# Rainwater harvesting and greywater recovery

## - Part 2 -

**Prof. Patrice CANNAVO**

**AGROCAMPUS OUEST / Agreenium, France**

Department of Physical Environment, Landscape Architecture
Environmental Physics and Horticulture research Laboratory

***Module 2: Resource use from a challenge perspective***

*Urban Agriculture for resource efficiency and waste management*

# Course outline

**1. Urban water hydrology**

- 1.1 Specificities of the urban context
- 1.2 Impacts of the vegetation on water regulation
- 1.3 Soil properties (reminder)

**2. Green roof potential for water runoff control**

- 2.1 Roles and constitution
- 2.2 Performance

**3. Greywater**

- 3.1 Origin, collection, treatment
- 3.2 Greywater reuse for irrigation

**4. Stormwater basin for road water runoff**

- 4.1 Operation
- 4.2 Infiltration performance and clogging process

**5. Self-assessment**

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# 2. Green roof potential for water runoff control

> 2.1 Roles and constitution

## An ancestral technique

- Thermal isolation
  - Thick mix of soil and rooted herbaceous plants laying on low putrescible wood tiles
  - Used in Scandinavia, Mongolia…
  - Technique already used in the paleartic zone by Inuits in north America

**Rediscovery at the end of the XX$^{th}$ century**

- Use in Germany in the 70-80s
  - Extensive green roof concept
  - Certified by a german working group (http://www.fll.de/)
  - Differences with ancient extensive green roofs (very small houses with solid structures) → modern extensive green roof = big houses or buildings thanks to growing media and adapted protection layers
  - 14 millions of m² in Germany

*Green roofs in Darmstadt in Germany*

# 2. Green roof potential for water runoff control



**Rediscovery at the end of the XX$^{th}$ century**

- Extension in the World
  - Innovative materials/products development in the USA
  - Japan, Scandinavia
  - In France, since 2010 = $1.10^6$ of $m^2.y^{-1}$ ; estimated areas in 2015 = 5 à $6.10^6$ $m^2$ over an actual potential of $25.10^6$ $m^2$

# 2. Green roof potential for water runoff control

> 2.1 Roles and constitution

## Different green roof categories

| | intensive | semi-intensive | extensive |
|---|---|---|---|
| Growing media thickness | > 30 cm | < 30 cm | < 8 cm |
| Weight | > 600 kg/m² | 150 à 350 kg/m² | 100 kg/m² |
| Support | concrete | concrete, steel, wood | concrete, steel, wood |
| Plant choice | very large | large | limited |
| Maintenance | important | limited | low |
| Global cost | high | average | economic |

# 2. Green roof potential for water runoff control



**Growing media**

- Functions
  - Root integration (*vegetation support*)
  - Nutrient and water supply for plants (*filter / exchange*)
- Properties
  - Light, compaction resistance, high water retention capacity
- Composition
  - Organic fraction = green waste compost (leaves, bark), peat
  - Mineral fraction = light and absorbant stones = expansed clay, pumice-stone, crushed bricks fragments





# 2. Green roof potential for water runoff control



## Vegetation (1)

- Sedums
  - Robust succulent plants, low water input,
    no maintenance

## Vegetation (2)

- Cover-crops (others than sedums)
  - carnation ; gypsophila ; thyme
- Flowering plants
  - origano ; allium (chive) ; maritim thrift (Armeria maritima) ; dwarf lake iris (iris Pumila) ; harebell, Centaureas
- Poaceas
  - Mainly fescues ; particularly blue fescue (Festuca glauca) and amethist fescue (Festuca amethystina)

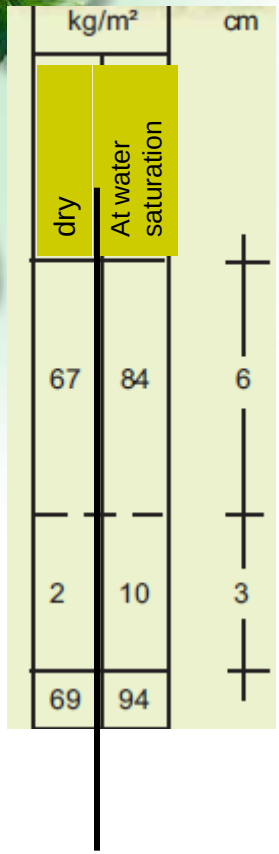


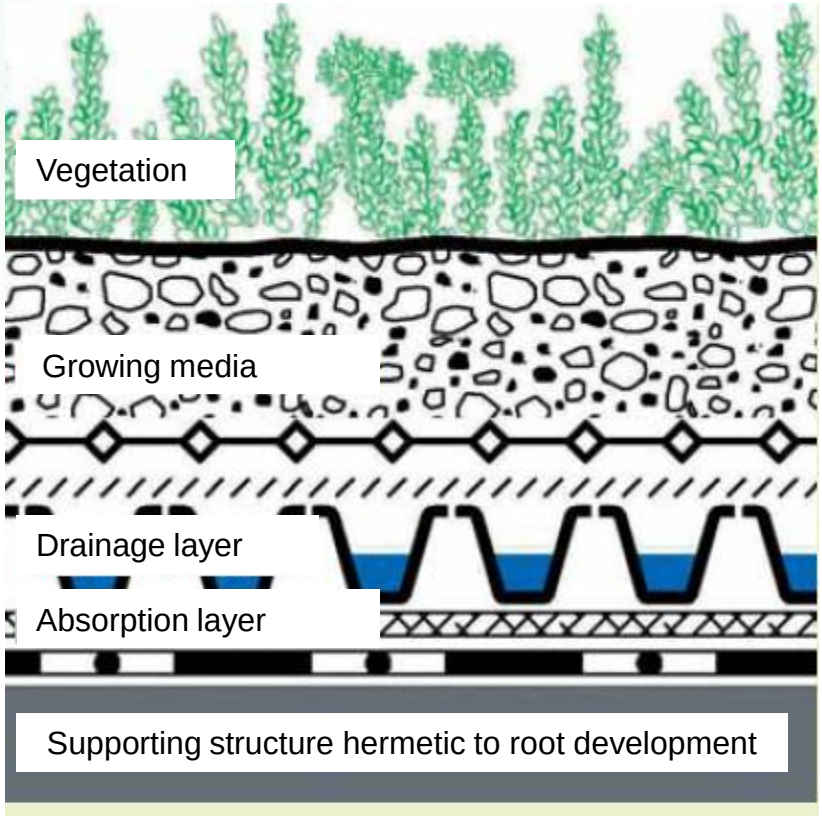


# 2. Green roof potential for water runoff control

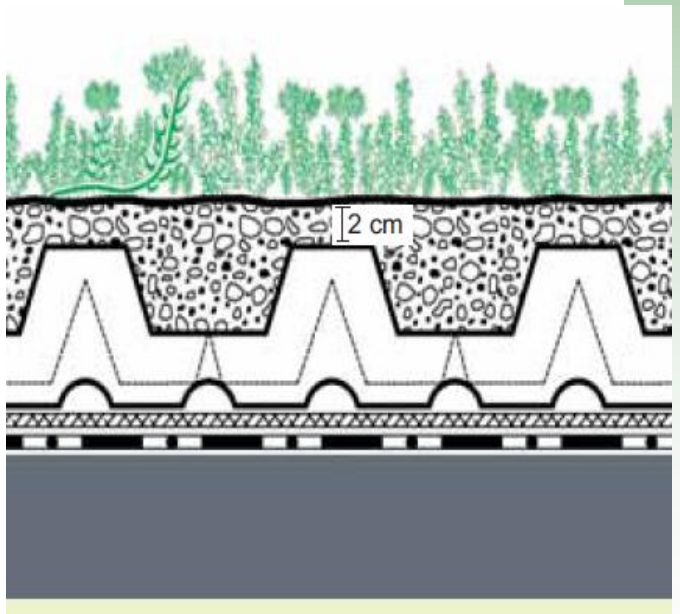
> 2.1 Roles and constitution

## Extensive green roof




| | | |
|---|---|---|
| Total height: | about | 9 cm |
| Weight at water saturation: | about | 95 kg/m² |
| Water holding capacity: | about | 25 l/m² |
| Runoff coefficient: | about | 0.38 |




| | | |
|---|---|---|
| Total height: | about | 10 cm |
| Weight at water saturation: | about | 60 kg/m² |
| Water holding capacity: | about | 21 l/m² |
| Runoff coefficient: | about | ND |

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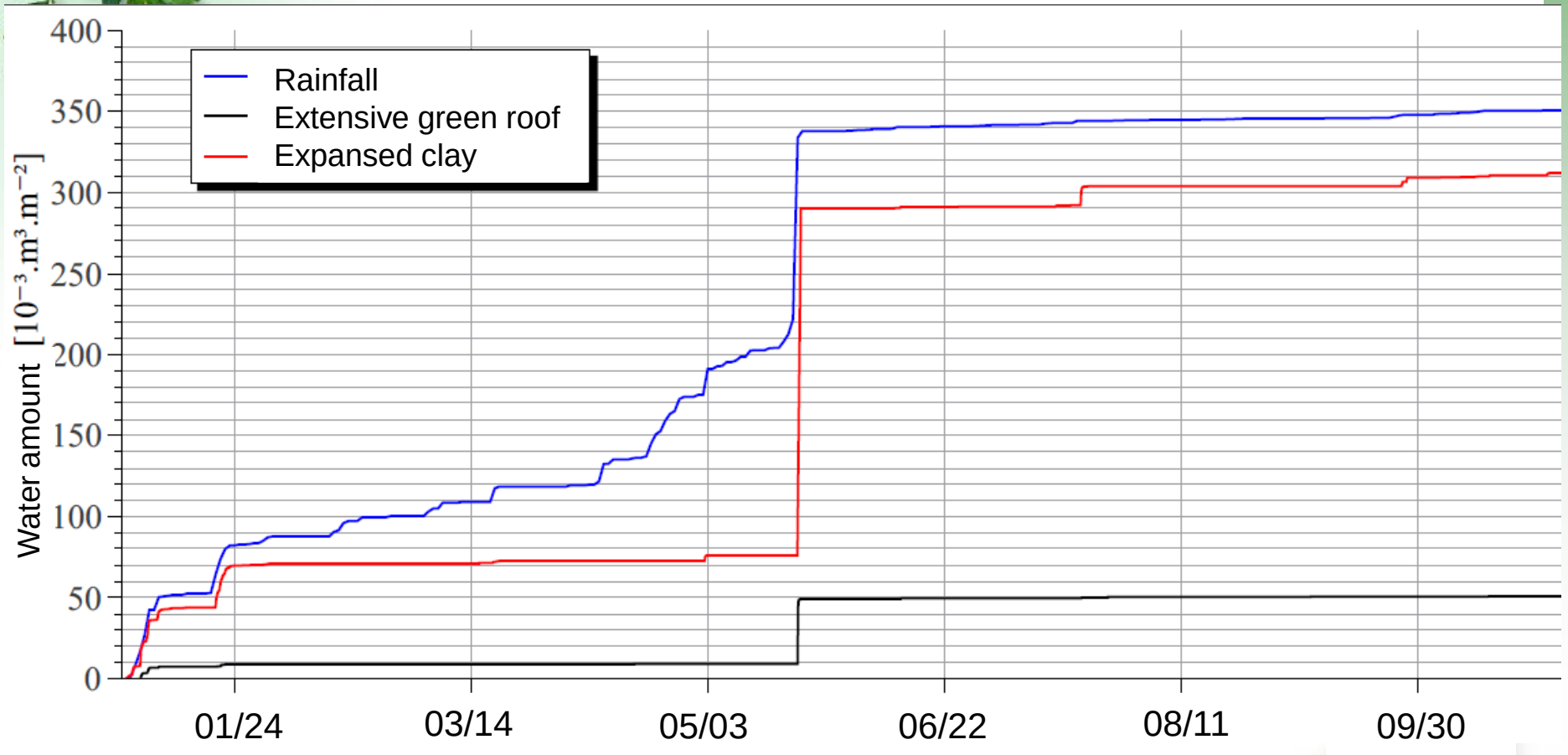
# 2. Green roof potential for water runoff control

> 2.2 Performance

## Runoff decrease




Extensive green roof with peat presents a stronger water retention than expansed clay
=> Lower water drainage and though lower runoff risk

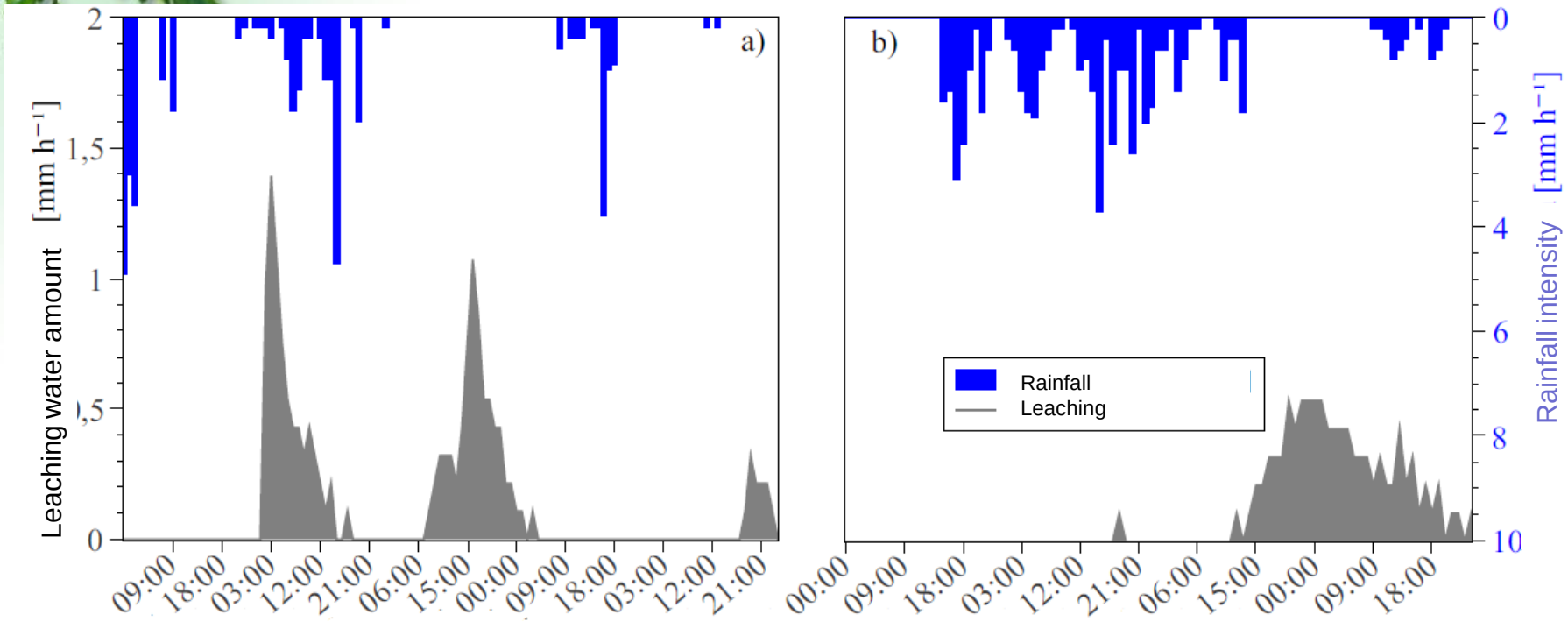
# 2. Green roof potential for water runoff control

> 2.2 Performance

## Runoff decrease

### Stormwater events

### Continuous winter rainfall




*Bouzouidja (2014)*

Phase difference of about 1 day between rainfall event and leaching beginning, corresponding to growing media water recharge (retention capacity)

=> Buffer effect of the growing media against urban water runoff

# Thank you for your attention !