Urban Water Management

Within the module:
Ecology and Water Resources
Summer 2012

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Institut für Wasserwirtschaft,
Hydrologie und
landwirtschaftlichen Wasserbau
Leibniz Universität Hannover

Part 5

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Overview

Contents today: Drainage (continued)

Storm water management

- best management practices
- source control
- real time control

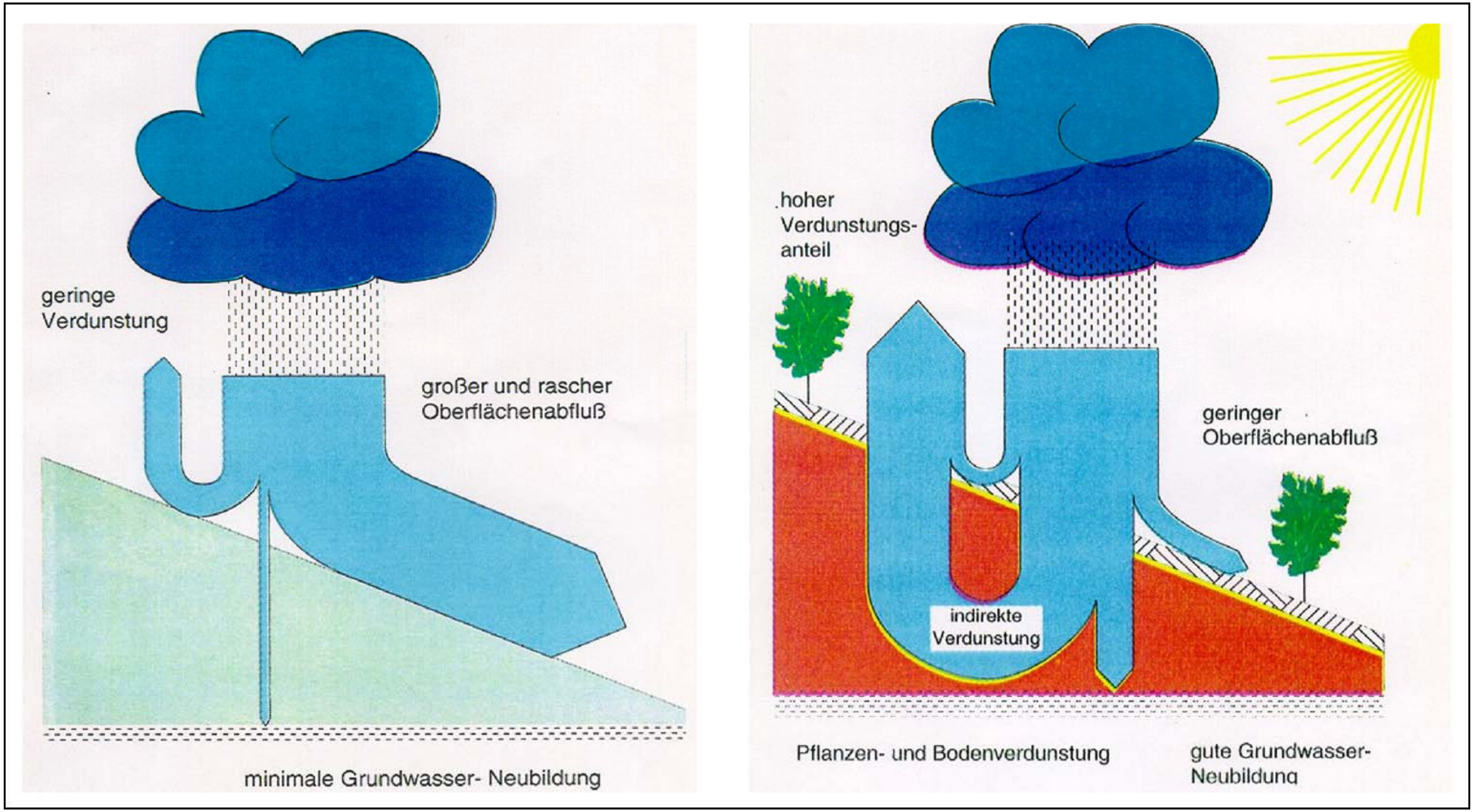
Stormwater management

- Traditional: Stormwater ***disposal***
  - ⇦ Hydraulic stress and pollution for receiving waters
  - ⇦ Alleviation: “end of the pipe” solutions

- Today : Stormwater ***management***
  - ● Best management practices
  - ● Source control
  - ⇦ Back towards the natural water cycle by increasing infiltration and evaporation
  - ⇦ Reduction of total runoff as well as peak flow
  - ⇦ Exploit infiltration potential as far as possible

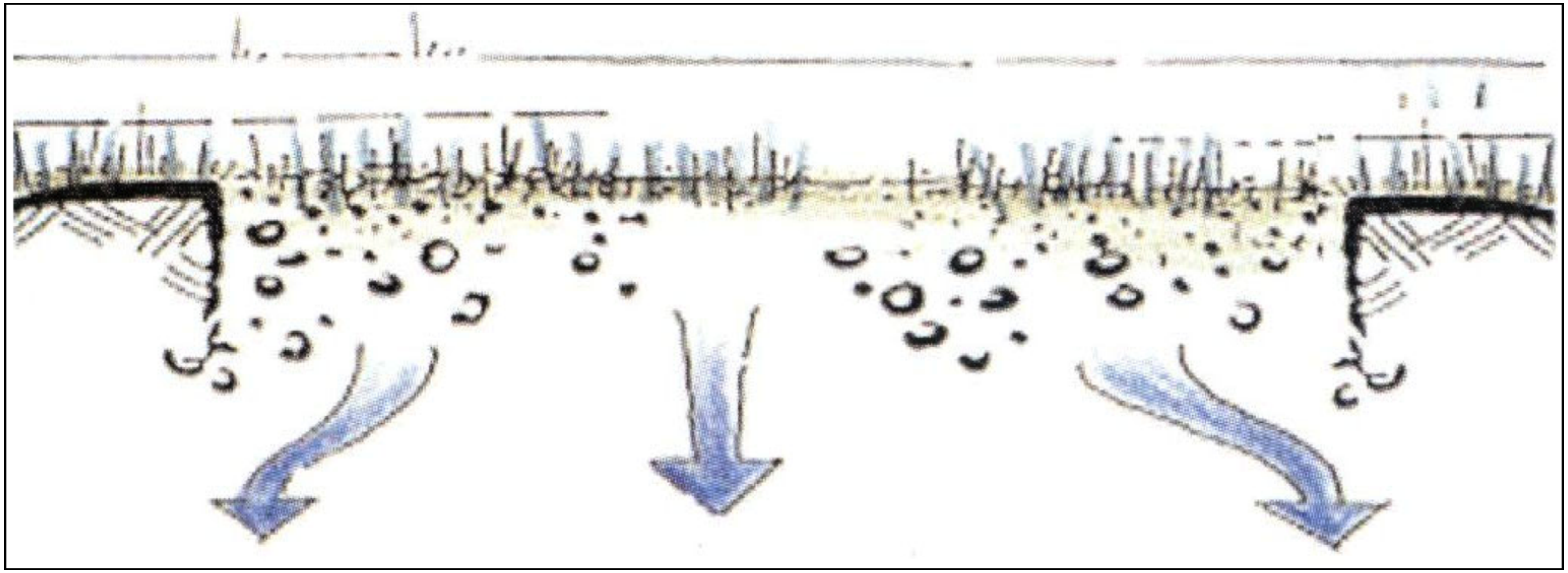
Stormwater management

Runoff from natural and impervious areas



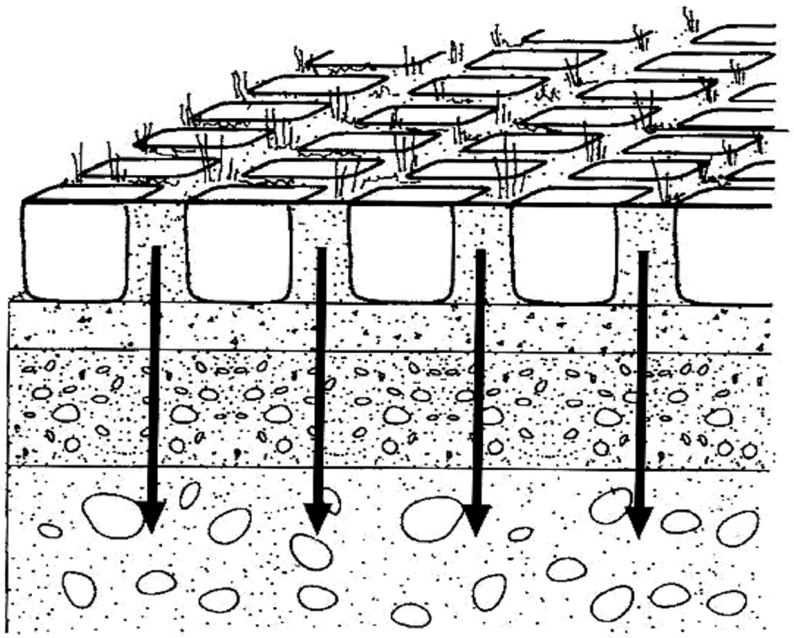
Stormwater management

Surface infiltration



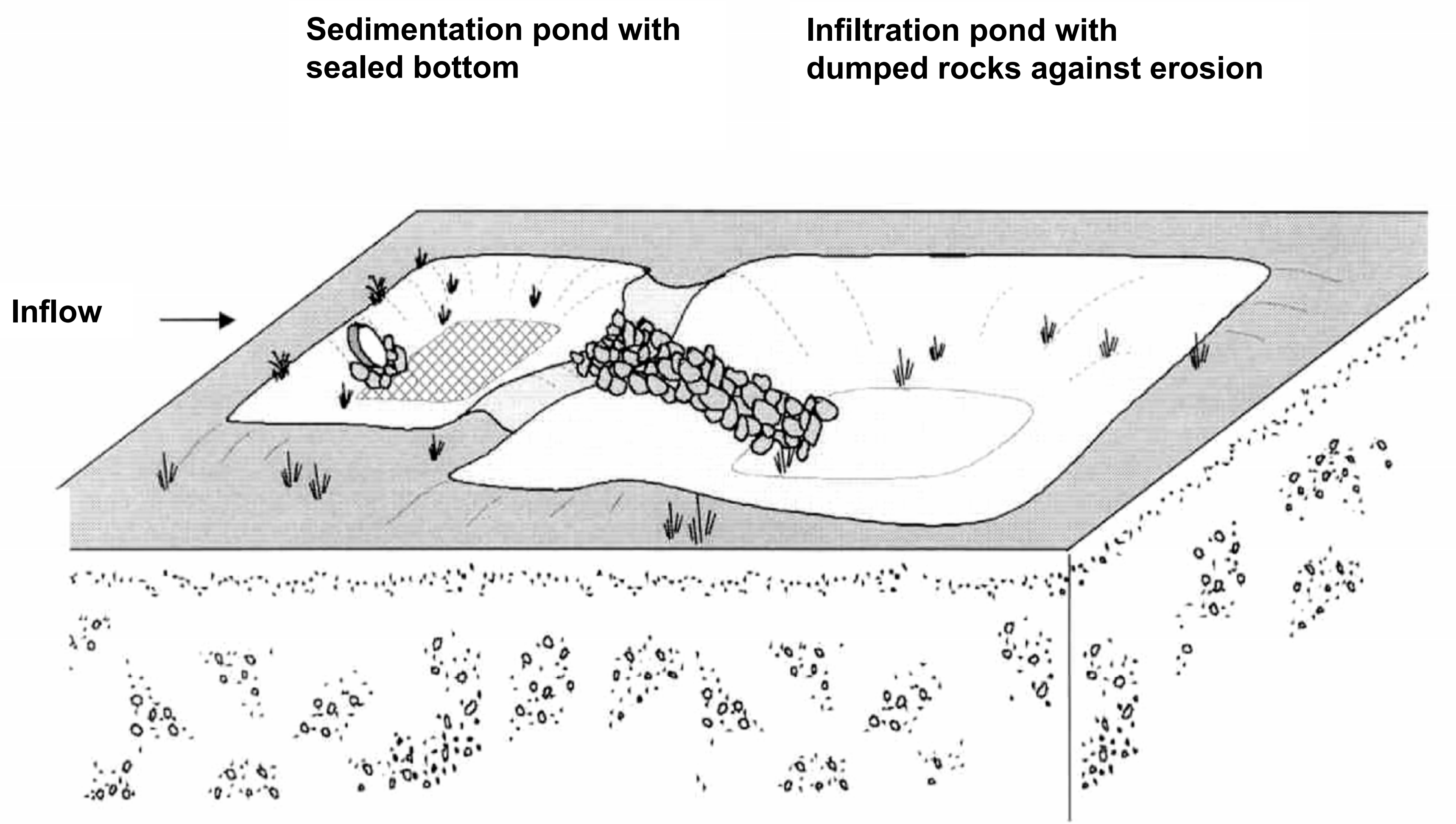
Stormwater management

Pervious paving: stones and wide joints



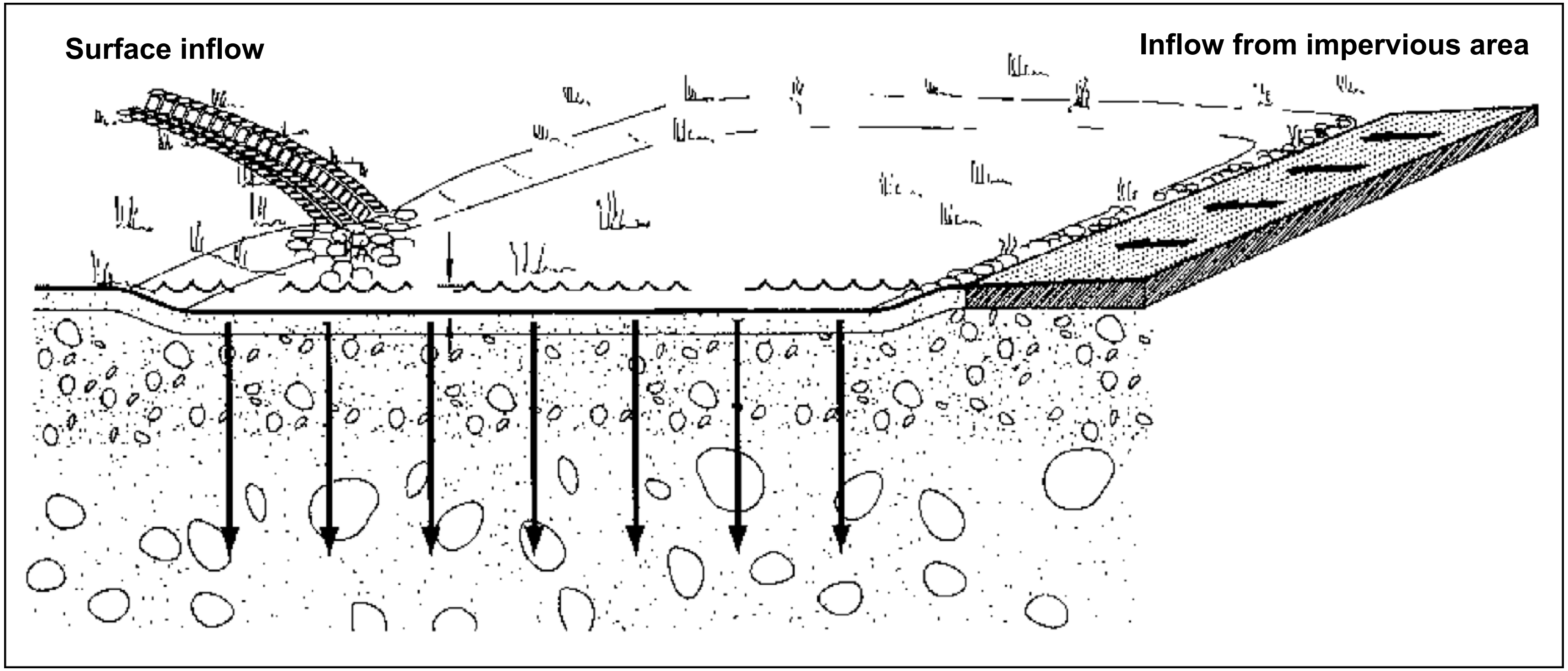
Stormwater management

Infiltration pond



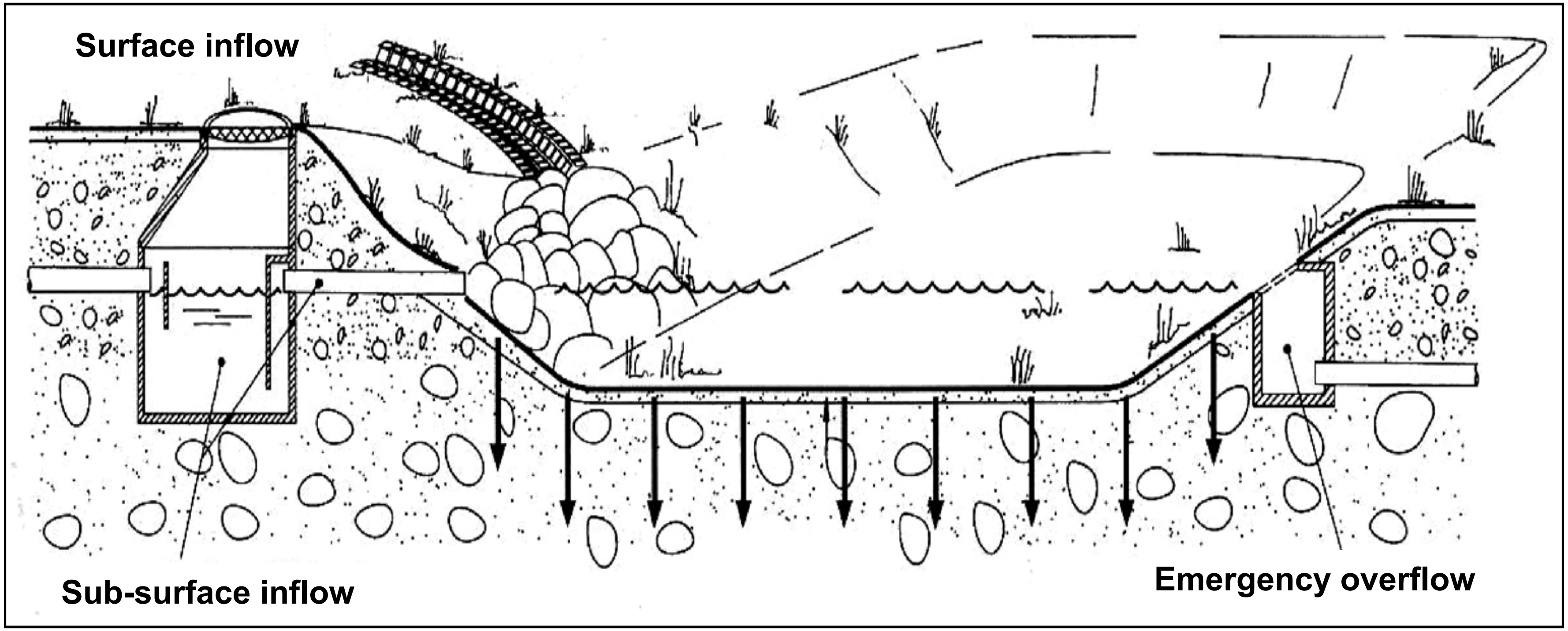
Stormwater management

Swale infiltration



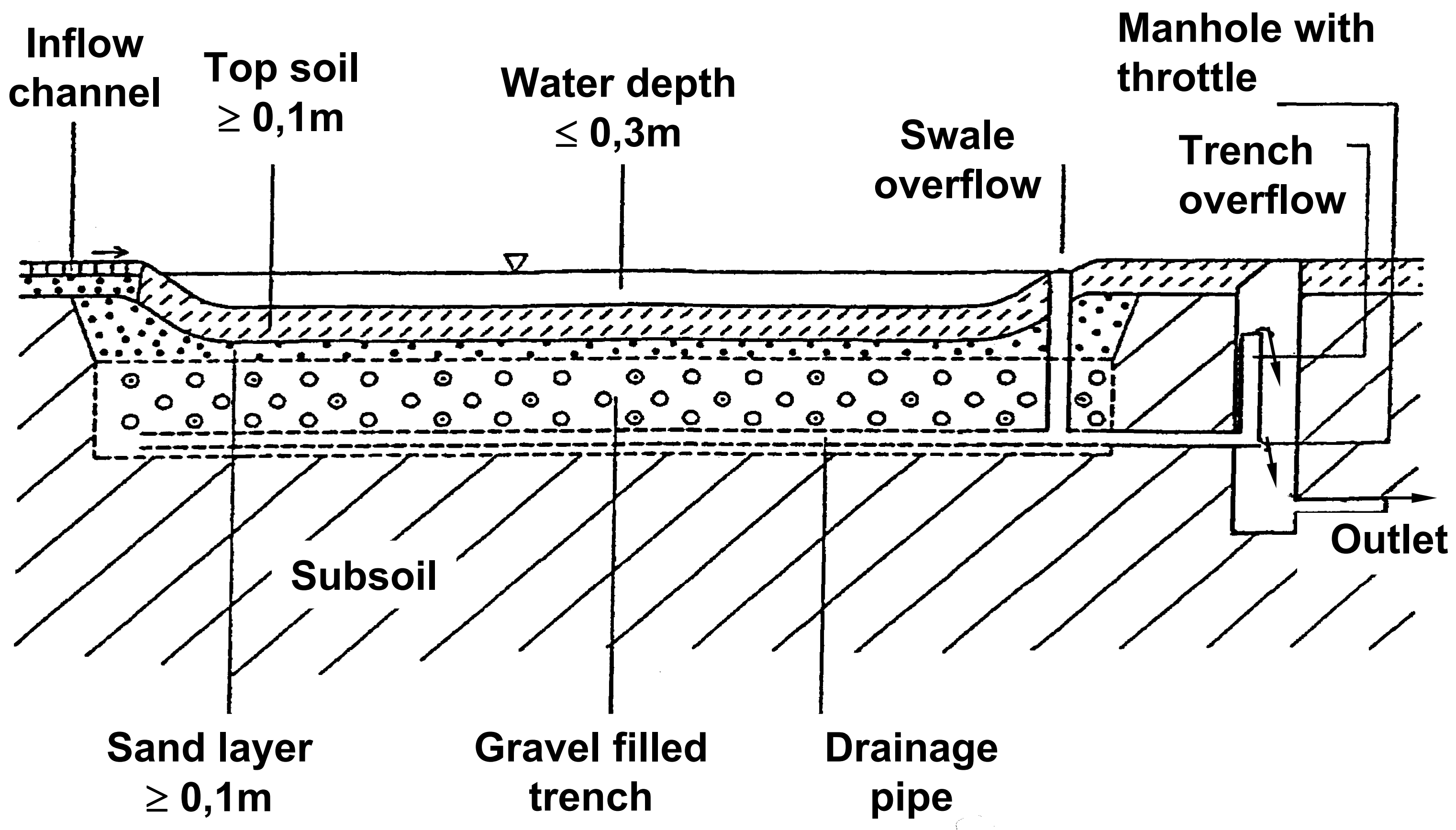
Stormwater management

Swale infiltration



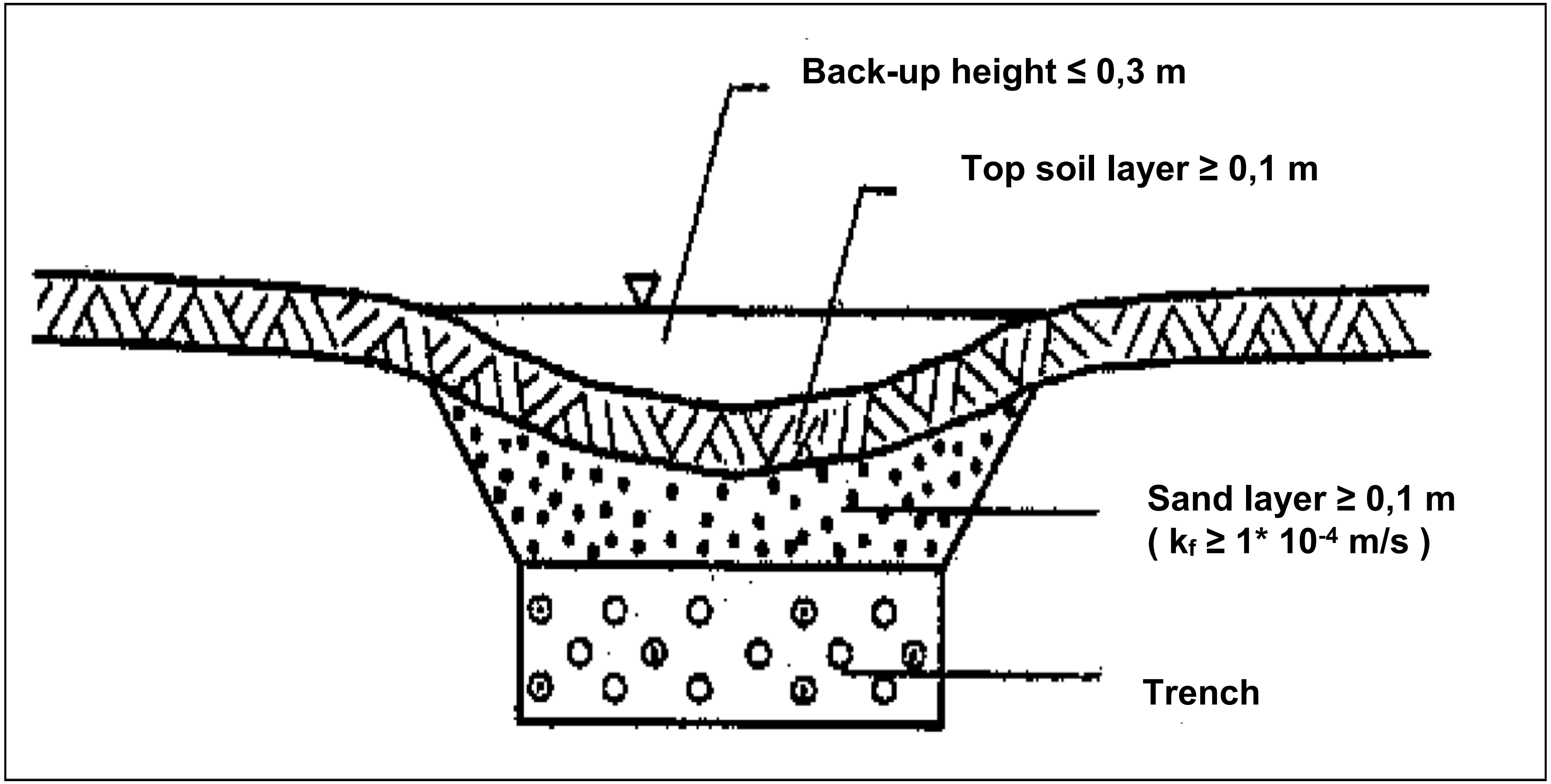
Stormwater management

The swale and trench concept



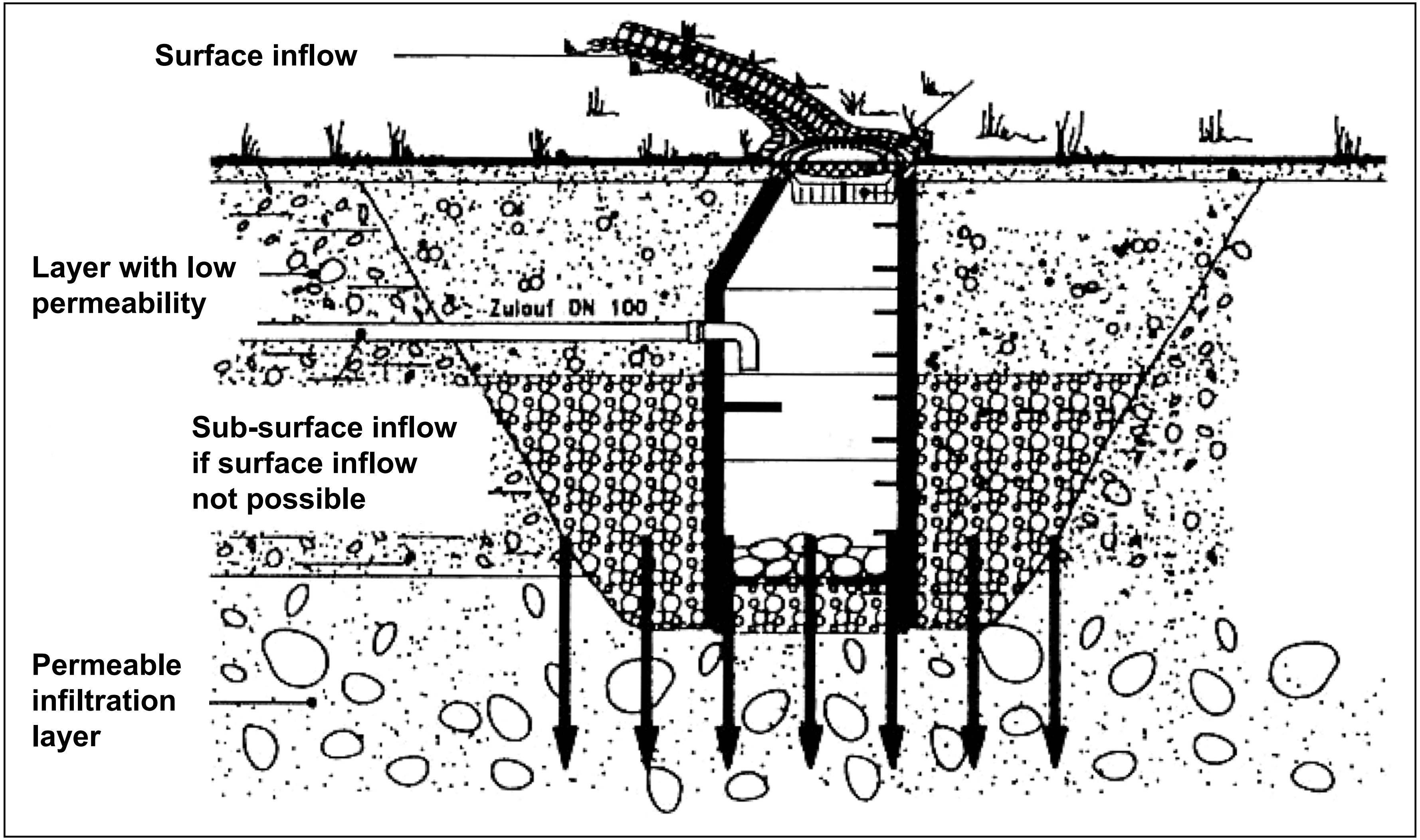
Stormwater management

Swale and trench



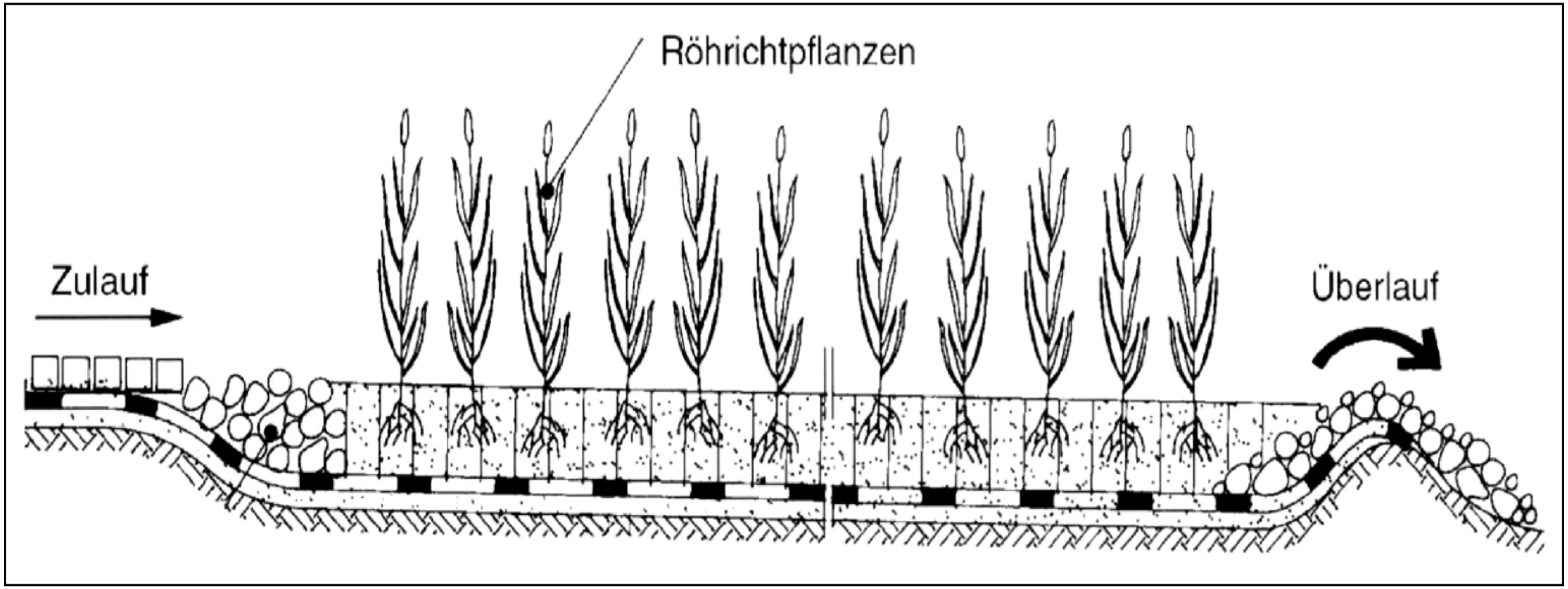
Stormwater management

Infiltration shaft



Stormwater management

Constructed wetland



Stormwater management

Surface discharge elements

Stormwater management

Design of surface discharge

Stormwater management

Infiltration swale

Stormwater management

Infiltration swale with design elements

Stormwater management

Rainwater harvesting

Stormwater management

Industrial estate: flooded swale

Stormwater management

Industrial estate: roof discharge via pipe bridges

Stormwater management

Infiltration and storage structures

- required volume

$$V_{s,imp} = \left(r_{D,f} - (q_{dr} + q_{perc})\right) \cdot D \cdot 0{,}06 \cdot x_{corr}$$

$V_{s,imp}$	=	specific volume related to the impervious area r
$r_{D,f}$	=	rainfall rate of defined duration D and frequency f [l/s*ha)]
q_{dr}	=	throttle runoff rate [l/s*ha)]
q_{perc}	=	percolation rate [l/s*ha)]
D	=	duration [min]
x_{corr}	=	correction factor (safety, flow time, throttle runoff variation)

Changes in statistical rain data ?

- Rainfall data ***from the past***
  are used to assess ***the present performance***
  and the design of ***future systems***
- Does rainfall behaviour change with time ?
- Do we have sufficient data to answer that question ?

  ⇦ Generally no .....

- ... but:

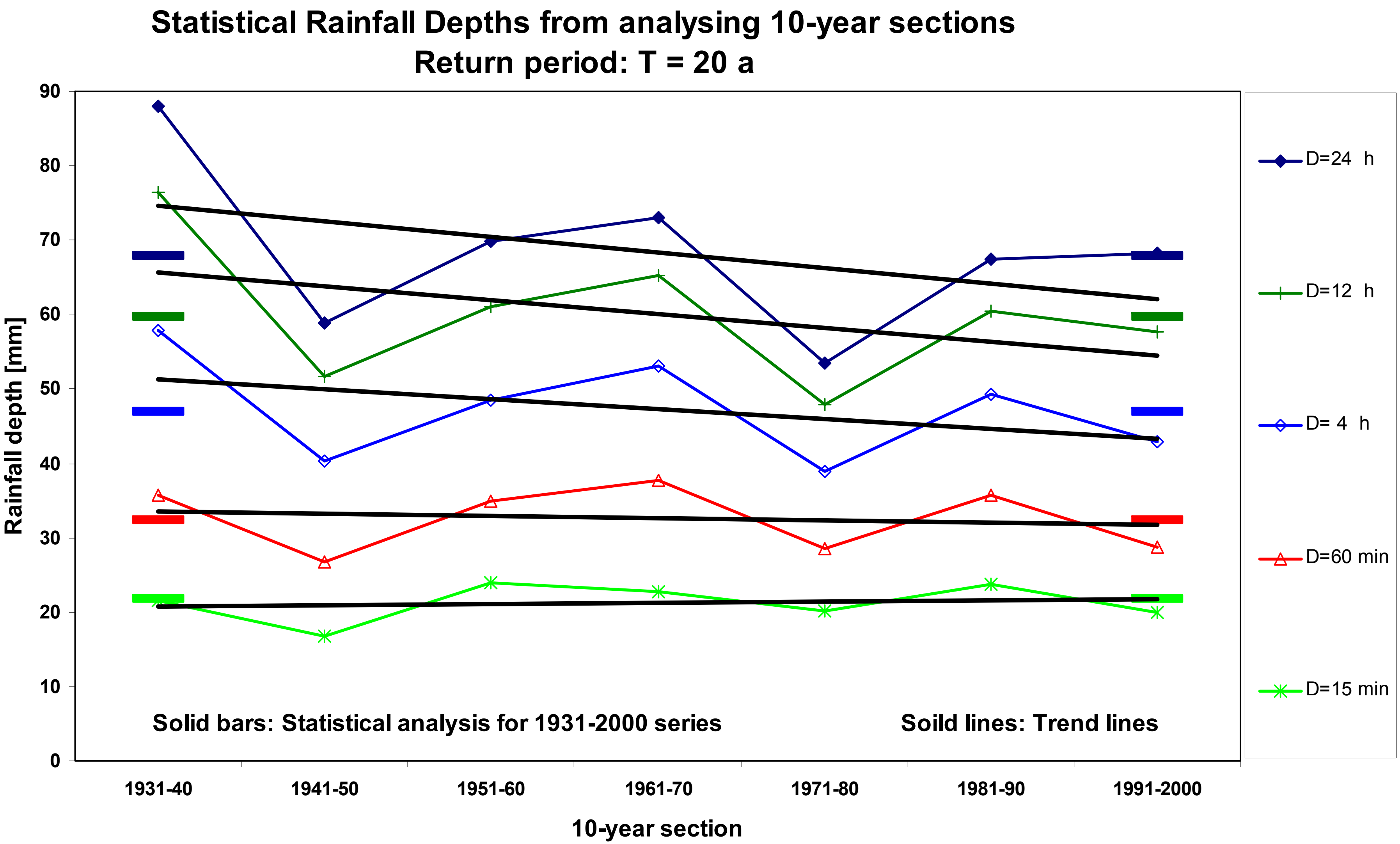
  Emschergenossenschaft/Lippeverband in Germany have operated rain gauges since 1930

  40 to 70 years of recorded rain data for 27 stations are available

Changes in statistical rain data ?

- Investigation of I-D-F relations
  - sections of 10 years
  - no overlapping sections
  - analyses for groups instead of singular stations
  - durations from 15 min to 24 hours
  - samples of 7 (5) values

Changes in statistical rain data ?



Changes in statistical rain data ?