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Urban EH demosite proposal

Pascal BREIL, *IRSTEA-Lyon, RIVERLY research Unit, Hydrological Processes & Spatial Modelling Team*

Gislain LIPEME KOUYI, *INSA, DEEP Laboratory, Dir. of the field observatory for urban water management.*

OTHU

Ecohydrology Workshop & Scientific Advisory Committee – 27/02-2/3/2018 – Faro, Portugal

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Where?





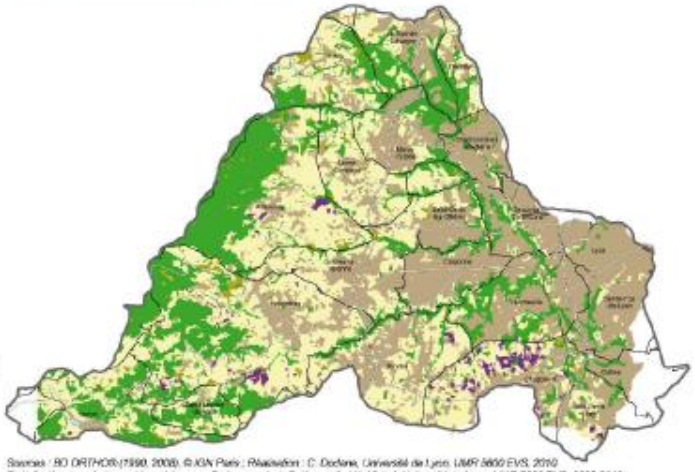
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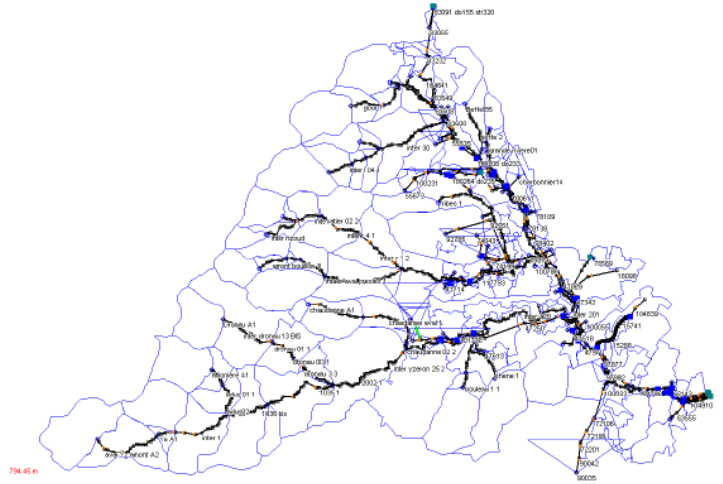
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Problematic

L'OCCUPATION DU SOL EN 2008

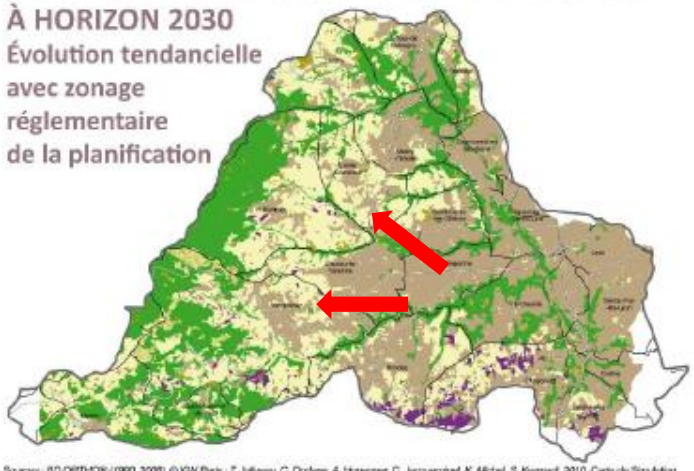


Sources : BD ORTHO® (1950, 2000) © IGN Paris ; Réalisation : C. Doctane, Université de Lyon, UMR 5600 EVS, 2010
Digitalisation des photographies aériennes : C. Jacquemmet, S. Kermadi et K. Michel, Université de Lyon, UMR 5600 EVS, 2008-2010

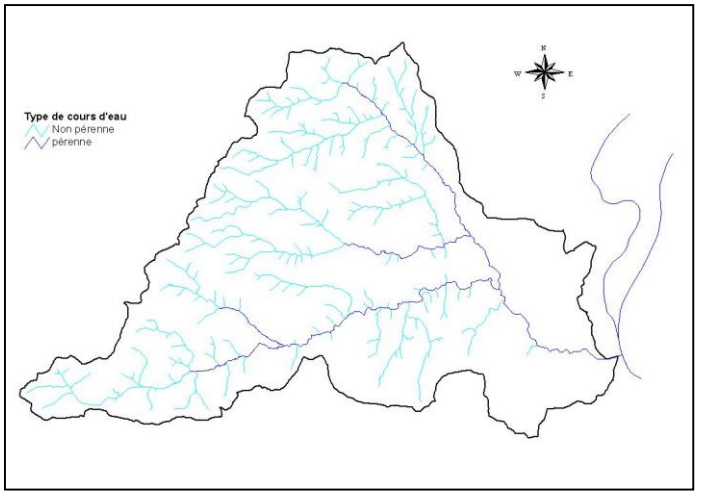


SIMULER L'EFFET DES OUTILS DE PLANIFICATION À HORIZON 2030

Évolution tendancielle avec zonage réglementaire de la planification



Sources : BD ORTHO® (1950, 2000) © IGN Paris ; T. Jolliveau, C. Doctane, A. Honegger, C. Jacquemmet, K. Michel, S. Kermadi, 2010. Carte de Simulation des usages du sol dans le bassin versant de l'Yzeron en 2030 (scénario S1Da) – Université de Lyon, UMR 5600 EVS. Simulation réalisée sur la continuation du rythme des changements d'occupation du sol passé (1950 - 2008) jusqu'en 2030, avec deux contraintes réglementaires de la planification (1. prise en compte des zones à urbaniser des POS et des PLU ; 2. prise en compte des périmètres possibles de protection et de mise en valeur des espaces agricoles et naturels périurbains dans l'agglomération lyonnaise) et sans effet (scénario S1tsa).



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Ecohydrology & Hydrobiology 13 (2013) 113–134

Contents lists available at SciVerse ScienceDirect

Ecohydrology & Hydrobiology

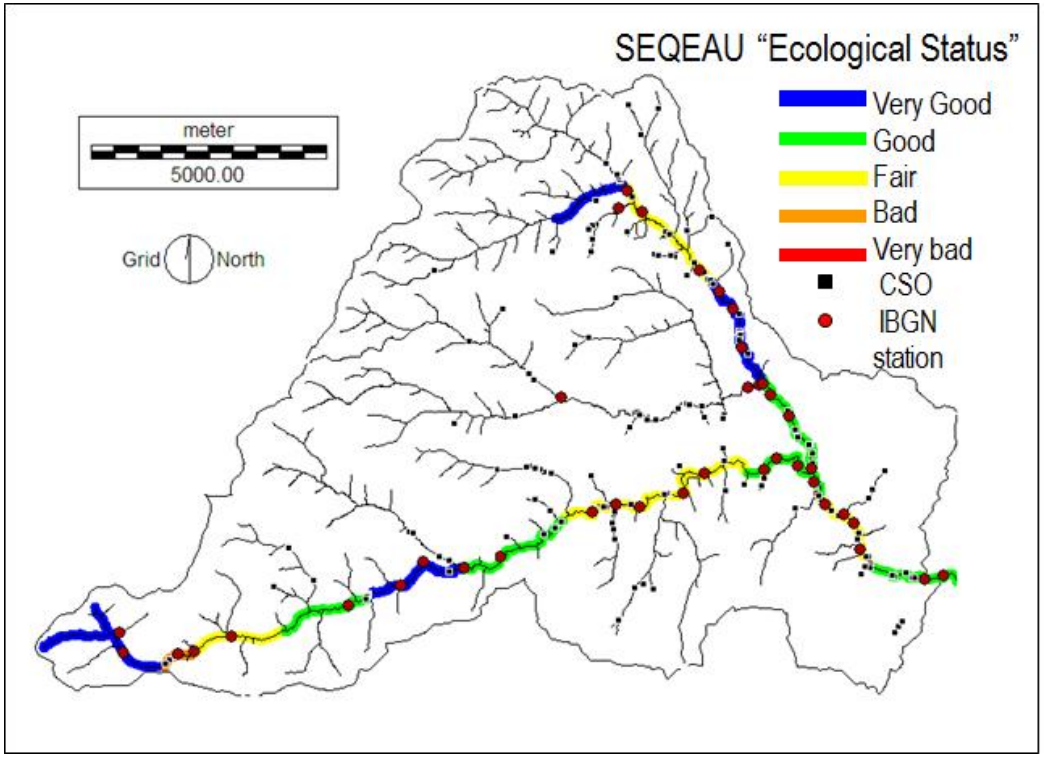
journal homepage: www.elsevier.com/locate/ecohyd

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Original research article

The role of ecohydrology in creating more resilient cities

Iwona Wagner [a,b,*], Pascal Breil [c]



Hydrological perturbation

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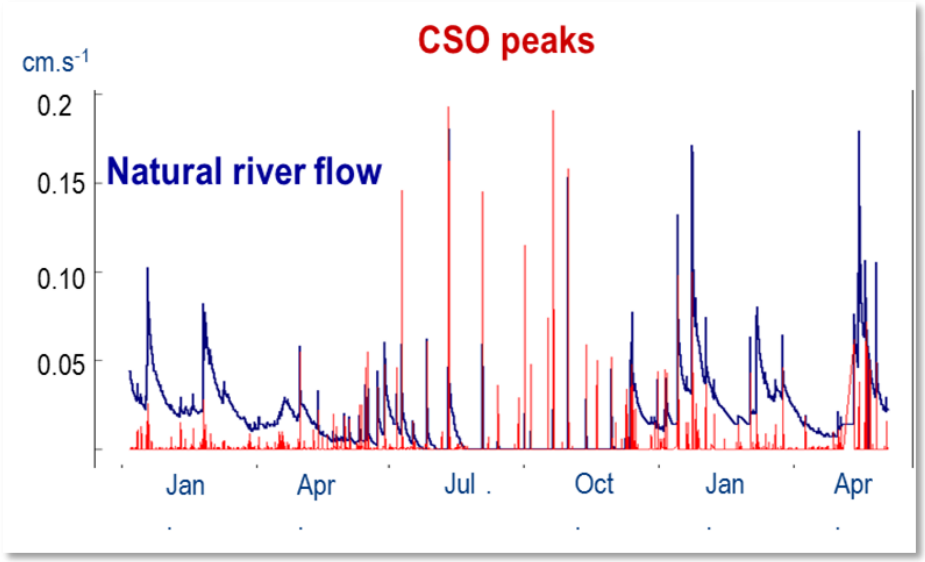






Erosion





Deposits

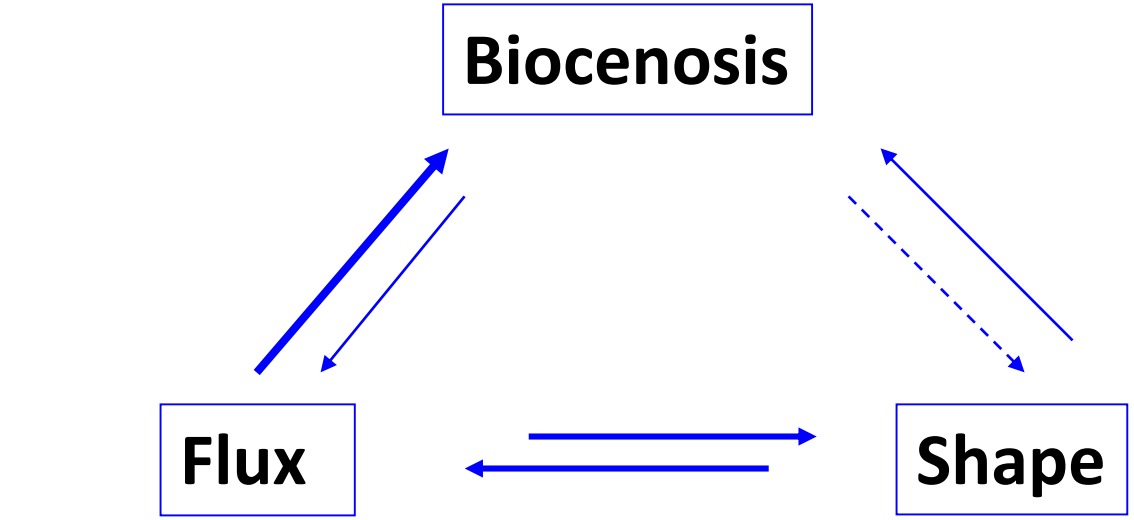


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EH dual regulation principle



Water related

macro- / micro-

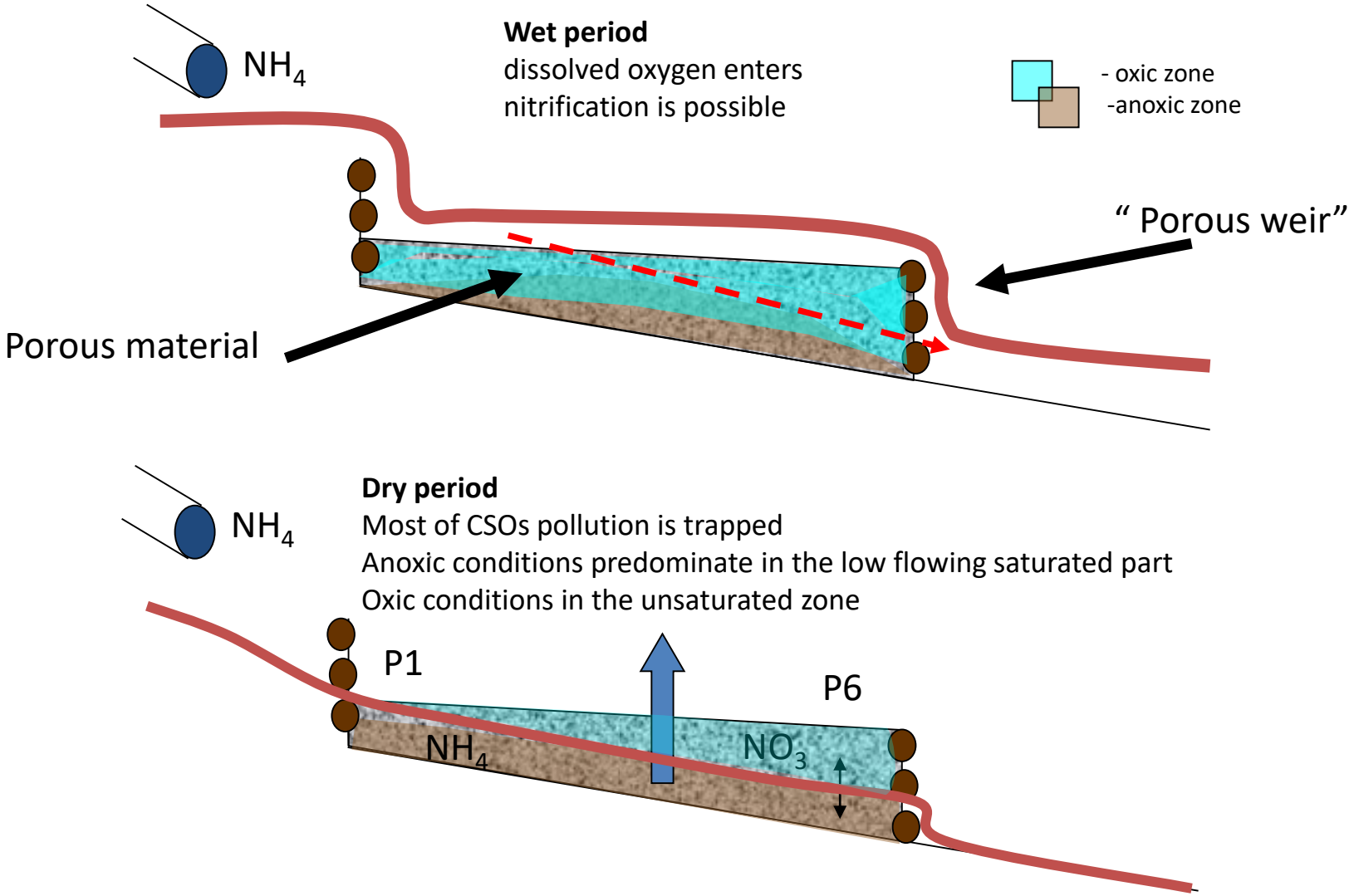
How to enhance self purification capacity of seasonal “little” streams?

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Constructed riffle… functioning hypothesis

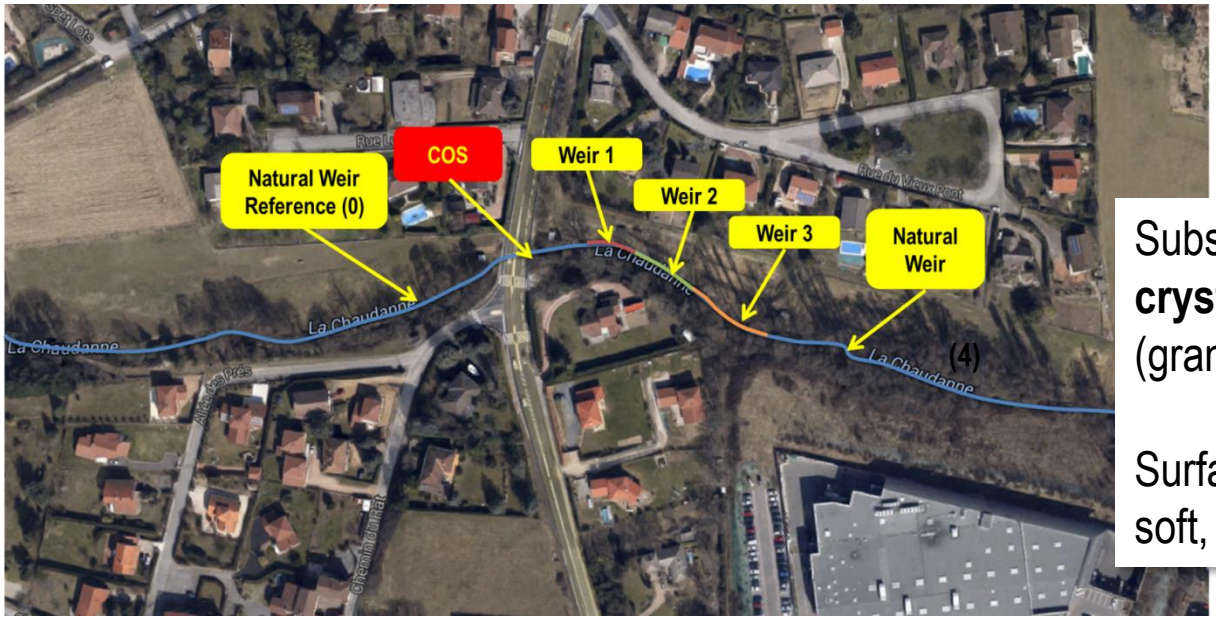


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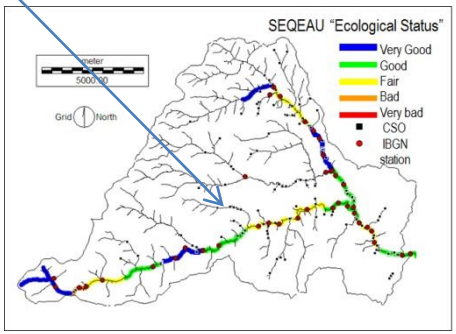
Experimental seasonal creek



Substratum essentially **crystalline** & **metamorphic** (granite, gneiss)

Surface formations thin and soft, types **arenas**

Catchment area: 2.7 km²
Wet season mean flow: 18 L/s

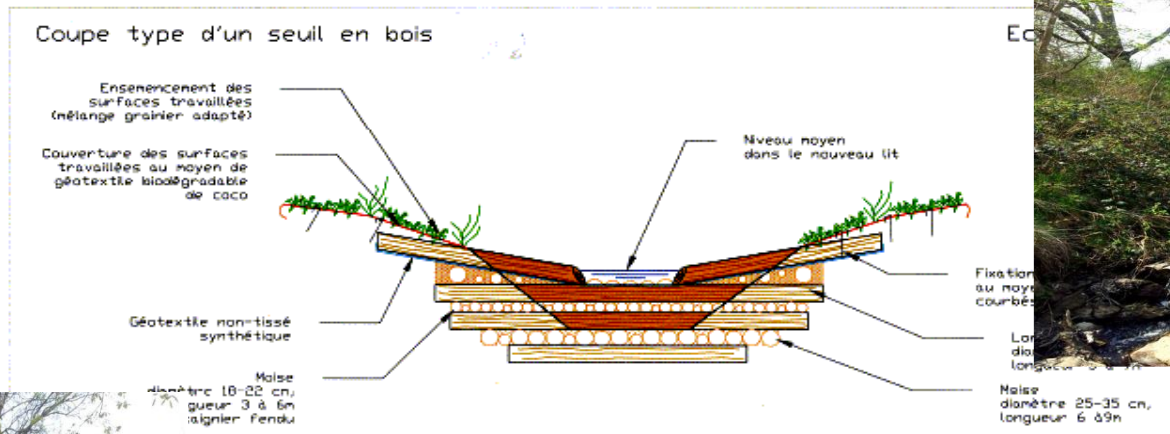


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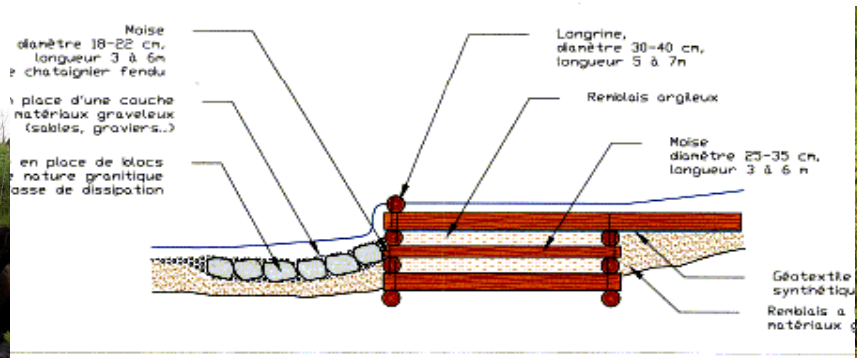
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Riffle design…empirical











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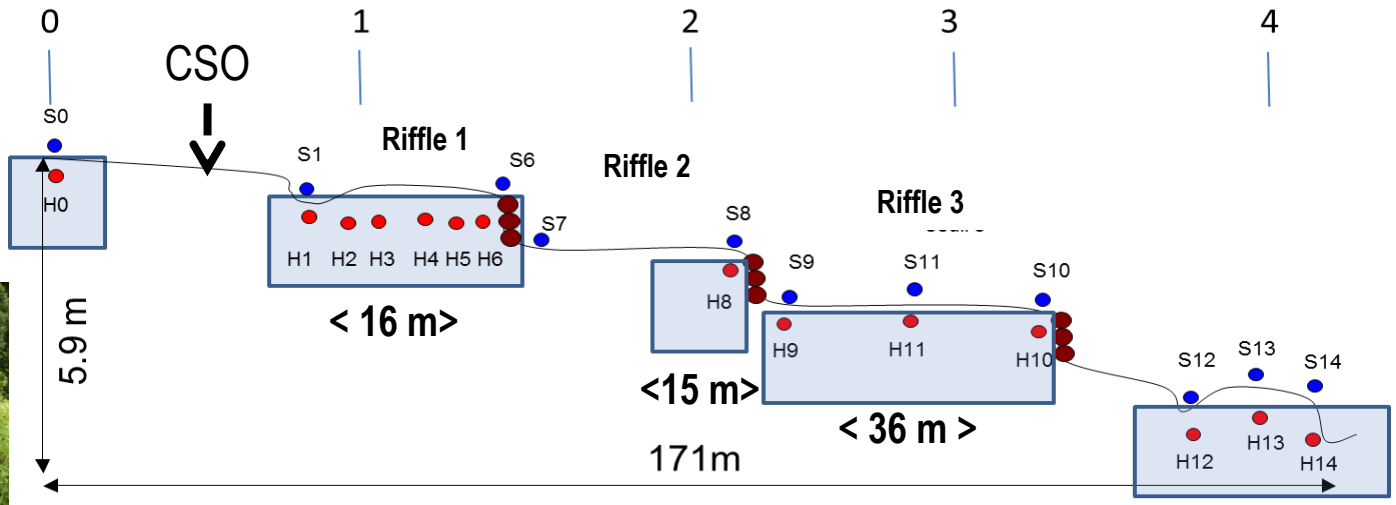
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Monitiring strategy







Proof of concept..trapping effect



0



CSO



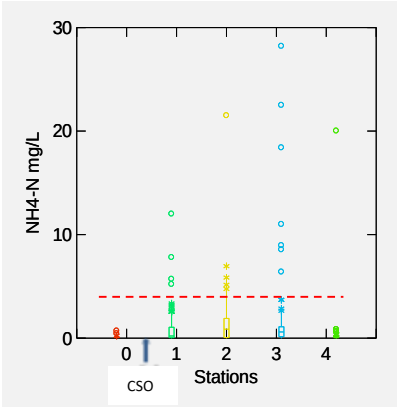
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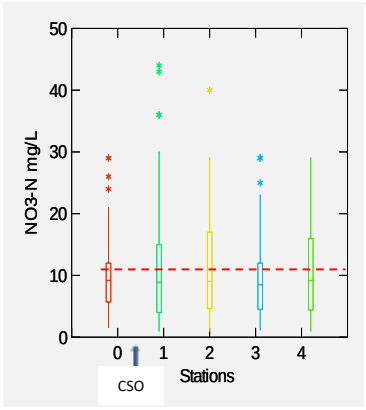


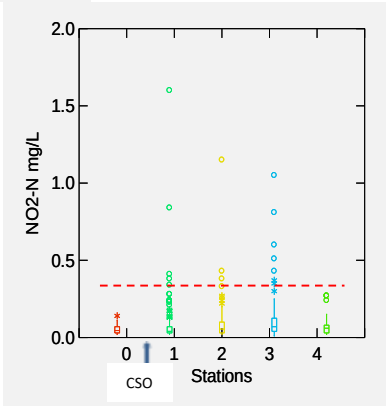
2 & 3

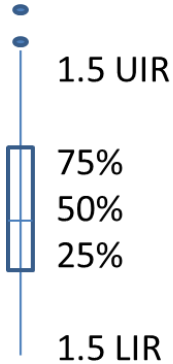


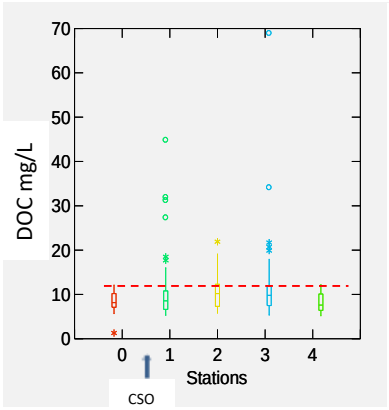
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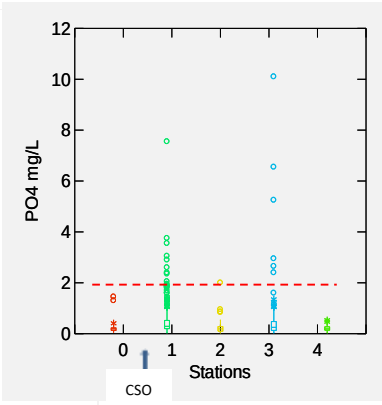












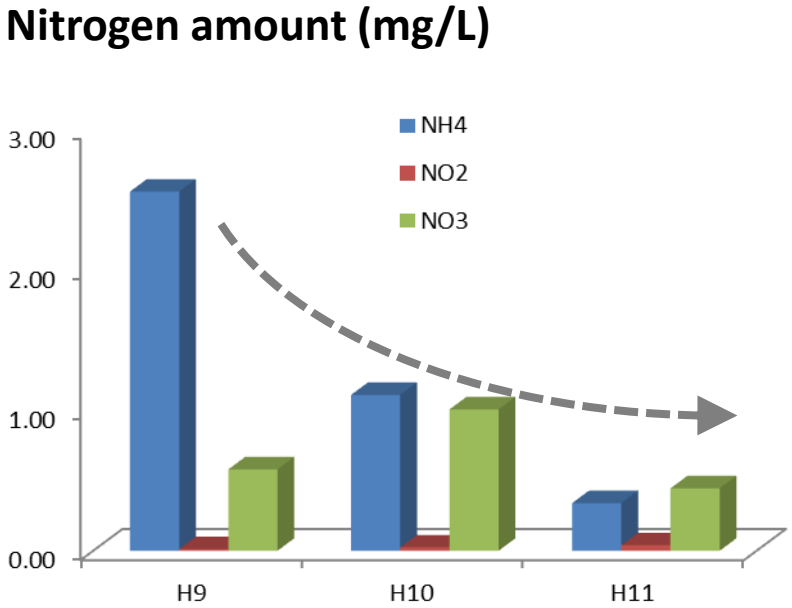
- NO3 fertilizers in excess
- CSOs pollution is trapped
  - Organic N, Organic C, P
- Is the pollution reduced?

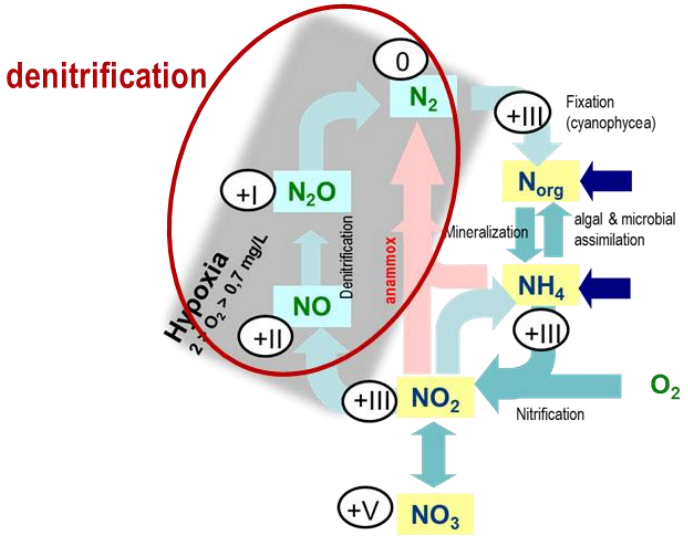
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Proof of concept…. biodegradation process / uptake..

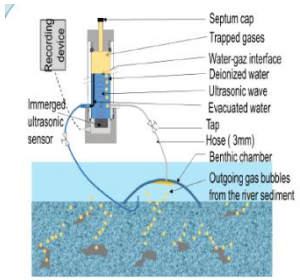




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Microbial activity measurement

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Gas sampling device



Figure 2 : System in operation on the field,

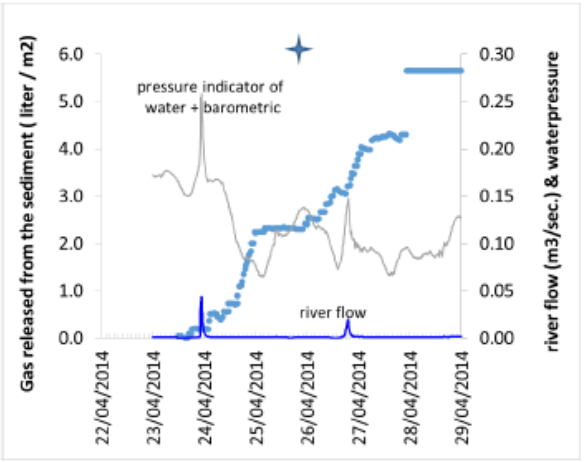
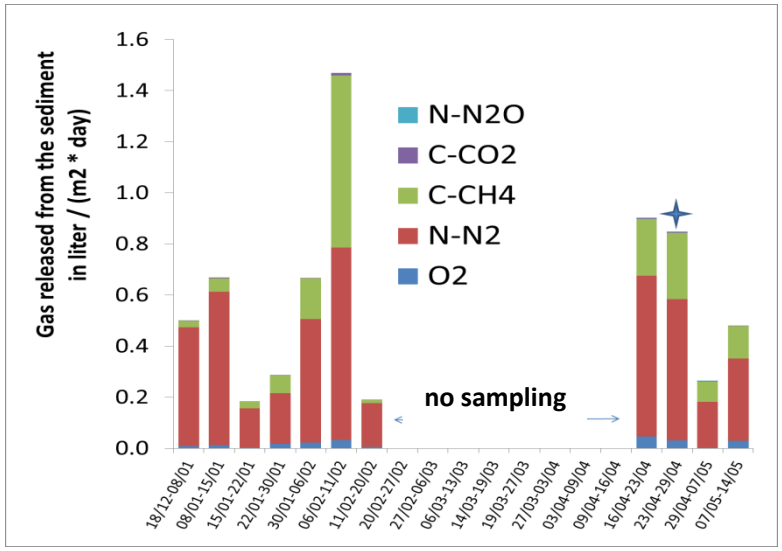
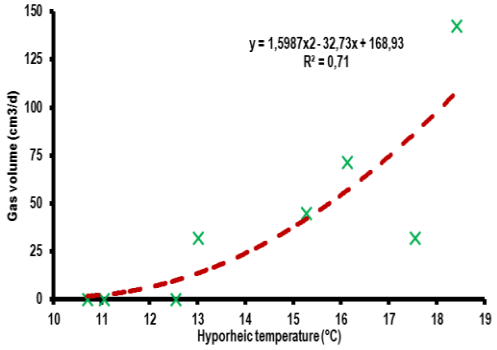


Figure 3 : dynamic of the gaz production per m² Influence of the barometric pressure.





Hyporheic gases were essentially CH_4 and N_2 & measured rate of production was 1L / m2.day

Nitrogen gazeous export was estimated to represent 5% of available N amount per day

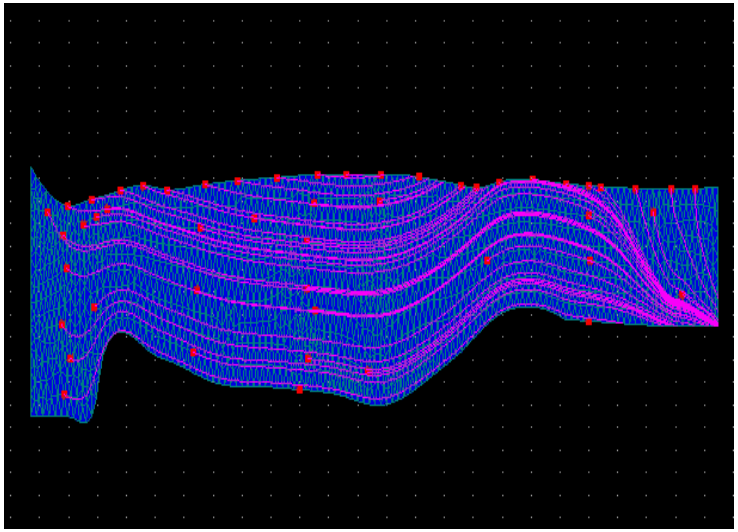
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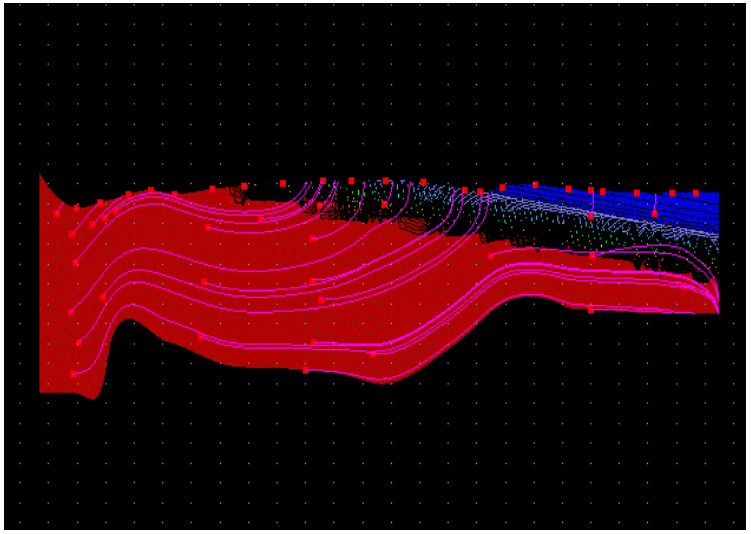
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Understanding the hydrodynamics…

« low flow condition…trapping phase»



« high flow condition…regeneration phase »

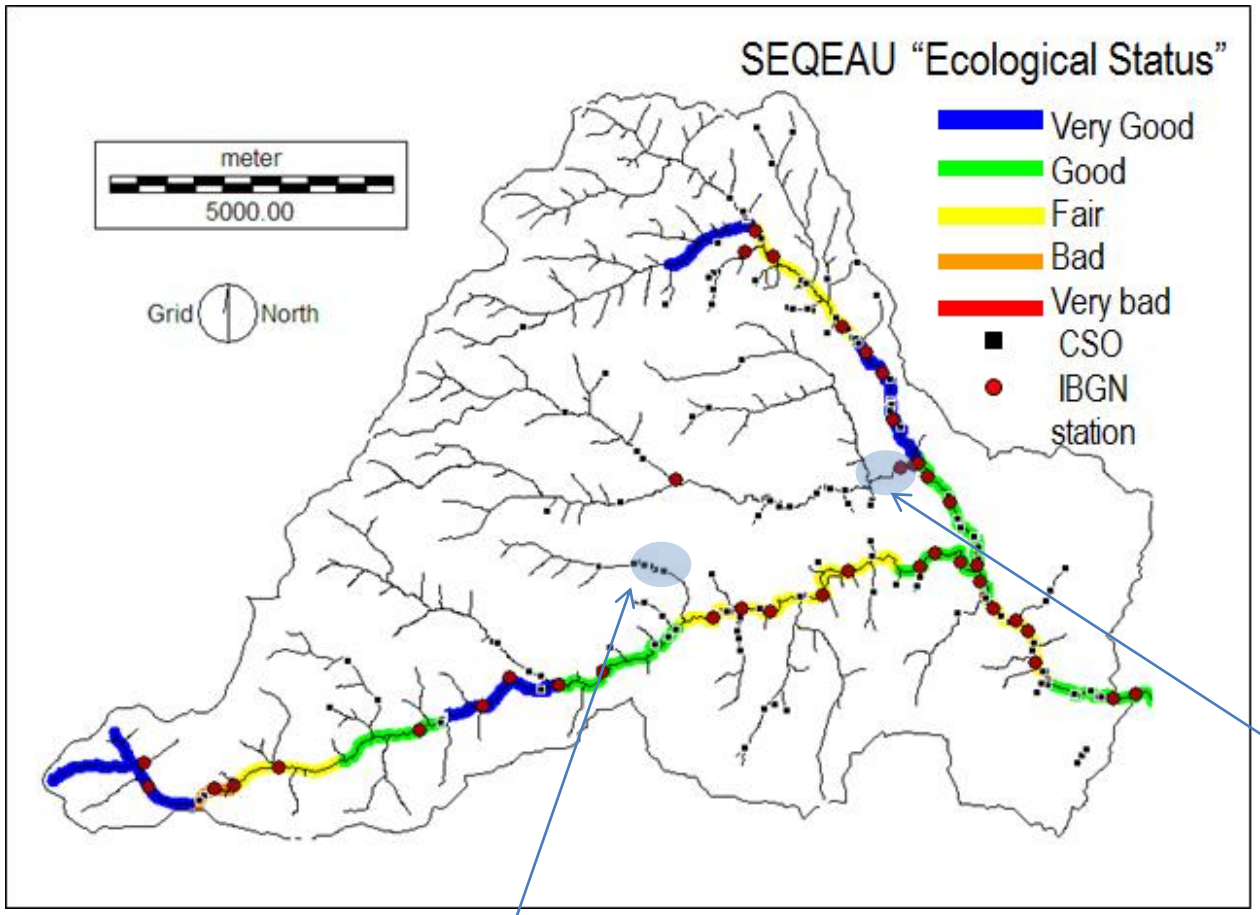


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Implementation strategy with the support of the river basin manager

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Replication site planned on 2018 for proof of transferability

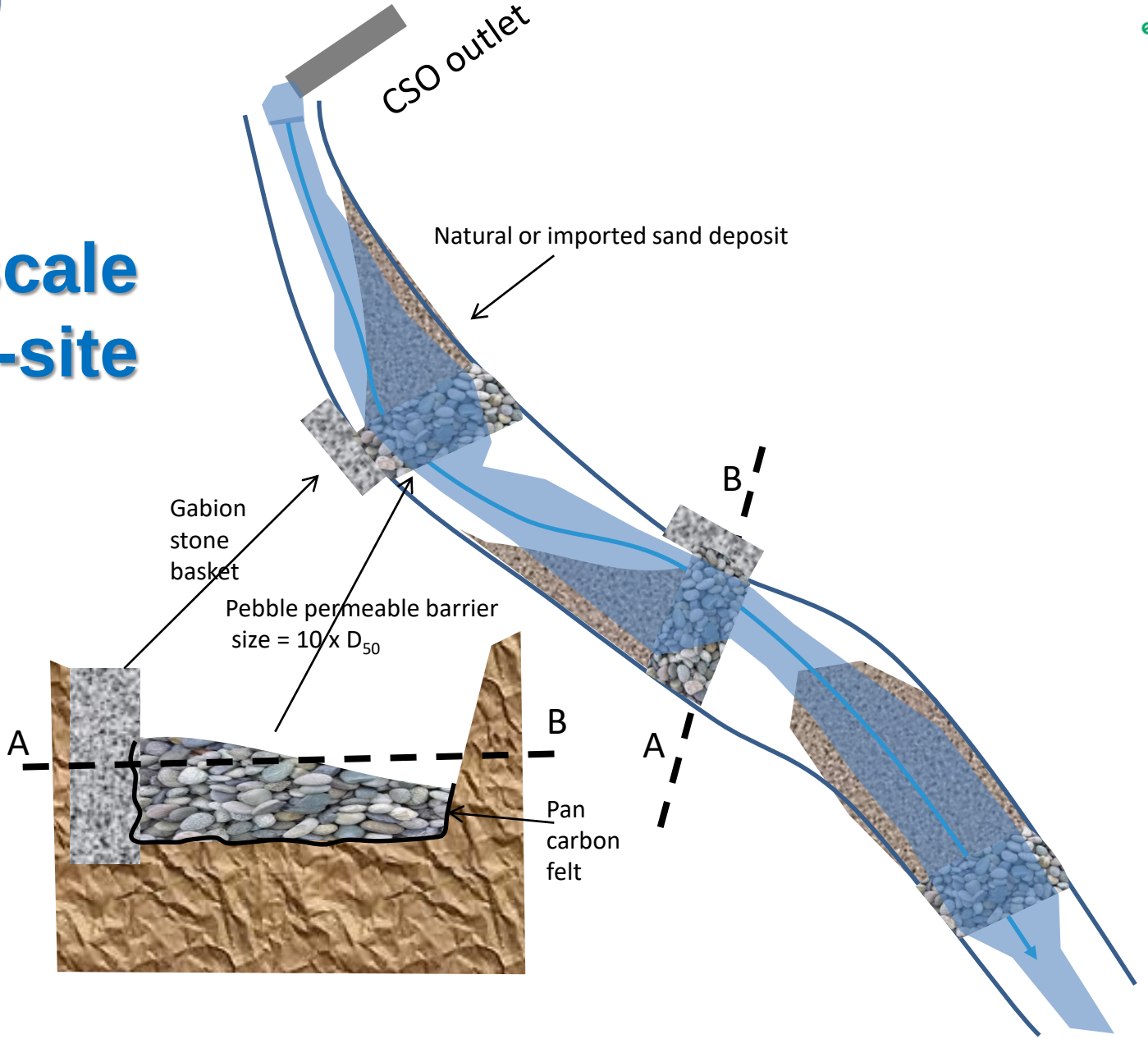
Demosite – proof of concept running since 2006

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Real scale demo-site

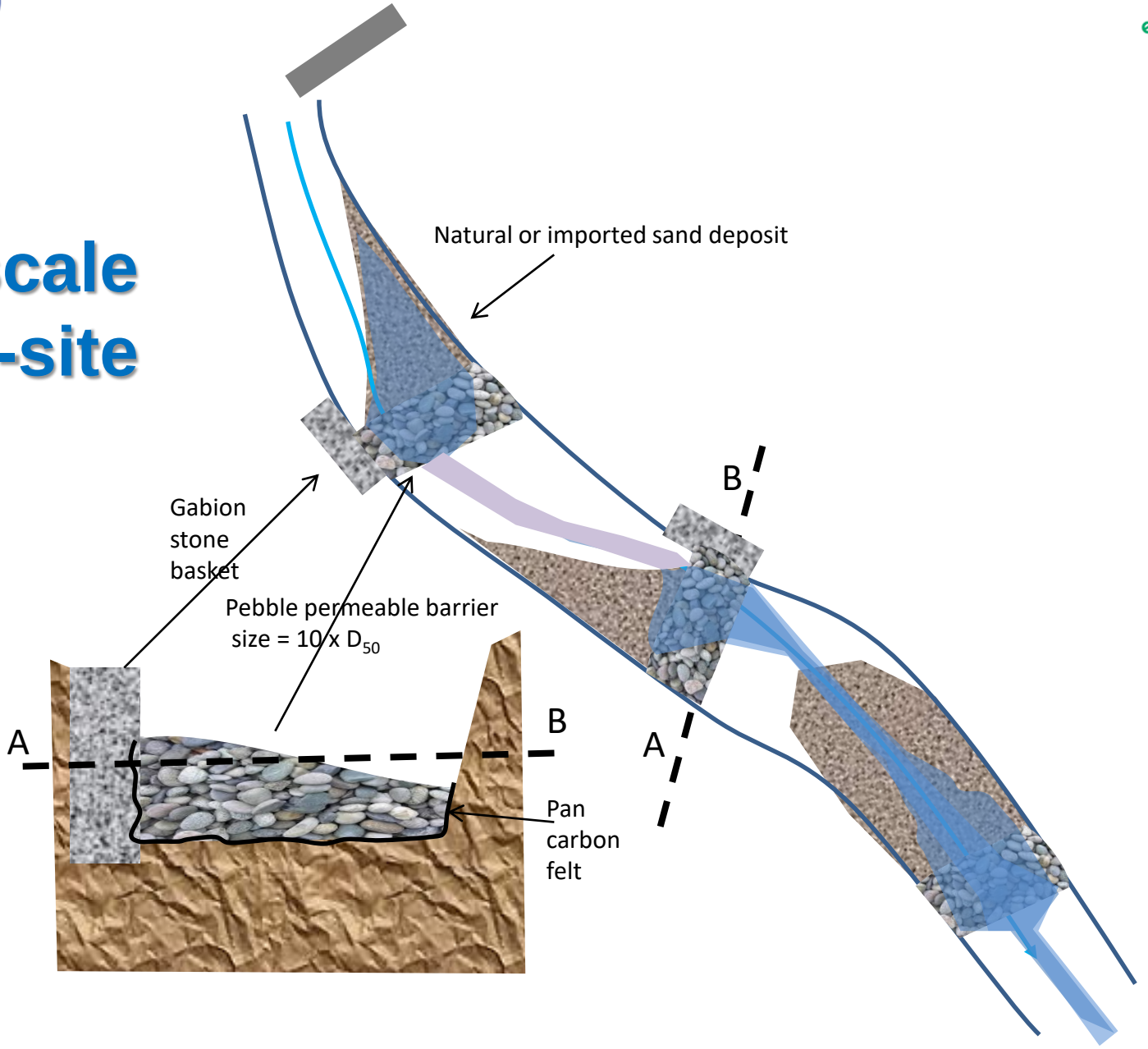


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Real scale demo-site



Could this large renovation project be part of the Lyon demosite ?

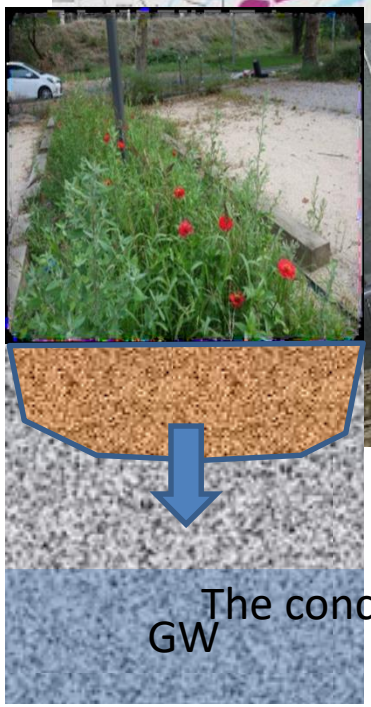
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Aims of SCMs (Stormwater Control Measures) regarding micropollutant in urban wet weather effluent : Comparison of the performance of source control vs "end of pipe" systems









The concept of "sponge city"

Constructed porous riffle

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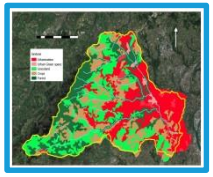
Demonstration site description

Lithology/geochemistry

Gneiss and granite bed-rocks covered with alocrisol (granitic brown acid soil) and sandy-silt to silty-sand colluvial into valleys.



N 45°44'30.37'' ; E 4°41'53.88''



Yzeron River catchment

Main Description

Main description : The Yzeron river basin is 147 km2 in area with a population is of 144 000 inhabitants (1 354 000 for Lyon metropolitan). Demosites are located N45°44'38.50''–E4°41'24.49'' and N45°45'28.24''–E4°45'04.09'' on seasonal rivers and at N45°47'05.92''–E4°52'18.43'' in a car park.

Principal services provided by the demosite (ecosystem services): This project focuses on the enhancement of natural regulating services by increasing local biodegradation capacity of soils and stream sediments to trap and naturally process polluted waters delivered by urban sewage systems.

Links with international/National conventions or programmes: The demosites are part of the Field Observatory for Urban Water Management (http://www.graie.org/othu/index.htm) itself included in the European-LTER network (https://data.lter-europe.net/deims/site/czo_eu_fr_030).

Conserve Ecohydrological processes in Natural ecosystems	Enhance Ecohydrological processes in novel ecosystems	Apply complementary Ecohydrological processes in highly impacted systems
✓ Yes o X NO	✓ Yes o X NO	✓ Yes o X NO

Ecohydrology Principles and solutions

EH IMPLEMENTATION PRINCIPLES

* Quantification of the hydrological processes at catchment scale and mapping the impacts
* Identification of potential areas for enhancement of ecosystem sustainability potential (carrying capacity).
* Managing biota to control hydrological processes and vice versa (ecological engineering)

EH SOLUTIONS

Into seasonal urban stream : constructed porous riffles to enhance the trapping of sewage organic pollution by porous sediment and its biodegradation by microbial activity. In the car-park : constructed soil for microbial processing and phyto-remediation of urban runoff water before its returning to ground water.

Ecohydrological infrastructure

Hydrological flow

Phytotechnology

Faunatechnology

Life zones

Life Zone *Moist forest*

Precipitation 734mm/yr *T* 11,56 °C

123 123

PET Ratio: 0,92
Elevation: 314m
Humidity: 80,5

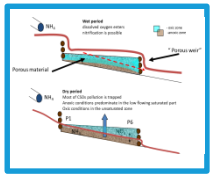


Major issues

P Pollutants & Nutrients

W Water over-abstraction D Drougnts

Up-dated in Janurry 2018



Social-ecohydrological system

Catchment Ecohydrological sub-system

EH Objectives

Water
Biodiversity
Ecosystem Services
Resilience
Cultural or social dimension

Are inputs to:

Metodology EH

This EH methodology is to amplify the self-purification capacity of soil and river bottom sediment that receive polluted urban runoff. It makes use of the hydrological rinsing and dewatering natural phases to promote the pollution storage, biodegradation and natural renewal of the biofilter installed.

Set conditions for:

Catchment sociological sub-system

Objectives

From several years of field experiment with a huge recording data set we can confirm that a sequence of 3 porous weirs installed in a small seasonal water course can fully trap and process organic pollution introduce during rainy events. This system is self maintained by high flow waters which regenerate the biofilter in place. The principle is in course of replication in another small water course where it should help the receiving main stream to recover its good ecological status.

Set conditions for:

Stakeholders

SAGYRC : The river syndicate office is a legal entity in charge to meet the WFD objectives. WWw

The OTHU field obsevatory for urban water management gathers 20 research labs since year 2000, working on innovative solutions to reduce the urabn footpring on the local water ressource. WWW.....

The Lyon metropolitan water direction is both a partner of the SAGYRC and the OTHU.

Participate in:

Activities

SAGYRC, is in charge to meet the WFD objectives. It implements actions all over the river systems since 2000, regarding for water quality, ecological quality, rules for water resource sharing during low flow period, protection of riverine inhabitants against flooding, river geomophological rehabilitation, education and training of people to river functioning, protection and rehabilitation of cultural heritage. The SAGYRC supports the implementation of the demosite in 2018 for the river selfpurification amplification in coordination with a project for flood control.

The Water direction of Lyon metropolitan supports the OTHU research project for more than 18 years. It is involved in the second demo-site where the objective is to reinfiltrate urban runoff after cleaning by soil and plant filter. The water direction is also in charge to renew of old main sewers that collect urban waters from the upper watershed to a centralized WWTP.

Results

Main Expected Result

- Reach WFD objective for the water mass of concern, by Increasing the carrying capacity of seasonal small water courses to cope with urban unmanageable runoff pollution, increase their resilience to future urban development.
- Develop a river reach scale mapping of the naturally varying carrying capacity all along the river network as to consider it in future land developments.

LATEST RESULTS

Confirmed that artificial riffles can help to trap and process the organique pollution issued by a combined sewer overflowing system.

Result for the car park.....

Contacts:
River demo : BREIL Pascal / pascal.breil@irstea.fr / IRSTEA- Riverly research unit
Car park demo : LIPEME KOUYI Gislain / email / INSA-Lyon – DEEP lab.

Developed by: An initiative of:

Ref papers
Breil P., Gervaix J., Namour Ph., Pons M.N., Potier O. (2018) Biodegradation of Urban Stromwater Pollution in a Sequence of Constructed Porous Riffles in a Mediterranean Creek. In book: Recent Advances in Environmental Science from the Euro-Mediterranean and Surrounding Regions. DOI10.1007/978-3-319-70548-4_48
Namour, Ph., Schmitt, L., Eschbach, D., Moulin, B., Fantino, G., Bordes, C., Breil, P. (2015). Stream pollution concentration in riffle geomorphic units (Yzeron basin, France). Science of the Total Environment 532 (2015) 80–90
Wagner I., Breil P., 2013. The role of ecohydrology in creating more resilient cities Ecohydrology & Hydrobiology 13 (2013) 113–134.
Breil P. (2017) Measuring, Modeling and Managing of the natural processes related to water flows - Social values of linked ecosystem services. Ecohydrology & Hydrobiology – Vol. 17, Issue 1, Pages 1–3; Special Issue guest Ed.
http://dx.doi.org/10.1016/j.ecohyd.2017.02.001

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Obrigado pela sua atenção

Ref papers

Breil P., Gervaix J., Namour Ph., Pons M.N., Potier O. (2018) Biodegradation of Urban Stromwater Pollution in a Sequence of Constructed Porous Riffles in a Mediterranean Creek. In book: Recent Advances in Environmental Science from the Euro-Mediterranean and Surrounding Regions. DOI10.1007/978-3-319-70548-4_48

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Breil P. (2017) Measuring, Modeling and Managing of the natural processes related to water flows - Social values of linked ecosystem services. Ecohydrology & Hydrobiology – Vol. 17, Issue 1, Pages 1–3; Special Issue guest Ed. http://dx.doi.org/10.1016/j.ecohyd.2017.02.001