European River Restoration Conference
Featuring the IRF Riverprize
Celebrating Successes and Addressing Challenges
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SESSION 04 WATER USES AND ENVIRONMENTAL FLOWS

Implementing river restoration taking into account constraints of water supply protection: the case study of the Bocq River at Spontin

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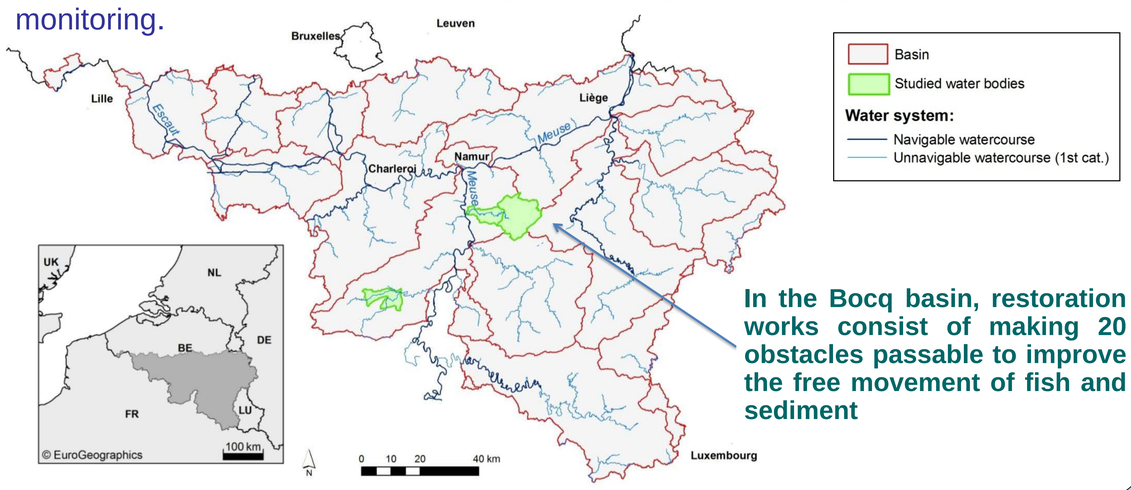
1. Context

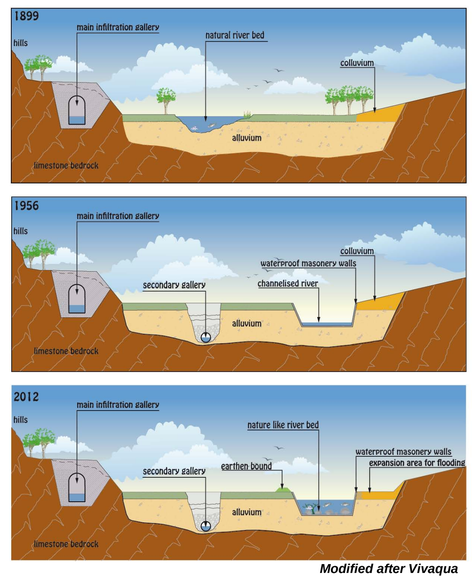
In the context of the **Water Framework Directive**'s goal of attaining "good ecological status", a LIFE+ project (called Walphy), co-funded by the European Union and the Service Public de Wallonie, was launched in 2009. It aims to undertake experimental river restoration projects and to assess their success on the basis of ecological and geomorphological monitoring.



In the Bocq basin, restoration works consist of making 20 obstacles passable to improve the free movement of fish and sediment

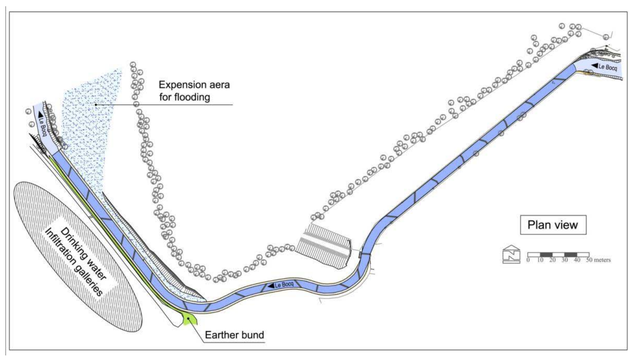
2. Bocq at Spontin: constraints of water supply protection

In the sixties, a reach of 600 meters of the Bocq was completely channelized in order to avoid any risk of contamination of the nearby important drinking water well field area. Ecological quality was consequently impoverished due to the loss of natural habitats (streambed and banks made of concrete and masonry). In addition, the hydraulic conditions (high flow, low depth) make it totally insurmountable for fish.

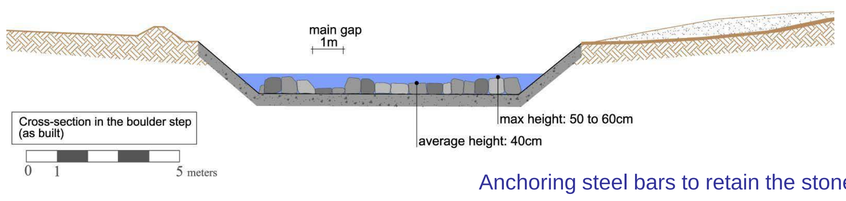


Modified after Vivaqua

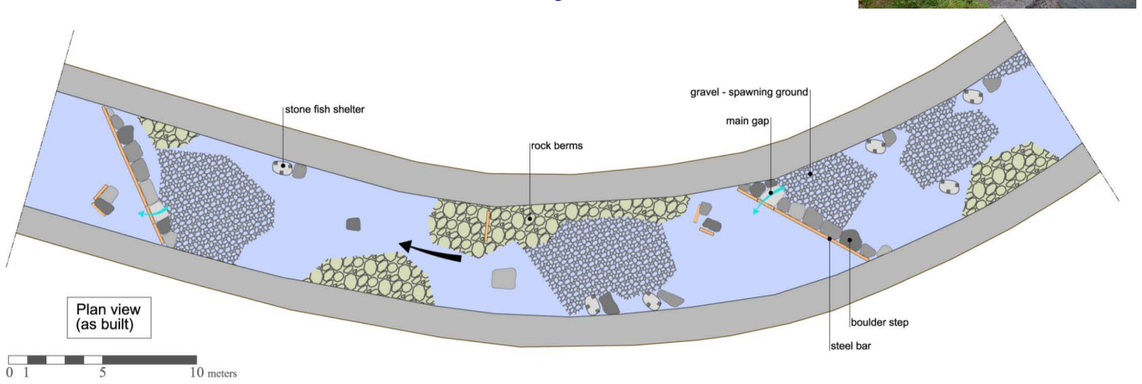
3. Restoration works (November 2011 – October 2012)



The project consists on building rock weirs at regular interval in order to create a succession of 23 steps and pools. Furthermore, various habitats schemes are implemented such as stone fish shelter or rock berms for aquatic vegetation. In addition a small dike and an expansion area for flooding have been completed to maintain an acceptable risk for flooding.



Anchoring steel bars to retain the stones



Total cost= 317000€

Rock berms quickly colinised by *ranunculus fluitans*

Fish shelter

200 tons of spawning gravel is added

Hydraulic parameters	Manning roughness coefficient	Bankfull discharge	Return period*
Before restoration works	0.017	35 m²/s	15 years
After restoration works	0.035	23 m³/s	5 years

After rehabilitation, the modified channel could be modeled as a natural stream with the riverbed lifted by 40 cm -the average height of the weirs- and a roughness coefficient increased by n=0.035. This law is validated for a discharge between 2 and 8 m³/s. On this based the maximum discharge reach 23 m³/s

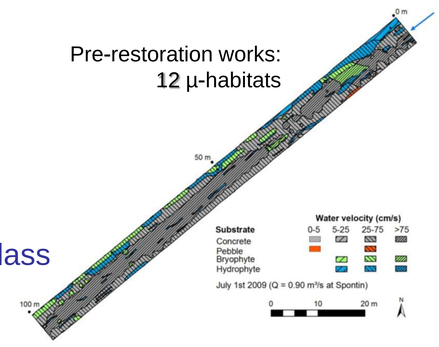
(*) Modified after SPW-DGO2, 2013

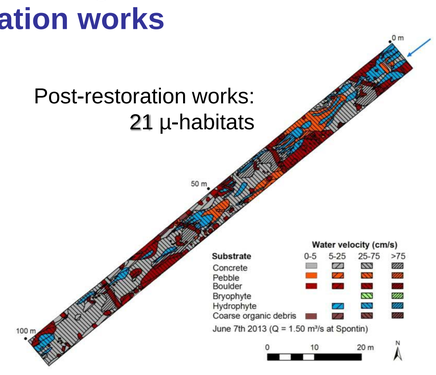
4. Monitoring

Aim : assessing the success of restoration projects through the comparison of data collected pre- and post- restoration works

a) Ecology

- **Microhabitat survey:**
  - Water depth
  - Water velocity
  - Dominant substrate class





• Electrofishing:	Before works 5/05/2011	After works 11/07/2013
Species		
Phoxinus phoxinus	0	2
Gobio gobio	0	1
Cottus gobio	59	357
Nemacheilus barbatulus	0	6
Salmo trutta fario	2	12
Salmo salar	0	14
Number of species	2	6
Biomass (kg/ha)	5.6	78.9
IBIP index /30	19	21

• Invertebrate:	Before works (2009)	After works (2013)
Numerical richness	2535	2657
Taxonomical richness	27	26
Faunal indicator group (/9)	Lepidostomatidae & Sericostomatidae (6)	Lepidostomatidae & Sericostomatidae (6)
IBGN (/20)	**13**	**13**
Shannon index (H')	0.93	0.53
Equitability index (J'/1)	0.65	0.37
Cb2 (Ln+Lv/20)	13.00	13.87
Morphodynamic coefficient (/20)	10.00	13.84

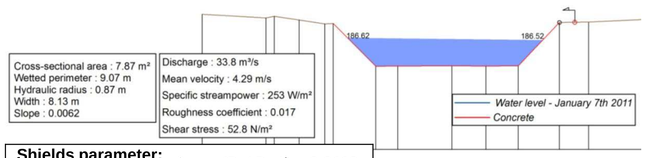
b) Geomorphology

- **Sediment transport:**

  - Calculating specific stream power, shear stress and competence before restoration work

  - Evaluating bedload mobility using PIT tagged pebbles

    ➡ Di max mob. : 0.31 m



Shields parameter: (Andrew, 1983) $\theta_c = a\,(D_i / D_{50})^b = 0.0113$	
a	0.045 (Komar, 1996)
b	-0.6 (Komar, 1996)
D_i / D_{50}	10 (D50 << Di)

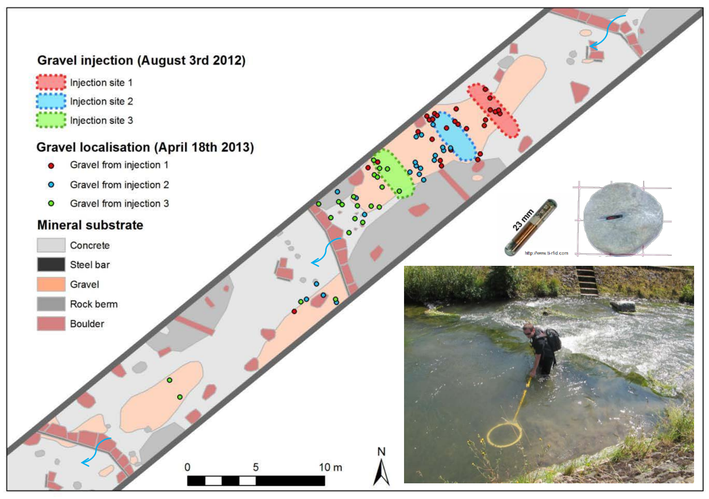
Diameter (m): (Graf, 1971) $D_i = \tau_c / (\theta_c\,(\rho_s - \rho_f)\,g) = 0.29$ m	
τ_c	52.8 N/m²
θ_c	0.0113
g	9.81 m/s²
$(\rho_s - \rho_f)$	1650 m²/s

- **Assessing the efficiency of the new spawning grounds:**

  - Evaluating the mobility of spawning gravels by injecting 100 tagged gravels

    Are spawning gravels unmovable and then subject to clogging or will they quickly dispersed downstream for a small peak flow ?

    February 1st 2013
    Q = 5.7 m³/s
    T ~ 0.4 yrs
    Recovery : 76 %
    D50 mob. : 35 mm
    D90 mob. : 43 mm
    Average distance : 5.0 m
    Maximum distance : 24.2 m



  - Clogging of the spawning grounds:

November 2012:
Thickness of the gravel layer: 22 cm
Depth of anoxia: 7.5 cm