

# Urban Water Management

Within the module:  
Ecology and Water Resources  
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Part 7

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## Overview

### Contents today:

#### 1. Pressures and impacts: flowing waters

- point sources → urban areas
- diffuse sources → rural areas

## Compounds and element fractions

| Compound        | Conversion factors |      | Nitrogen fraction   |
|-----------------|--------------------|------|---------------------|
|                 | →                  | ←    |                     |
| NO <sub>3</sub> | 0.226              | 4.43 | NO <sub>3</sub> - N |
| NO <sub>2</sub> | 0.305              | 3.28 | NO <sub>2</sub> - N |
| NH <sub>4</sub> | 0.778              | 1.29 | NH <sub>4</sub> - N |

### Atomic weights

- nitrogen (N) 14,01
- oxygen (O) 16,00
- hydrogen (H) 1,00

## Pressures and impacts: Flowing waters

### Differentiate:

- base flow - continuous - stationary
- direct runoff - sporadic - instationary

### also for pressures:

- continuing - e.g. input from groundwater, WTP discharge
- sporadic - e.g. erosion from fields, CSO

## **Kinds of approach**

### **Balances (typically for a year)**

- yearly loads
- yearly runoff volumes
- mean concentrations
- distribution in time not accounted for

### **Single events**

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## **Kinds of approach**

### **Single events (processes, sequences)**

- e.g. oxygen balance (content dynamics)
  - changes due to conversion and degradation processes
    - locally over time
    - along the flow path
- e.g. hydraulic pressures („hydraulic stress“)
  - interstitial
  - deposition, erosion
  - displacements
- e.g. conservative substances
  - heavy metals
  - PCBs

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## **Important**

**Results / findings cannot be transferred,  
especially not from balances to single events**

**Example: runoff coefficient**

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## **Pressures and impacts: Flowing waters**

### **Differentiate:**

- urban areas                      - continuous  
   - sporadic
- rural and other areas        - continuous  
   - sporadic

### **Urban areas**

- waste water treatment plant discharges
- stormwater and combined sewer overflow discharges

### **Rural areas**

- drains, inflow from groundwater
- surface runoff

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## Pressure sources

### Urban areas

- waste water treatment plant discharges
  - parameters: BOD, COD, NH<sub>4</sub>, PO<sub>4</sub>, ....
    - effluent concentrations:
      - to be monitored regularly,
      - typically 24h mixed sample;
      - minimum standards
    - acceptable water course immission:
      - generally mean values,
      - globally or individually set
    - loads: multiply concentrations with wastewater amount
    - wastewater amount: water use in l/(c-d) plus infiltration water

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## Pressure sources

### Urban areas

Typical concentrations of inflow to and runoff from wastewater treatment plants

|                     | BOD  | COD  | NH <sub>4</sub> -N | Total N | Total P |
|---------------------|------|------|--------------------|---------|---------|
|                     | mg/l | mg/l | mg/l               | mg/l    | mg/l    |
| raw sewage (inflow) | 280  | 600  | 45                 | 70      | 6       |
| runoff (standards)  | 15   | 75   | 10                 | 18      | 1       |
| runoff (achieved)   | 10   | 40   | 1 .. 3             | 7       | 0,2     |

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## Pressure sources

### Urban areas

- stormwater discharges and combined sewer overflows in separate and combined sewer systems

stormwater pollution

- from rain pollution and wash-off
- variable over time for each rain event
- mean yearly load:
  - 600 kg/(ha·a) COD (ha = impervious area only)
  - at 800 mm rain per year and  $\psi_m = 0,7$ :
  - 560 mm runoff
  - mean concentration:  $600 \text{ [kg/ha]} / 560 \text{ [l/m}^2\text{]} \approx 107 \text{ mg/l}$

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## Pressure sources

### Rural areas

- continuous:
  - groundwater (base flow)
  - drains
- sporadic:
  - rain induced direct runoff
  - quality affected by erosive compounds
- parameters: generally not (only) COD
- nutrient load from:
  - drains
  - agricultural discharges
  - groundwater

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## Pressure sources

### Urban and rural areas

- yearly nutrient loads discharged into the surface water bodies (1995)

| Discharge from          | Loads in [t/a] and (%) |          |
|-------------------------|------------------------|----------|
|                         | Phosphorus             | Nitrogen |
| Precipitation           | 1 (2)                  | 20 (3)   |
| Agricultural discharges | 7 (12)                 | 20 (3)   |
| Drain water             | 1,5 (3)                | 45 (6)   |
| Erosion                 | 18,5 (31)              | 45 (6)   |
| Groundwater             | 1 (2)                  | 330 (42) |
| Industrial sewage       | 6 (10)                 | 60 (8)   |
| Stormwater treatment    | 6 (10)                 | 20 (3)   |
| Domestic sewage         | 17 (30)                | 235 (30) |
| Total                   | 58                     | 775      |

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