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Ecohydrologie et Urbanisation

Pascal Breil

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Ecohydrologie et Urbanisation

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Jeudi 24 octobre 2019, à 14H,
Au Centre IRD-UCAD de Hann, bâtiment H4, 1er étage



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Educational, Scientific and
Cultural Organization

International
Hydrological
Programme

IHP-VIII 2014-2021



I – FIRST PRINCIPLE (Zalewski 2010)



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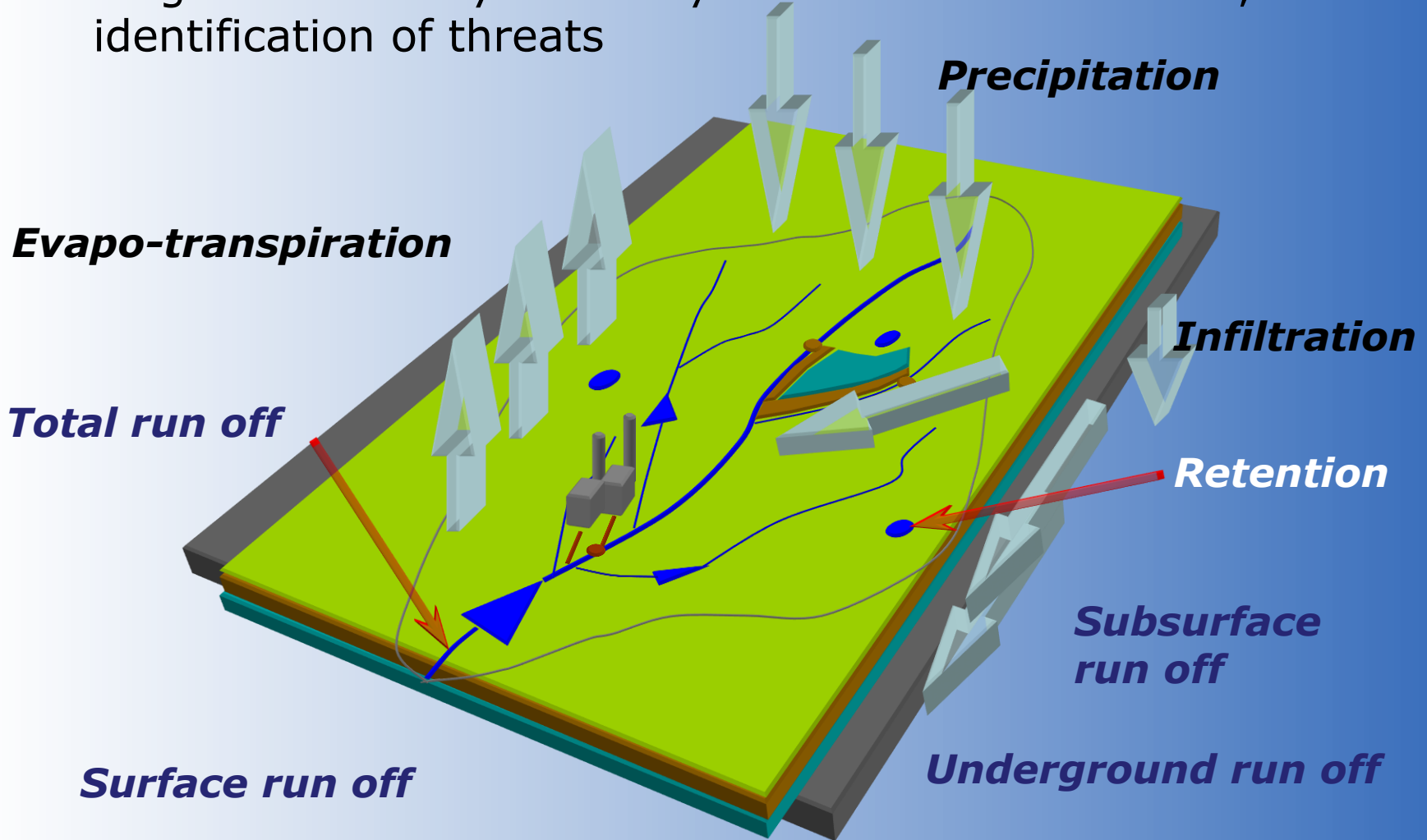


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Quantification of hydrological cycle as a template for biogeochemical cycles analysis in a catchment scale, and identification of threats



II – SECOND PRINCIPLE

(Zalewski 2008)



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programme

Centre for Ecohydrology
Under the auspices
of UNESCO

Identification of potential areas for enhancement of ecosystem carrying capacity

RETENTION IN THE CATCHMENT
by enhancement of landscape diversity

TRANSFORMATION
into biomass in land water
ecotones

Hot spots

TRAPPING
- in plant biomass (seasonally removed)
- storage in the unavailable pool in bottom sediments

DENITRIFICATION
in anaerobic conditions of wetlands

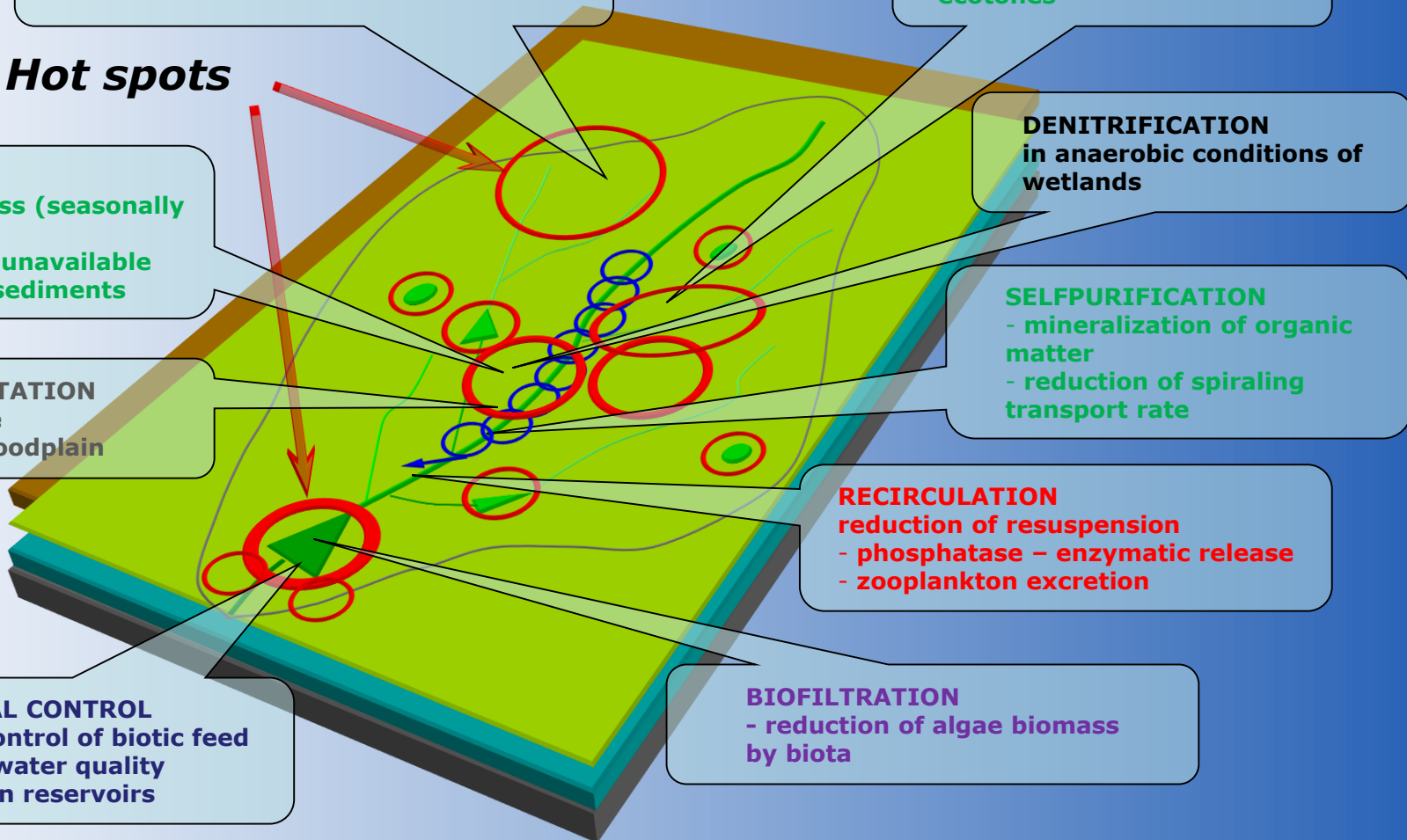
SELPURIFICATION
- mineralization of organic matter
- reduction of spiraling transport rate

SEDIMENTATION
- pondage
- at the floodplain

RECIRCULATION
reduction of resuspension
- phosphatase – enzymatic release
- zooplankton excretion

HYDROLOGICAL CONTROL
hydrological control of biotic feed back towards water quality improvement in reservoirs

BIOFILTRATION
- reduction of algae biomass by biota



III – THIRD PRINCIPLE

Using biota to control hydrological processes and vice versa, using hydrology to regulate biota dynamics



Dual regulation

CONSERVATION

Bioenergy production

Aquaculture

Reservoir – Hydrobiomani pulation

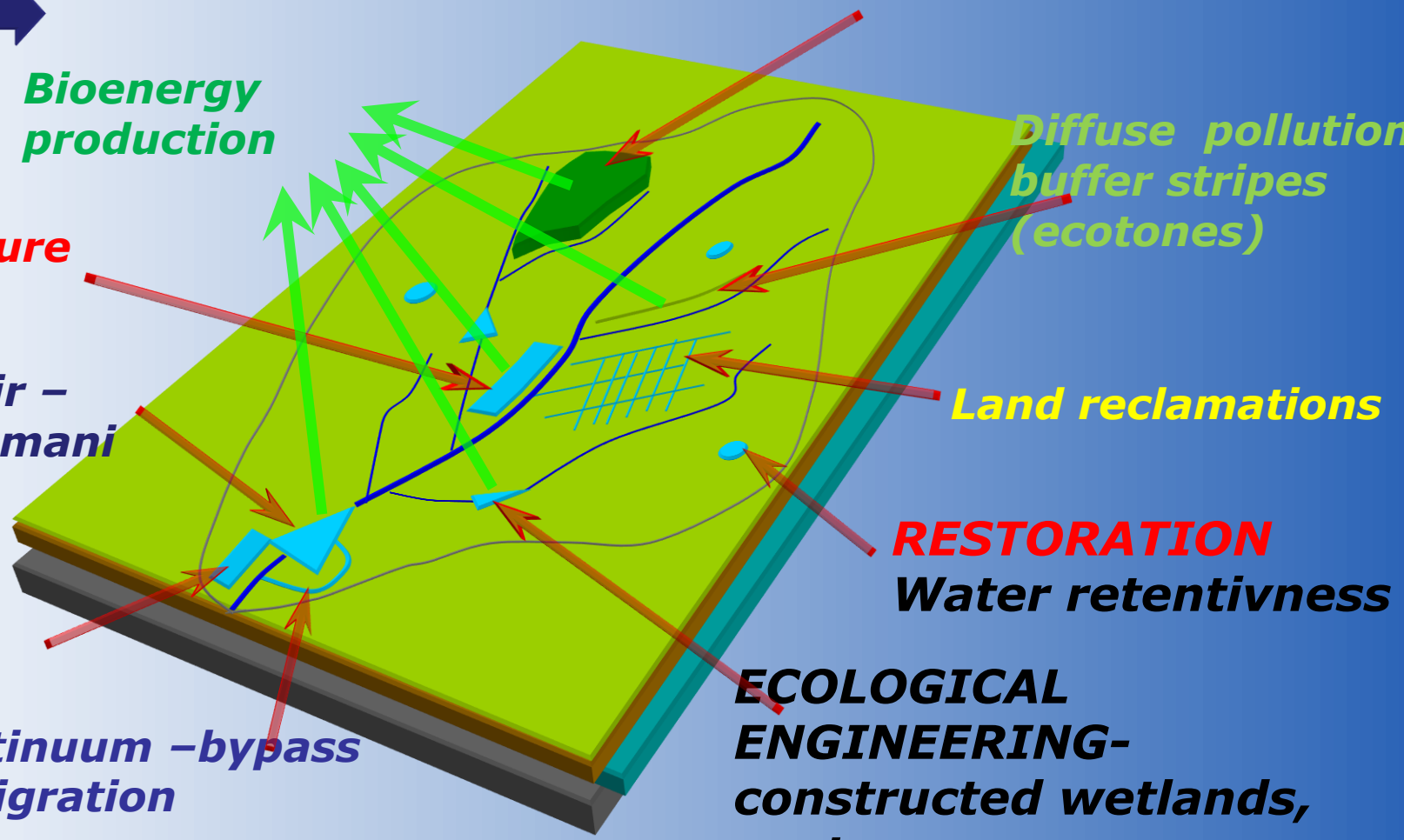
Diffuse pollution buffer stripes (ecotones)

Land reclamations

RESTORATION
Water retentivness

ECOLOGICAL ENGINEERING- constructed wetlands, ecotones

River continuum –bypass for fish migration
Sediment release/use system





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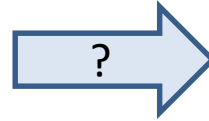
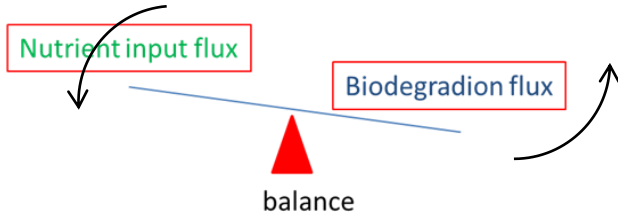
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Dual regulation principle

Polluted water courses



Natural water courses

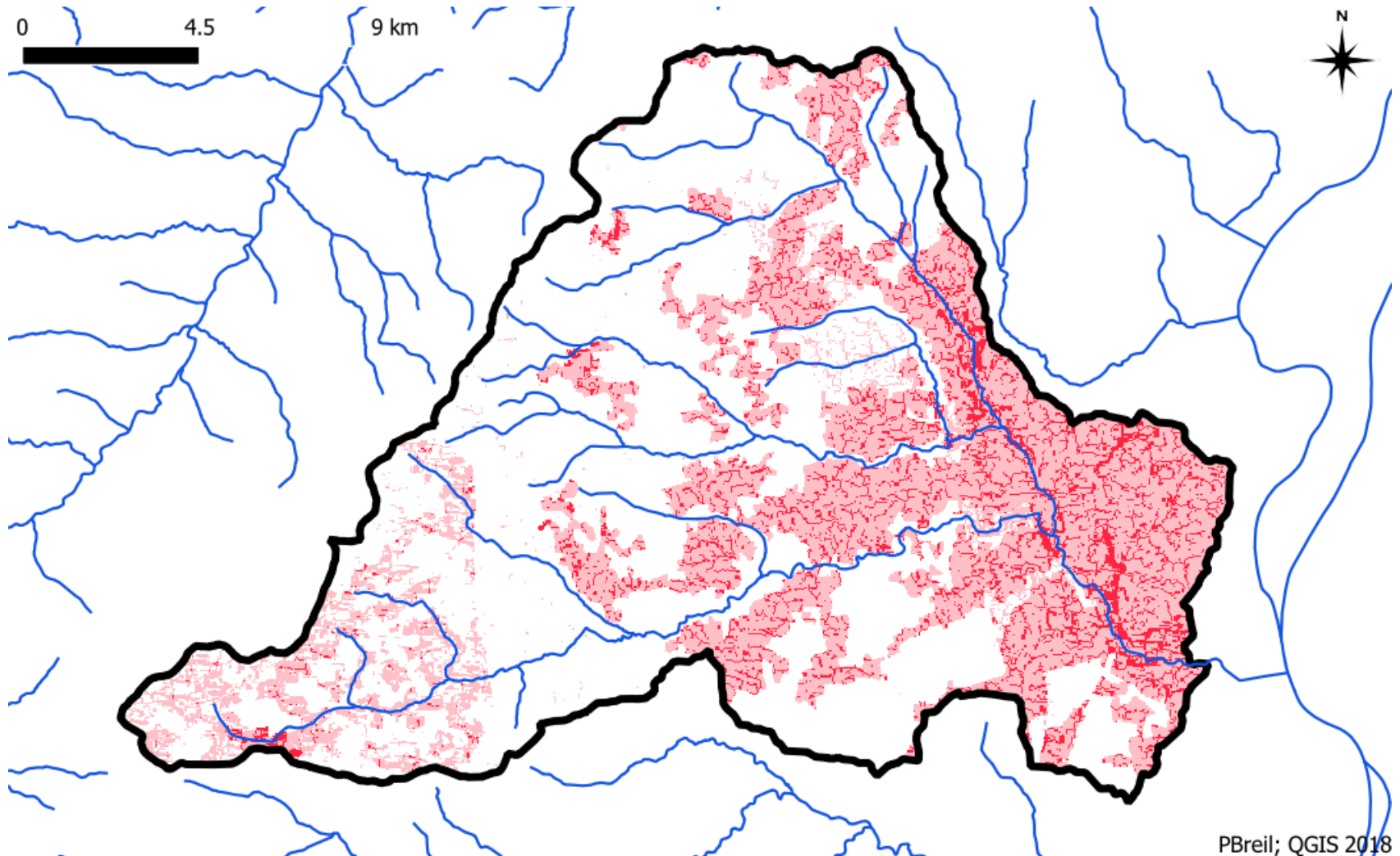


$$\text{Biodegradation flux} = \text{Biodegradation kinetic} * \text{Reactive surface}$$

$$\text{Nutrients flux} = \text{Concentration} * \text{water discharge}$$

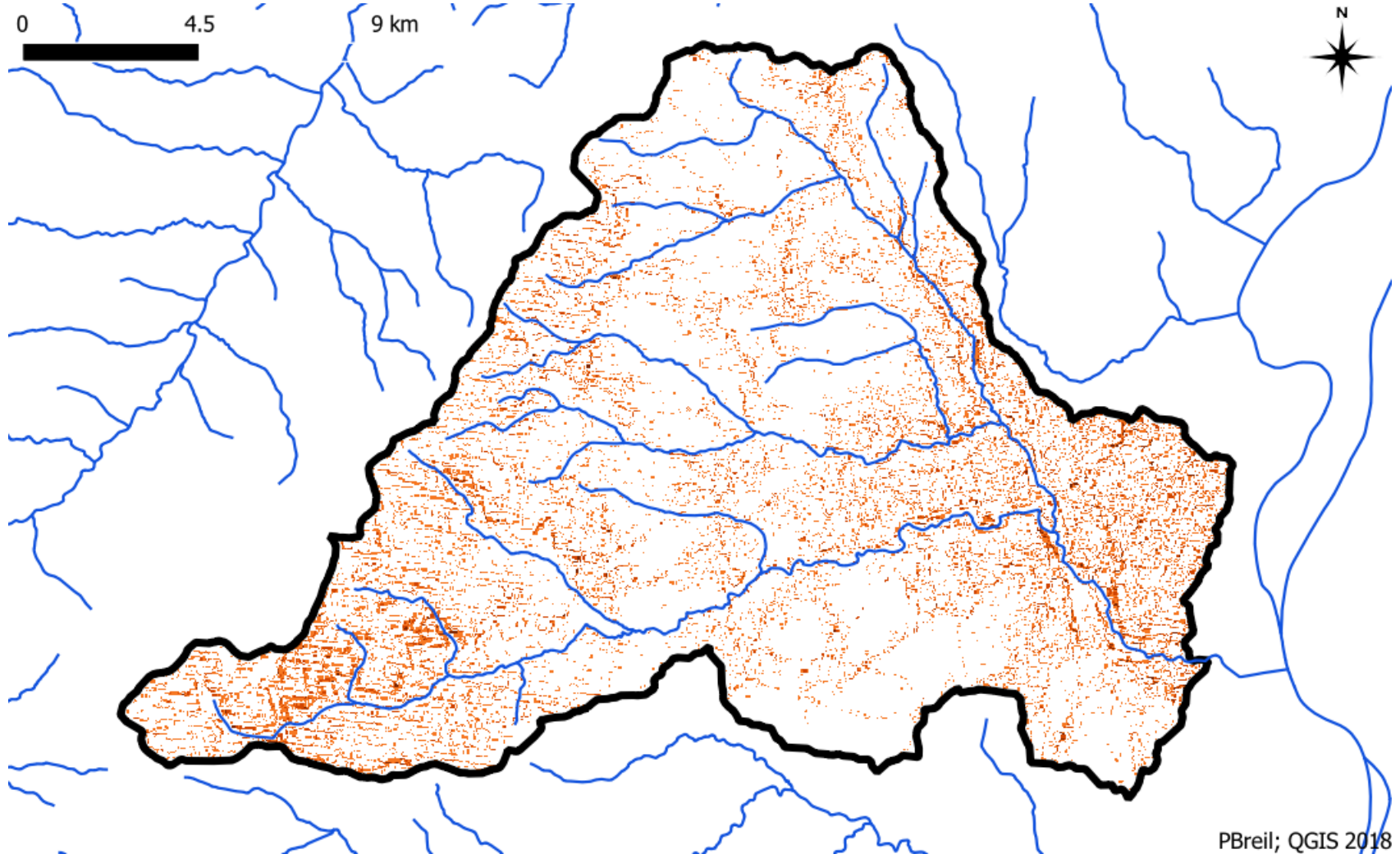
I – hydrological cycle

Where surface runoff does initiate?



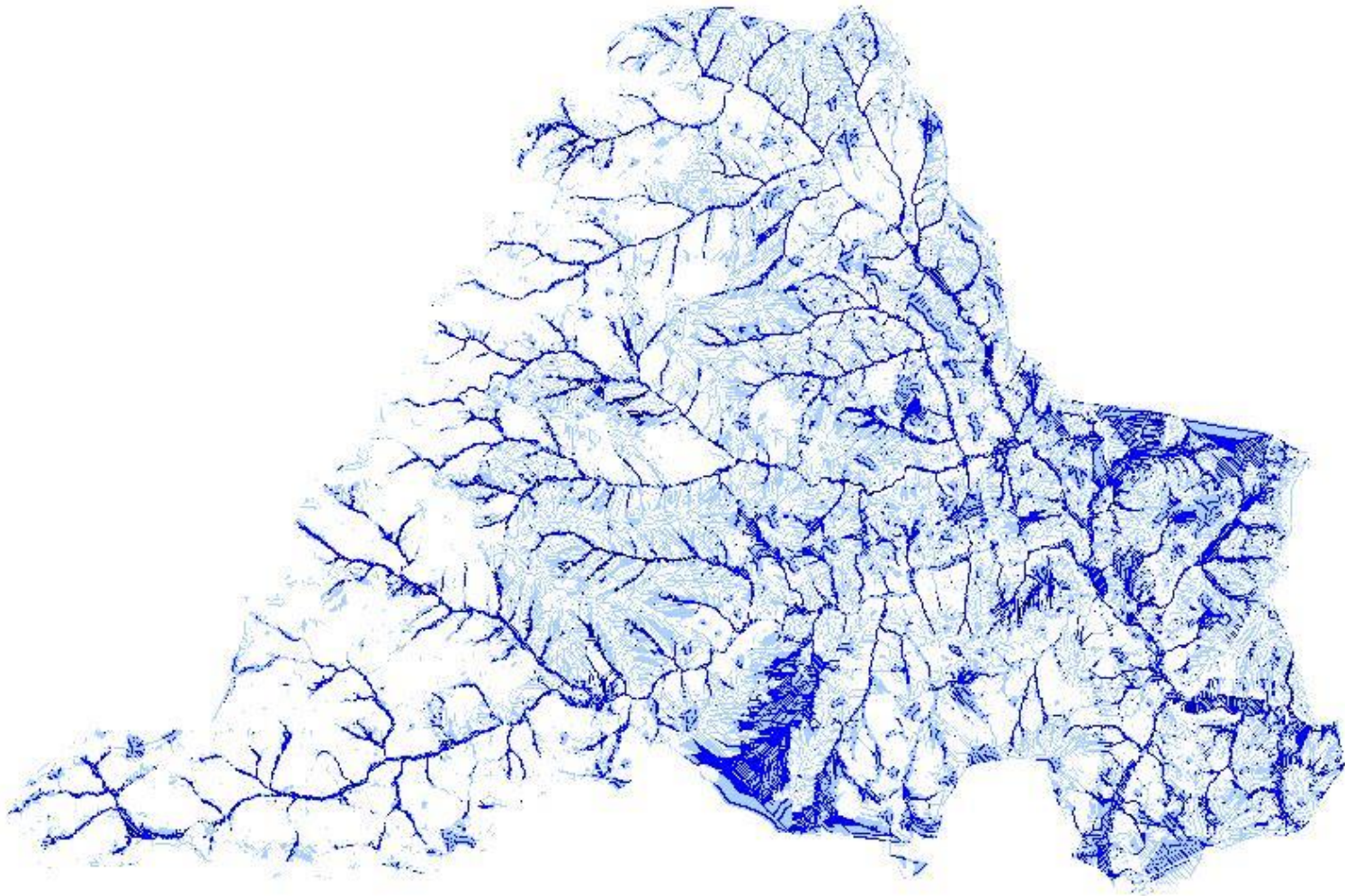
I – hydrological cycle

Where surface runoff does circulate?

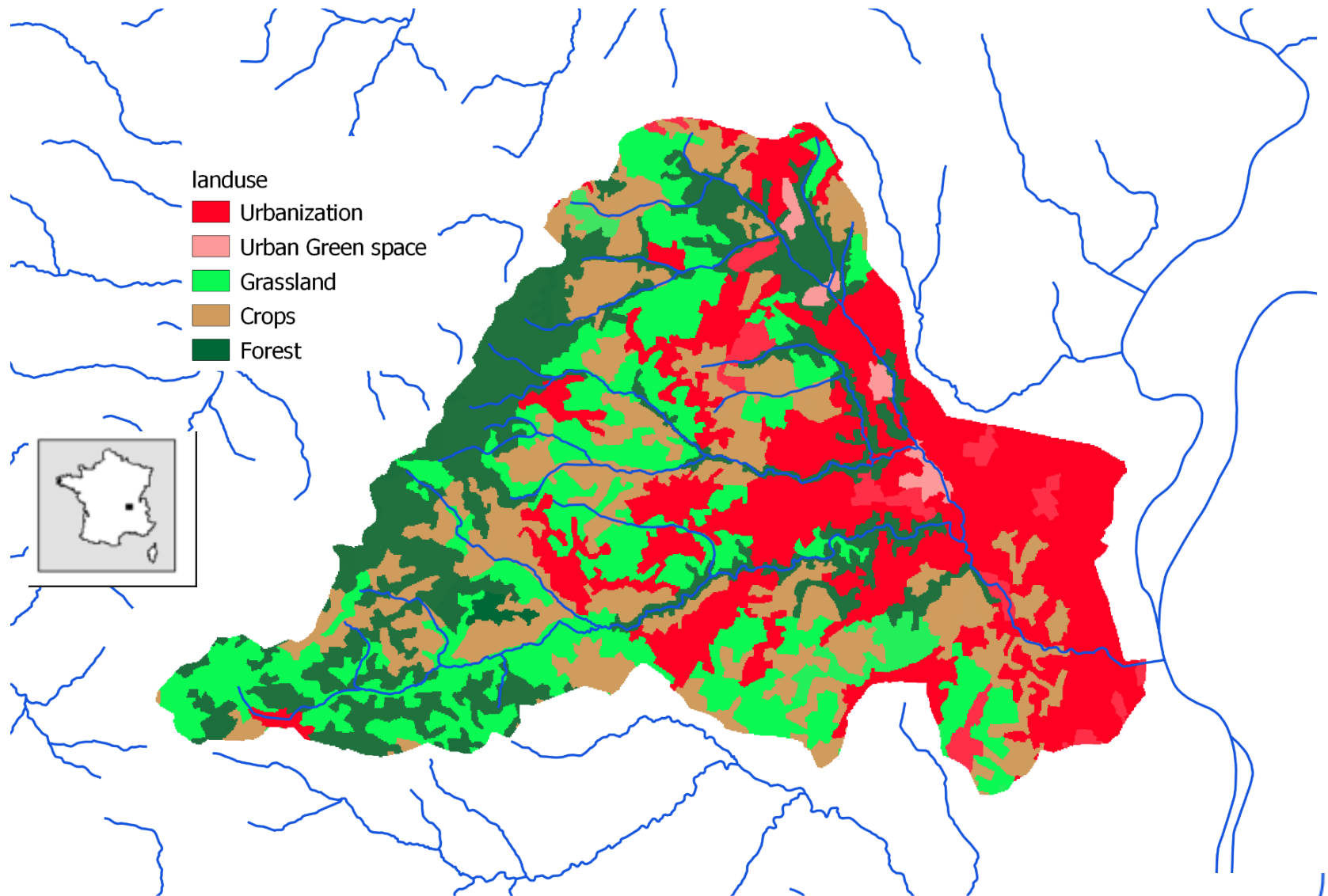


I – hydrological cycle

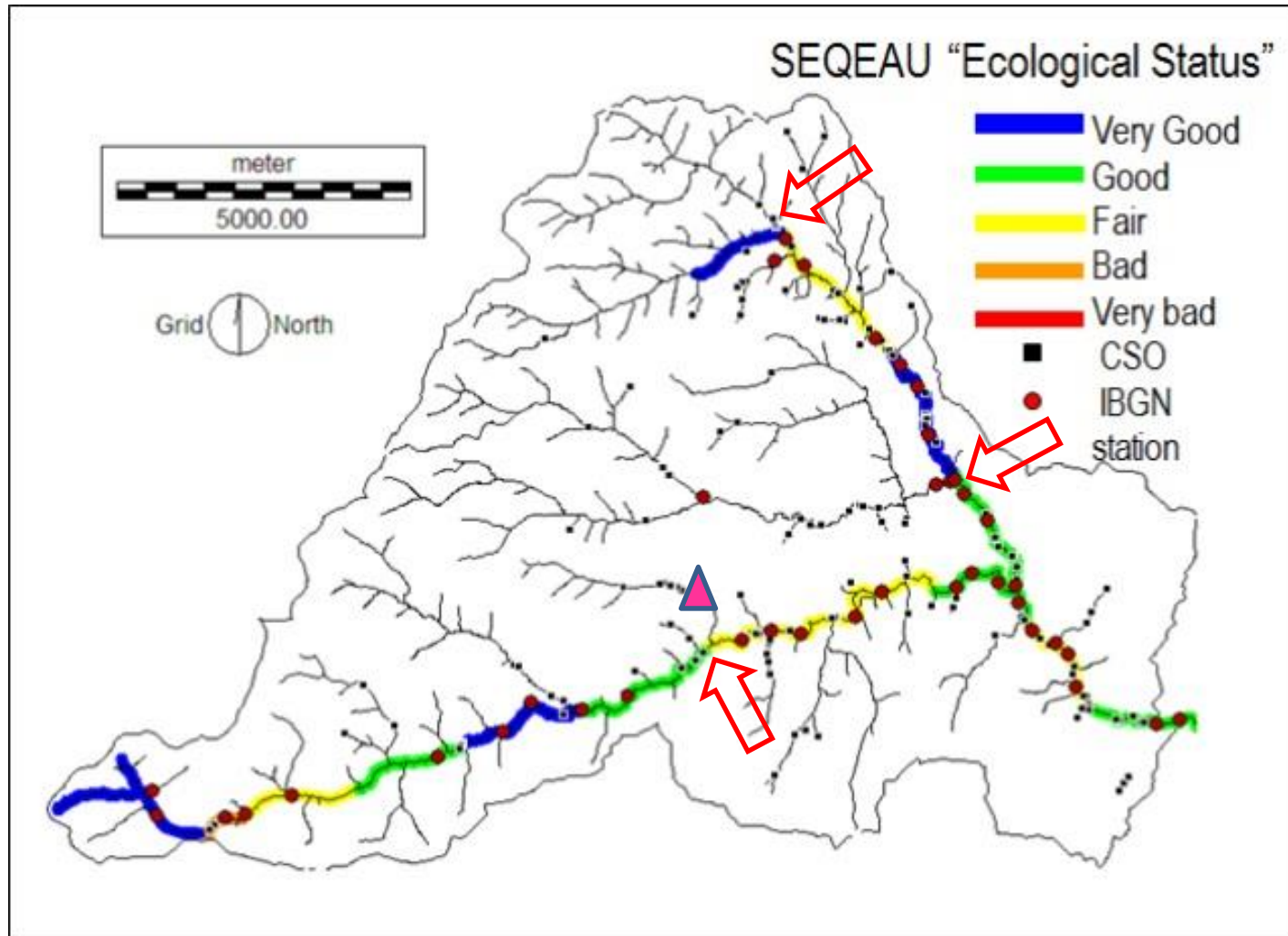
Where surface runoff does accumulate?



II – Type of of threats



II – Type of threats

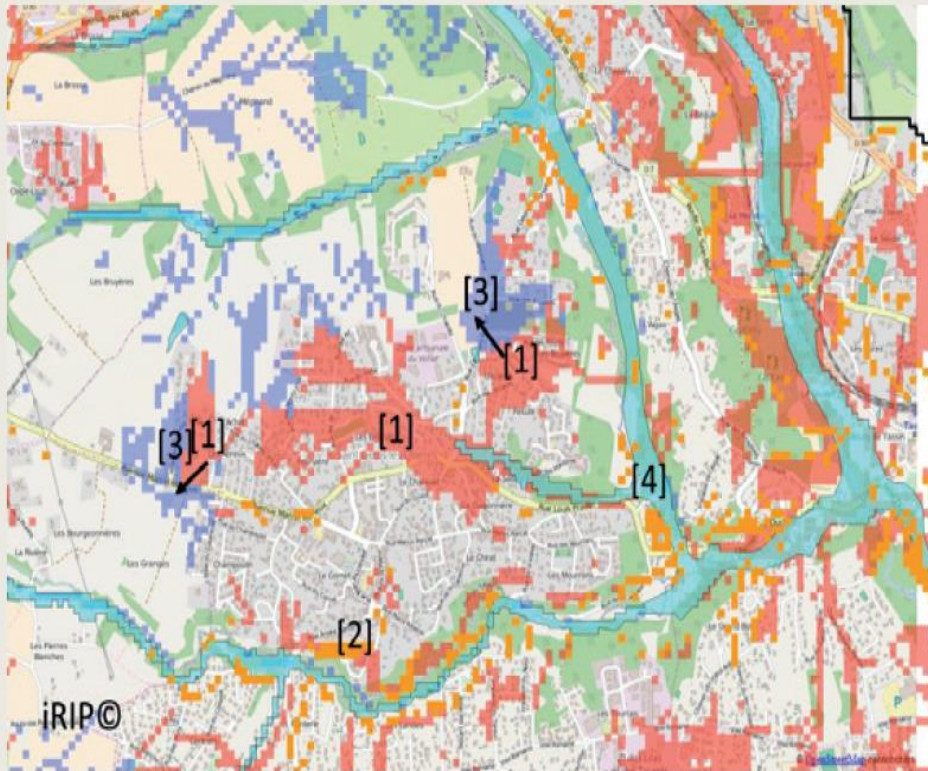


II – Type of threats ***Rural land use***



II – Type of threats PeriUrban land use

- ② Il faut savoir cartographier les étapes du ruissellement intense pluvial afin d’imaginer des moyens de prévention adaptés.



L'inondation par ruissellement intense.

- [1] zone de production – la lame d'eau peut atteindre quelques centimètres tout en s'écoulant.
- [2] zone et axe de transfert – le ruissellement peut se concentrer, prendre de la vitesse et éroder les parties meubles, devenir boueux.
- [3] l'écoulement est ralenti ou bloqué, la hauteur d'eau peut augmenter, inonder et les matières transportées se déposer, ensevelir.
- [4] la limite de la zone inondable (EAIP) par débordement des cours d'eau.

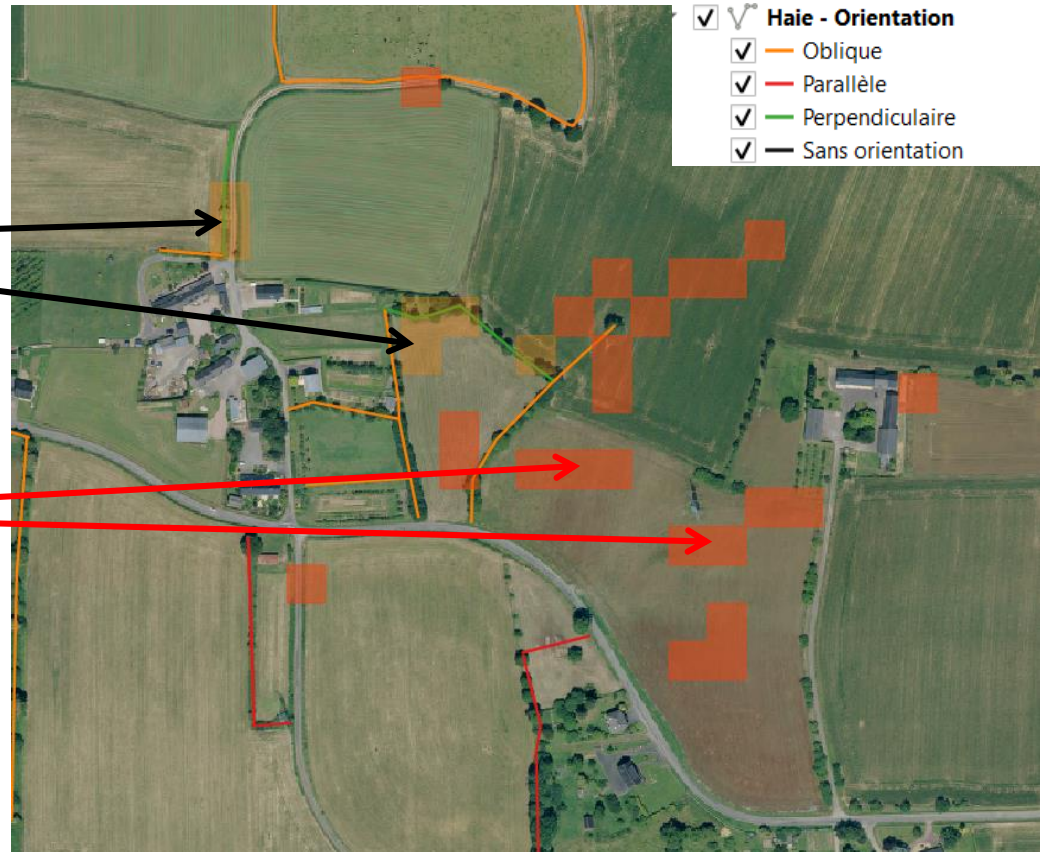
III – Natural based solution opportunities

Rural land use

- ✓ Haie - Orientation
- ✓ Oblique
 - ✓ Parallèle
 - ✓ Perpendiculaire
 - ✓ Sans orientation

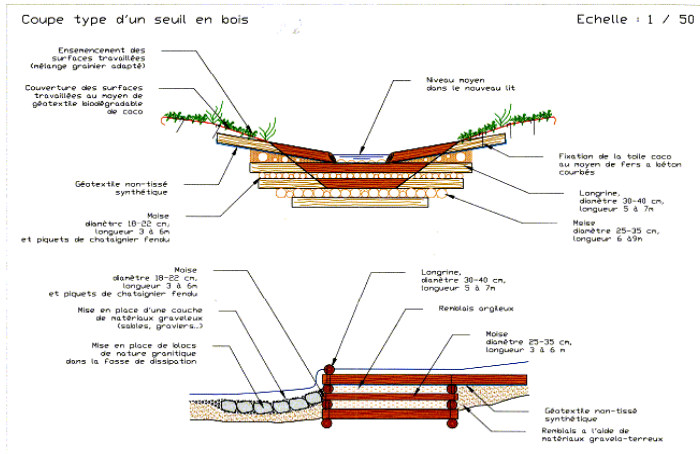
Haie
« efficace »
interceptant un
transfert de
ruissellement

Transfert de
ruissellement
non intercepté
par une haie



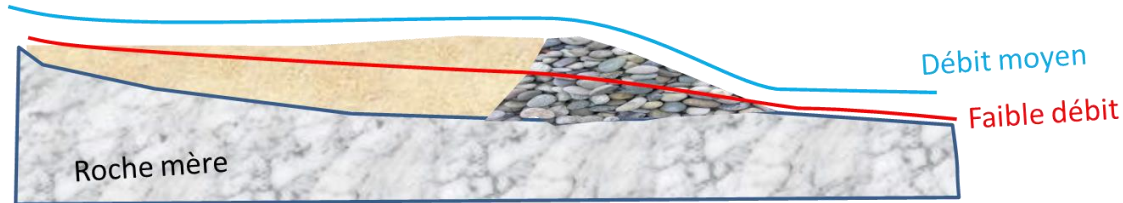
III – Natural based solution opportunities

Periurban land use



“Porous weir”

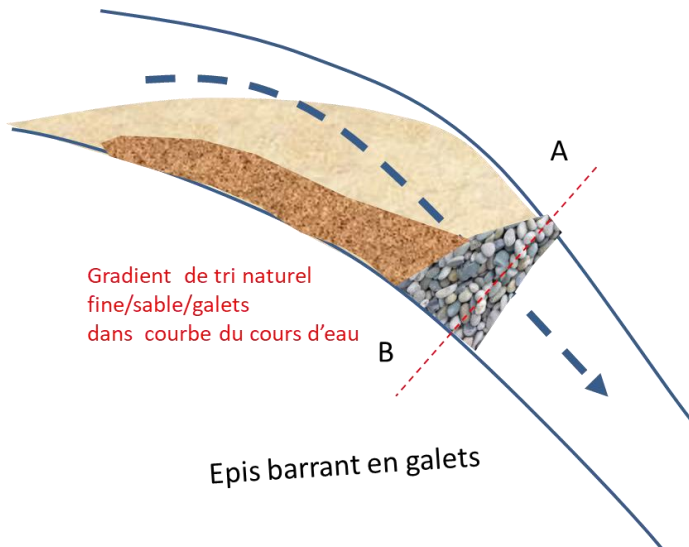
III – Dual regulation into seasonal- rivers



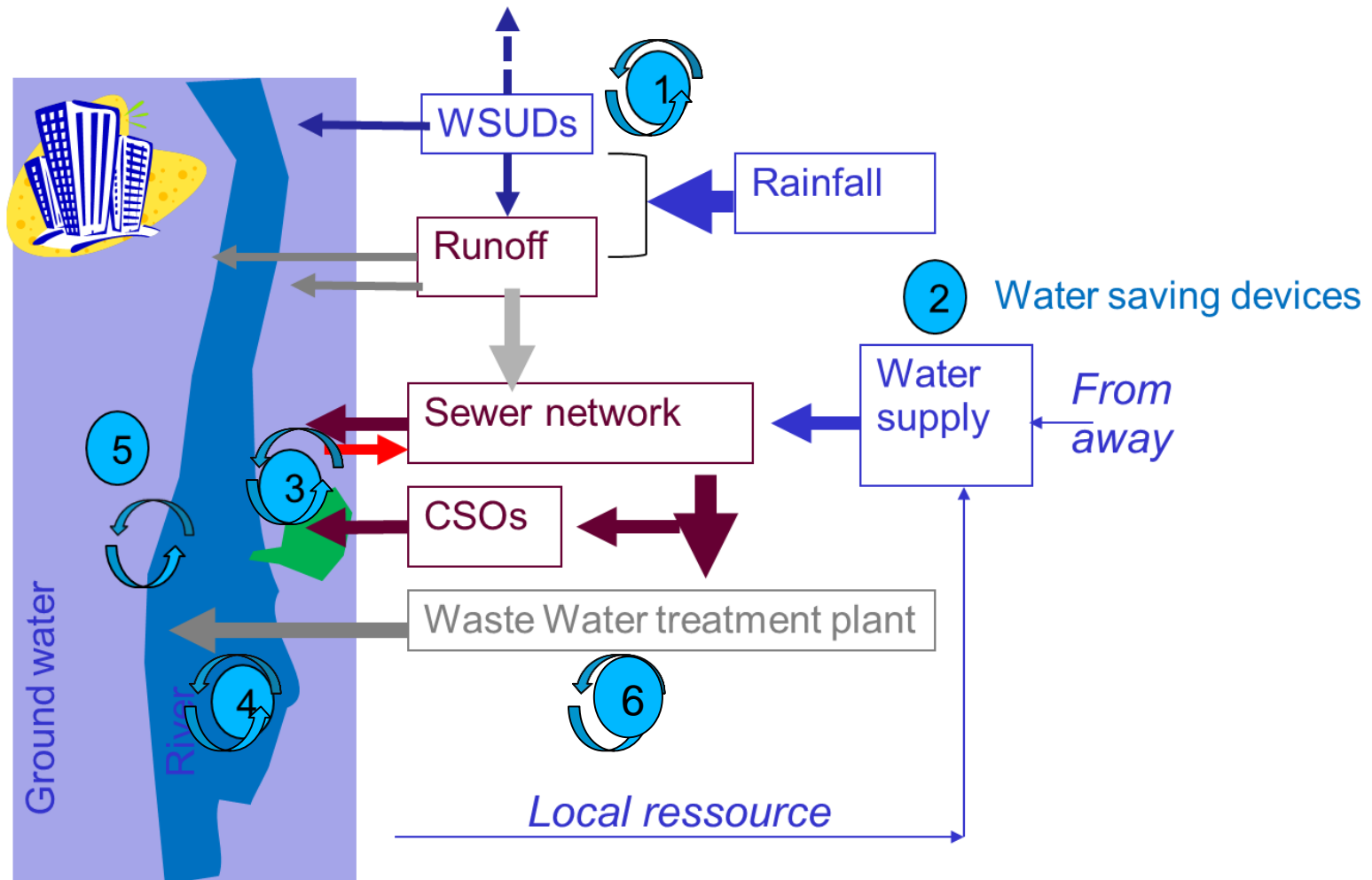
Ep moyenne du lit de sable de 40 cm à calculer selon pente locale. Détermine hauteur de l'épis



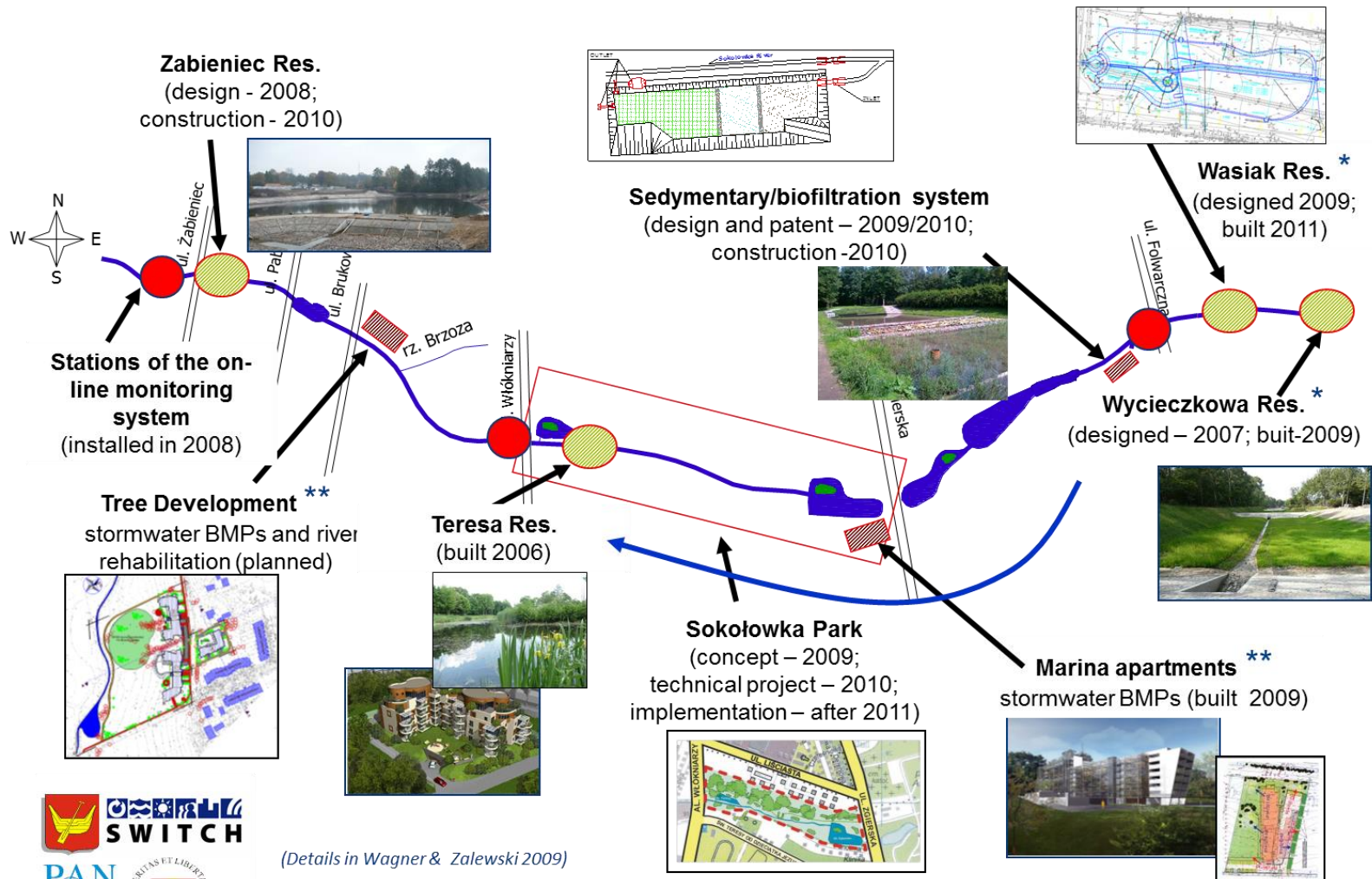
Fonctionnement:
Interception pollution complète à faibles débits
Régénération biochimique à débit moyen
Régénération physique à fort débit



III – Natural based solution opportunities Into dense urban land use



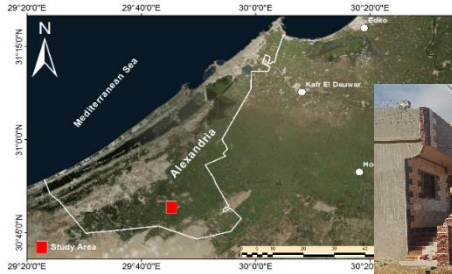
VI- range of solutions in dense urban areas



(Details in Wagner & Zalewski 2009)



Egyptian case



Rural area
(Diab Village)



Deterioration of
soil quality and
limited cultivation



High salt concentration of
the ground water
and canal irrigation



No wastewater
treatment system



Samples were collected from available water sources

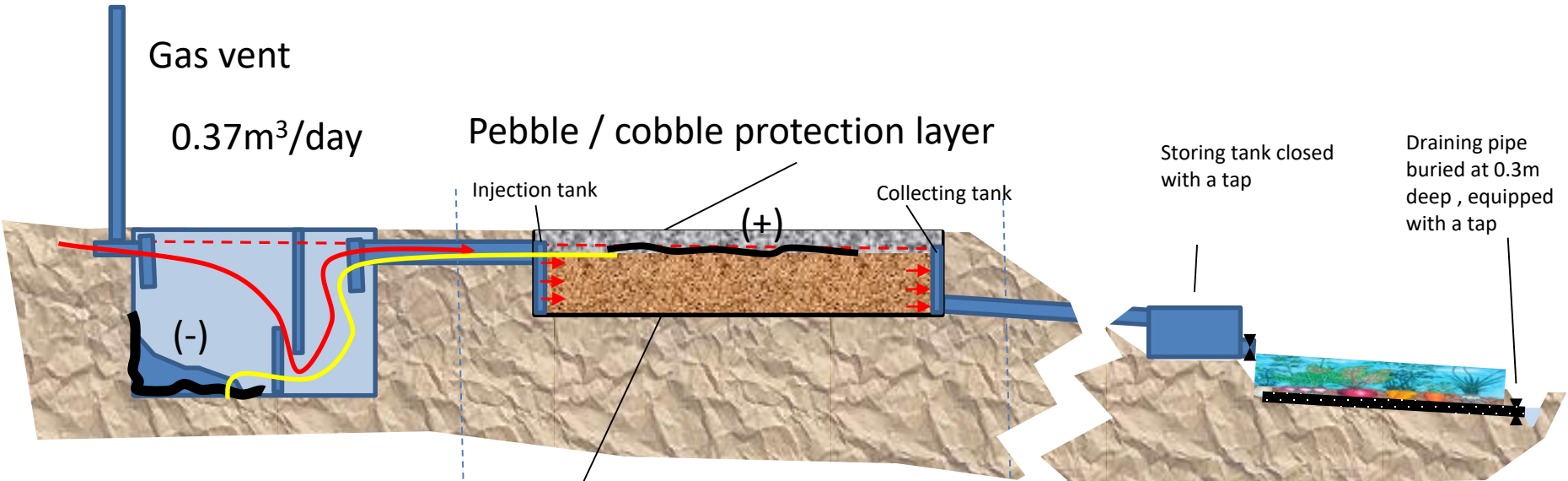


Public participation

- **Community entering through “Future Protectors” NGO**
- Deciding after Listening
- Sharing decisions
- The output can be start-ups



Anaerobic biodegradation



Sceptic tank principle

Anoxic biodegradation phase

Design
3-4 m³ for 5 persons

Must be cleaned every
3 years

Medium to coarse sand
(0.25 ϕ <math><1\text{mm}</math>)

Oxic mineralization phase

Design assuming
Hydraulic conductivity of 10^{-4} m/s
Sand Volume of 0.5 m X 2.0 m X 12.0 m
Hydraulic gradient of 0.5 m

Which gives:
A flux of 0.36 m³/day
Residence time of 10 days
Storage capacity of 3.7 m³

Phase 1 : washing soil by flooding irrigation (as it is practice by local people). Duration is 40 days for a plot of 5m² flooded each night under 0.07 m of treated WW.

Phase 2 : drip irrigation with 0.007 m / day (0.7 cm) required for vegetable growing in arid zone (FAO data).



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WHAT ARE THE DEMONSTRATION SITES?

<http://ecohydrology-ihp.org/demosites/>

The Ecohydrology Programme is also based on a network of demonstration site which integrate the concept of “**enhanced ecosystem potential**” with EH strategies closely related with water to improve IWRM on specific areas.

They:

- Are **long-term monitoring** projects involving different local stakeholders in order to solve environmental, economic and social issues.
- Use the **most appropriate** and **cost-effective** ecohydrological engineering solutions for each ecosystem as management tools for Integrated Water Resources Management (IWRM).
- Provide contribution for both **human** sustainable development goals (e.g. Goal 2) and **environmental** ones (Goal 6, in particular targets 6.5 & 6.6, and Goals 13, 14 and 15).

These projects follow a solution-oriented approach for the enhancement of **W**ater resources, **B**iodiversity and ecosystem **S**ervices for society and of the **R**esilience to various forms of anthropogenic impacts (**WBSR+C**).

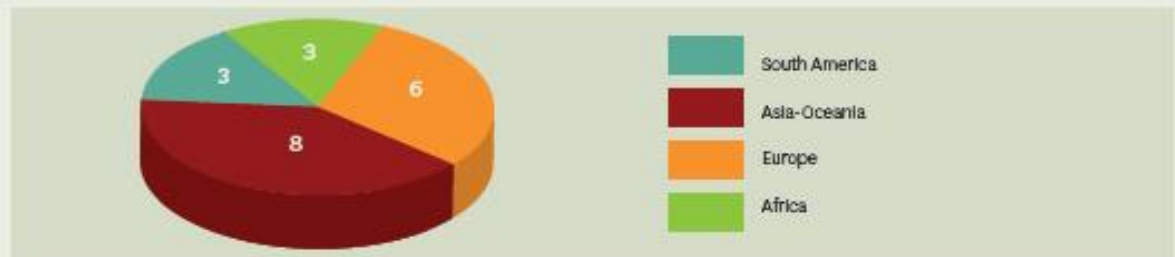
Network of the demonstration sites



LEGEND

Demonstration sites

- Basins
- Inland wetlands
- Rivers/Lakes
- Estuaries/Coastal Water





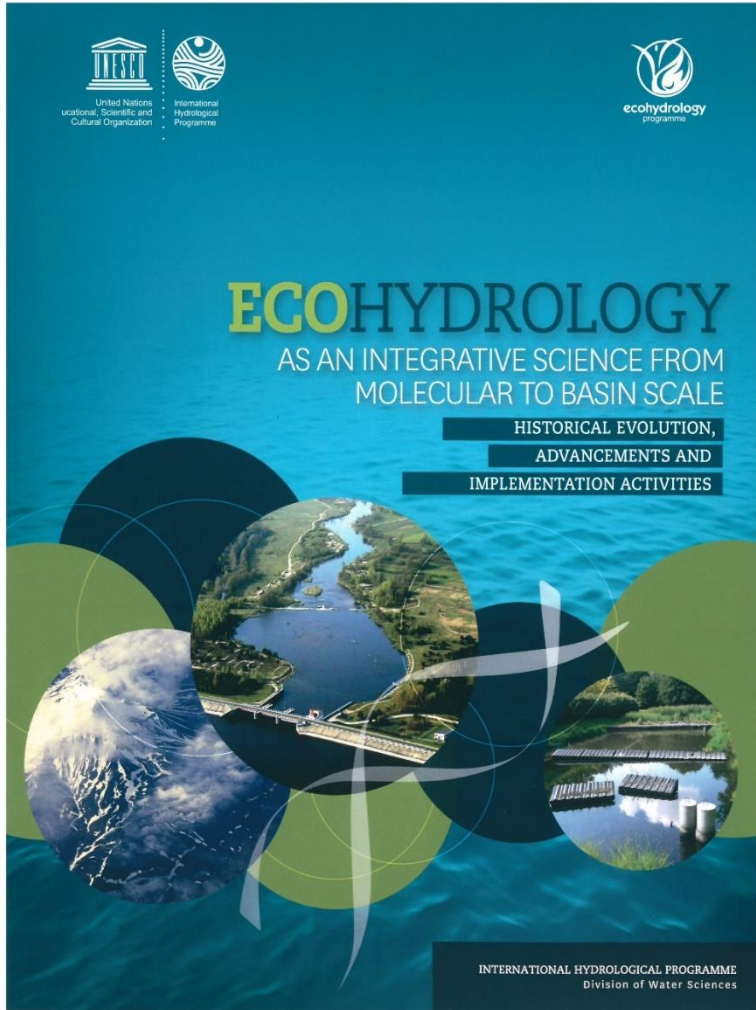
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Dissemination Material



EcoHydrology is not just greening!

