

Integrated Stormwater Management (iSWM) for Ho Chi Minh City - application and adaptation of European solutions for rapidly urbanizing agglomerations in the tropics.

- Vietnamese title translation -



ESTABLISHING AND CONSOLIDATING RESEARCH PARTNERSHIPS
BETWEEN VIETNAMESE AND GERMAN INSTITUTIONS



- Thiết lập mối quan hệ đối tác trong lĩnh vực nghiên cứu giữa các viện nghiên cứu Việt Nam và Đức -

Christian Lorenz, Hydrologist, Ph.D.

OUTLINE

- » Background
 - » Motivation
 - » Objectives
 - » Water Management Basics
 - » Review of state-of-the-art Technologies
 - » Challenges in the Sub-equatorial Tropics
 - » Future Scenarios for HCM City
 - » Technology Adaptation
 - » Integrated Solutions
 - » Conclusion & Outlook

BACKGROUND: Vietnamese German Cooperation

Funding Programmes by the German Federal Ministry of Education and Research (BMBF):

currently running @ BTU Cottbus, Germany since 2008:

“Megacity Research Project TP. Ho Chi Minh - Integrative Urban and Environmental Planning Framework Adaptation to Climate Change”

“Sustainable Development of the Megacities of Tomorrow - Energy and Climate Efficient Structures in Urban Growth Centres” (Future Megacities):

funded definition project and project proposal @ BTU Cottbus, Germany since 2012:

„Integrated stormwater management for high-dense urban agglomerations in the tropics: the case of Ho Chi Minh City, Vietnam” - iStormWater HCMC

“International Partnerships for Sustainable Technologies and Services for Climate Protection and the Environment (CLIENT)”

RESEARCH FOCUS OF VIETNAMESE AND GERMAN PARTNERS:

- **Integrated Vulnerability Assessment of the region of HCMC**
- **Elaboration of guidelines for energy-efficient and climate change adapted urban structures on three spatial levels (conurbation, neighbourhood, building)**
- **Data Acquisition, Hydrogeological Modelling, Administrative integration, integrated Stormwater Management System Design (incl. EIA)**
- **Set up of necessary System Components (construction measures at Pilot Plant Site etc.), capacity building, Operation (Monitoring, impact, efficiency)**

RESEARCH FOCUS OF VIETNAMESE AND GERMAN PARTNERS:

**System Analysis → Guidelines for
Practical Application**

**Development of technical
applications**

etc.), capacity building, Operation (Monitoring, impact, efficiency)

INTEGRATIVE APPROACH

Global Climate Change → focus on LOCAL effects

Urban Development → challenges for urban water management

- European High-Tech solutions → established in a different climatic, scientific and administrative framework
- management demands in the tropics → Vietnamese partners
- long-time operational experience → e.g. German partners

→ need for international R&D projects, which focus on implementation adaptation of European High-Tech solutions to framework conditions in the tropics: Case Ho Chi Minh City

- Intelligent, efficient and SUSTAINABLE use of limited natural resources

→ Public Lecture Topic: Water management

- Regional/urban water resource management
- Energy and consumption-optimized water infrastructures
- Water sanitation technologies
- Planning tools for water management

iNTEGRATED STORMWATER MANAGEMENT OFFERS INTERDISCIPLINARY SOLUTIONS FOR PROBLEMS REGARDING:

- ✓ **FLOODING**
 - RUN OFF vs. INFILTRATION
- ✓ **GROUNDWATER DRAWDOWN**
 - SUBSIDENCE
- ✓ **SALTWATER INTRUSION**
 - DRINKING WATER SUPPLY

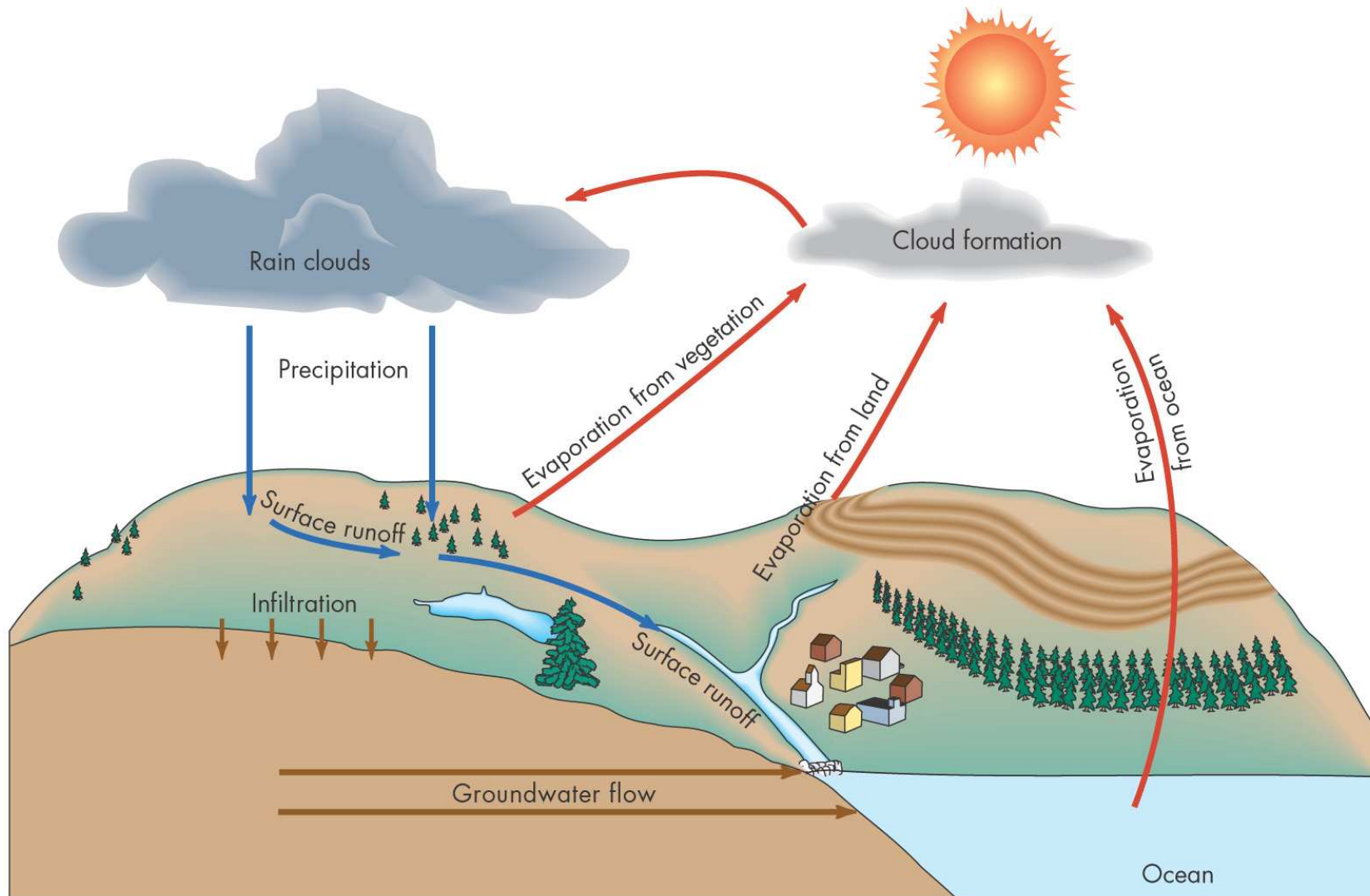


It's all about water...



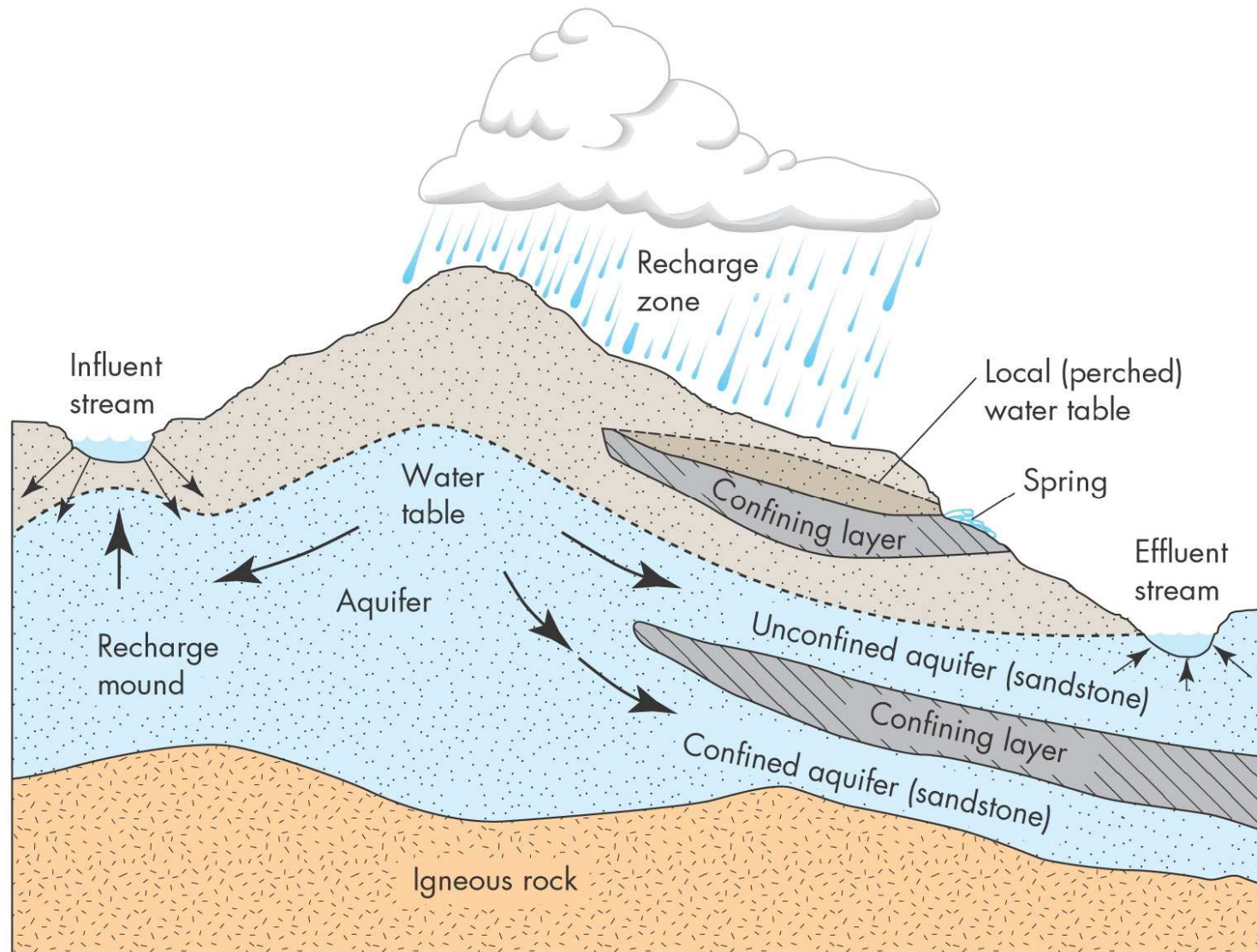
4photos.net

Water cycle



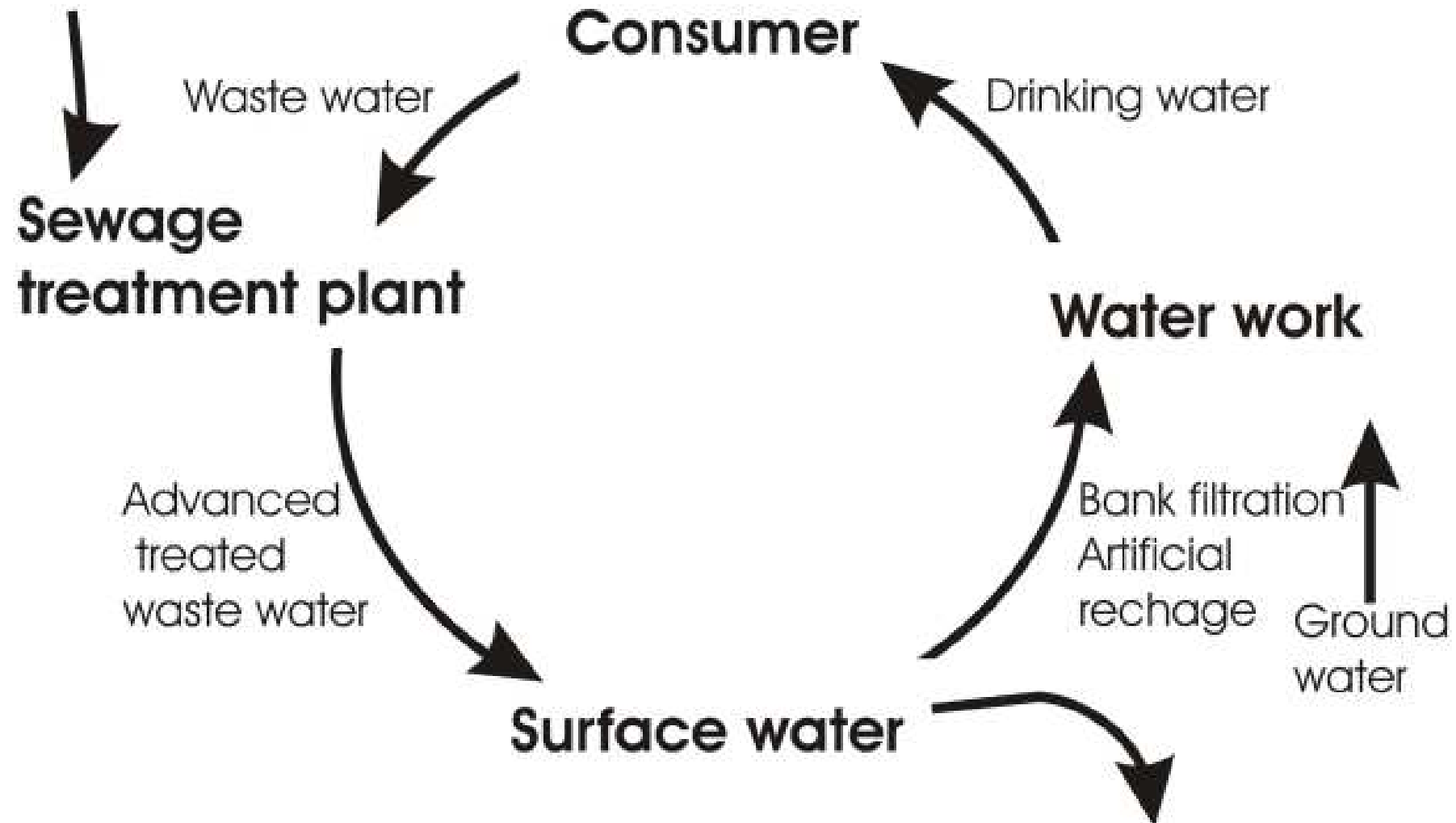
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GROUNDWATER DISCHARGE vs. RECHARGE



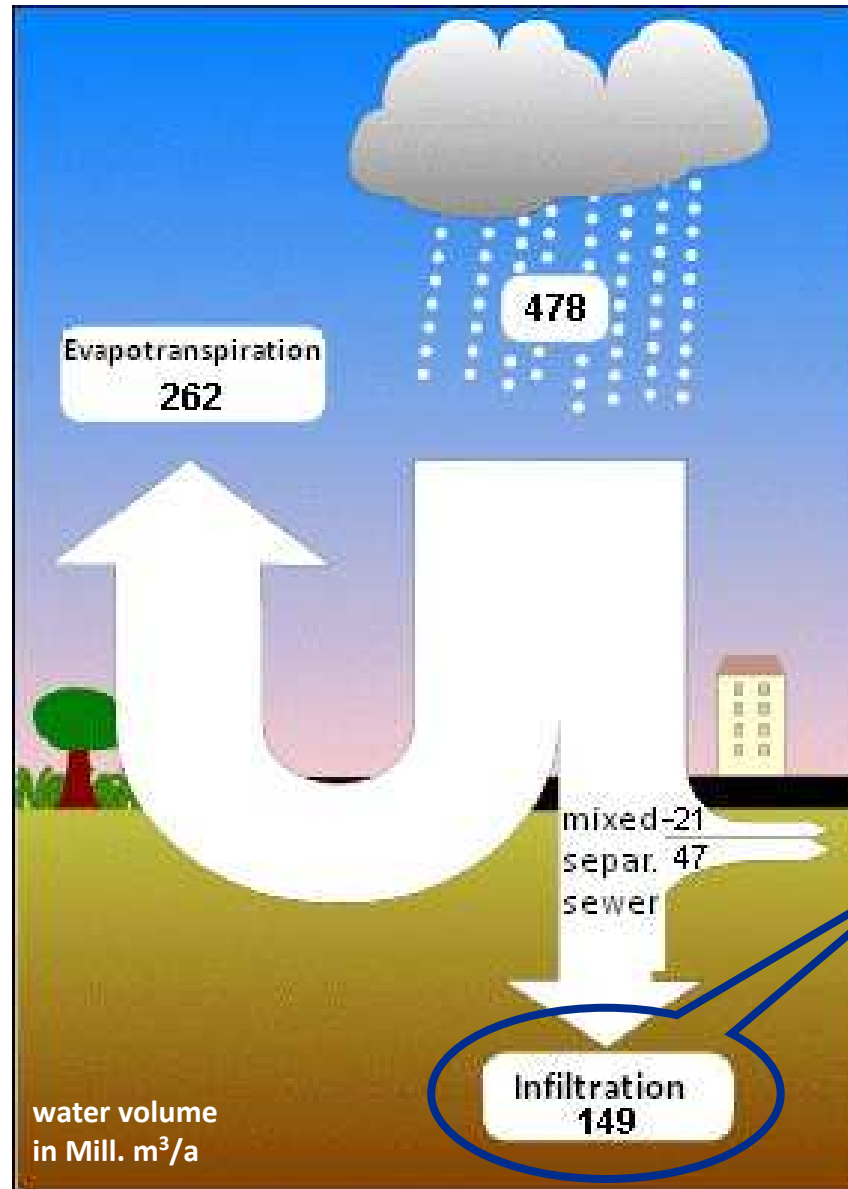
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- › **artificial recharge**
- › **groundwater drawdown → overuse?**
- › **mining → e.g. water table lowering**
- › **melioration → e.g. drainage, irrigation etc.**
- › **sealing measures**
- › **evaporation...**
- › **rising of groundwater table → e.g. tidal effects**



KompetenzZentrum Wasser Berlin, 2003, modified

European Example: Urban Water Balance in Berlin, Germany

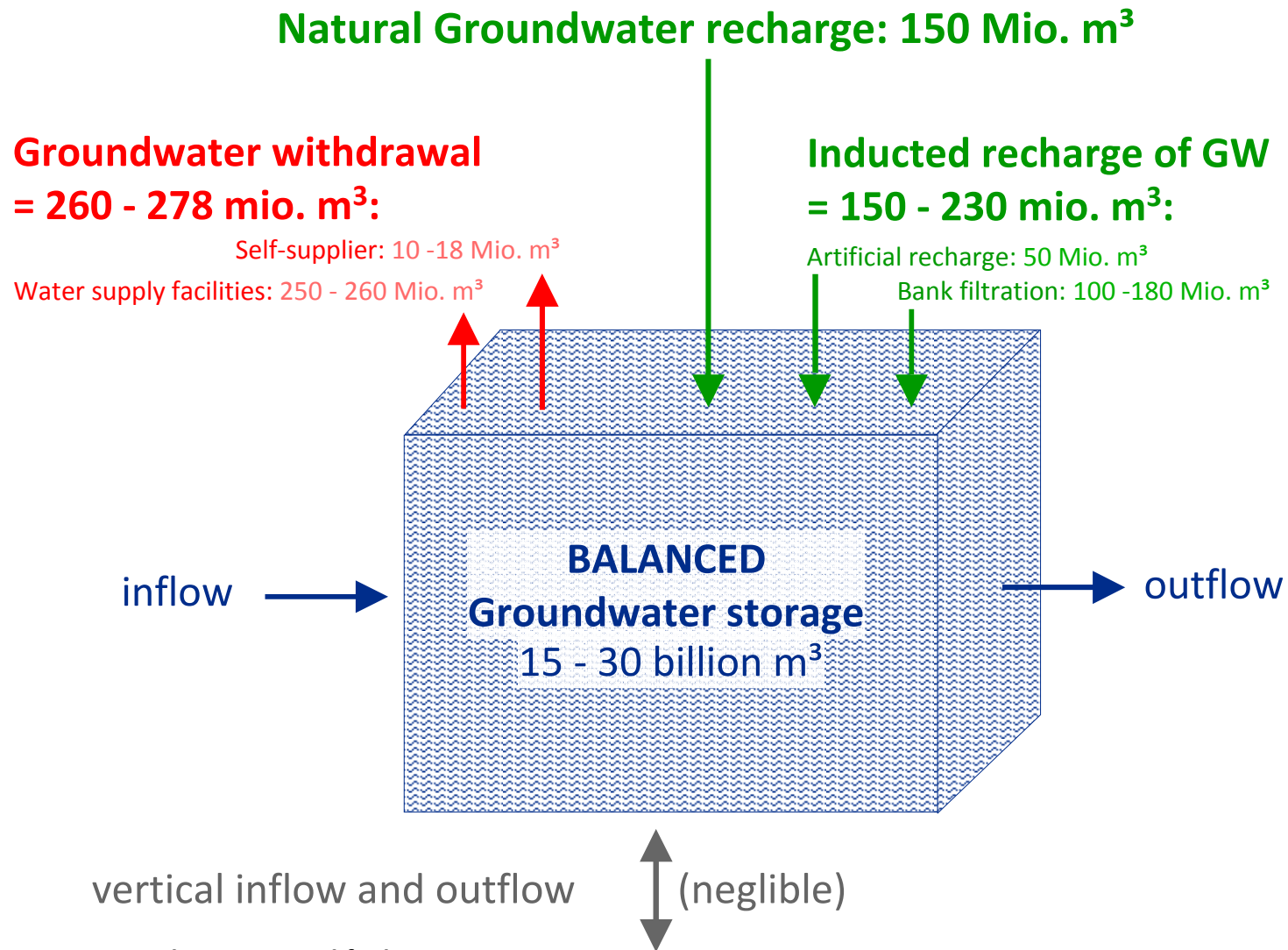


water "loss" by water abstraction

→ DISCHARGE

natural water gain by infiltration

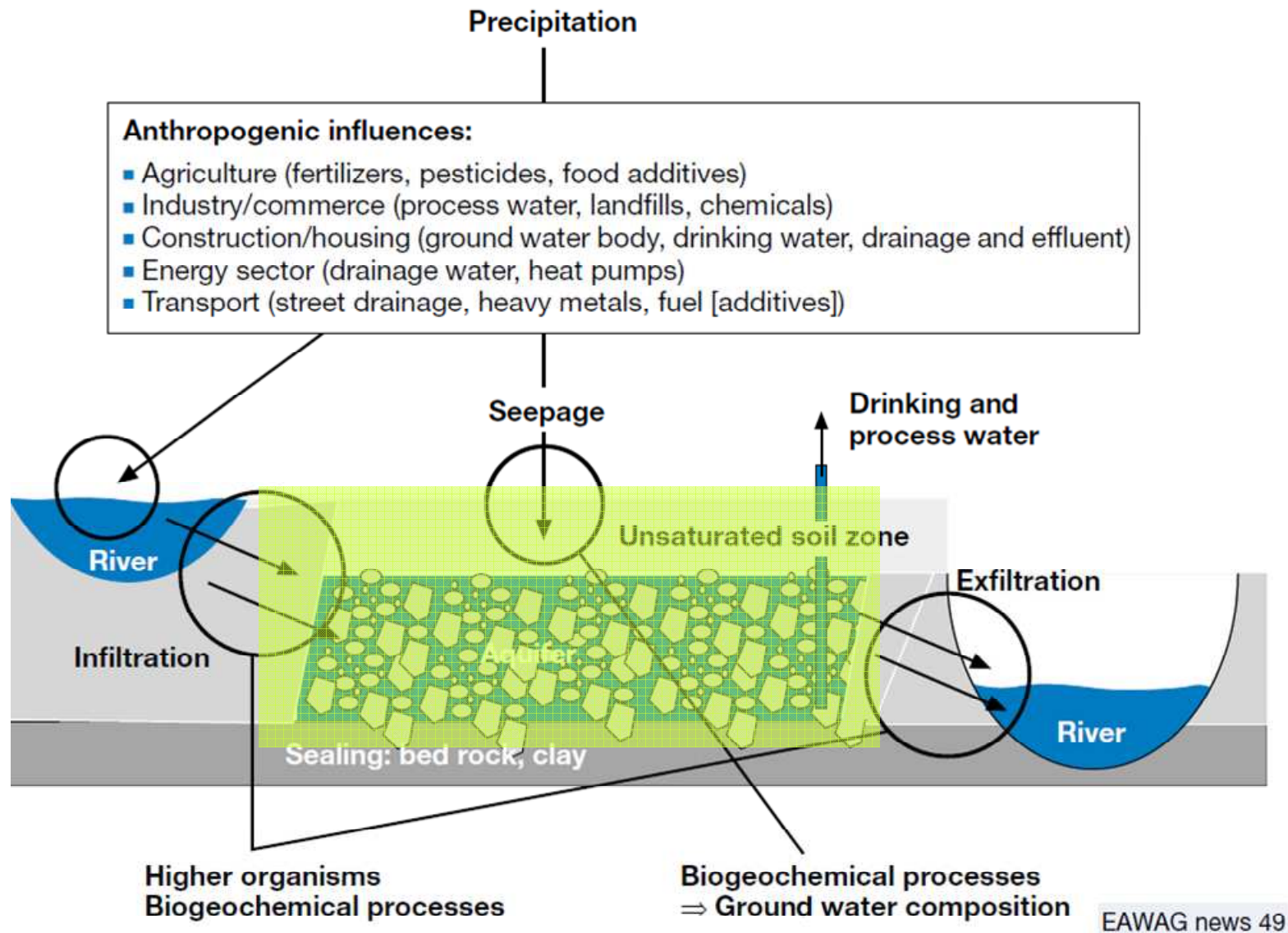
→ RECHARGE



KompetenzZentrum Wasser Berlin, 2003, modified

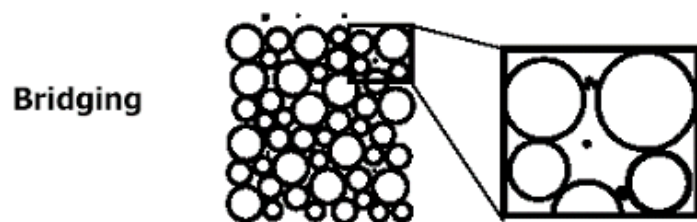
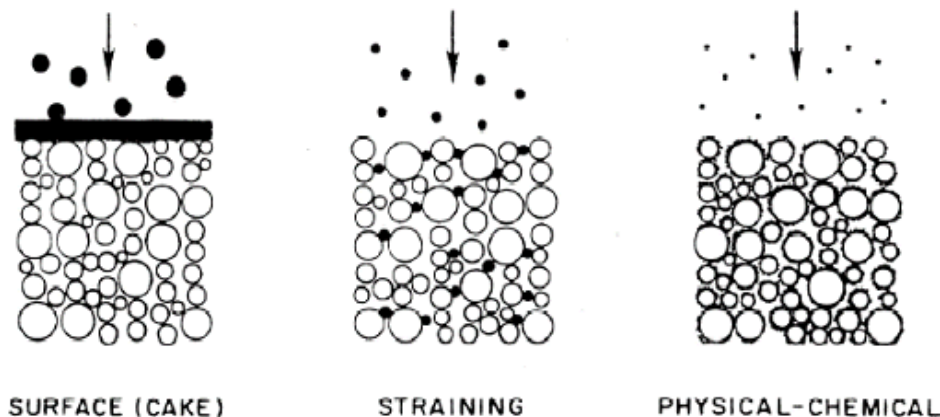
→ discharge = loss
→ recharge = gain

From contaminated seepage water to clean groundwater



Permeability of sub ground » prerequisite for infiltration

- Colmation is the physical clogging / blockage of the sediment pores by fine-grained material or biofilm/s
- Clogging can vastly decrease the amount of water that can be recharged into the aquifer
- reversible process → Suffosion

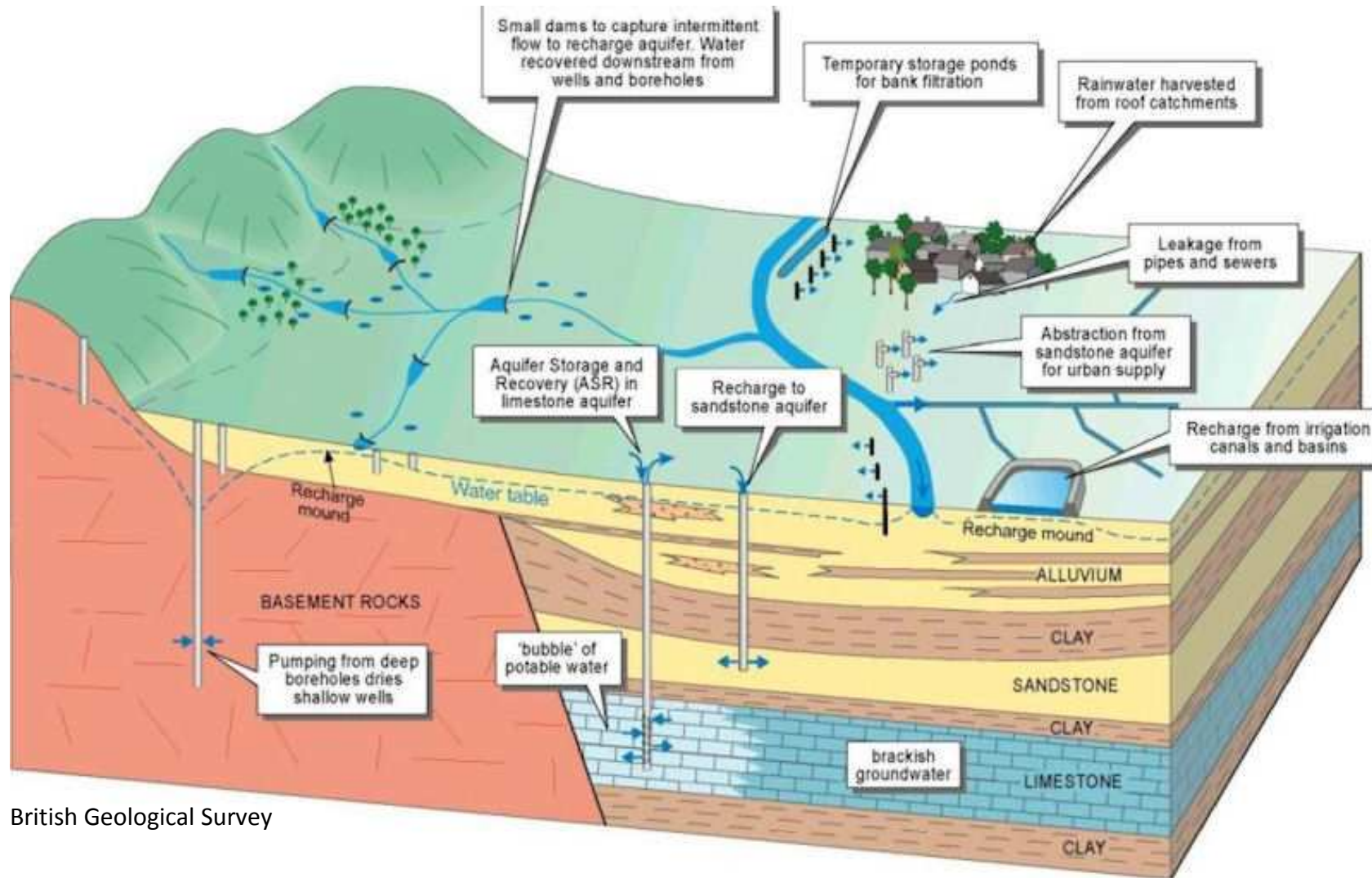


McDowell-Boyer et al., 1986

- › **Surface clogging** occurs with the gravity settling of fine-grained sediments sealing the surface of the aquifer
- › **Straining** occurs under pressure, when the fine-grained sediment enters the pores of the aquifer
- › **Physical-chemical clogging** is due to reaction of the recharge water with the aquifer sediment or matrix, such as the deposition of calcite
- › **Bridging** is a special type of clogging, where although the amount of sediment involved is low, silt grains get wedged across the interstices of the aquifer preventing flow of water

- › **Artificial Recharge through basins or wells**
- › **Bankfiltration**
- › **Aquifer Storage and Recovery (ASR)**
- › **Soil Aquifer Treatment (SAT)**

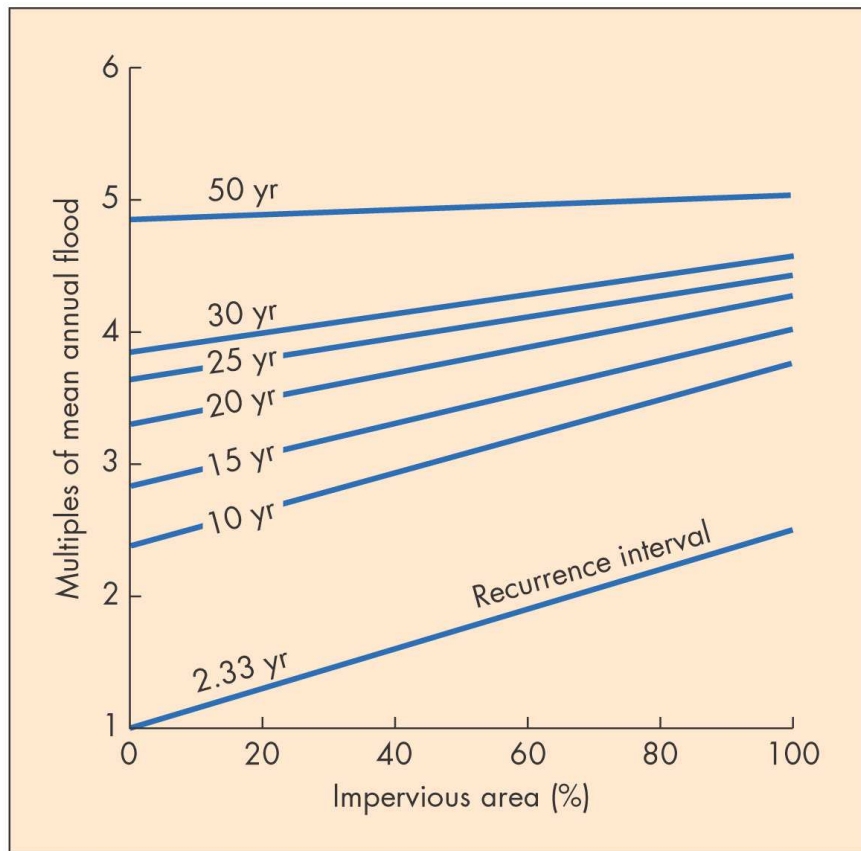
Basic components of Integrated Water Management



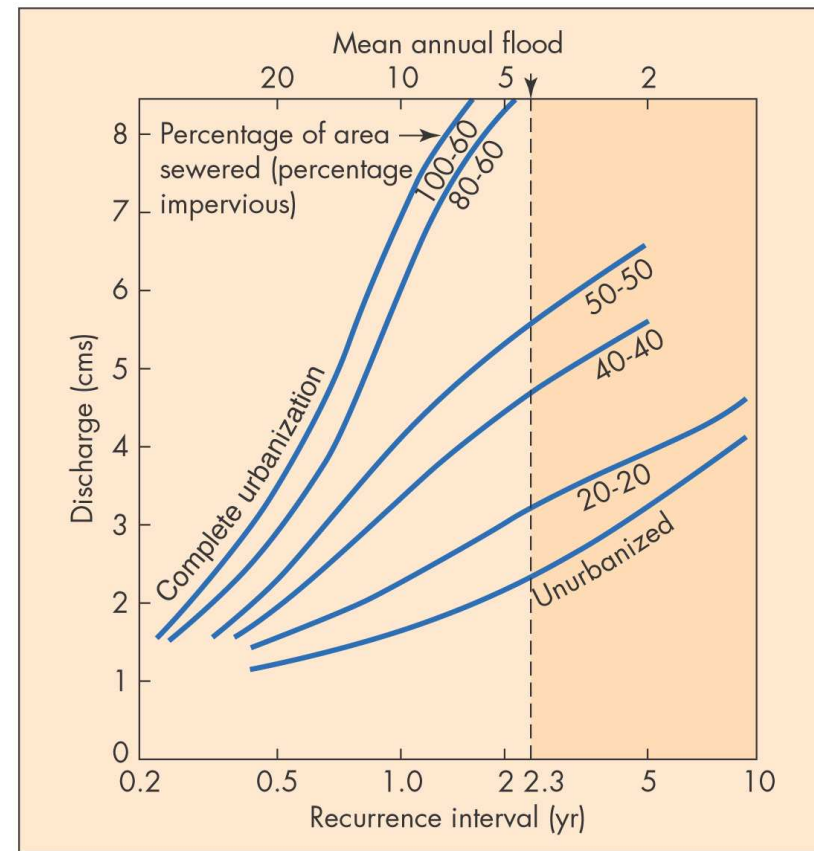
British Geological Survey

Prerequisite for groundwater recharge: INFILTRATION potential of soil

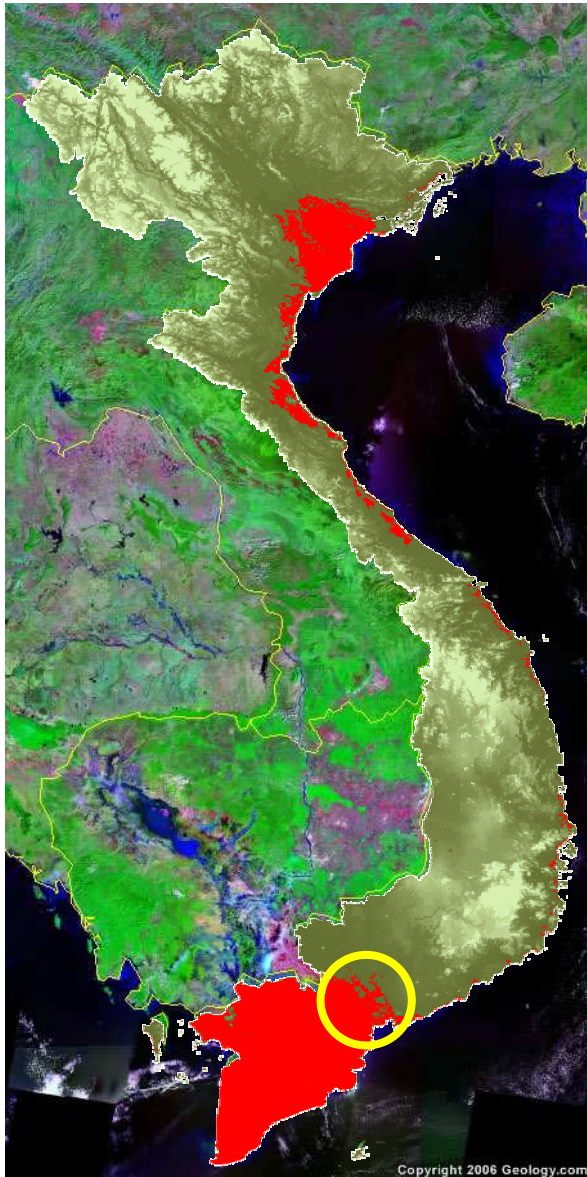
Urbanization → sealing measures → counteracts infiltration potential → impairment of flood protection



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- » 2095 km² (dense urban area 460 km²),
- » 24 districts (19+5), ca. 7,4 Mio. inhabitants (2010)
- » high urbanization pressure (infrastructure & residential area development etc.)
- » high densification → high soil sealing
- » natural soils: alluvial clayish, cohesive sediments; marine sands (infiltration potential)
- » low elevated and adjacent to the Mekong - delta river network
- » facing tidal influenced & climate change induced effects: sea level rise & change of frequency and intensity of **precipitation**

Challenges in the tropics: Case study of Ho Chi Minh City

Climatic framework: Tropical monsoon climate
» **spatially** and **temporally** variable **precipitation**:

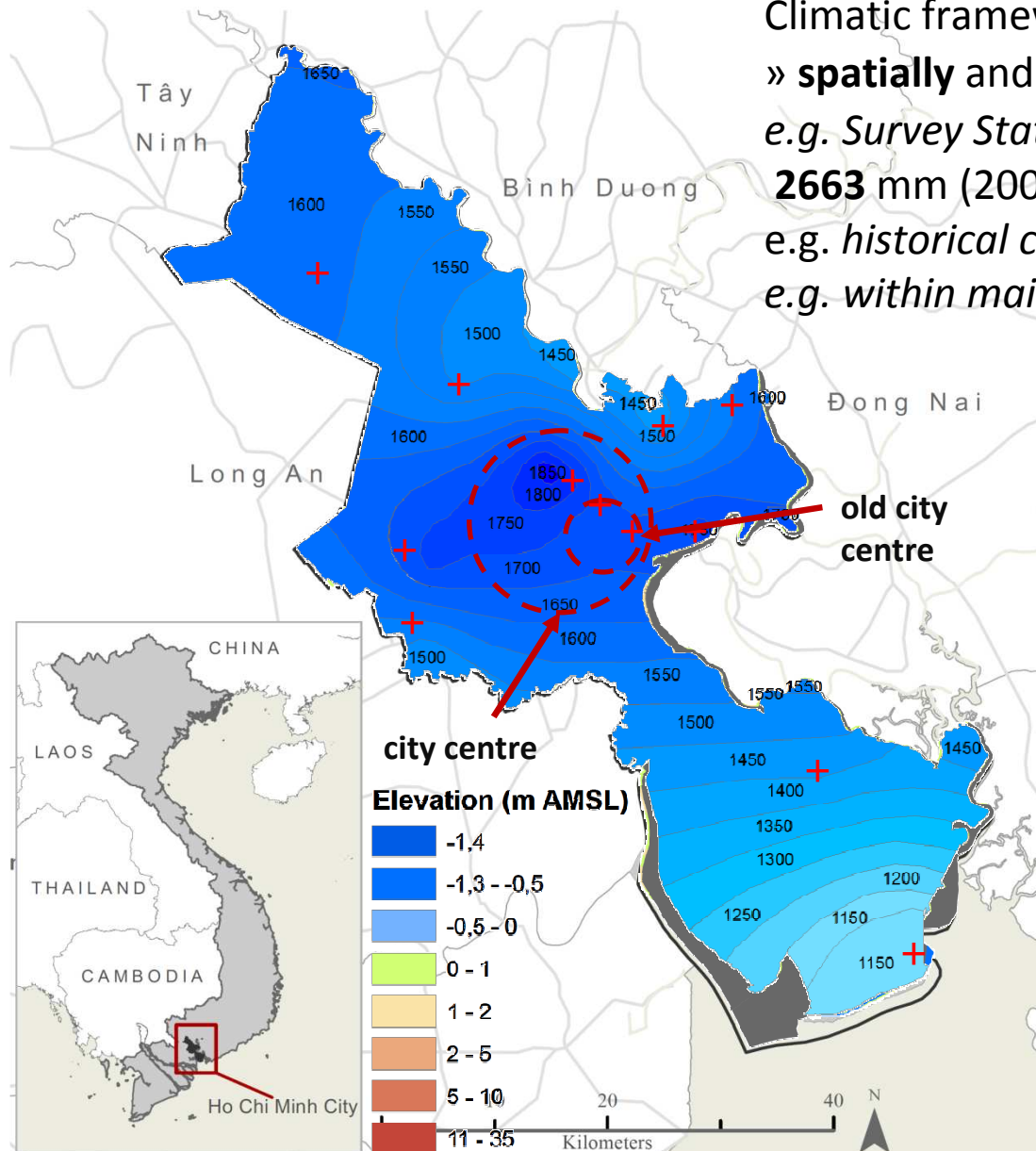
e.g. Survey Station Tan Son Hoa Airport:

2663 mm (2002) vs. 1321 mm (2000)

e.g. historical city centre: **1667 mm**

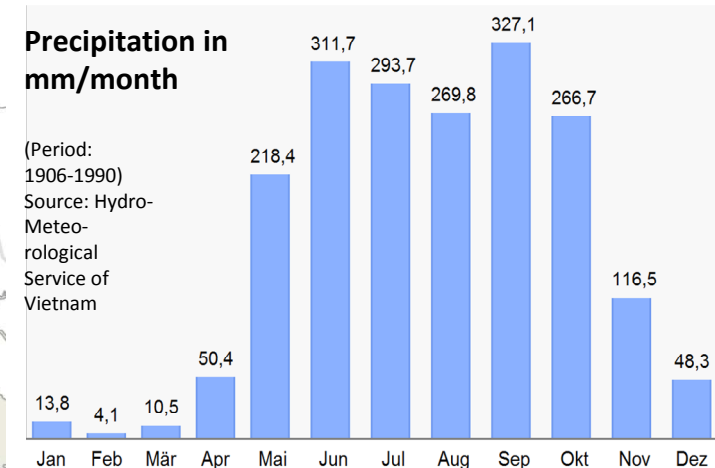
e.g. within main urban centre: **1850 mm**

(Viêt 2009)



Precipitation in mm/month

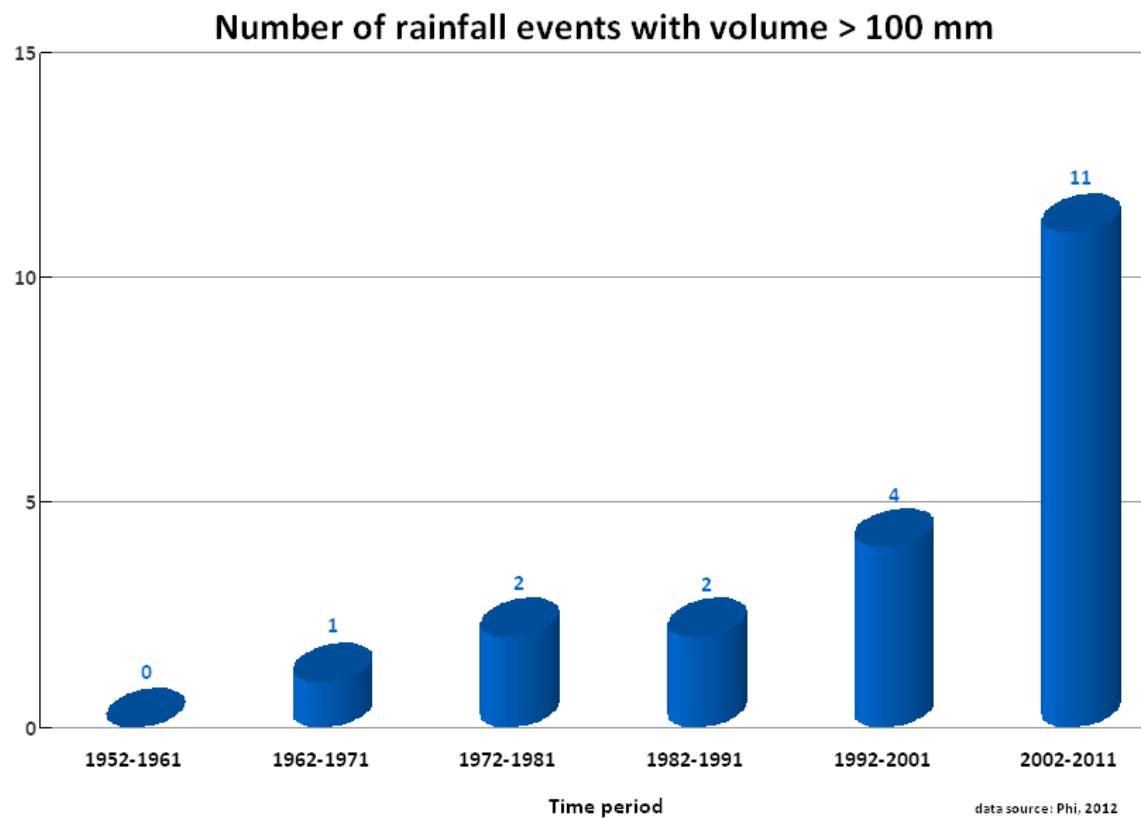
(Period: 1906-1990)
Source: Hydro-Meteorological Service of Vietnam



Ho Chi Minh City - Frequency of flooding events

	Present		2050	
	Regular flood	Extreme flood	Regular flood	Extreme flood
Number of communes affected (from a total of 322)	154	235	177	265
Area of HCMC flooded (ha)	108,309	135,526	123,152	141,885
% of HCMC area affected	54	68	61	71

Source: ADB (2010).



Ministry Of Natural Resources and Environment (MONRE) statement



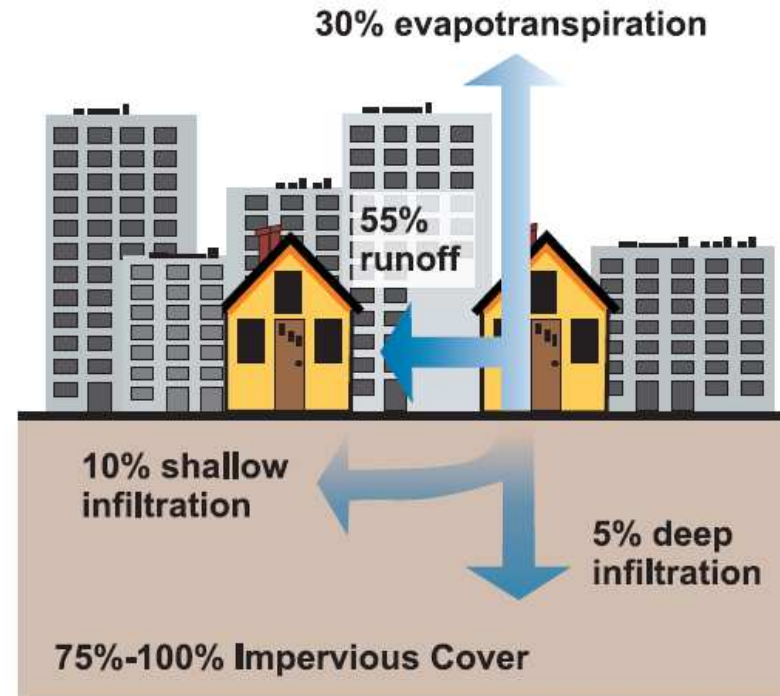
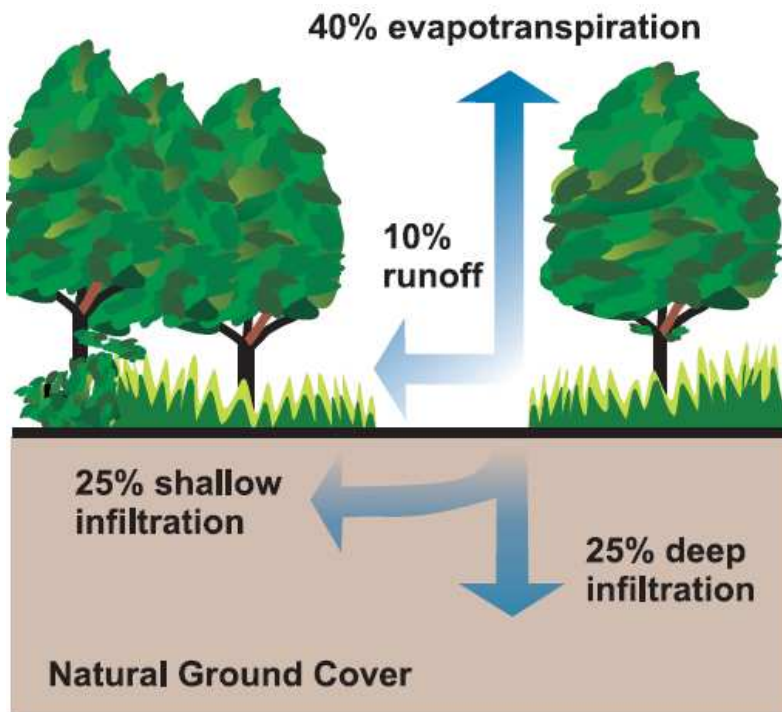
Saigon facing land subsidence, rising flood

„Saigon, which was once known as Pearl of Far East, has encountered increasing floods due to rising water and land subsidence, a result of poor urban planning and the exploitation of underground water over long periods of time.” [...]

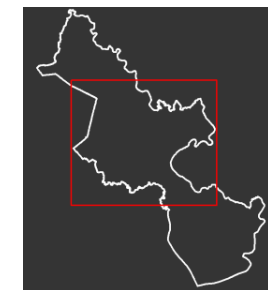
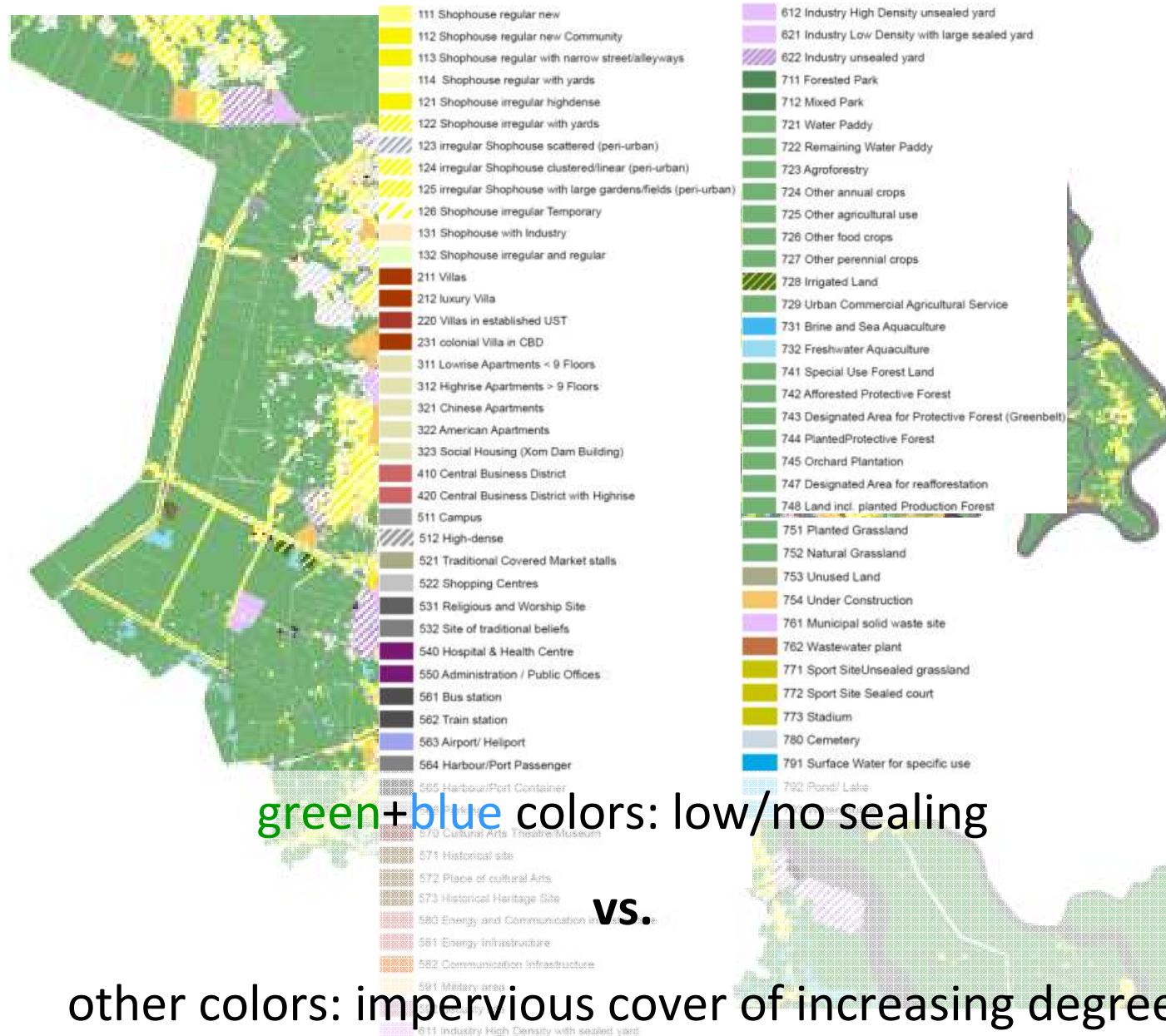


Water budget changes by land use changes...

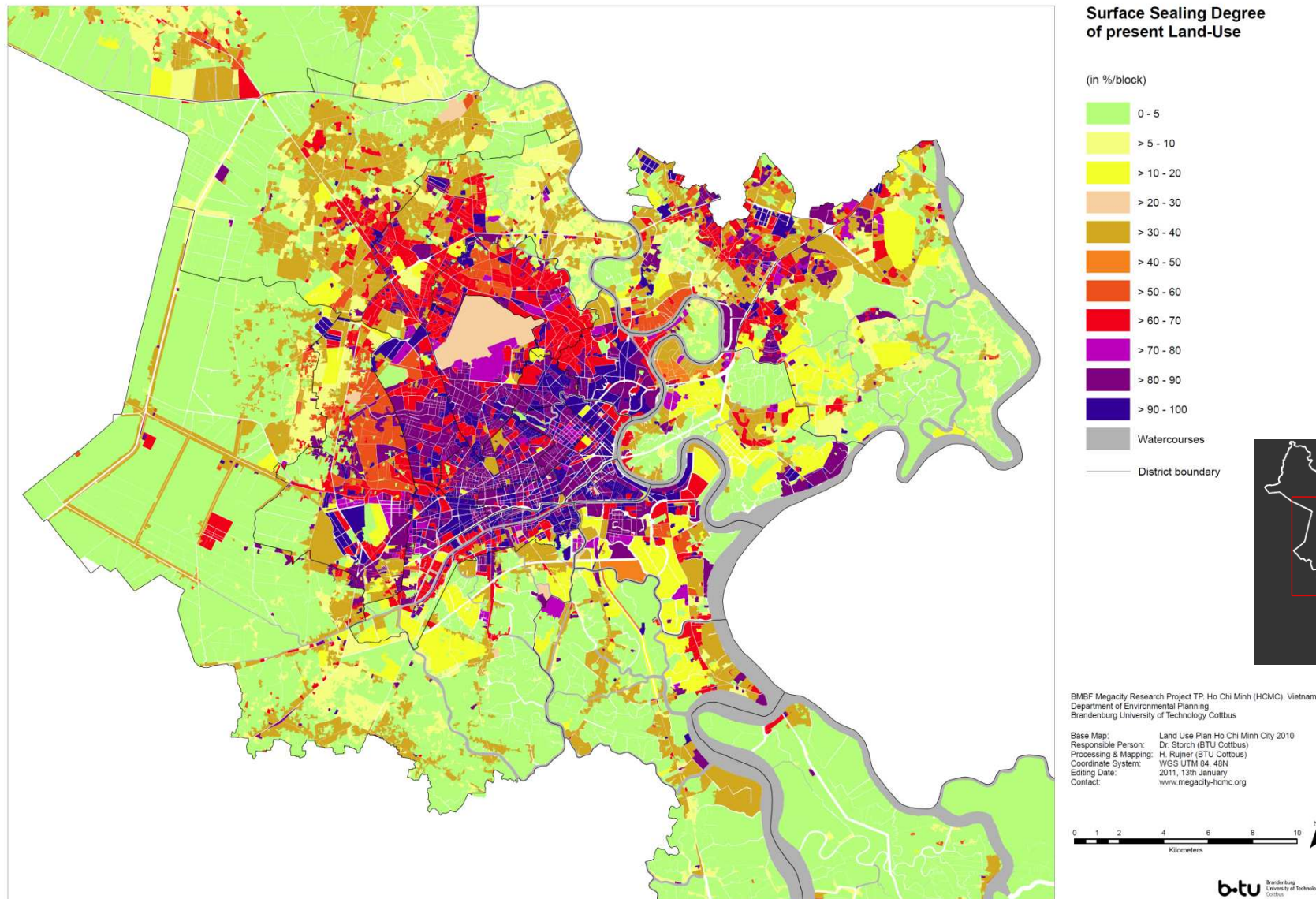
EPA, 2003



Urbanization accelerates land use changes...



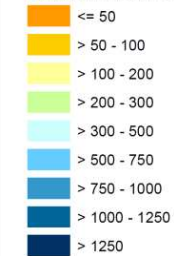
Land use changes implicate changes in imperviousness cover ratio...



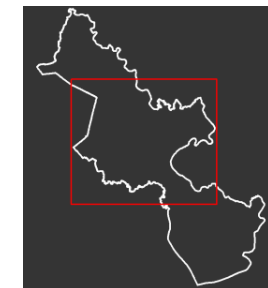
Changes in sealing degree lead to changes in water budget components...

**Water Balance Map 2/4:
Surface Run-off by Precipitation**

Long-term mean value in mm/a

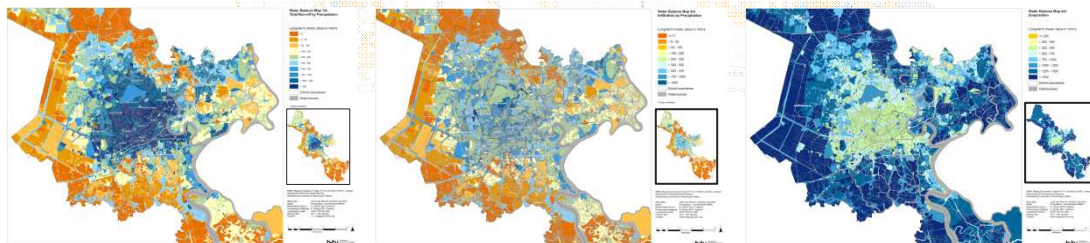
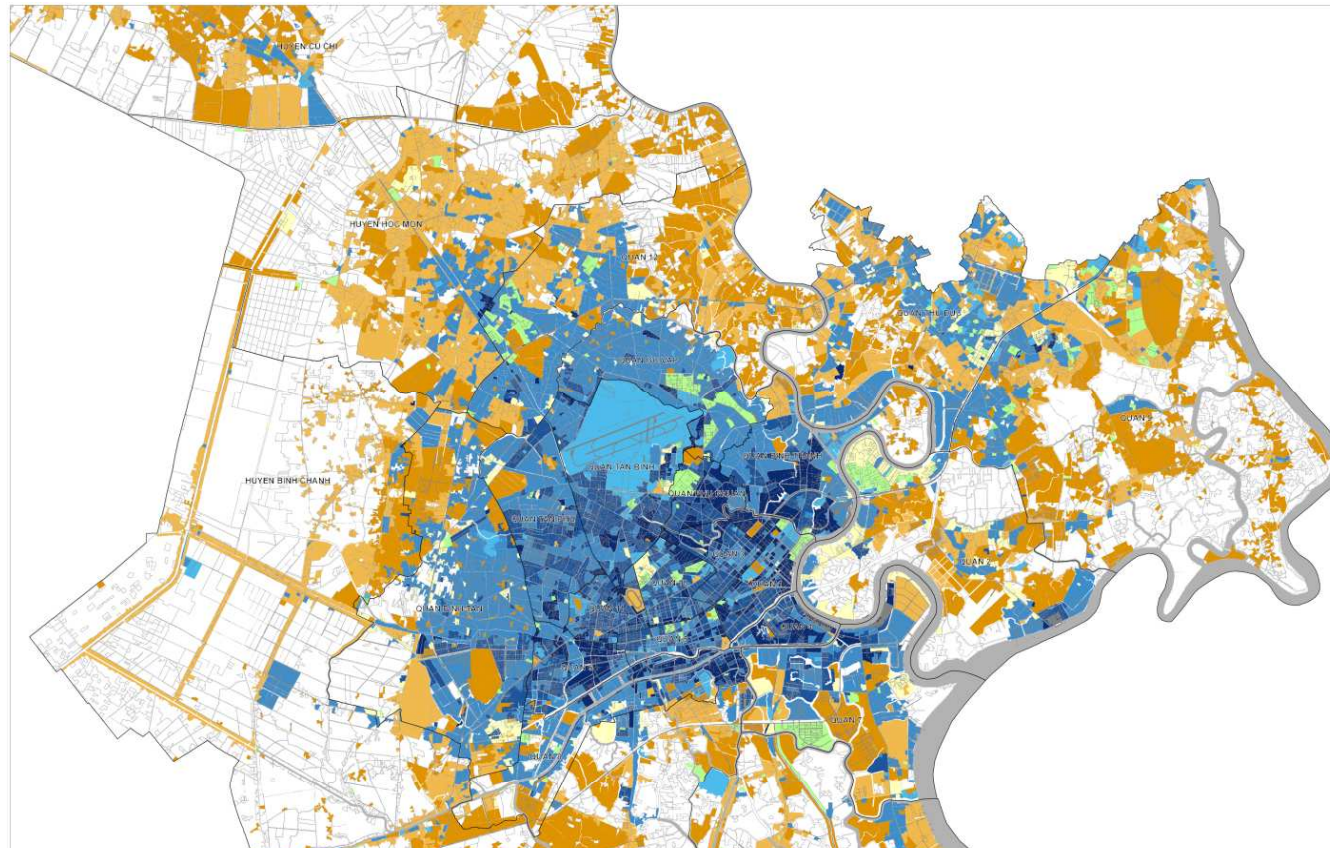
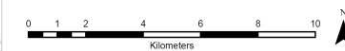


Block boundaries
District boundaries
Watercourses



BMBF Megacity Research Project TP. Ho Chi Minh (HCMC), Vietnam
Department of Environmental Planning
Brandenburg University of Technology Cottbus

Base Map: Land Use Plan Ho Chi Minh City 2010
Model: Precipitation - Runoff Model ABIMO
Responsible Person: Dr. Storch (BTU Cottbus)
Processing & Mapping: H. Rujner (BTU Cottbus)
Coordinate System: WGS UTM 54, 48N
Editing Date: 2011, 13th January
Contact: www.megacity-hcmc.org



Total Run-off

Infiltration

Evaporation

Another action field: NON-sustainable water management

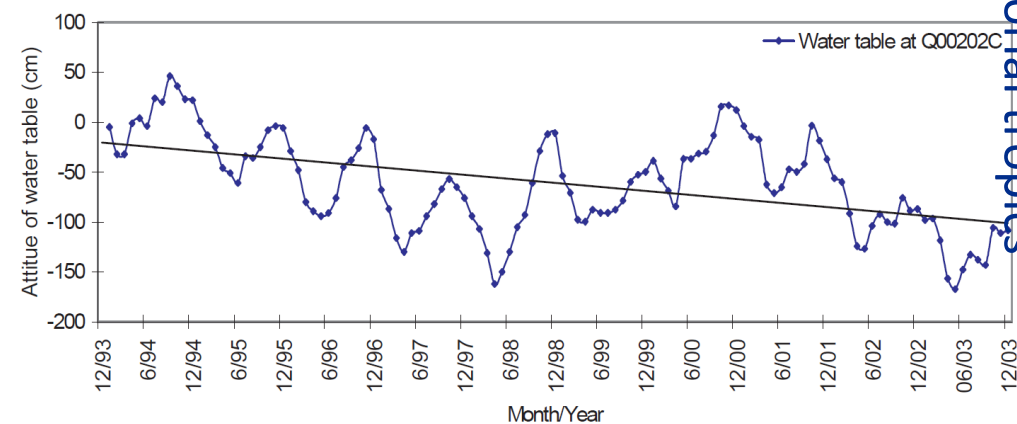
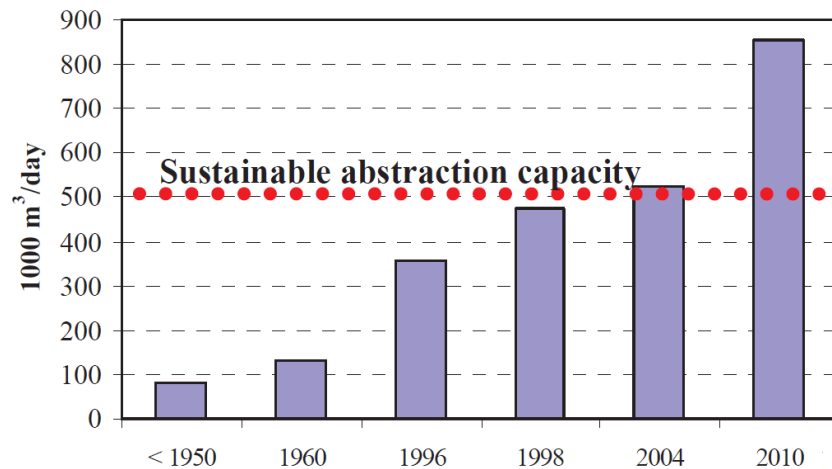
» PUBLIC water supply vs. “informal” use of groundwater

➔ OVERUSE of groundwater resources

➔ decreasing groundwater tables

➔ increasing subsidence problems

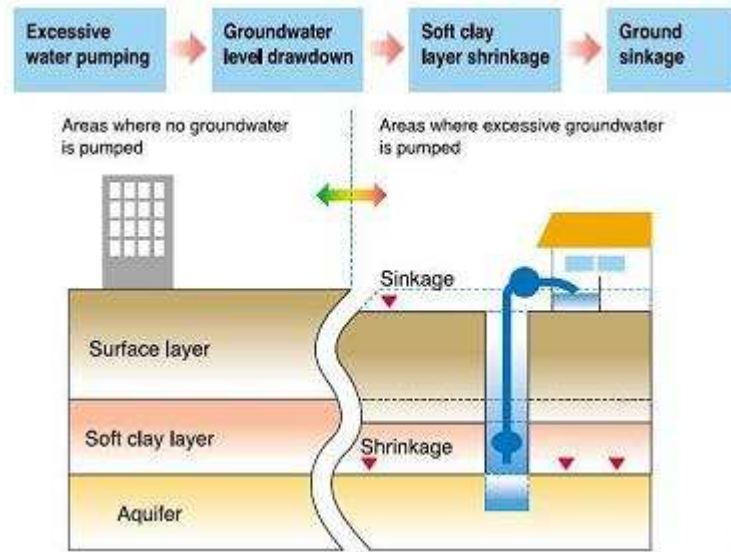
Challenges in the sub-equatorial tropics



IGES, 2006

Groundwater OVEREXPLOITATION → Subsidence effects

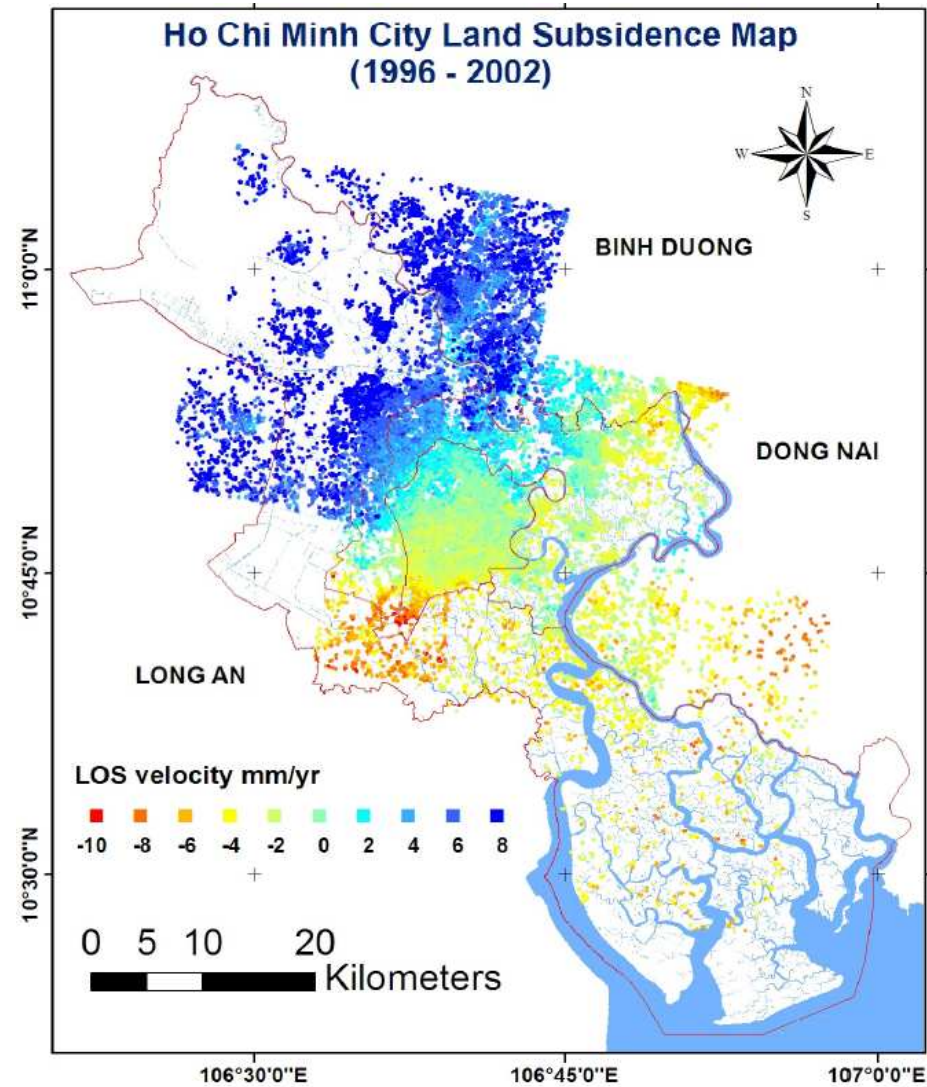
Osaka City Environment Bureau



- » average subsidence rate in HCMC
→ 2 to 2.5cm/a (normal: 0.1-0.6cm/a)
- » (Phi,2012)



Photo: Tuoi Tre



Dinh, 2010

Challenges in the sub-equatorial tropics

Urban Development Scenarios for Ho Chi Minh City

Future scenarios for Ho Chi Minh City



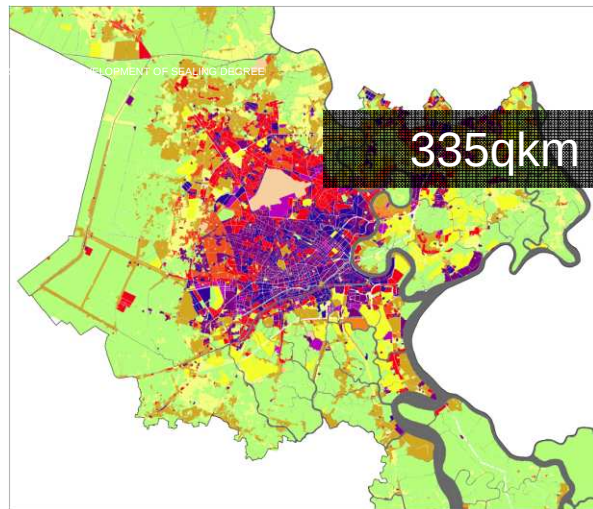
annalisasjofalk.wordpress.com



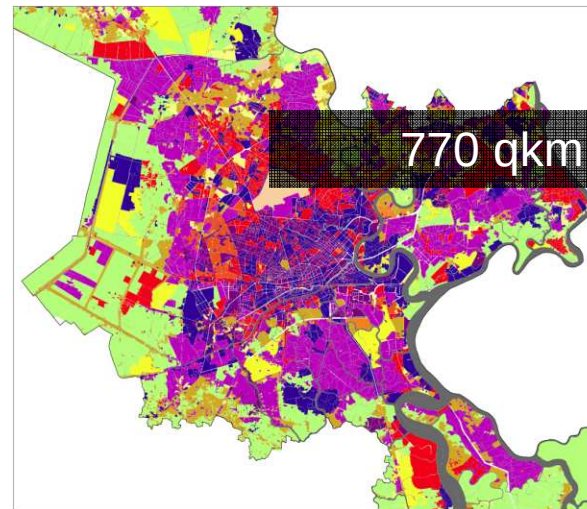
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URBAN DEVELOPMENT SCENARIO for Ho Chi Minh City

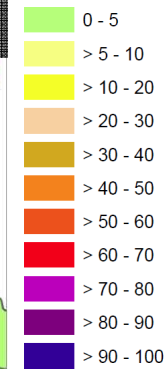
Future scenarios for Ho Chi Minh City



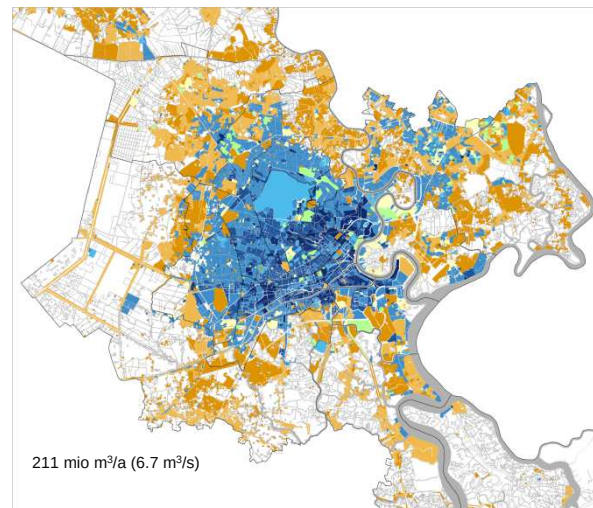
current situation



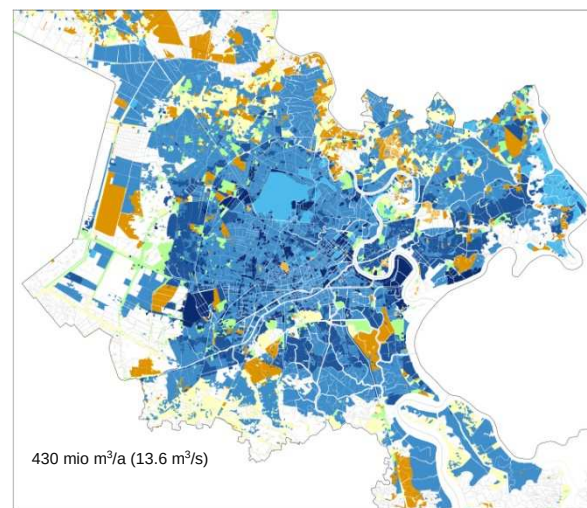
planned up to 2025



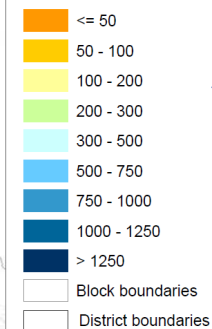
sealing
degree



211 mio m³/a (6.7 m³/s)

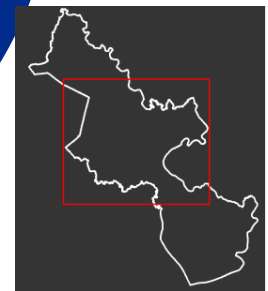


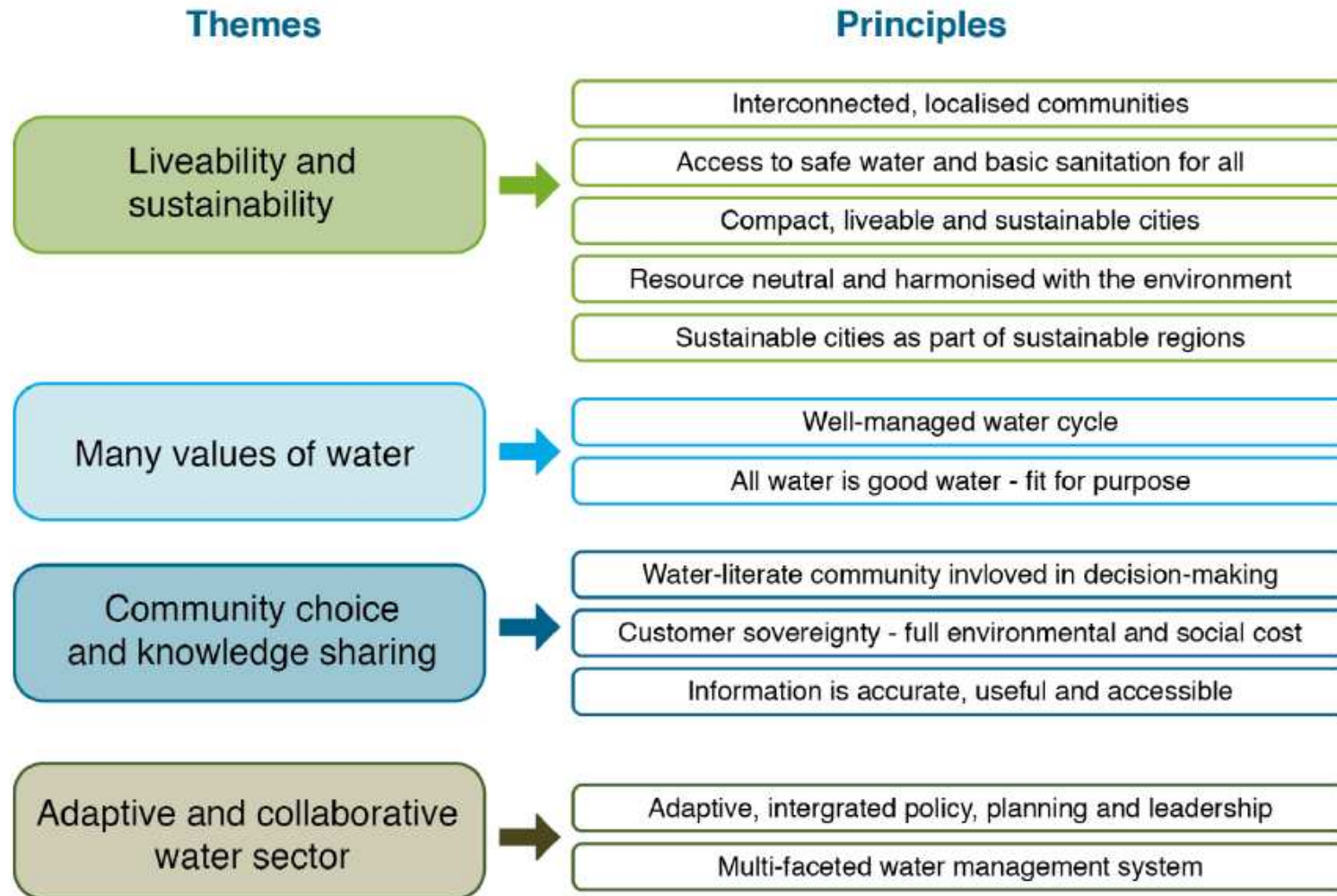
430 mio m³/a (13.6 m³/s)

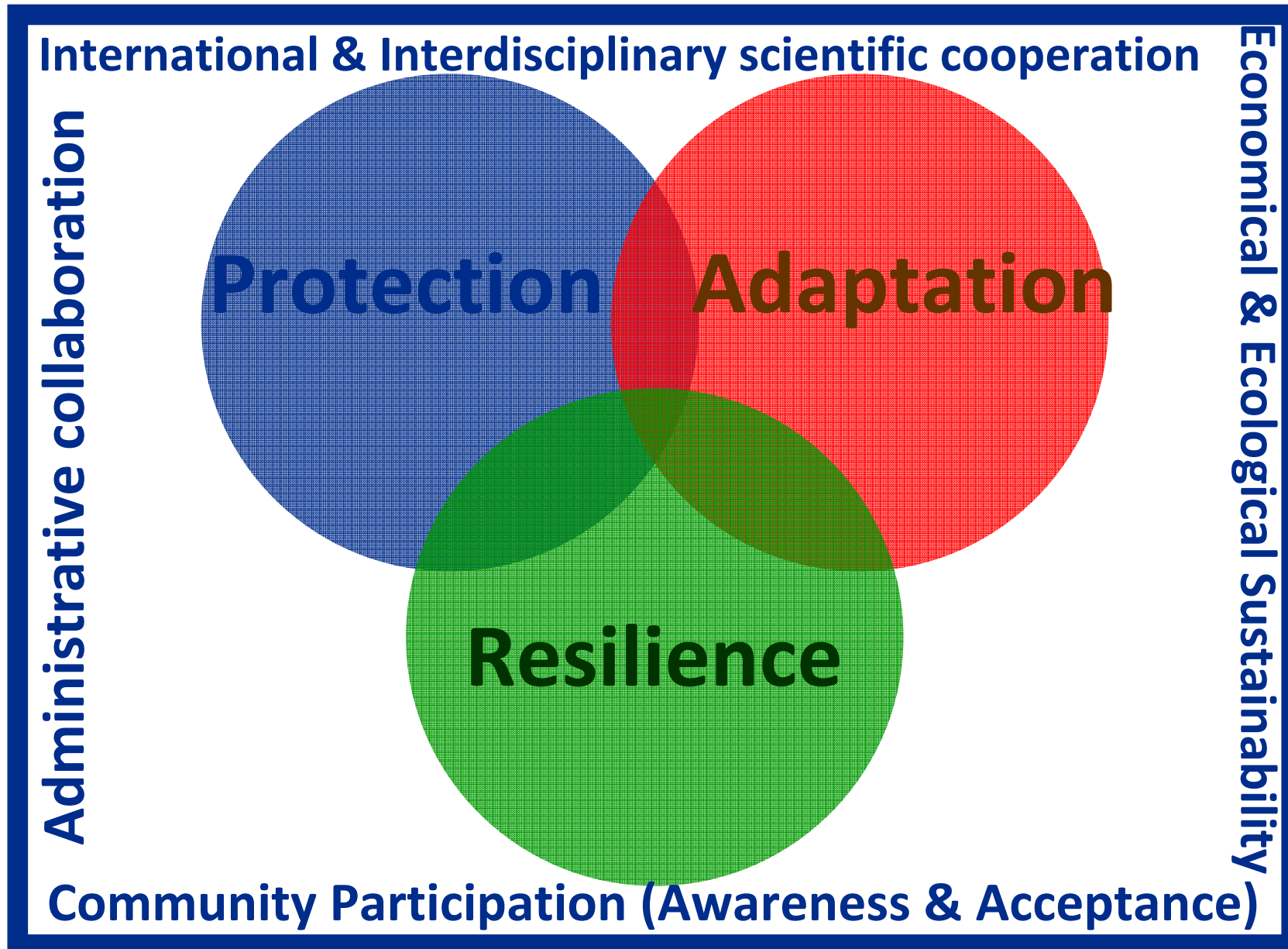


surface
run off

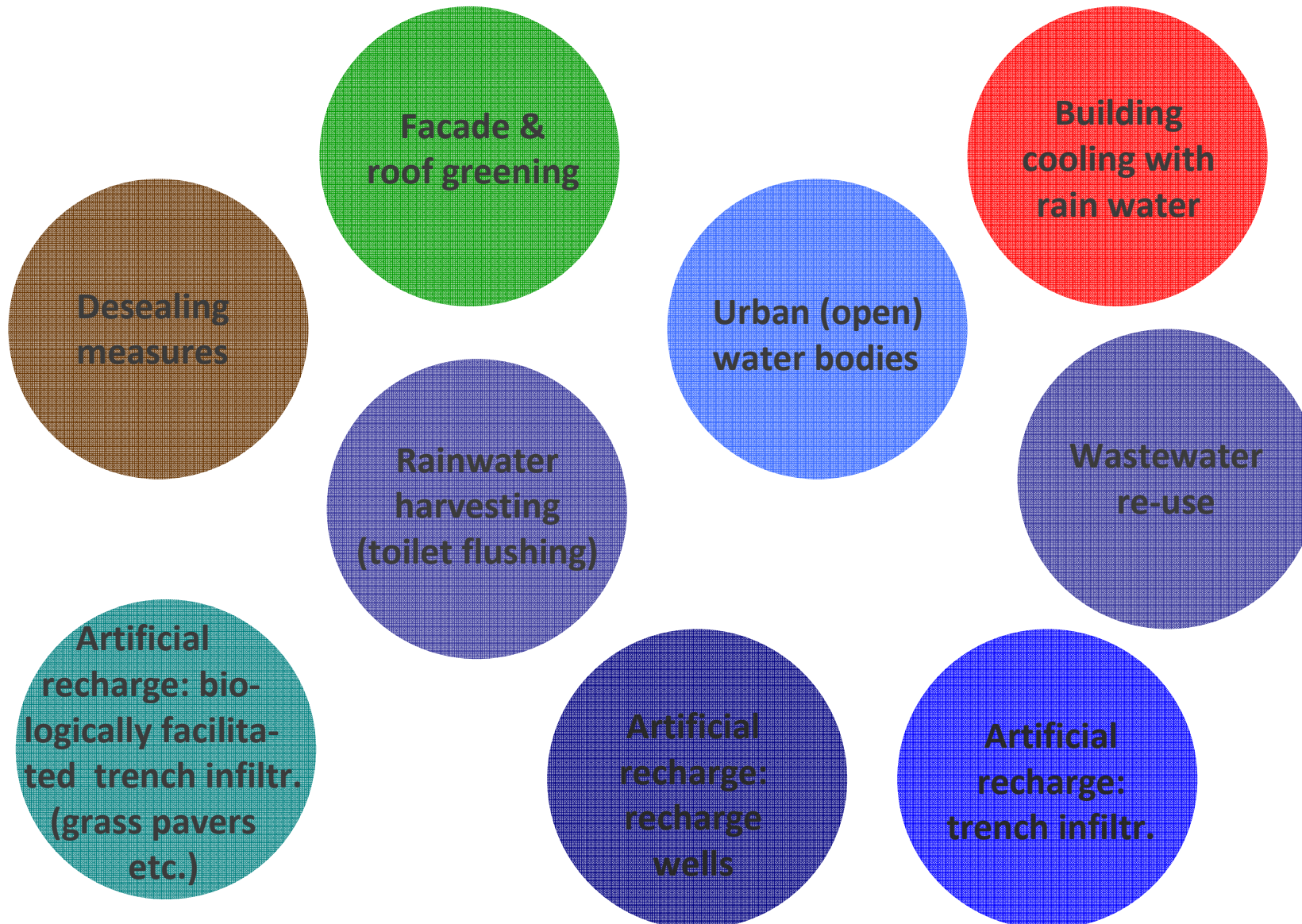
Rujner, 2011







Selection of adaptation measures for flood protection



Rainwater harvesting for stormwater management



Rainwater Collection in Multistoried Roofs

Rainwater harvesting and subsequent infiltration → Groundwater recharge



combined system of

shade provider

rain shelter

water collector

→ **targeted water
flow into**

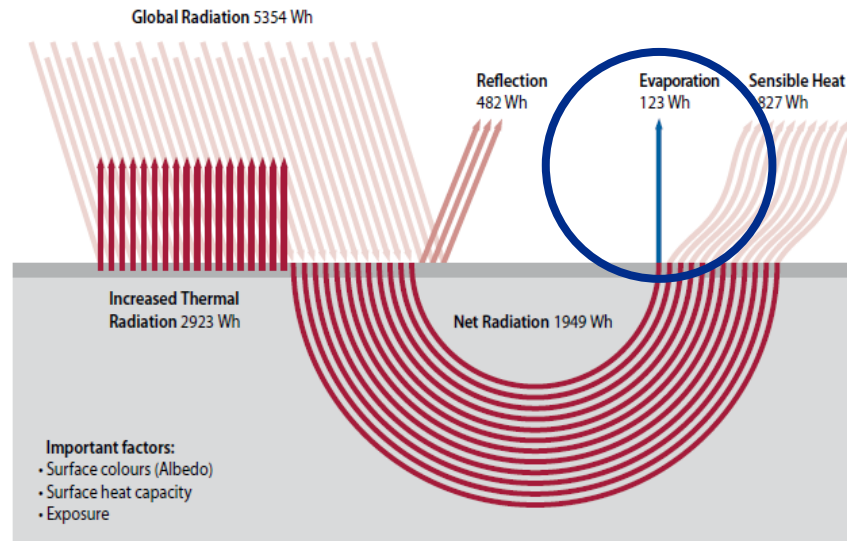
infiltration trenches

→ **on-site system for
direct recharge**

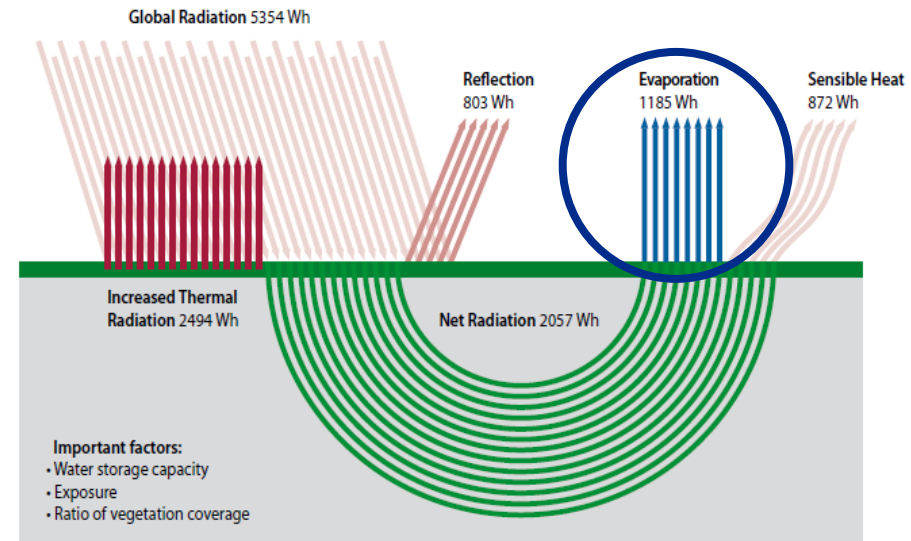
(small scale)

Green roofs - city (building) cooling → energy efficient comp. to AC

"Bitumen roof"



Extensive roof greening



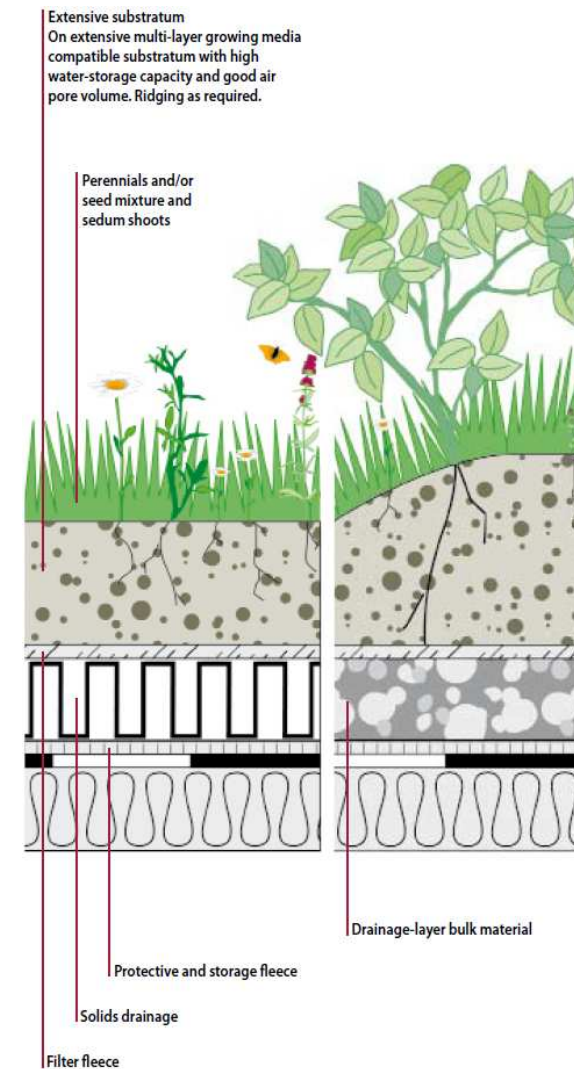
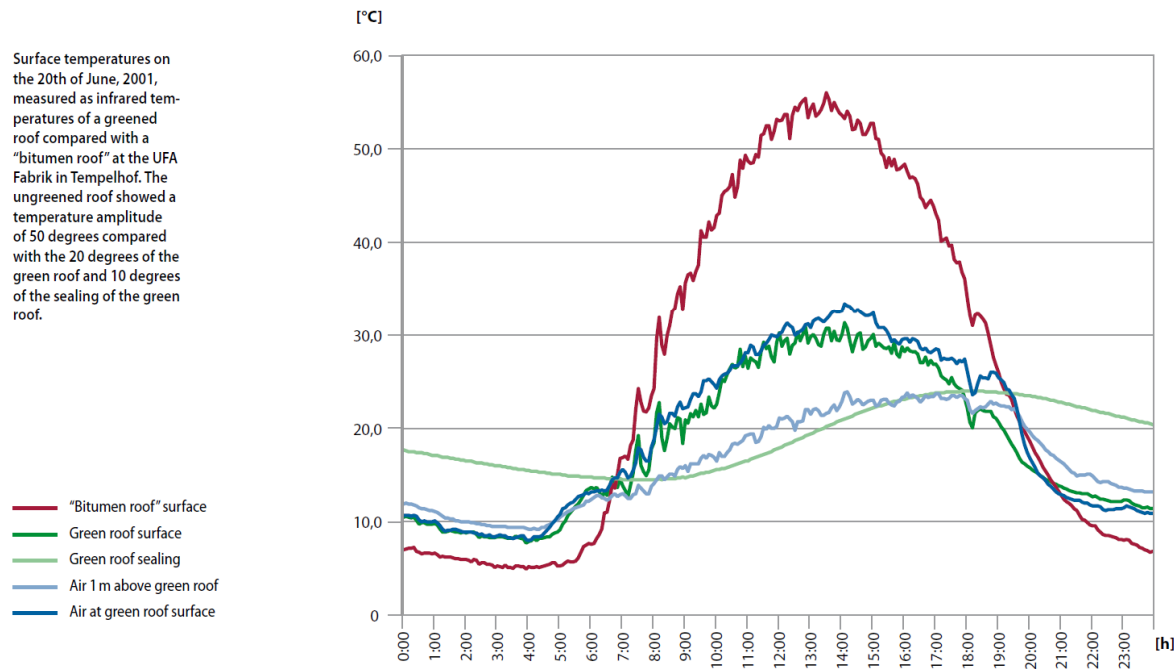
Schmidt, 2012



Berlin Senate for Urban Development, 2010

Green roofs - Heat buffer and active building cooling function

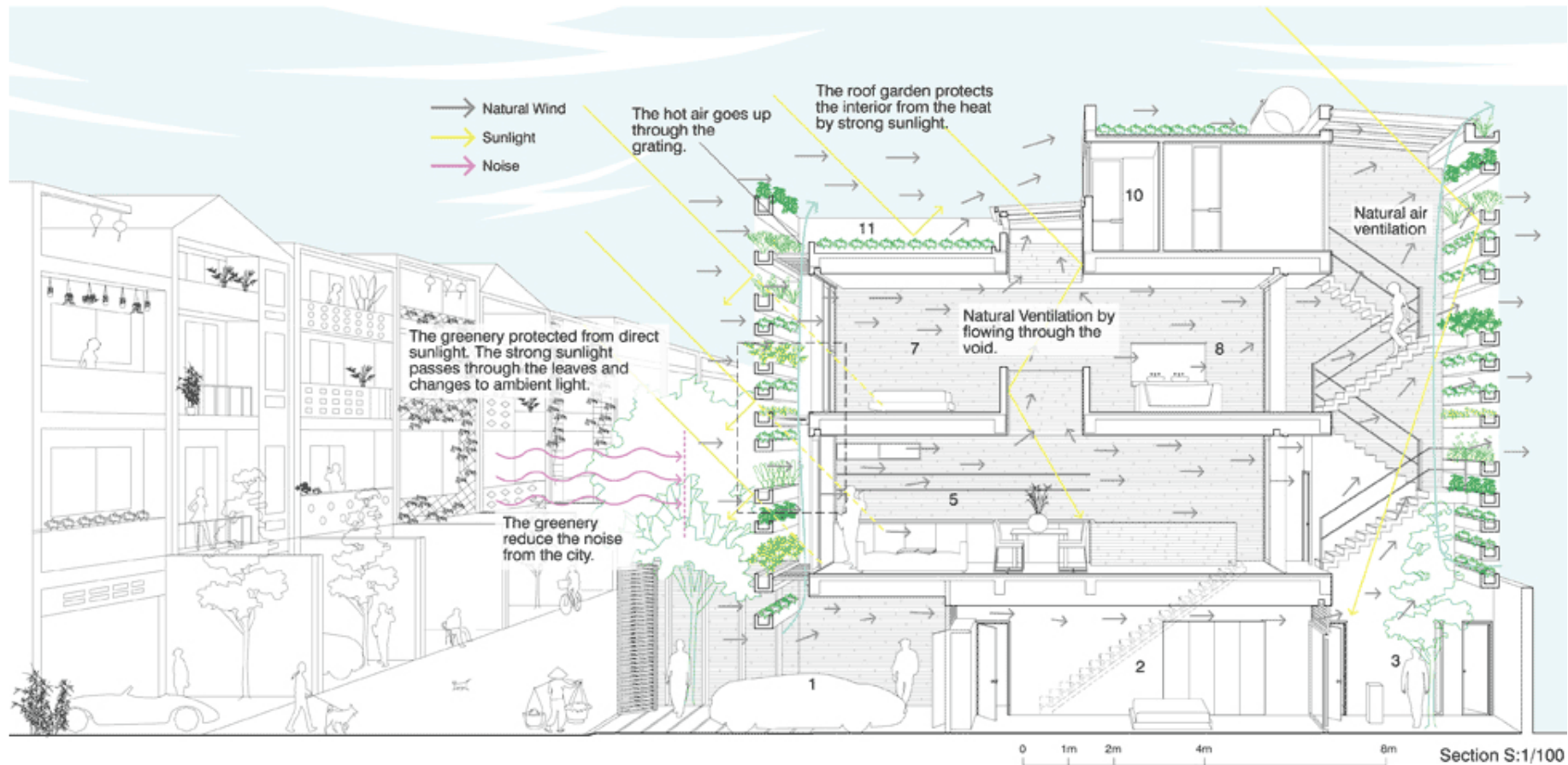
Temperature range on 20.06.2001 at the UFA Fabrik in Tempelhof, Berlin



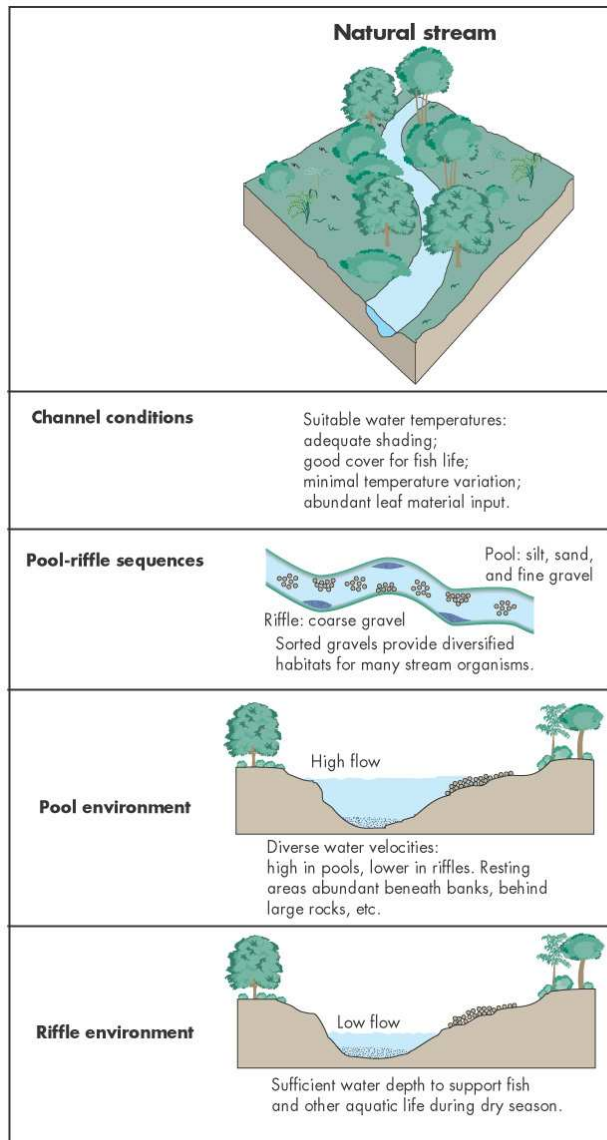
Green roofs - Pilot shophouse “Ha House” in Ho Chi Minh City (District 2)



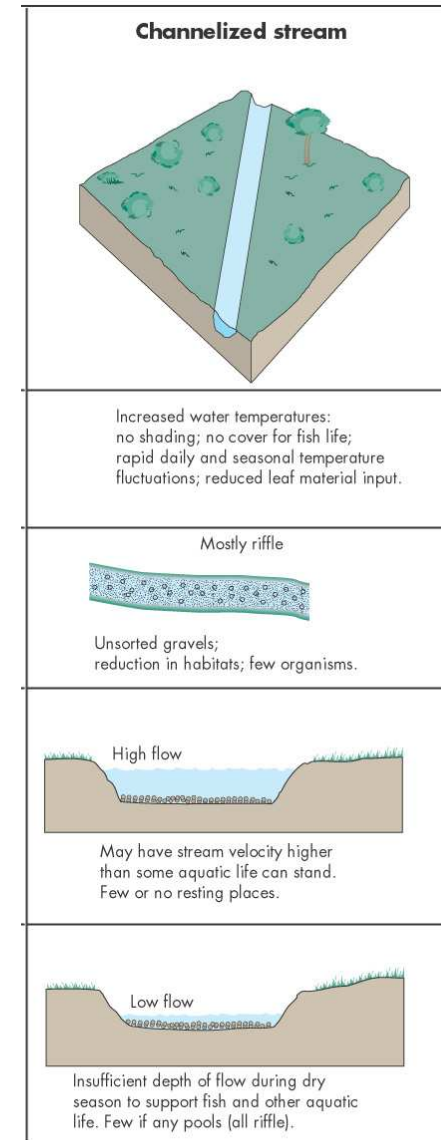
Green roofs - Pilot shophouse “Ha House” in Ho Chi Minh City (District 2)



Re-Establishing natural surface water conditions



Run Off
<
Infiltration
>
Evaporation
>
Temperature
<
Biodiversity
>
Recreation
>



Active, Beautiful, Clean Waters (ABC Waters) Programme of the Public Utilities Board, Singapore



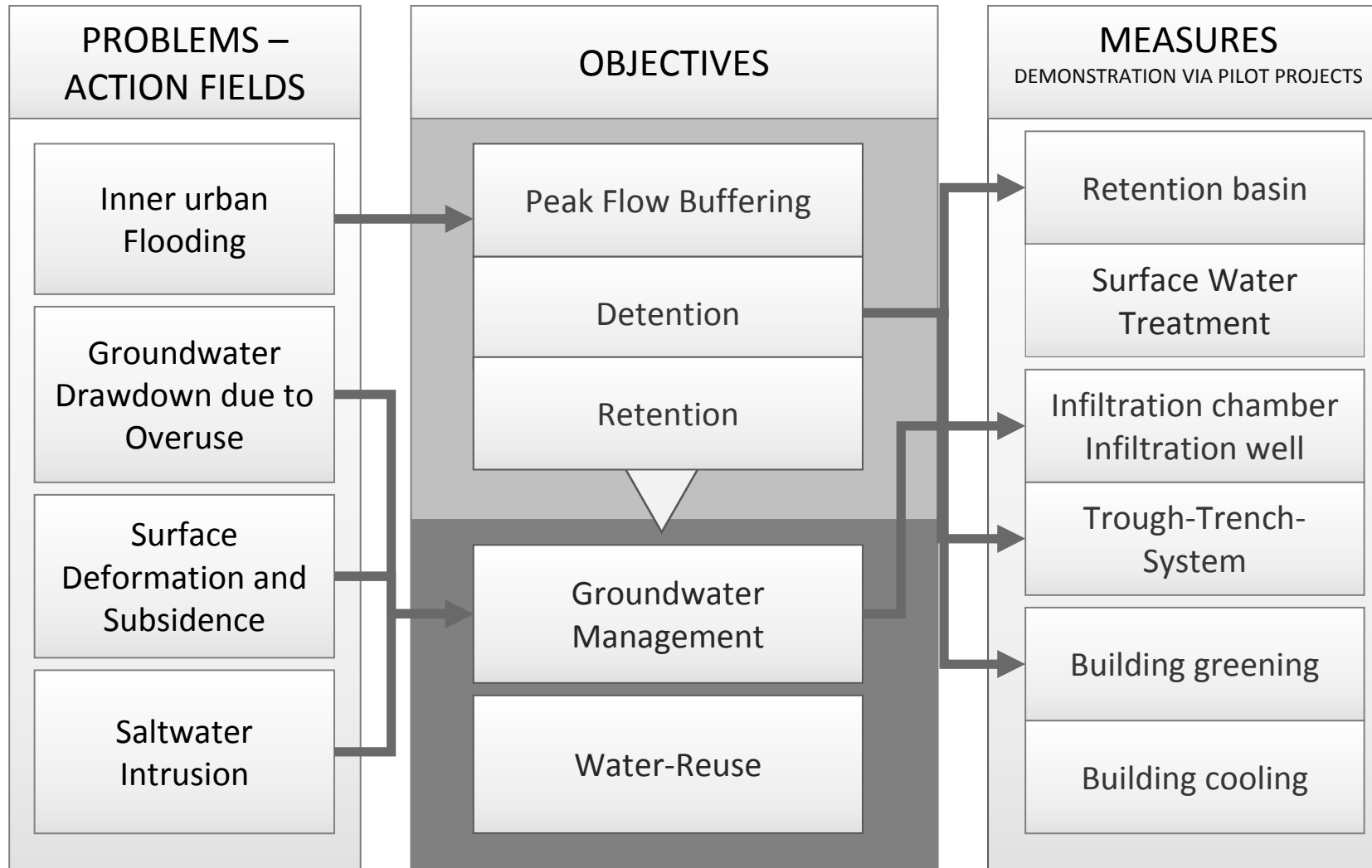
“smart combination of water source, flood management, biodiversity, recreation”



Re-Development site: Kallang River-Bishan Park, Singapore



Problem-oriented solution finding for urban water management



INTEGRATED URBAN WATER MANAGEMENT

» project planning → construction measures etc. → information need

Necessary framework conditions for water management set up

COMPONENT	VALUE	REQUIRED PARAMETER
PRECIPITATION	urban precipitation distribution	long-term mean precipitation (mm/time; depends on seasons)
EVAPOTRANSPIRATION	local climate factor	potential evaporation
	soil water availability	usable field capacity (0-30cm/ 0-150cm)
	connection to groundwater	Groundwater table depth
	utilisation specific evaporation coefficients	land use type urban structure type
EVAPORATION / RUN-OFF	imperviousness	soil sealing built-up, soil sealing non-built-up /traffic spaces coating classes non-built-up/traffic spaces
RUN-OFF	drainage system	connection to drainage, drainage connection degree

INTEGRATED URBAN WATER MANAGEMENT

» comprehensive historic, current and future monitoring !

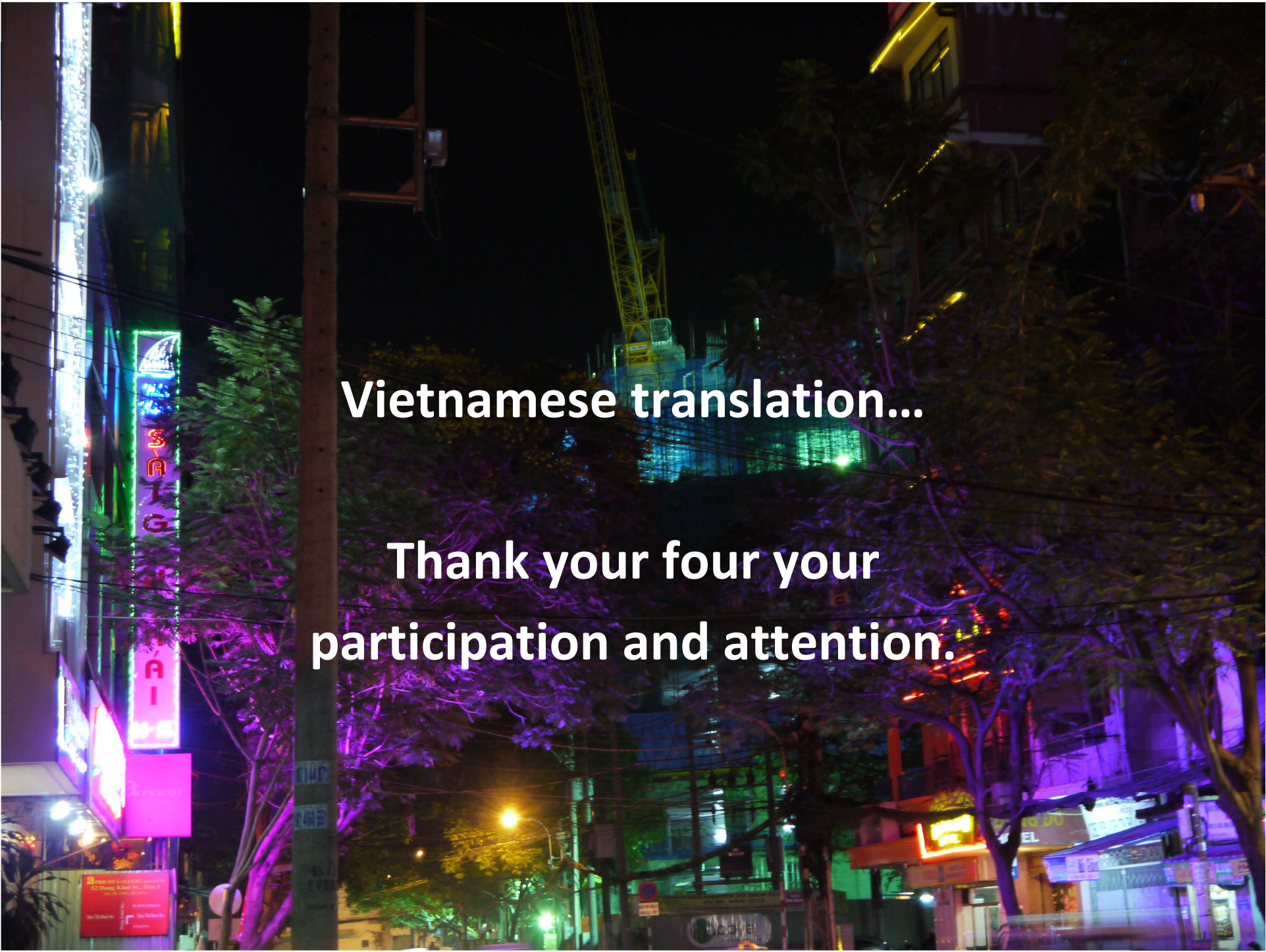
- » **awareness for changes of natural water budget by**
 - » urbanization (pressure, degree etc.)
 - » water abstraction (type, volume etc.)
 - » climate change (global & local)
 - » **determination of challenges**
 - » water need vs. water availability
 - » local climatic conditions
 - » data need
 - » **adaptation of state-of-the-art technologies**
 - » international collaboration (knowledge exchange)
 - » construction by local companies
 - » **sustainable operation of water management systems**
 - » capacity building, parameter monitoring, R&D
-
- ➔ **offers chance of re-balance of natural systems**
 - ➔ **offer sustainable urbanization - at least on the water sector**

Outlook: Sustainable Urban Development for Ho Chi Minh City? !



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PC of HCMC: Competition for Conceptual Urban Design for Ho Chi Minh City
Key Design Theme: "Preservation and Development in Balance"

A nighttime photograph of a city street in Vietnam. On the left, a building features a vertical neon sign with the word 'SAIGON' in red and green letters. Below it, there are other illuminated signs, including one with the letters 'A I' in red. In the background, a yellow construction crane is visible against the dark sky. The street is lined with trees, and various other lights and signs are visible in the distance, creating a vibrant urban scene.

Vietnamese translation...

**Thank you for your
participation and attention.**