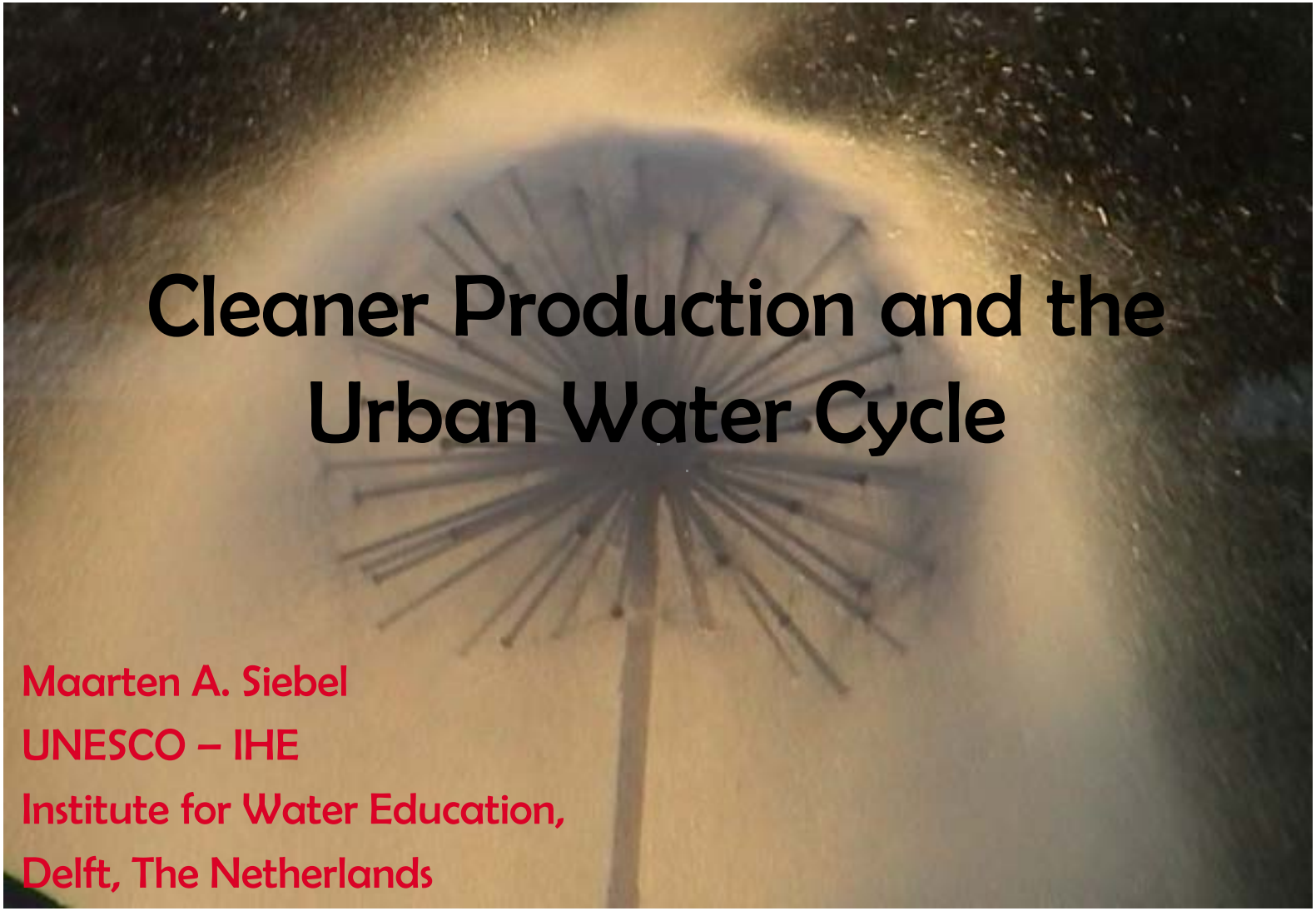

# Cleaner Production and the Urban Water Cycle

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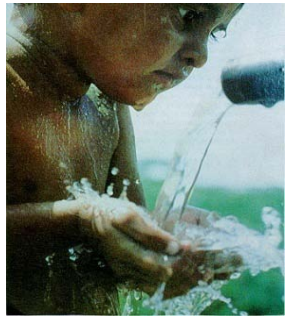
# Contents

- Definitions and terminology
- Present approach and drawbacks
- Ideas for improvement
- Water Management in the city of tomorrow

# Definitions and terminology

The Urban Water Cycle includes all aspects of water in the urban setting:

- drinking water
- industrial water
- city maintenance water
- used water
- rainwater



# Definitions and terminology (2)

Cleaner Production: approach in which processes and activities are carried out in such a manner that the environmental impact thereof is as low as possible

"Better an ounce of prevention than a pound of cure"

Includes

- concept of sustainability
- process optimization
- resource recovery
- life cycle approach
- prevention

# Definitions and terminology (3)

Waste material –
a material which has lost the value it had before usage

Used material –
a material that was used but still has a value or may be given back its value

# History of UWM

Developed from conditions of

- small populations
- small water consumption levels
- abundance of suitable water
- little availability of consumptive products with negative side effect on quality of water
- disease prevention

# Present approach to UWM

Drinking water:

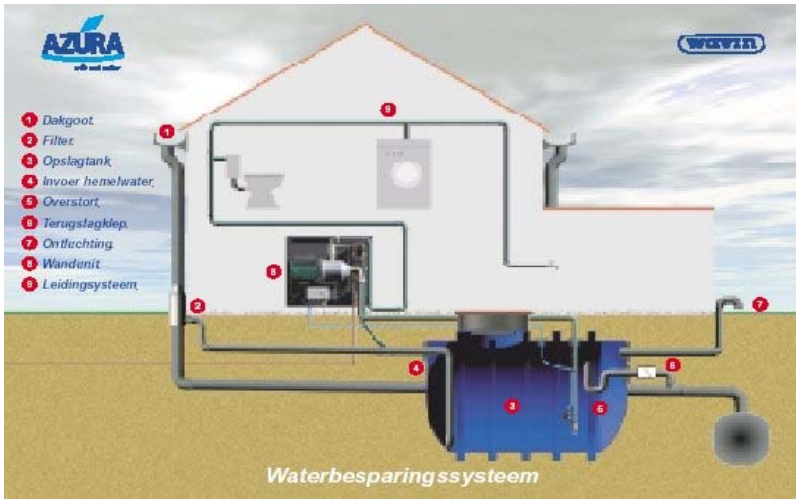
- often brought in over long distances – insufficiency at closer distances
- 130 – 500 l/cap/day used *v.s.* 2 – 10 l/cap/day needed
- large-sized infrastructure, large environmental impacts
- 15 – 80% distribution losses (=> wasting water, chemicals, energy)
- drinking water used to transport waste, to dilute resources (N, P), to dilute pathogens
- used groundwater (rainwater) is not returned to underground resulting in desiccation

# Present approach to UWM (2)

Industrial water:

- water of drinking quality may or may not be needed for industrial production, water for the process, for transport, water for cooling, water for cleaning; using quality differentiation may help out
- on-site treatment to specifications may be appropriate
- industrial processes often obsolete, implying a high water to product ratio (meaning high water consumption, high water pollution)

# Present approach to UWM (3)




City maintenance water:

- surface water, if available, or drinking water used for fire fighting, street cleaning and green areas
- use of treated city water or rainwater rarely considered

# Present approach to UWM (4)

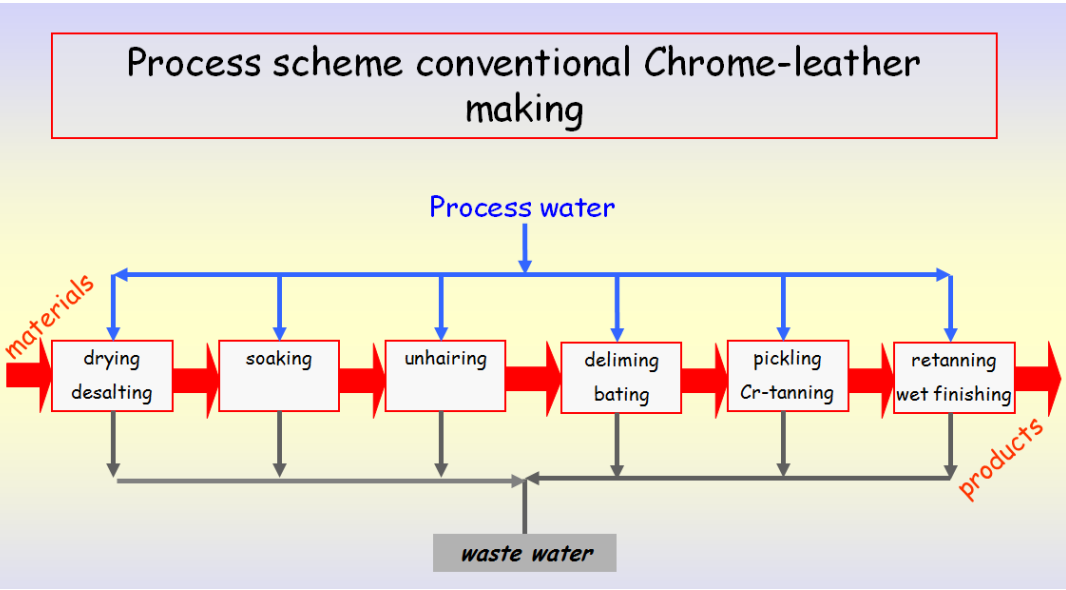
Rain water:

- usually removed into sewer systems as soon as possible
- disrupting treatment processes (suspended growth systems)
- disrupting receiving waters
- rarely adequate measures taken for storage and later usage
- rarely actively returned to groundwater
- because of increased covered surface area, flows into treatment plants increase, less water reaches groundwater for replenishment

# Present approach to UWM (5)

- large volumes
  - large volume of abstractions
  - large treatment plants
  - large impact on receiving waters
  - potentially serious impact when malfunctioning
- dilute -> difficult to recover useful components
- -> difficult to deal with pathogens
- groundwater rarely returned

# Present approach to UWM (6)




Used water - industrial:

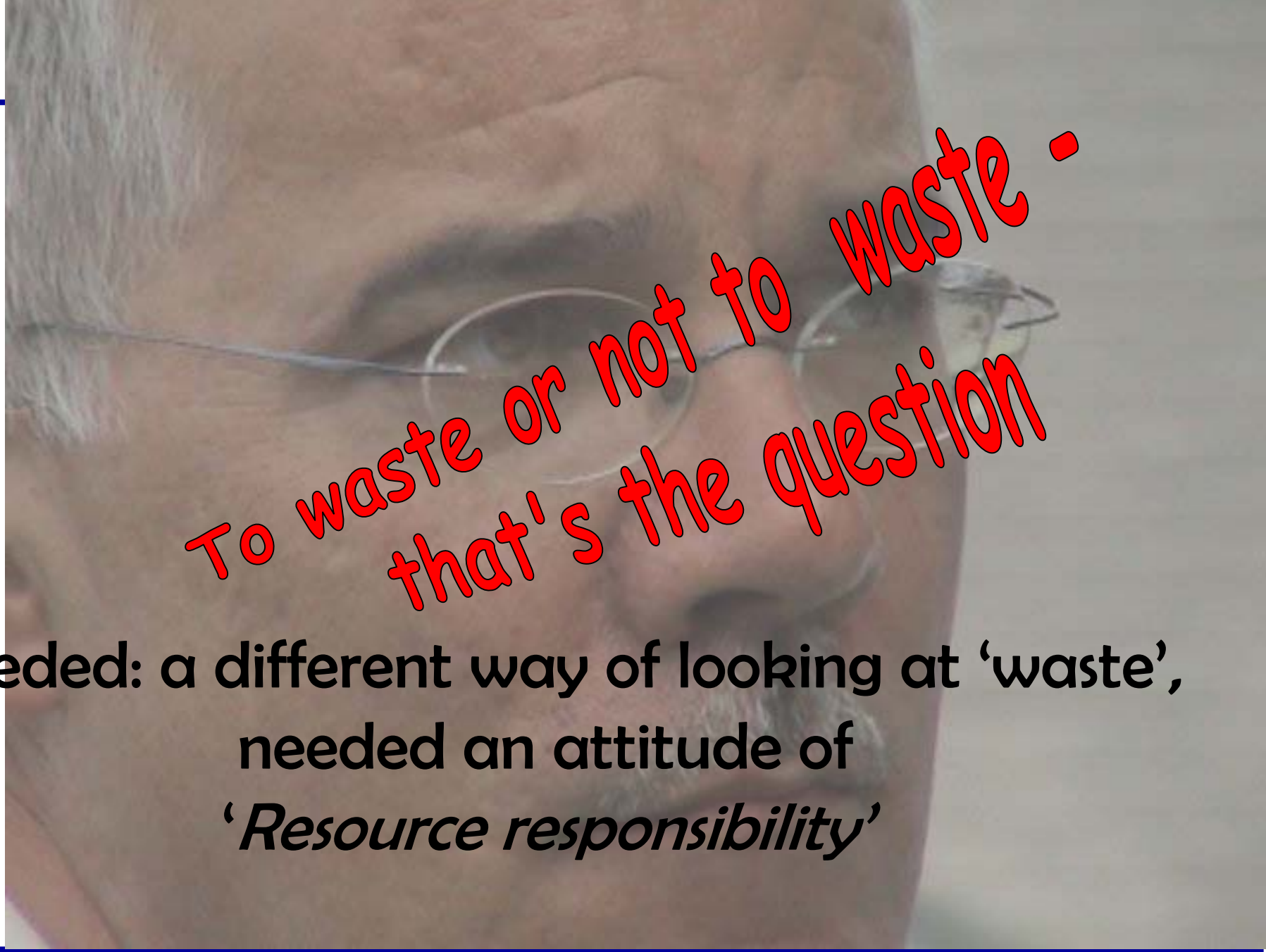
- mixing wastewaters -> difficult to treat, difficult to recover useful components
- microbial degradation processes maybe affected by toxicity
- in case of toxicity, treatment is phase transfer, toxins from effluent to sludge
- water saving or internal reuse still limitedly used

# Drawbacks to present approach to UWM

## *In Summary*

- Water (~ drinking water) used to transport and dilute wastes – wastage of water, chemicals, energy
- Ongoing pollution of resource water, even when applying (conventional) treatment (a 5 M pe. plant, 90% efficient, discharges 0.5 M pe.)
- Dilution/wastage of resources (*e.g.* water, N, P, heavy metals)
- Dilution/distribution of resources into the environment
- Infrastructural investments unaffordable
- Groundwater depletion

- *'Take and dump'* attitude




Needed: a different way of looking at 'waste',
needed an attitude of
'*Resource responsibility*'

# Ideas for improvement

1 *Raise a resource awareness attitude*: 'less-is-better', conservation of resources, avoid wastage

- Raise modern society with concept of finite resources
  - lights, tv switched off when not needed, taps are closed!!)
  - production of wastes is limited, used materials reused/recycled
  - process efficiency is maximized
  - dumping gradually disappears

*Eventually, this approach may become sustainable. Thriftiness is returned*

# Ideas for improvement (2)

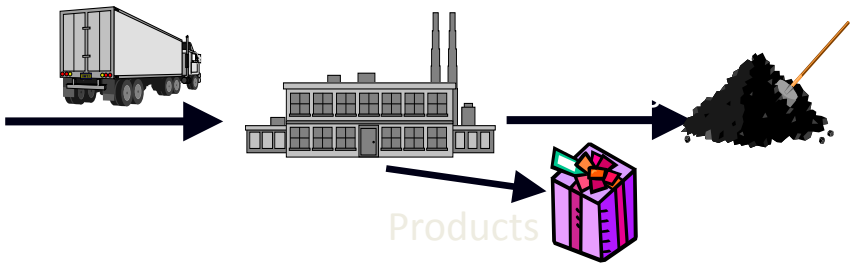
2. *Choice of resources*: the right resources for the right job

- different water qualities for different uses of water for industrial processes – *is drinking water quality needed for flushing skins in the leather industry?*
- alternatives: bottled water (but avoiding the creation of a plastics problem), water saving devices, internal reuse, dry sanitation, etc. in the domestic arena

# Ideas for improvement (3)

## *3. Generation of industrial wastes*: reconsider before considering treatment

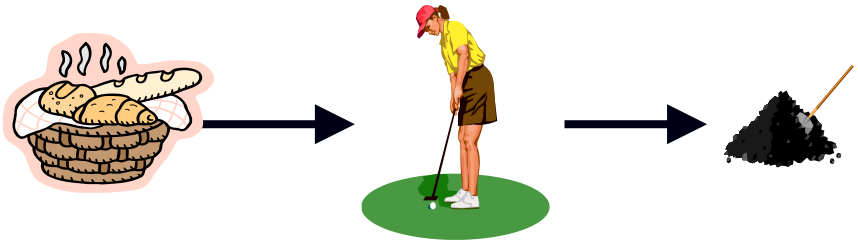
- production of wastes is inherent to conversion processes but can be reduced through process optimization




- improve process performance: personnel training, motivation, procedural changes, reuse, recycling, recovery, smarter treatment.....

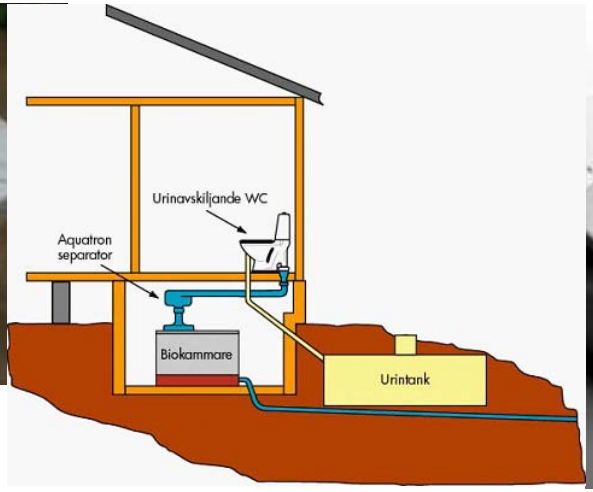
## *3. Generation of domestic wastes*: reconsider before considering treatment

- production of domestic waste is a given but use the high nutritional value

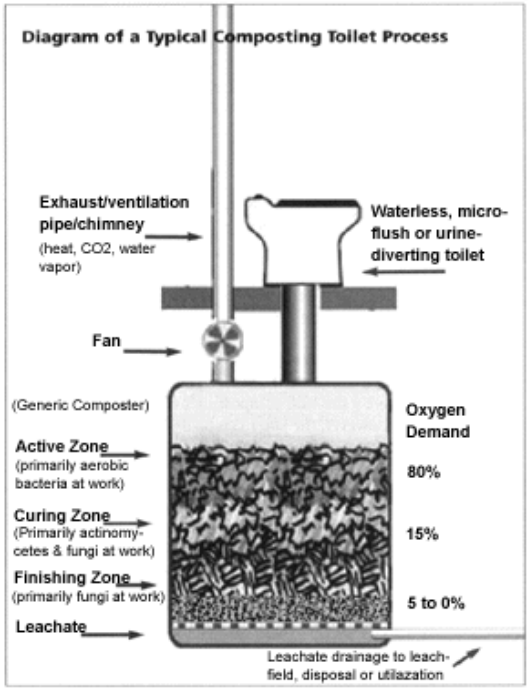


contained in the both the feaces and in the urine

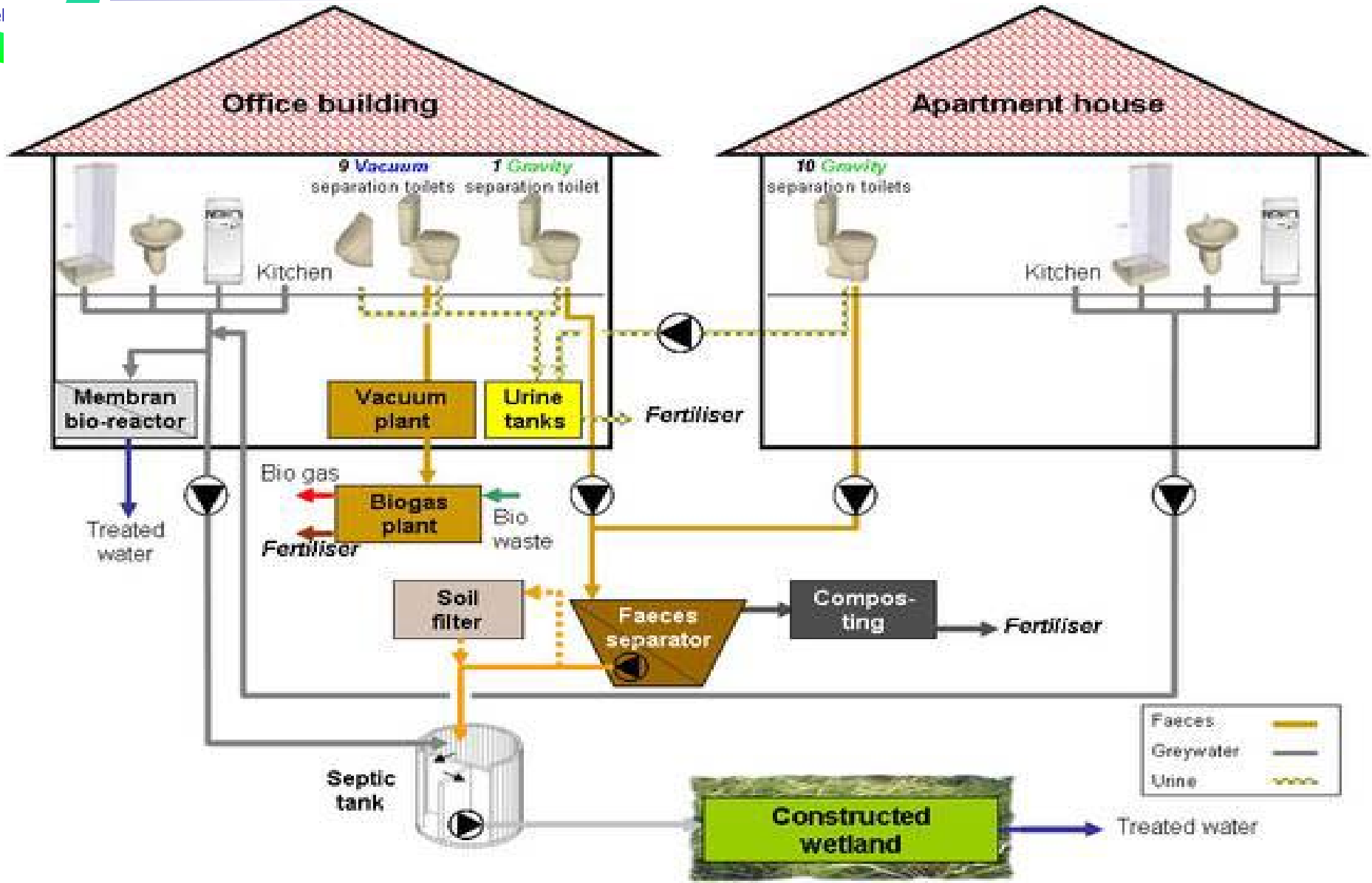
# Ideas for improvement (5)




- human urine (potentially high fertilizer value, highly concentrated N & P, large fraction of domestic BOD) to be kept separate:
  - separate low water flush systems,
  - separation toilets
  - continuous or batch collection systems for nutrients collection and recovery/reuse,
  - urine storage and collection at times of low sewer flow,
  - dry sanitation systems eg. composting toilet



# Ideas for improvement (5)



# Ideas for improvement (6)

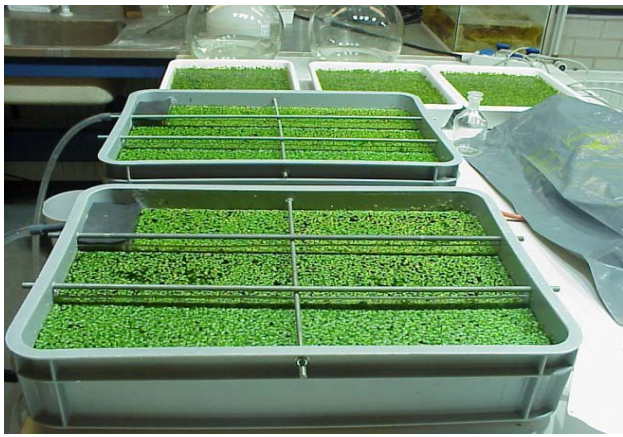




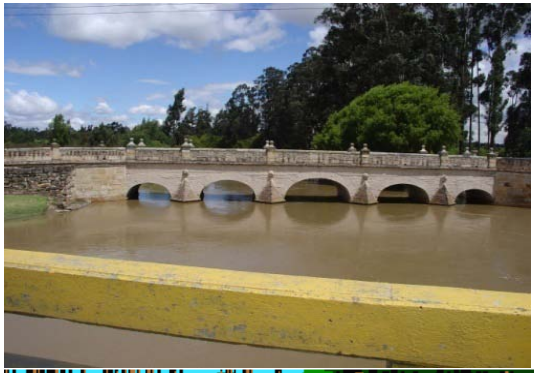
4. *Quality of waste*: Do no dilute what is concentrated, do not pollute what is separated;
   - focus on reuse, recycle, recovery
   - 'clean' waste: one type of waste in high concentration is a reusable product
   - restrict or prohibit (!!) the use of products with negative side effects on waste quality

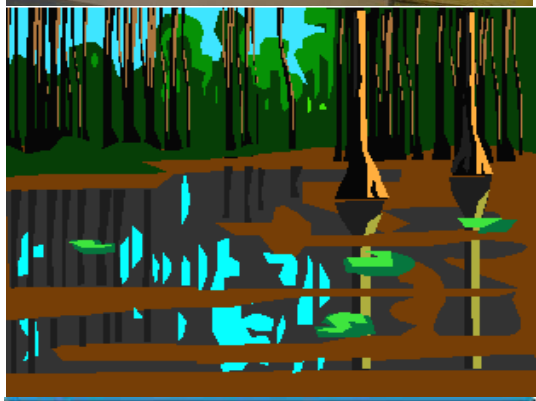
# Ideas for improvement (7)

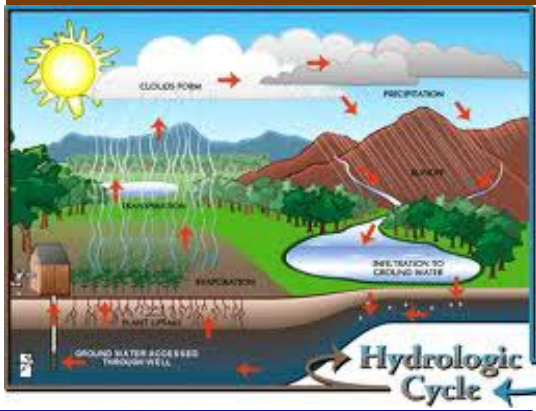

5. *Treatment*: maximize reutilization
   - reutilize energy contained in organic components: anaerobic treatment to recover energy
   - reutilize wastewater effluent for irrigation, fish ponds (if clean)
   - reutilize N & P, duckweed/algae ponds
   - reutilize metals absorbed to plants



# Ideas for improvement (8)

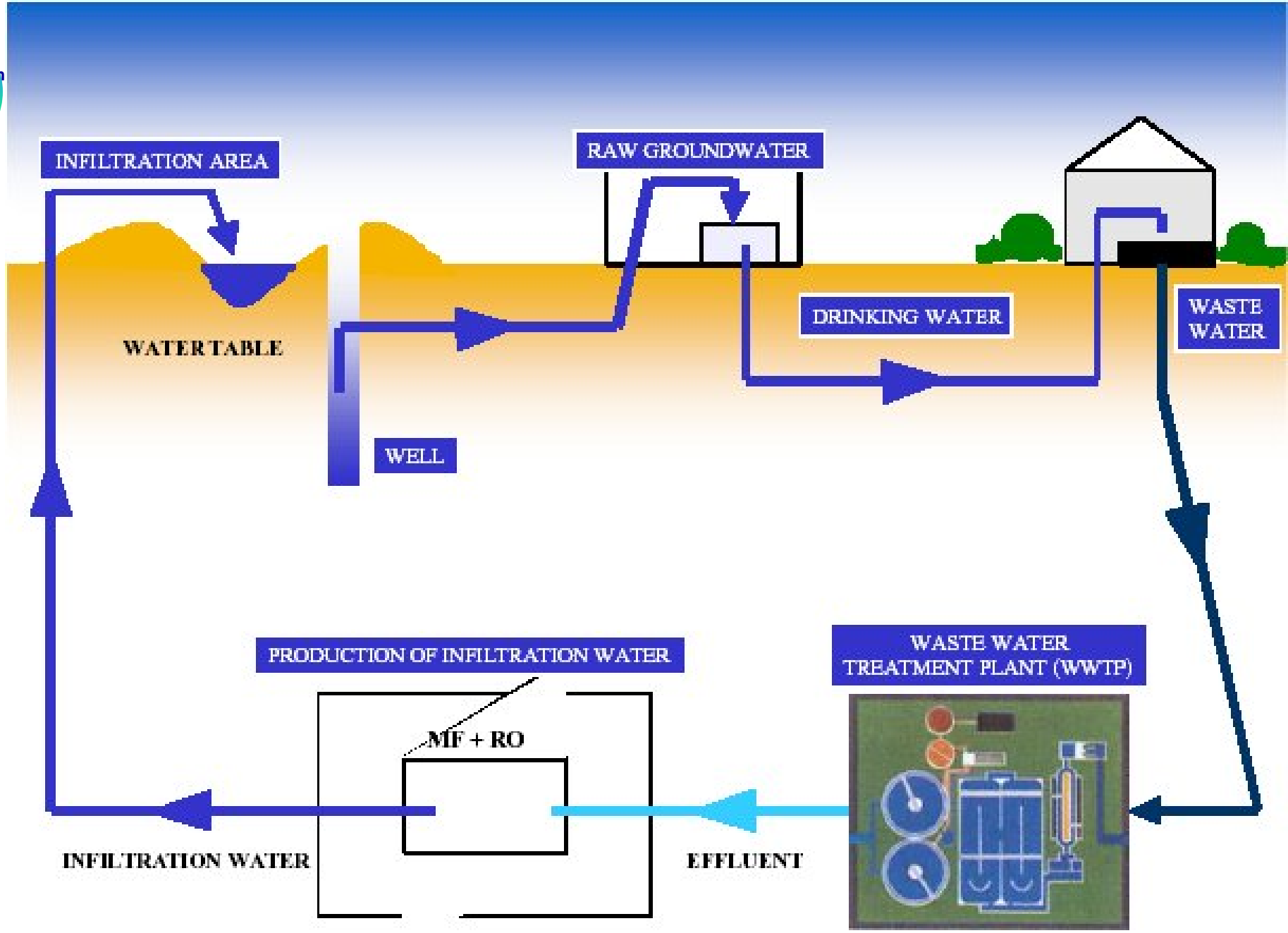







6. Resources -> use and reutilize 'nearby', concept of 'own water':

- used water is dealt with such that groundwater is not depleted, downstream neighbors are not affected, water remains available
- concept of responsibility for maintaining water of sufficient quantity and quality for village level/urban use
- 'use' rainwater for recharge or other purpose example: artificial swamp in Holland


INFILTRATION AREA
RAW GROUNDWATER
WATER TABLE
DRINKING WATER
WASTE WATER
WELL
PRODUCTION OF INFILTRATION WATER
WASTE WATER TREATMENT PLANT (WWTP)
MF + RO
INFILTRATION WATER
EFFLUENT

How does water management in the city of today, compare with that in the city of tomorrow? What has to be different and why?

Next 4 sheets contrast the present day urban water management with water management in the city of tomorrow where villages or urban units assume the responsibility for maintaining water of sufficient quantity and quality

# Water management in the city of tomorrow

| Aspect | City of today | City of tomorrow |
|---|---|---|
| | **UWM organization** | |
| 1. Organizational structure | Separate entities for different types of water,<br>Covering entire urban area | One entity for 'water' covering entire urban area<br>City subdivided in water management units (WMU) with high level of responsibility<br>Water is a tradable good between units |
| 2. Units | Depending on preference of water entities | Determined by possibilities to manage water within a unit |
| 3. Philosophy | Various types of water have no relationship | Various types of water are part of the same cycle and serve various purposes at different times |

# Water management in the city of tomorrow (2)

| Aspect | City of today | City of tomorrow |
|---|---|---|
| | ***Drinking water*** | |
| 1. Quality | One quality for all uses | One quality for drinking, a second quality for other uses |
| 2. Distribution | Underground piping system, vendors | Drinking water through shops, second quality through piping system |
| 3. Origin | From wherever available | From nearby |

# Water management in the city of tomorrow (3)

| Aspect | City of today | City of tomorrow |
|---|---|---|
| | ***Wastewater*** | |
| 1. Quality | Any quality wastewater is accepted | Only 'clean' wastewater is accepted, dischargers responsible for quality of wastewater submitted |
| 2. Collection | Collection from domestic and industrial origin to point of discharge or (central) treatment | Collection of 'clean' wastewater within the WMU to point of further processing<br>Specific waste flows kept separate |
| 3. Treatment | Predominantly of the activated sludge type | Further processing determined by the reuse/recovery options and the specific use of the water within the WMU<br>Indirect reuse is objective |
| 4. Discharge | Into nearest surface water | Depending on possibilities within WMU, *e.g.*: irrigation, groundwater recharge, surface water discharge |

# Water management in the city of tomorrow (4)

| Aspect | City of today | City of tomorrow |
|---|---|---|
| | **Rainwater** | |
| 1. Approach | Removal as quick as possible so as not to have flooding problems | Make best possible use of this resource |
| 2. Processing | Removal into sewer | Collection, temporary storage, followed by some type of treatment |
| 3. Usage | None | Various options, *e.g.*: street cleaning, green areas, ground water recharge, or drinking/process water |

# Thank you