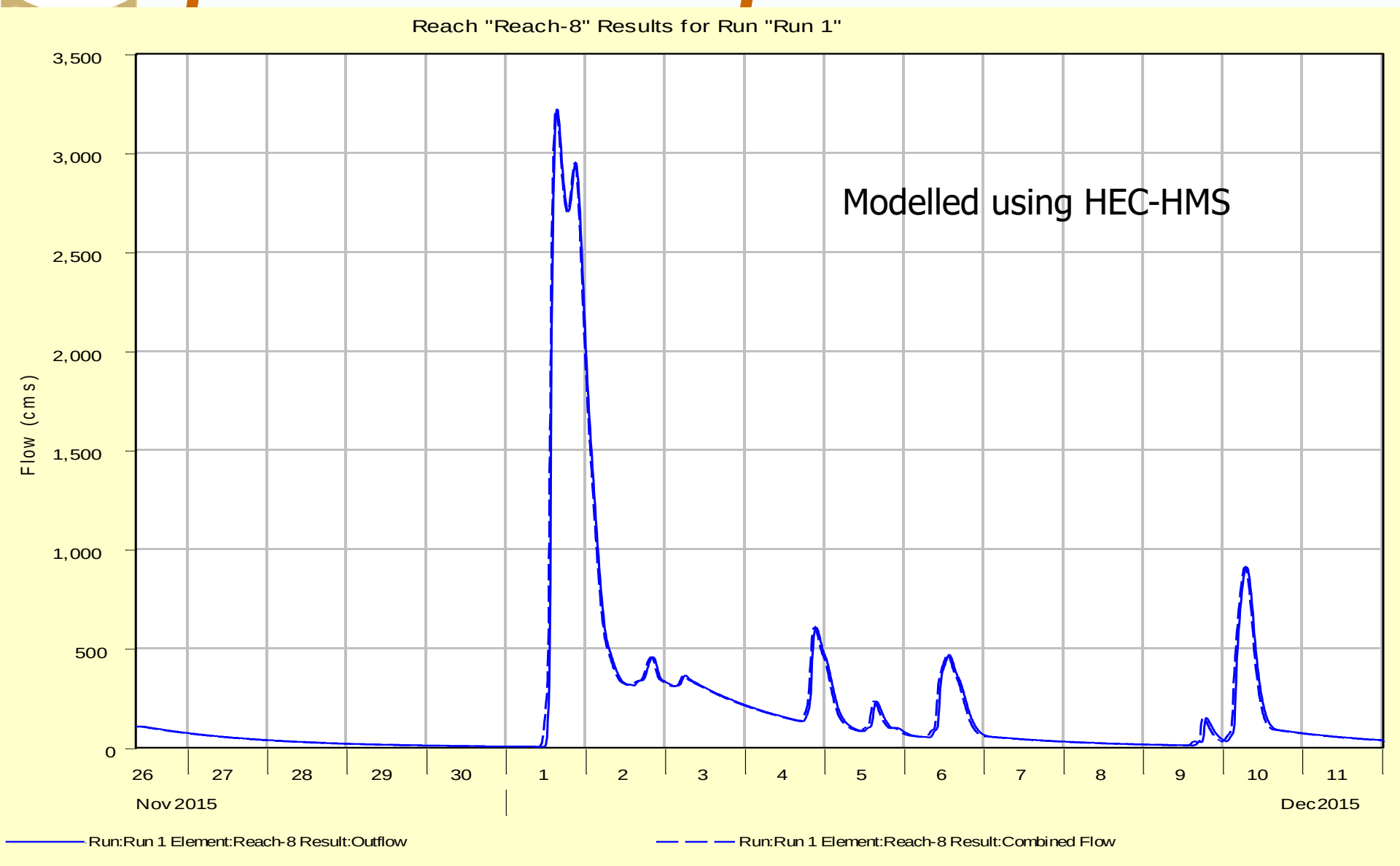
Landuse



Chembarambakkam Release



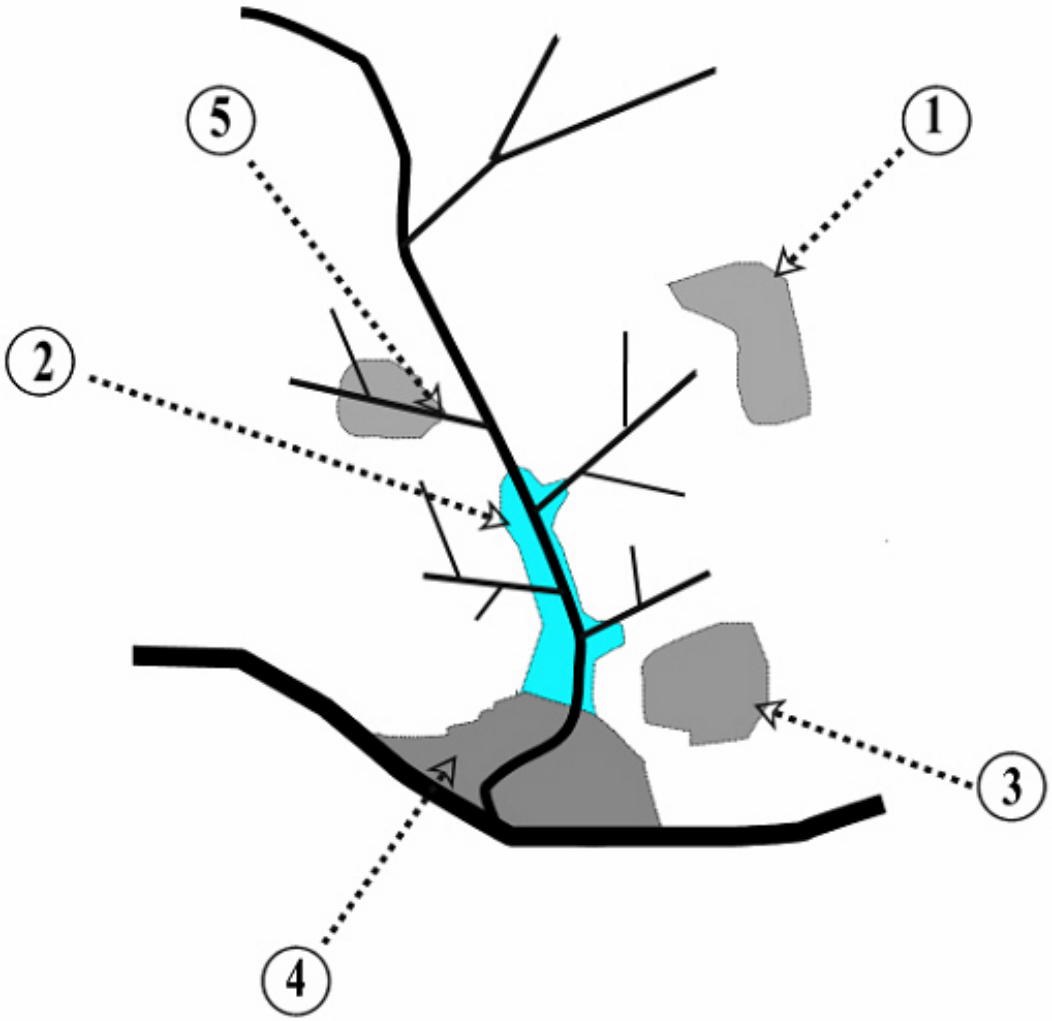
Estimated unregulated flow from the reset of the watershed



Flooding Vs water logging

- Flooding in December could not have been prevented
  - Chembarambakkam release is only a small piece in the entire scheme that lead to Chennai flooding
- However an efficient, well designed, well maintained storm drainage system could have minimized the level of water logging and damage

Causes and types of urban flooding



(1) Lack of drainage infrastructure

(2) Backup due to elevated downstream water levels

(3) Flooding in low-lying areas

(4) Innundation caused by high river water levels

(5) Blockage of the drainage system

Source: Urban Stormwater Management in Developing Countries, 2005

Lacuna

- Insufficient coverage with storm water drains
- Lack Proper connectivity
  - Linkage to major canals and waterways
- Insufficient capacity
  - Original design intensity of 31.39 mm/h
    - 1hr storm duration and 2yr return period
    - Seems very less based on the IDF curve
      - Should have been > 50 mm/h

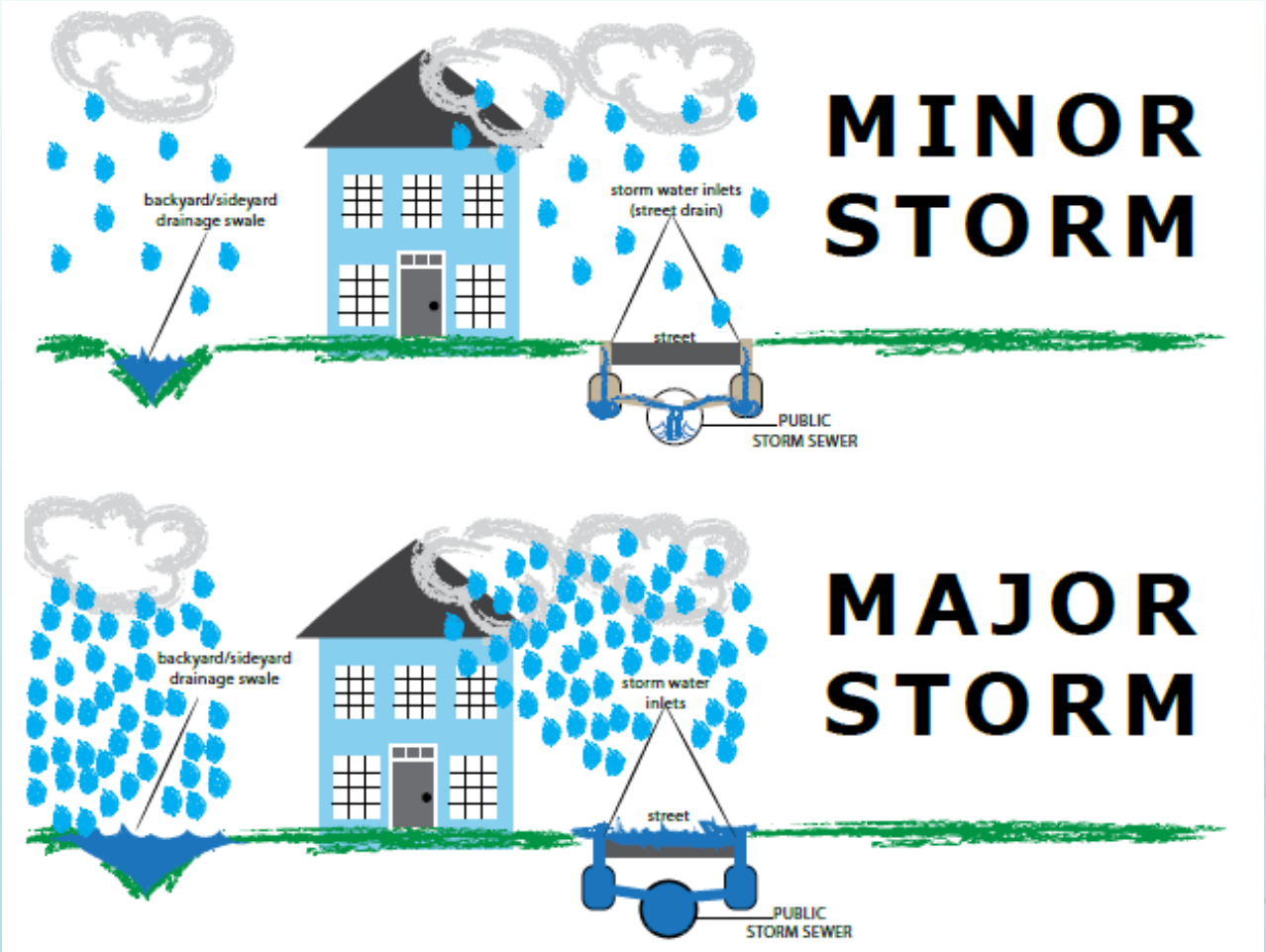
Excessive amounts of litter in a drainage channel

Source: Urban Stormwater Management in Developing Countries, 2005 Photo: Birgitte Helwigh

Blocked inlet to the stormwater drainage system

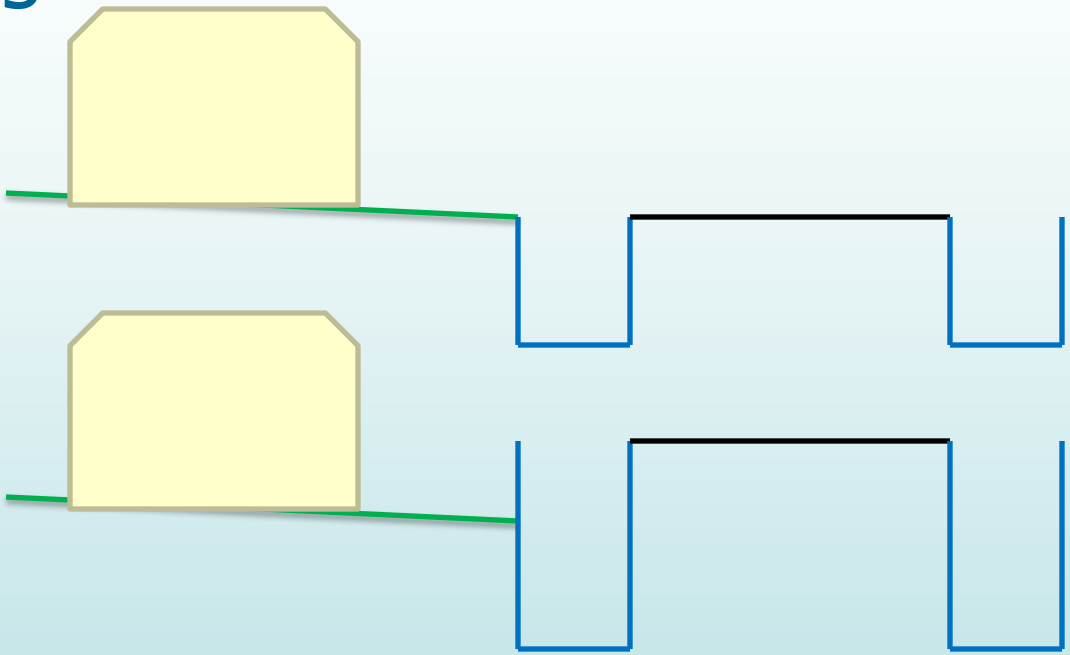
Source: Urban Stormwater Management in Developing Countries, 2005 Photo: Birgitte Helwigh

- During major Storm, roads should act as a major drainage pathway



Lacuna

- Aggradation of roads due to resurfacing

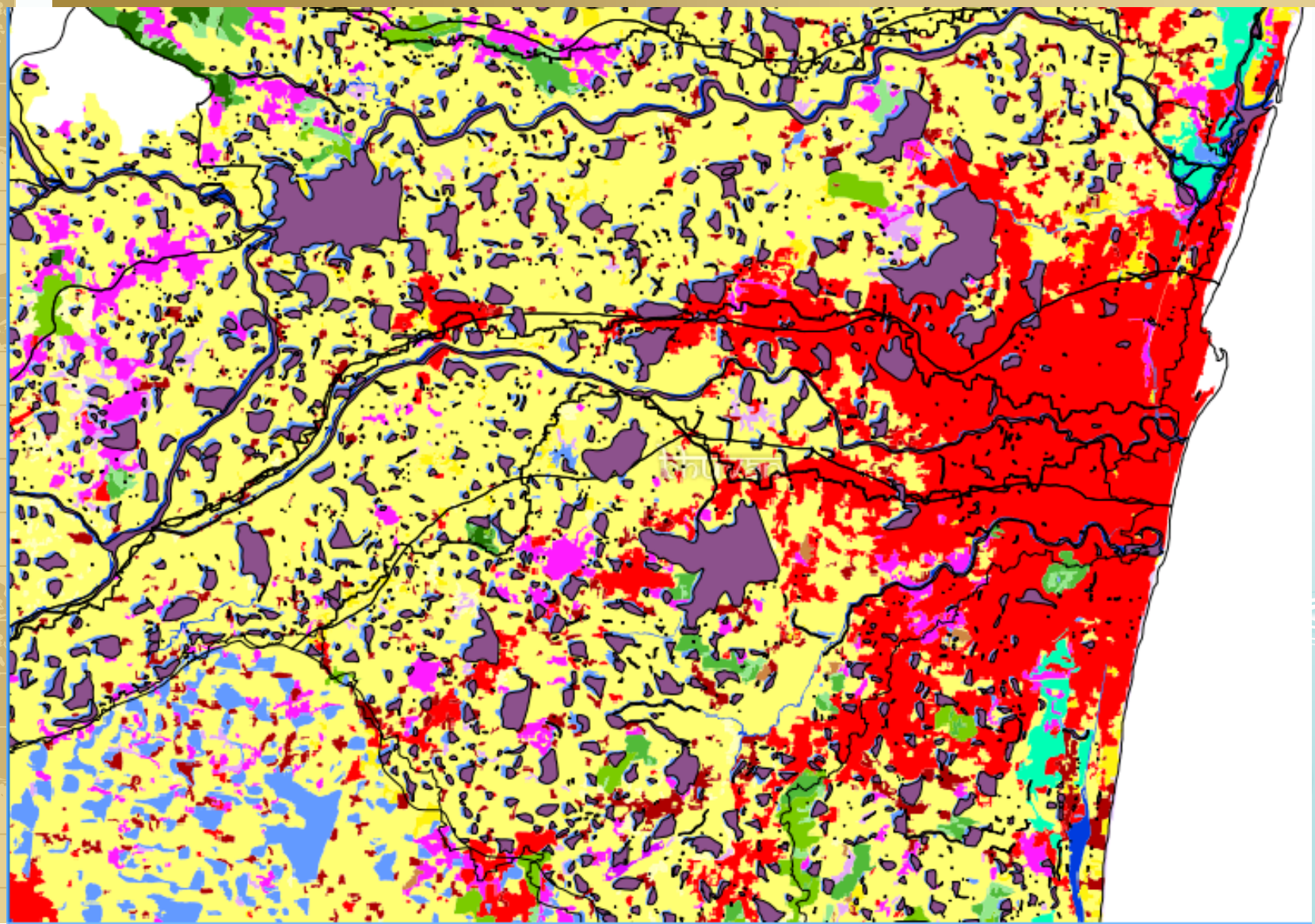


- Roads fragment the natural drainage pathways
  - Lack of adequate cross drainage works along roads

Asset

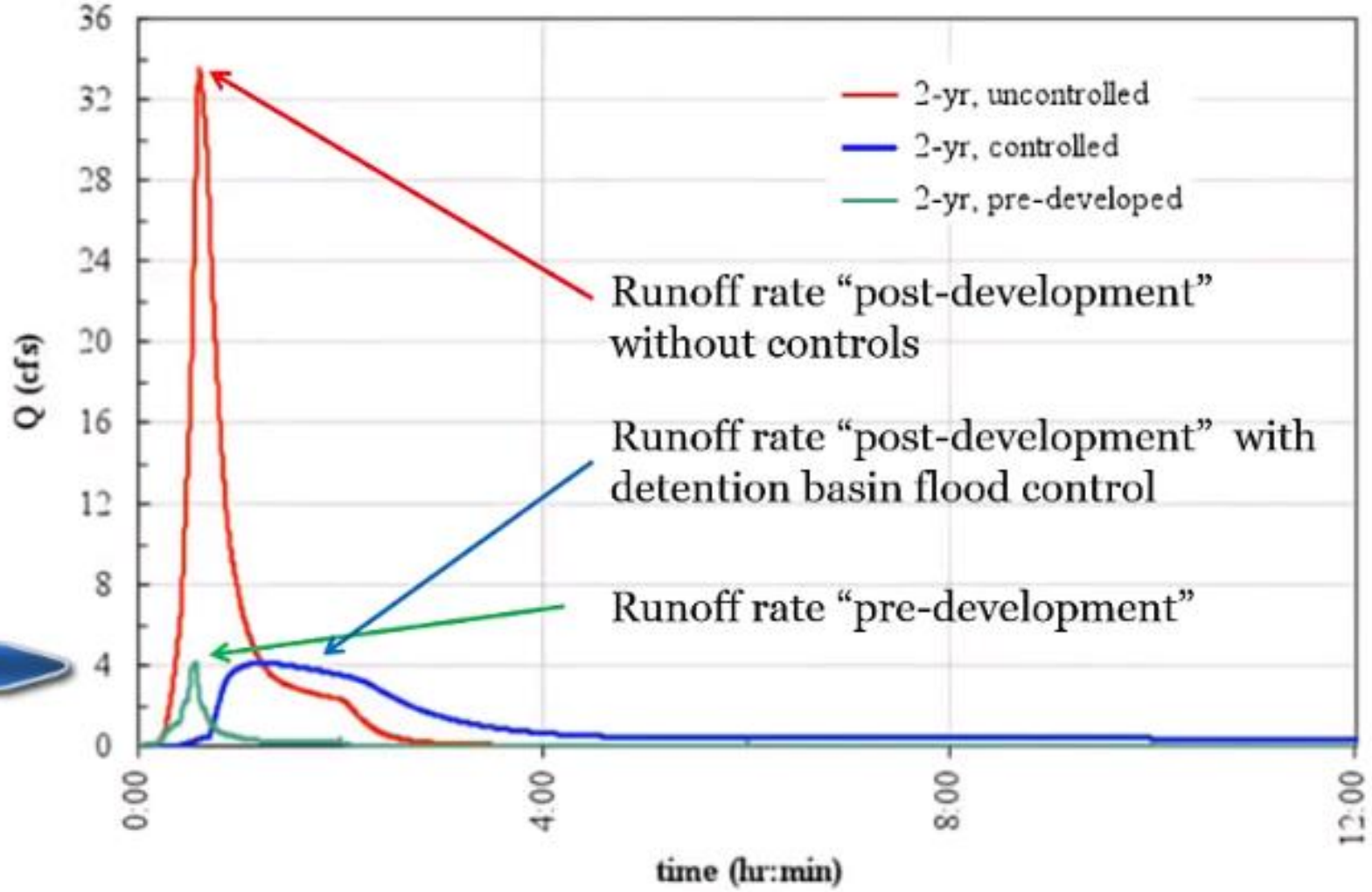
- 5 major water ways
  - Adyar
  - Cooum
  - Kosathaliyar
  - Buckingham canal
  - Otteri Nullah
- 31 major canals
- 1,660 km of storm water drains
  - 205km of drains with a width of 0.6m or more
- 100’s of water bodies

100's of water bodies



Stormwater Management

- Problem
  - Localized flooding
- Paradigm (1970's)
  - Drainage engineering
  - Put it in pipes, convey to rivers/stream as fast as possible
- Paradigm (Present)
  - Control stormwater rate and volume through
    - Low Impact development (LID's)
    - Sustainable Drainage (SuDS)


36
32
28
24
20
16
12
8
4
0
Q (cfs)
0:00
4:00
8:00
12:00
time (hr:min)
2-yr, uncontrolled
2-yr, controlled
2-yr, pre-developed
Runoff rate "post-development" without controls
Runoff rate "post-development" with detention basin flood control
Runoff rate "pre-development"

The Way Forward

The SuDS philosophy

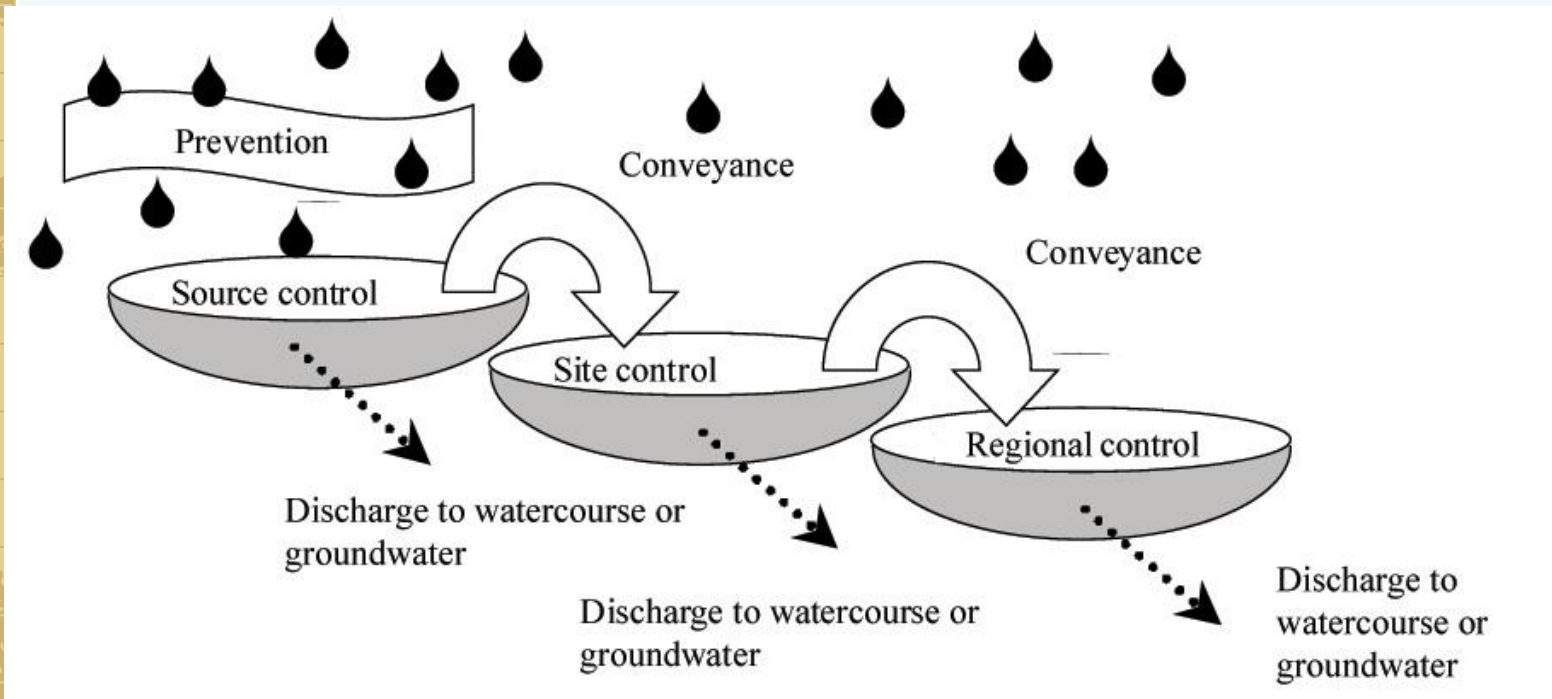
- Going beyond traditional rainwater harvesting
  - Mimic natural drainage from a site
  - Where possible, manage water on the surface
  - Manage runoff close to source
  - Provide multiple benefits

SuDS scheme at Stamford

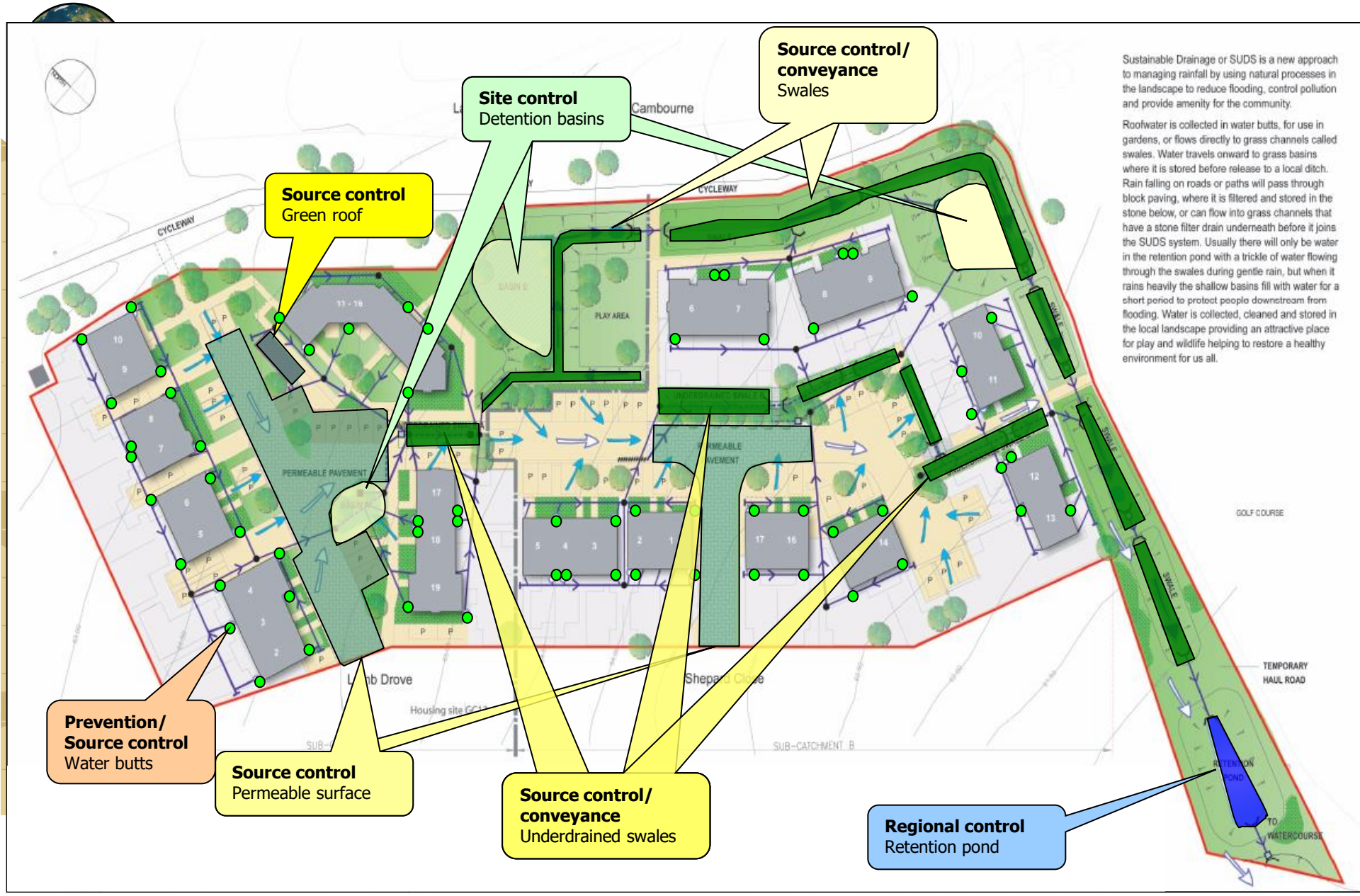
Robert Bray Associates

Sustainable Drainage Systems (SUDS)

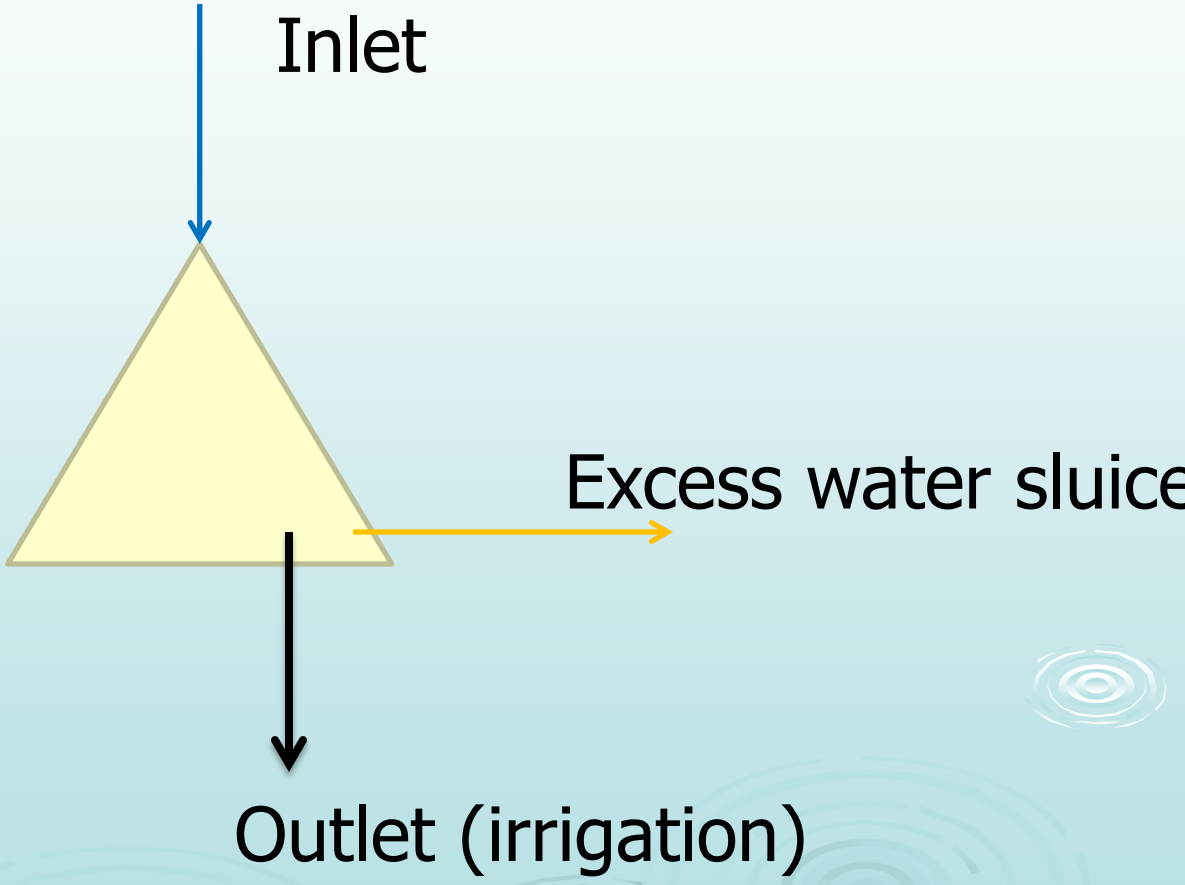
- SuDS management train



Source: CIRIA, 2000
www.susdrain.org


Source control/ conveyance
Swales
Site control
Detention basins
Source control
Green roof
Sustainable Drainage or SUDS is a new approach to managing rainfall by using natural processes in the landscape to reduce flooding, control pollution and provide amenity for the community.
Roofwater is collected in water butts, for use in gardens, or flows directly to grass channels called swales. Water travels onward to grass basins where it is stored before release to a local ditch. Rain falling on roads or paths will pass through block paving, where it is filtered and stored in the stone below, or can flow into grass channels that have a stone filter drain underneath before it joins the SUDS system. Usually there will only be water in the retention pond with a trickle of water flowing through the swales during gentle rain, but when it rains heavily the shallow basins fill with water for a short period to protect people downstream from flooding. Water is collected, cleaned and stored in the local landscape providing an attractive place for play and wildlife helping to restore a healthy environment for us all.
Cambourne
CYCLEWAY
CYCLEWAY
PLAY AREA
PERMEABLE PAVEMENT
SWALE
SWALE
SWALE
GOLF COURSE
TEMPORARY HAUL ROAD
Housing site
SUB-CATCHMENT B
TO WATERCOURSE
Prevention/ Source control
Water butts
Source control
Permeable surface
Source control/ conveyance
Underdrained swales
Regional control
Retention pond

Traditional Tank System

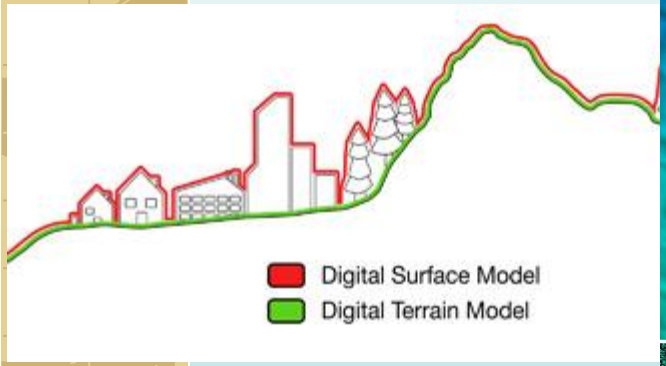


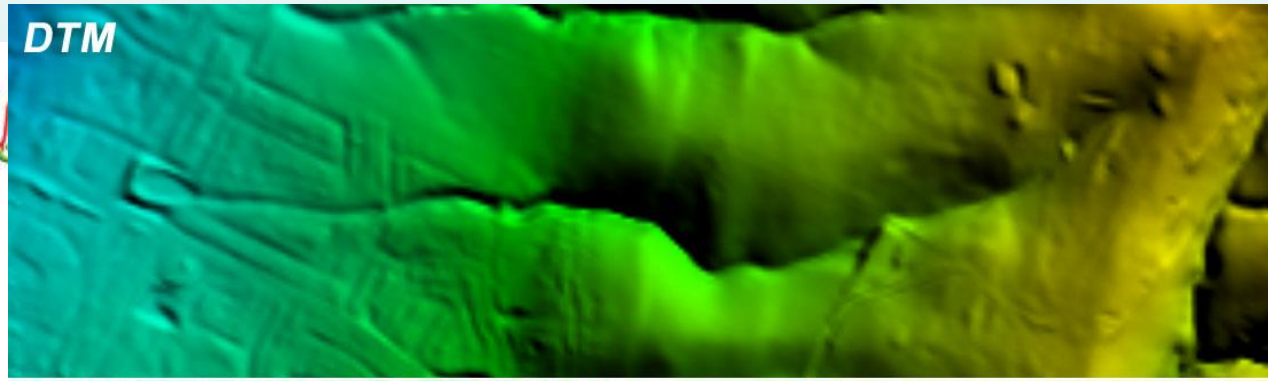
Analogy to the modern day SuDs

- Tanks naturally served as retention basins
  - Reducing the flood volume
  - Reducing the flow magnitude
- But the current state of most tanks
  - Either the tanks totally disappeared
  - Inlet cutoff
  - Outlet none existent
  - Excess water sluice not maintained to dispose off flood to the natural drainage

Data needs for Drainage Planning

- Digital Terrain Model
- Digital Surface Model





Storm Drainage network on GIS

Data needs for Drainage Planning

- Elevation of storm water drain, junctions and other appurtenances
- Road and street networks along with their levels
- Mapping urban catch basins for each storm sewer
- Develop a numerical Storm Water Management Model for the city

Flood Plain Modelling and mapping

US Army Corps of Engineers®

Tangible actions

- Mandate SuDs for new developments
  - Permit system for storm water discharge
  - Ensure that urbanization does not necessarily result in higher rate of runoff
  - Macro drainage in place before new development
- Major Canals
  - Design/size for 50-100yr return period
- Arterial drains and Canals
  - Design/size for 10 – 25yr return period
- Collector drains and Feeder Drains
  - Design/size for 2-5yr return period

Tangible actions

- Design intensity of 31.39 mm/h seems low
  - Using a TOC based approach to get appropriate duration and intensity from IDF
- Rather than CPHEEO manual, adopt Indian Road Congress codes
  - IRC:042-2014 – Road Drainage
  - IRC:050-2013 – Urban Drainage
- Ensure road resurfacing does not result in aggradation of road level
  - Adopt IRC:120-2015

Tangible actions

- Adequate cross-drainage works
- Proper solid waste management
- Ensure proper network connectivity
  - Linkage to major canals and waterways
- Maintenance all through the years
  - Rather than just before the monsoons
- Community Education on waste segregation and solid waste management