



# Water management in urban areas

## Introduction

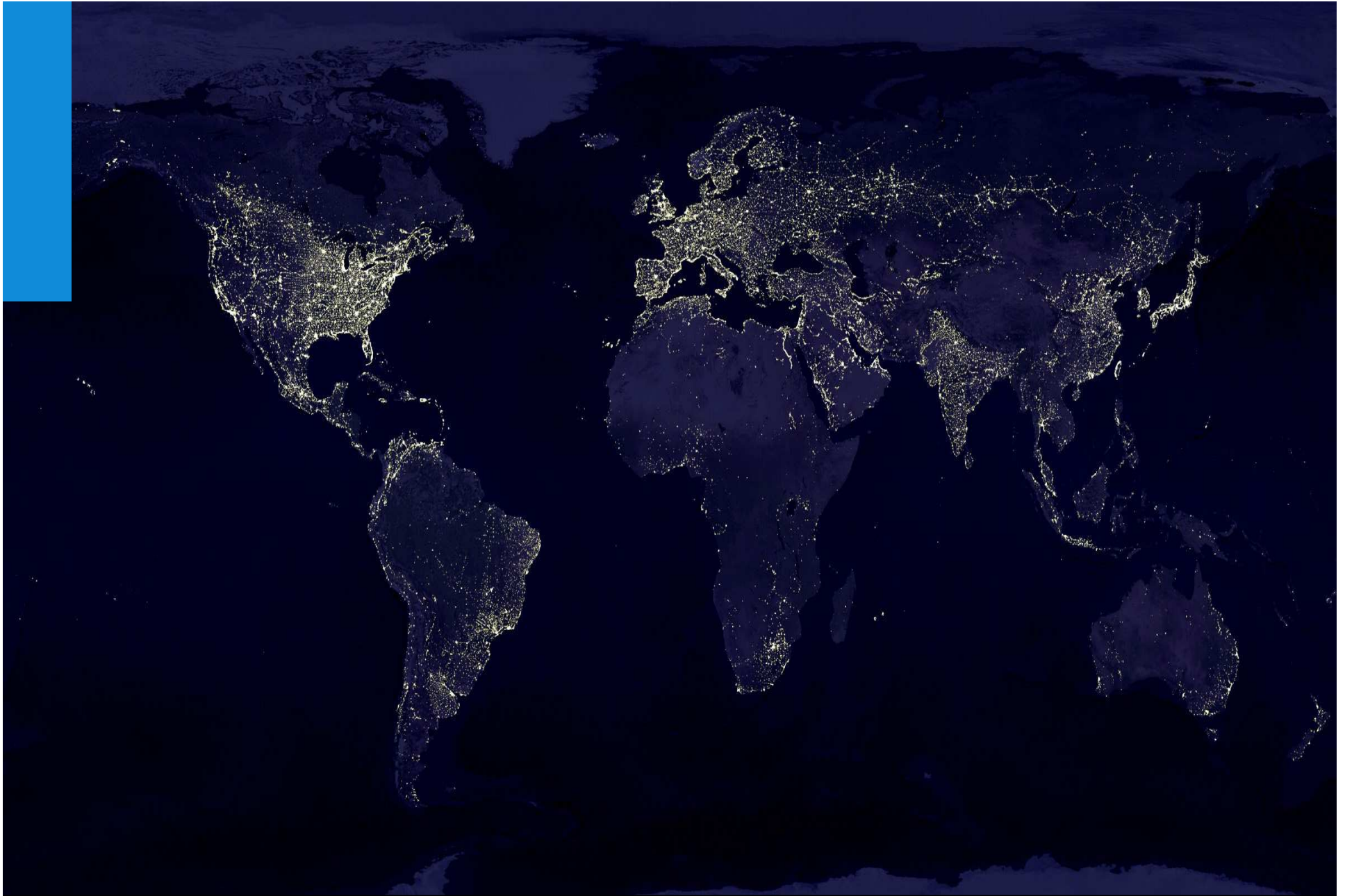
Dr. ir. Frans H.M. van de Ven

6-2-2009

# Content

- Urbanization
- Water in the urban environment
- The urban water system
- Stakeholders
- Challenges to the urban environment
- Course approach







# Urbanization

## Metropolitan areas



# Urbanization

## The Netherlands



# Urbanization

## Delft





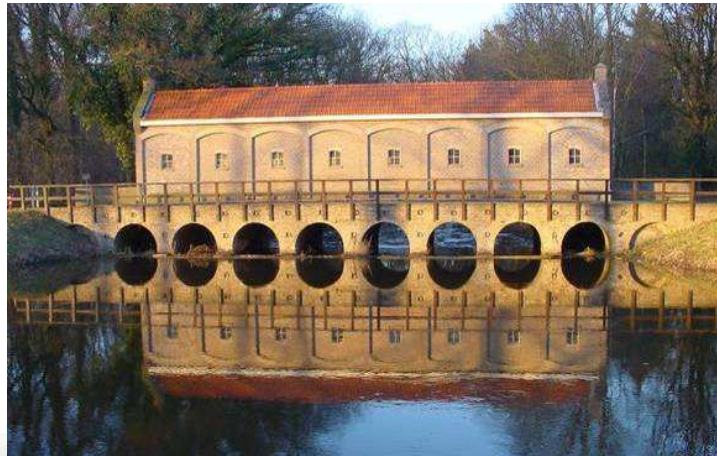
# Urbanization

## Consequences

- Concentration of people, materials, waste, energy, etc...
- High complex networks (infrastructure, social networks)
- Specific climate (Urban heat island)
- Parasitic character

# Water in the urban environment

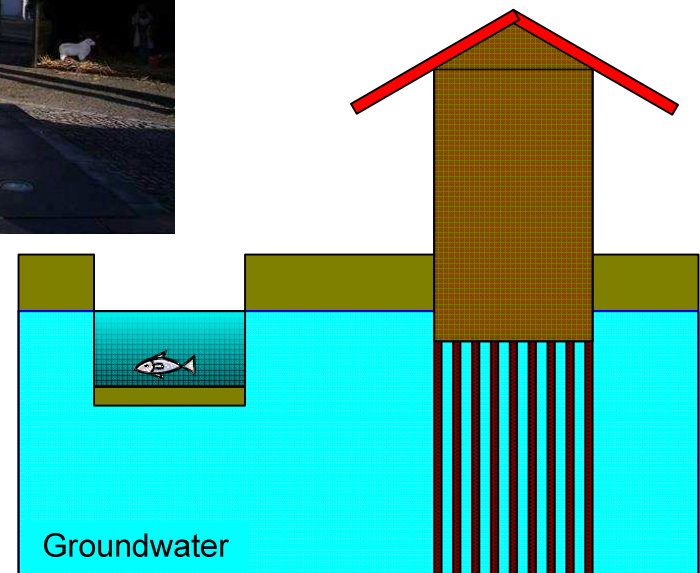
## Surface water





# Water in the urban environment

## Groundwater



# Water in the urban environment

## Drinking water



# Water in the urban environment

## Multiple functions

### Surface water

- Discharge water surplus
- Store water (peak and seasonal)
- Supply water
- Transport pollutants
- Retain pollution
- Break down pollution
- Support aquatic ecosystem
- Support terrestrial ecosystem
- Water related recreation
- Urban landscape quality
- Separate (function, area)
- Cultural identity
- Housing

### Groundwater

- Discharge water surplus
- Store water (peak and seasonal)
- Supply water to vegetation
- Provide water (industry, households)
- Transport pollution
- Retain pollution
- Break down pollution
- Support terrestrial ecosystem
- Maintain anaerobic underground
- Reduce weight (grainstress)
- Reduce subsidence
- Reduce oxidation (e.g. of peat)
- Store energy

### Drinking water

- Human water supply
- Household water supply
- Public health
- Industrial water supply
- Irrigation water supply
- Cleaning / flushing
- Fire fighting
- Groundwater recharge (leaking)



# The urban water system

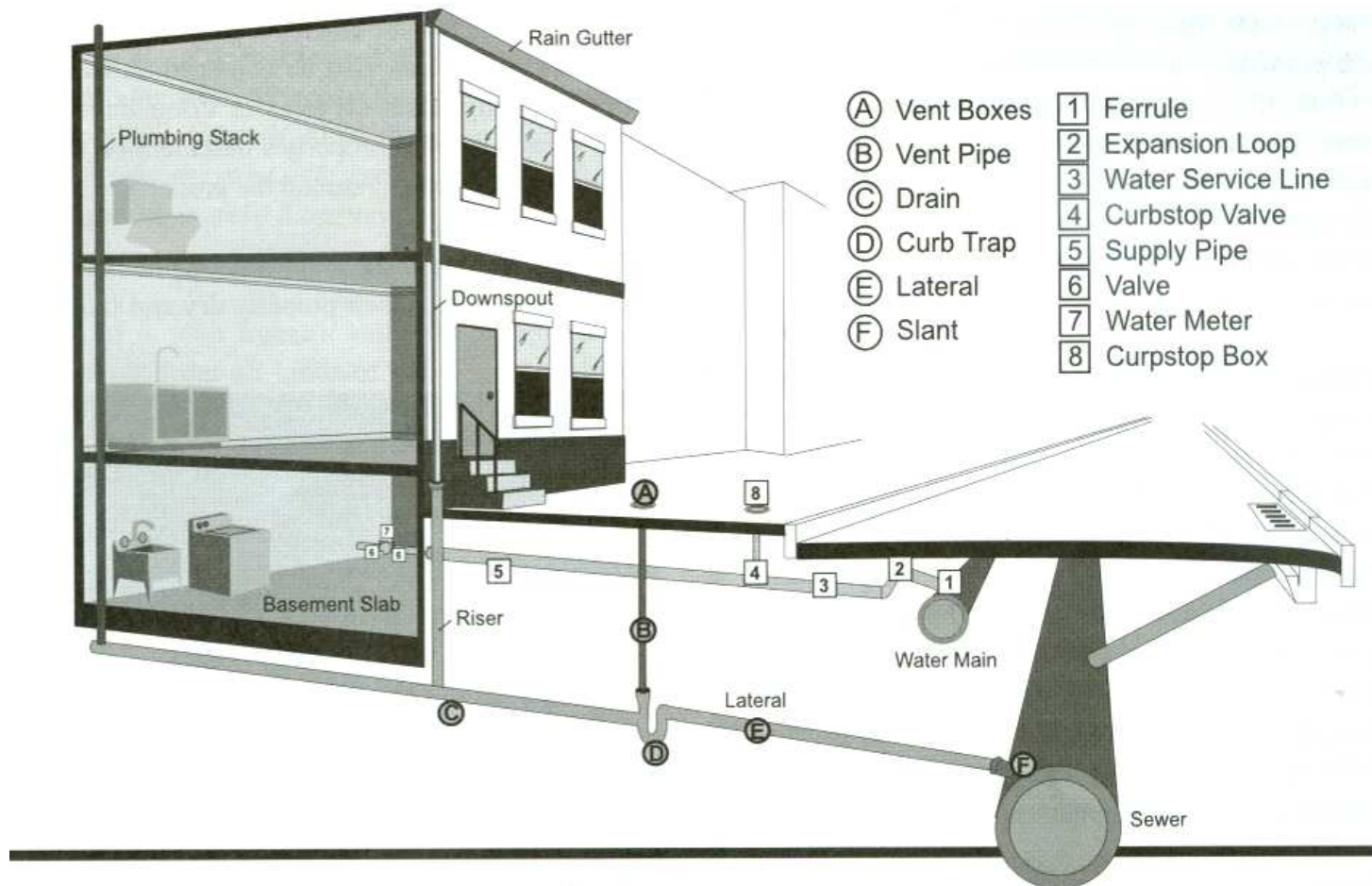
Specific field in Hydrology and Water Management

- Paved area
- Drinking water system
- Sewer systems
- Physically separated from surrounding area



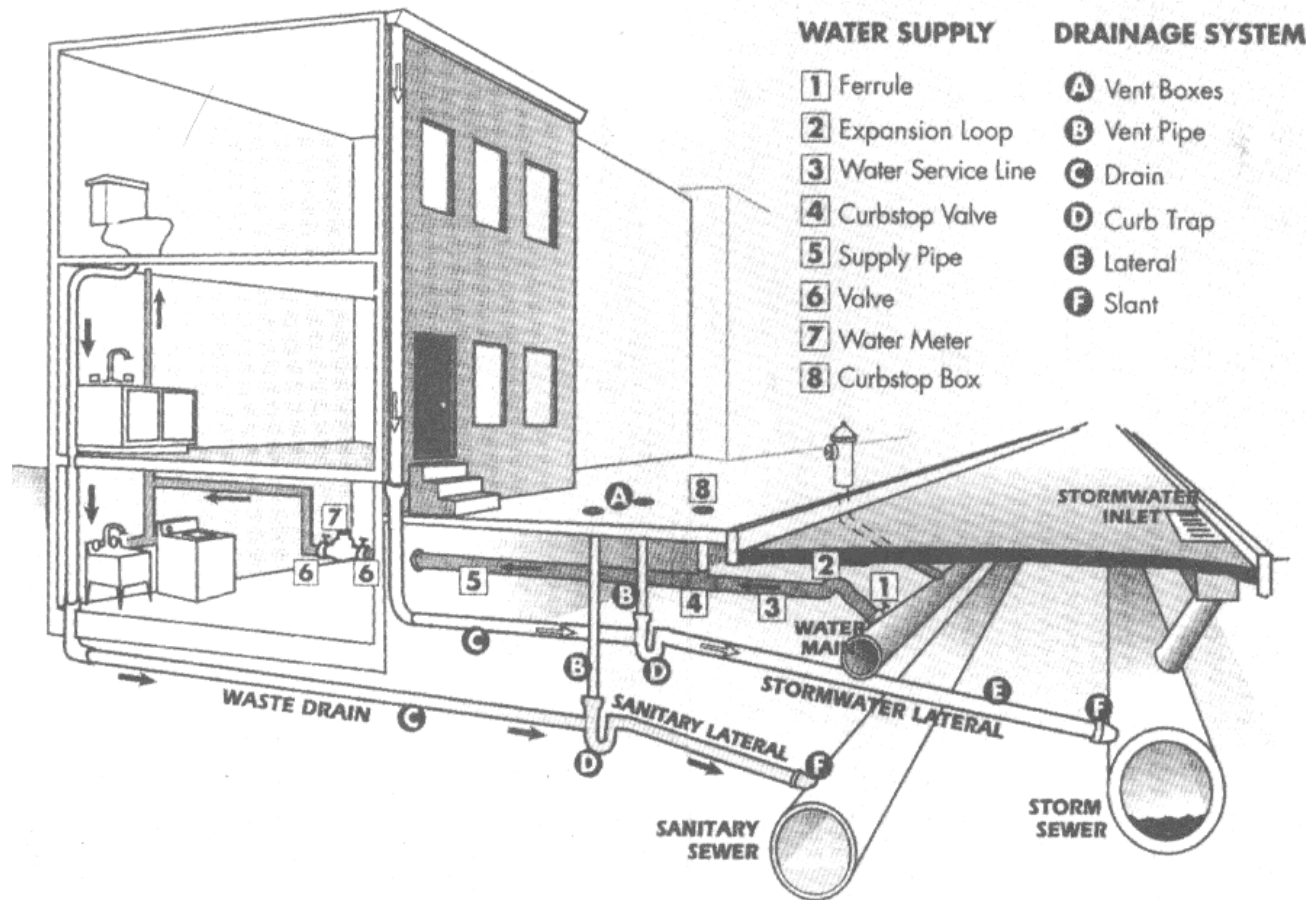
# The urban water system

## Combined sewer system



# The urban water system

## Separated sewer system

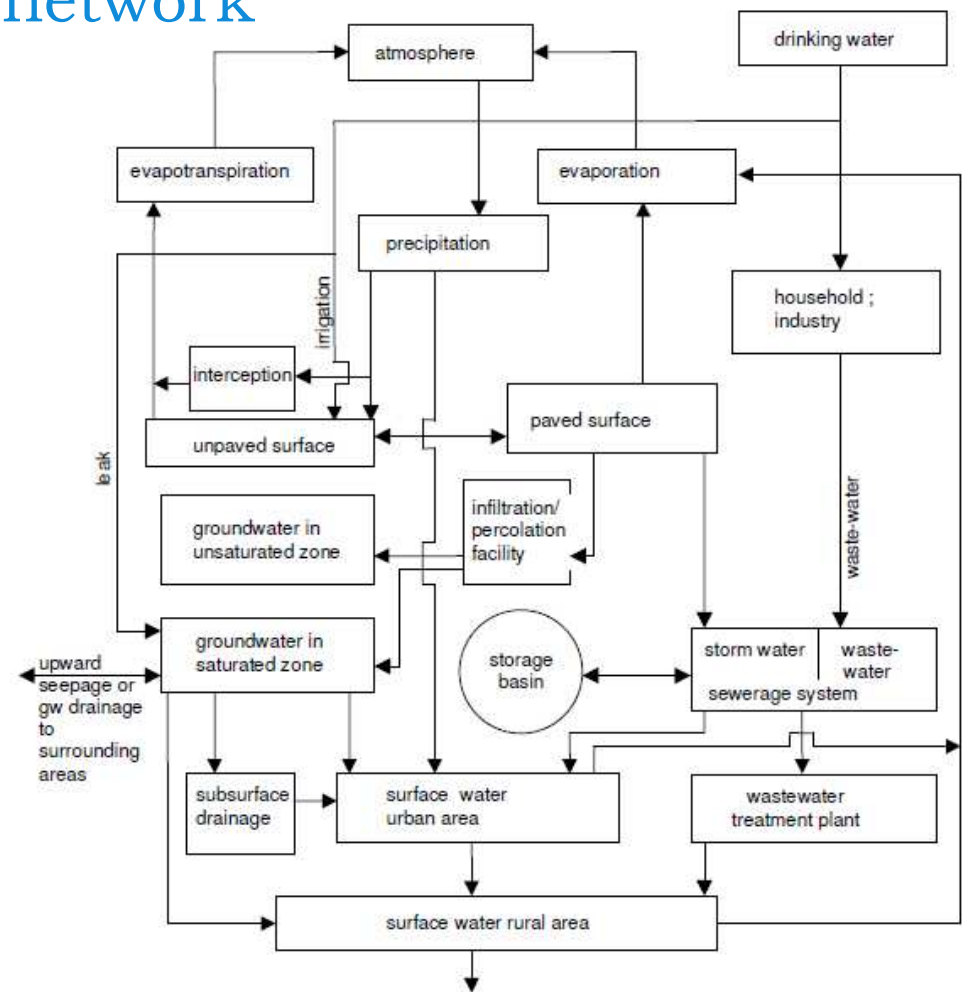




# The urban water system

## A complex hydrological network

- Precipitation (external)
- Surface water
- Groundwater
- Drinking water
- Wastewater



# The urban water system

## Numerous specific hydrological processes

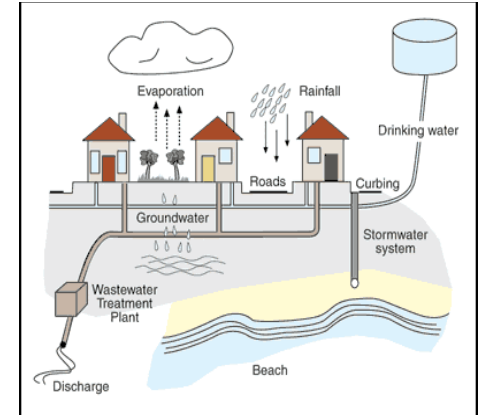
- Rainfall – runoff (paved/unpaved)
- Interception (vegetation, structures)
- Evapo-transpiration (ponds, vegetation)
- Infiltration (permeable pavement)
- Subsurface flows (modified soils, drainage)
- Surface water flows (peak discharge, flushing)



# The urban water system

## Planning and design

- Considering all functions and relations
- Obeying (legal) requirements and regulations
- Creating sustainable urban systems

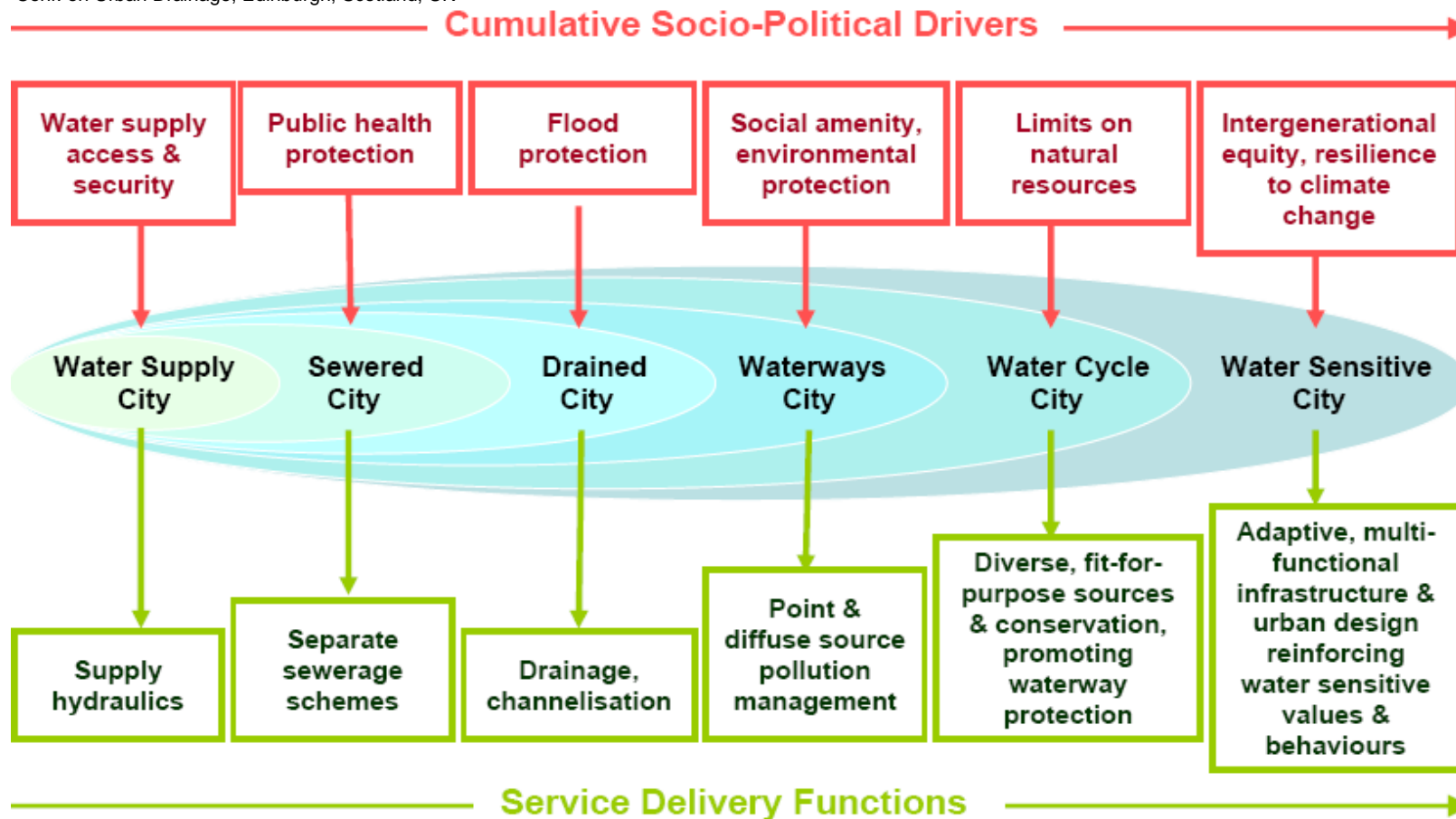




# The urban water system

## Extending ambitions

Source: Brown, R.R., N. Keath and T. Wong, 2008, Transitioning to Water Sensitive Cities: Historical, Current and Future Transition States. In Proc. 11th Int. Conf. on Urban Drainage, Edinburgh, Scotland, UK



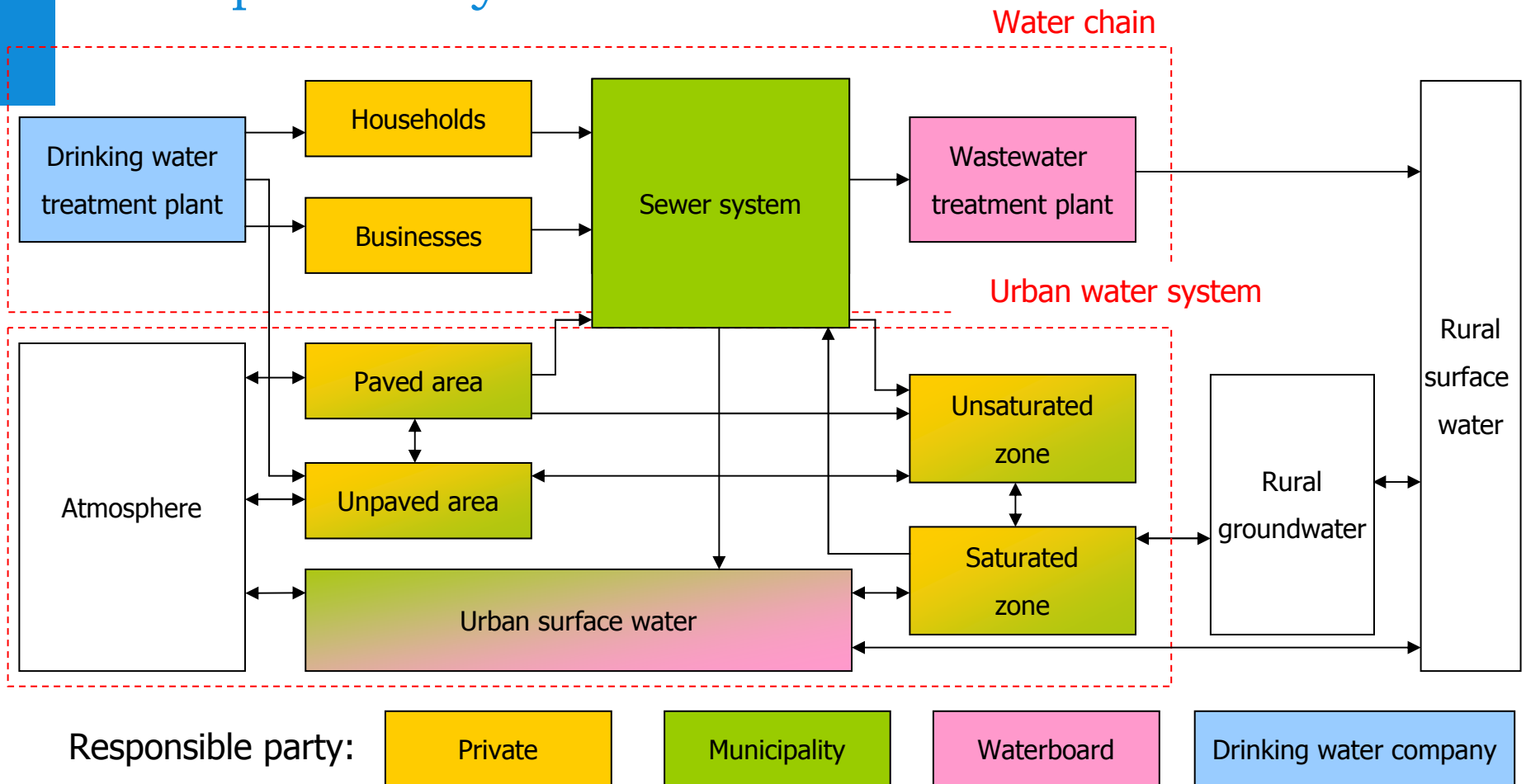
# Stakeholders

## Multidisciplinary

- Government
  - Provinces
  - Municipality's
  - Water boards
- Landowners
  - Inhabitants
  - Businesses
  - Project developers
- Drinking water company's
- Consultants
  - Engineering firms
  - Research institutes
- Specific interest groups (NGO's)
  - Environmental organizations
  - Cultural heritage groups

# Stakeholders

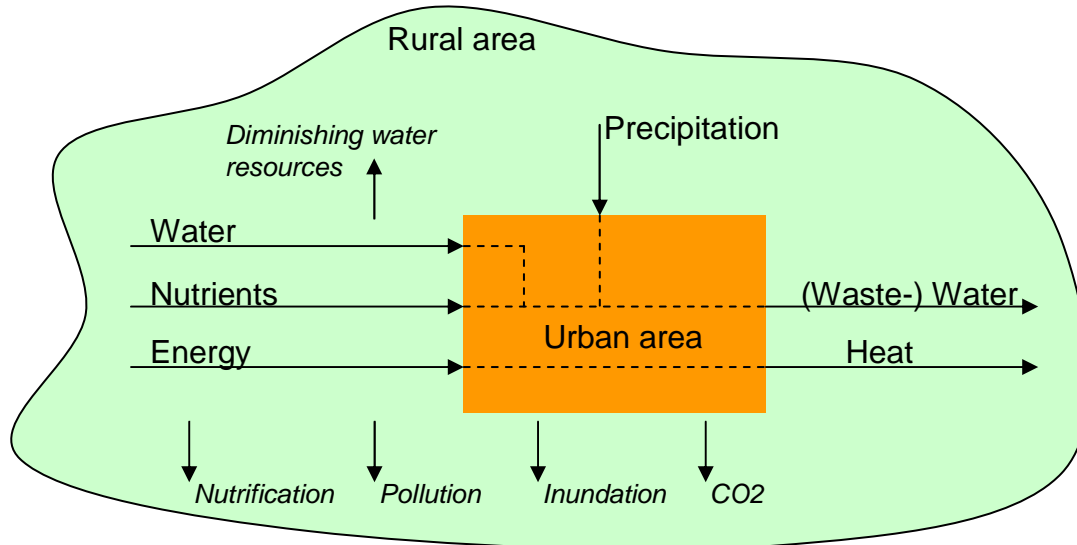
## Responsibility



# Challenges to the urban environment

## Continuing urbanization

- Increased demands of resources
- Increased loads on and out of the system
- Limited suitable land available





# Challenges

## Climate change

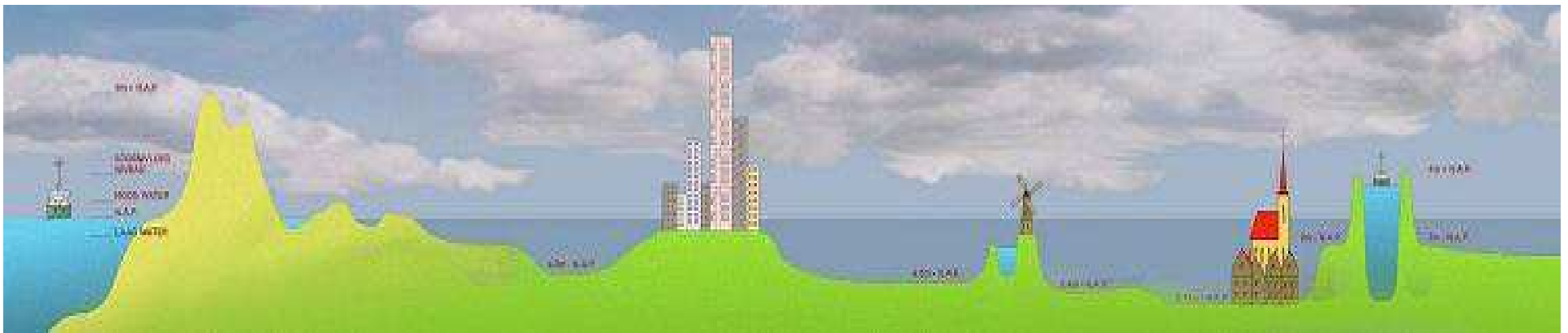
- Flooding
  - Increased rain intensities
  - Higher peak discharges
- Drought
  - Prolonged dry spells
- Warming
  - Global warming
  - Urban heat island



# Challenges to the urban environment

## Inundation

- Pluvial flooding  
Precipitation exceeds run-off capacity
- Fluvial flooding  
Capacity of a water course is exceeded
- Coastal flooding  
Storm surges cause flooding of low lying areas
- Groundwater flooding  
Rise of the groundwater table beyond upper boundary's



# Challenges to the urban environment

## Subsidence





# Course approach

## Overview

- Lectures
- Lecture notes
- Assignment
- Excursion
- Oral exam





# Course approach

## Lectures

- 05 Feb – 19 Mar '09      Thursdays 13:30 – 16:30 (2.98)
- 09 Apr – 14 May '09      Thursdays 09:30 – 12:30 (2.98)
  
- 30 April '09      No lectures
  
- Content (indicative)
  - Introduction      05/02
  - Processes      05/02 – 05/03
  - Design      12/03 – 16/04
  - Planning      23/04 – 14/05

# Course approach

## Lecture notes

- Online available at blackboard (in progress)
- Hard copy available via blackboard web shop (2007 version)

• Content	Chapter
• Introduction	1
• Processes	2
• Design	3-4
• Planning	5



# Course approach

## Assignment

- Small research on specific topic

# Course approach

## Excursion

- 28<sup>th</sup>-29<sup>th</sup> of May including accommodation for the night
- Visiting relevant projects and sites
- Organized by 2 volunteers





# Course approach

## Oral exam

- Knowledge about basic principles
- Understanding overall relations
- Relevance of different interests
- Available dates: 4-5 June (enrollment list at room 4.78)