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Introducing economy into potentiality mapping of mar scheme

Jean-Christophe Maréchal, Madjid Bouzit, Fanny Moiroux, Yvan Caballero,
Jean-François Desprats

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INTRODUCING ECONOMY INTO POTENTIALITY MAPPING OF MAR SCHEME

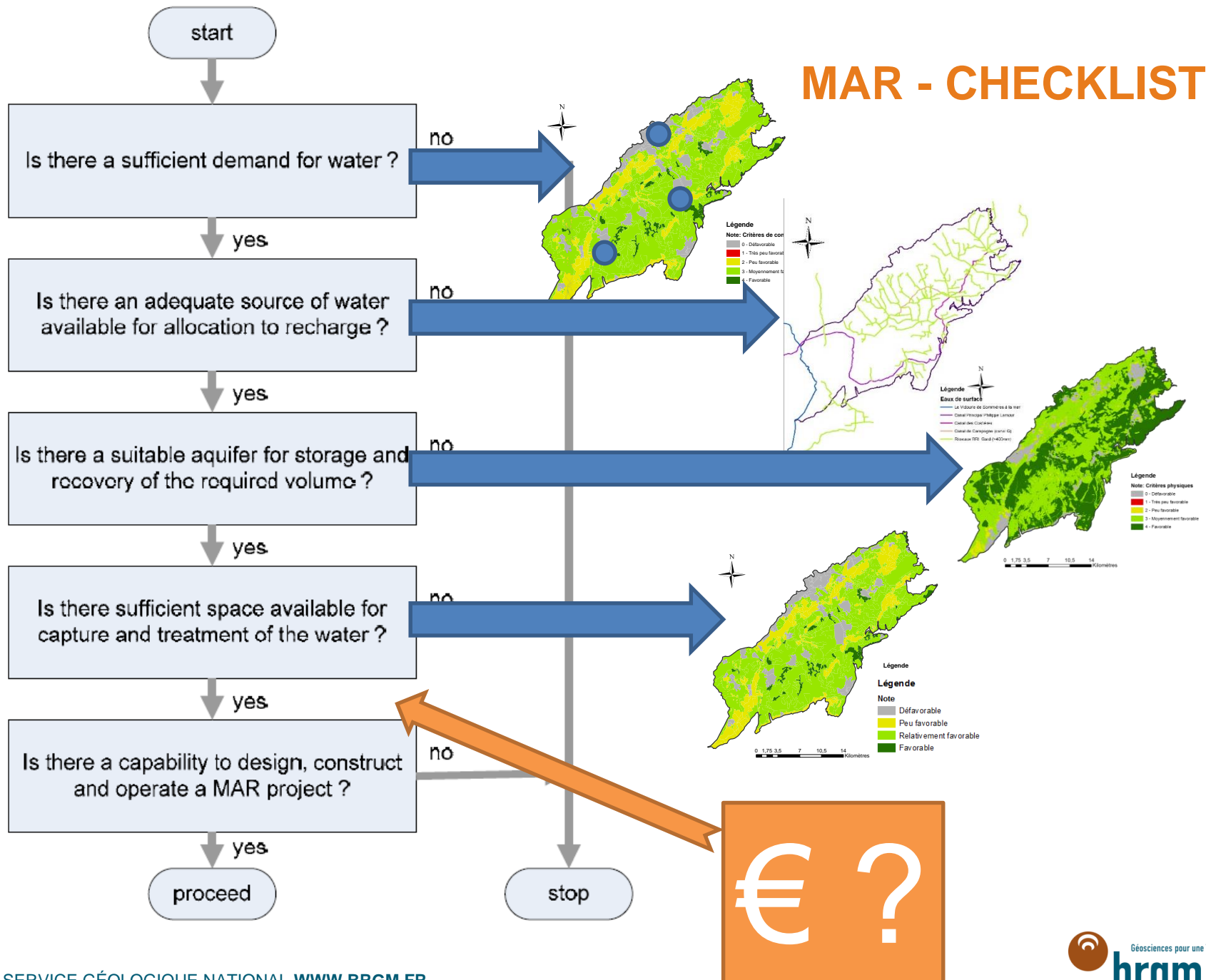
*MARECHAL JC., BOUZIT M., MOIROUX F.,
CABALLEO Y. AND DESPRATS JF.*



Géosciences pour une Terre durable

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MAR - CHECKLIST

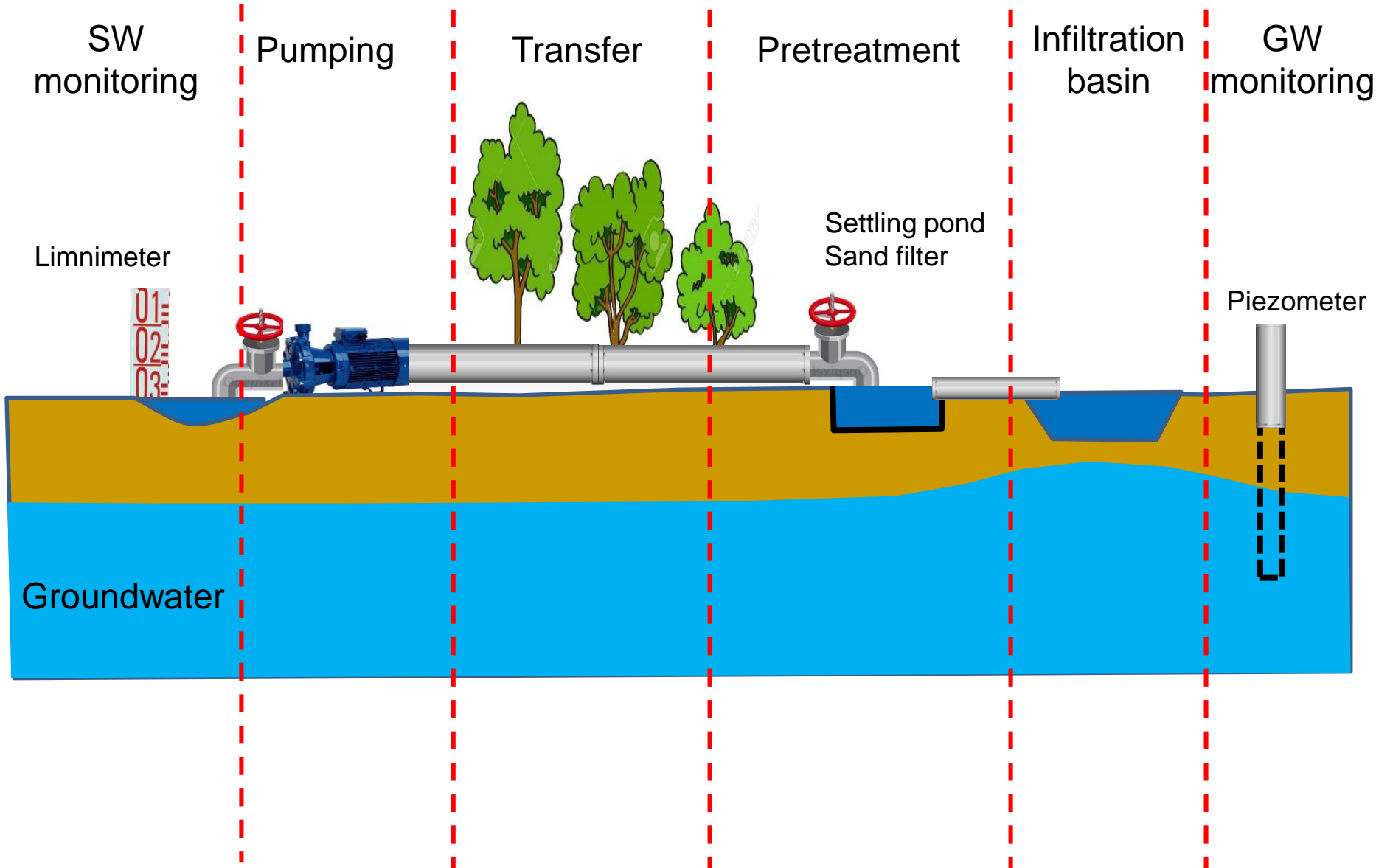


OBJECTIVE: COSTS MAPPING

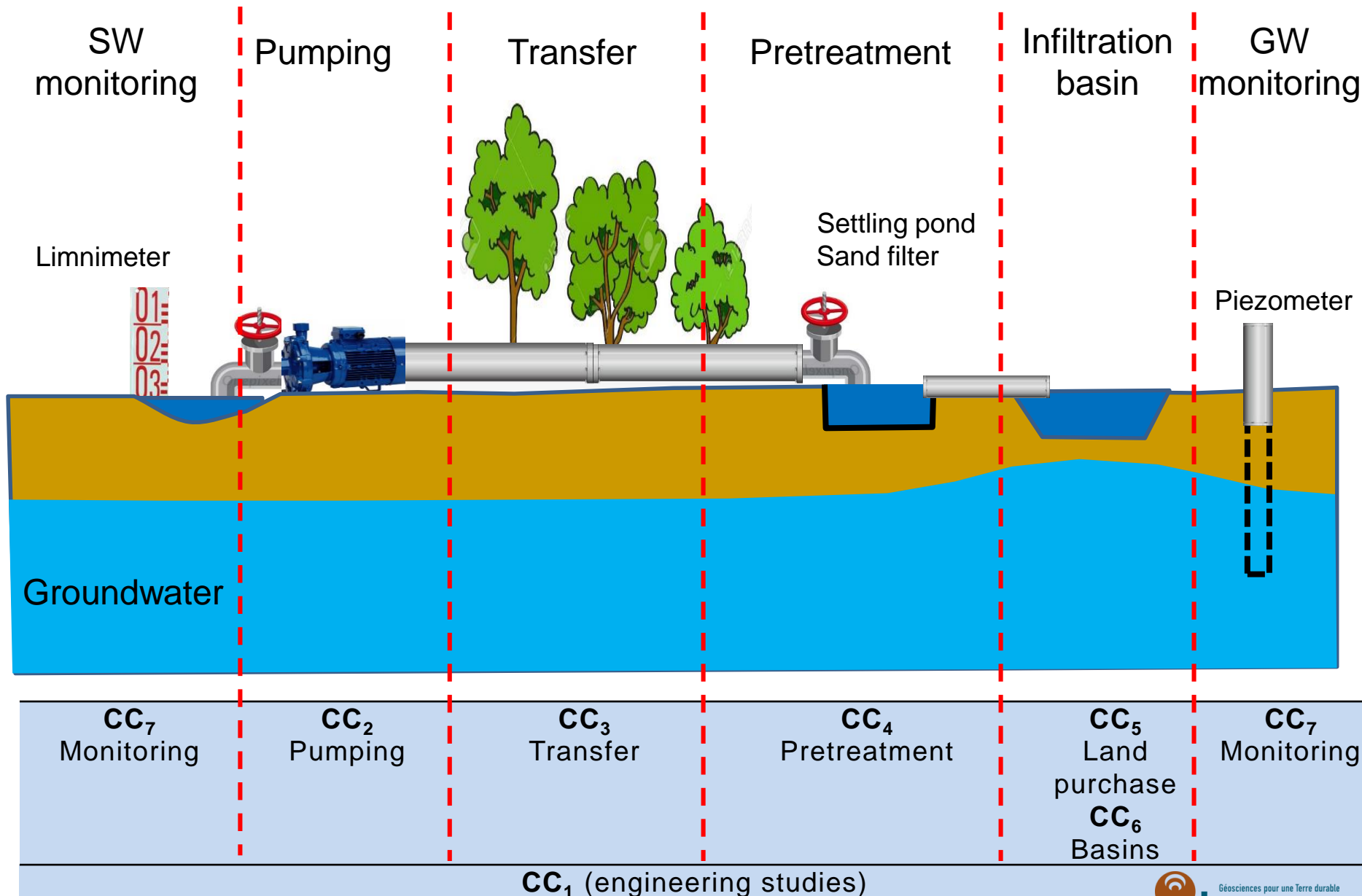
Outline:

- Identify the engineering components of a MAR scheme (indirect recharge)
- Identify the associated capital and operational costs functions
- Evaluate the costs function
- Calculate a levelised cost map (€/m³) according to life duration of MAR
- Application to a real case study
- Analyse the sensitivity of levelised costs
- Conclusion

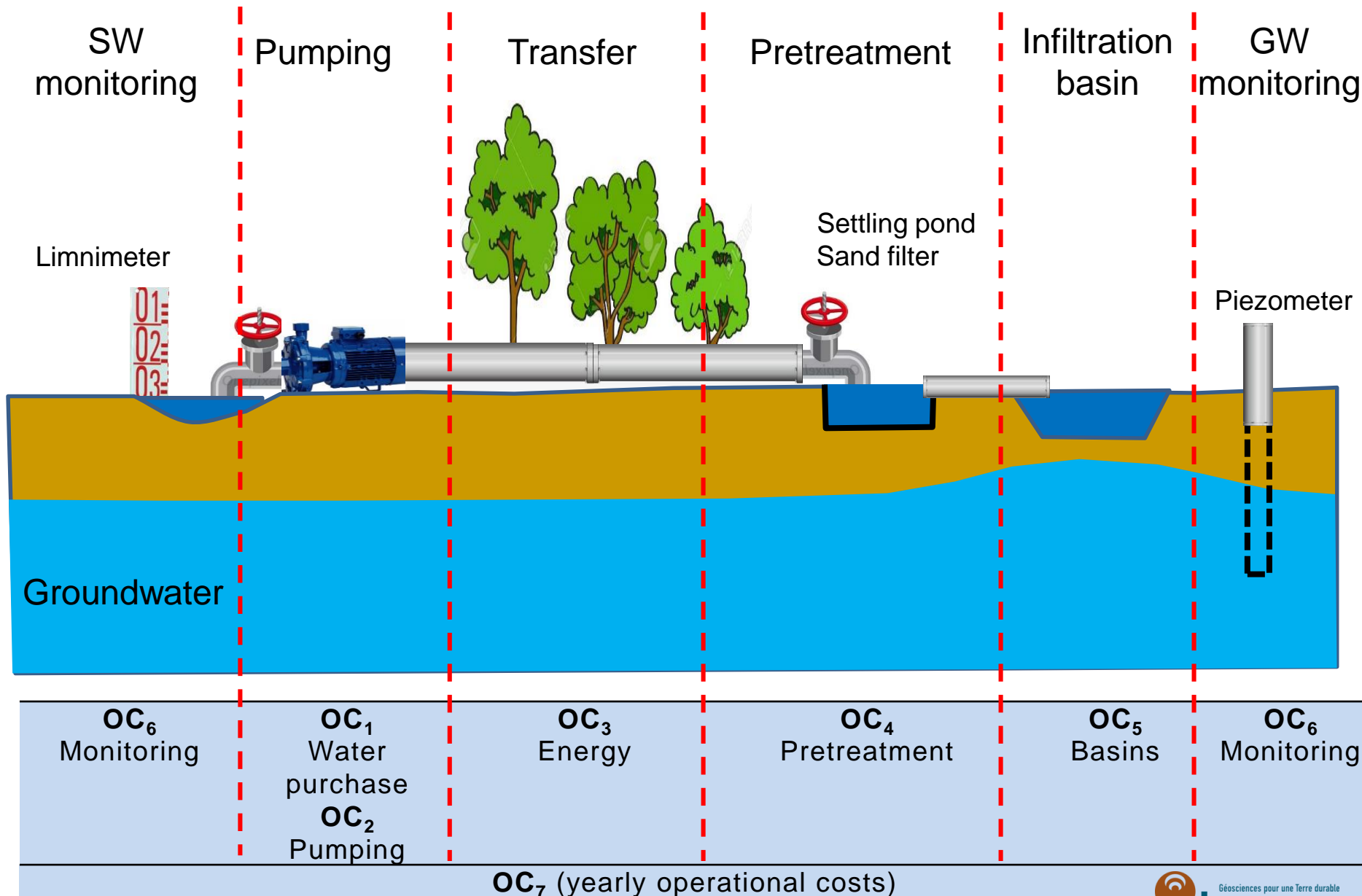
ENGINEERING COMPONENTS OF AN INFILTRATION BASIN SCHEME



CAPITAL COSTS OF AN INFILTRATION BASIN SCHEME

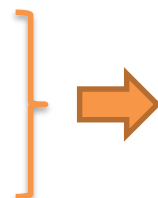


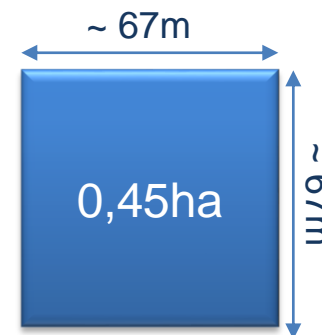
OPERATIONAL COSTS OF AN INFILTRATION BASIN SCHEME



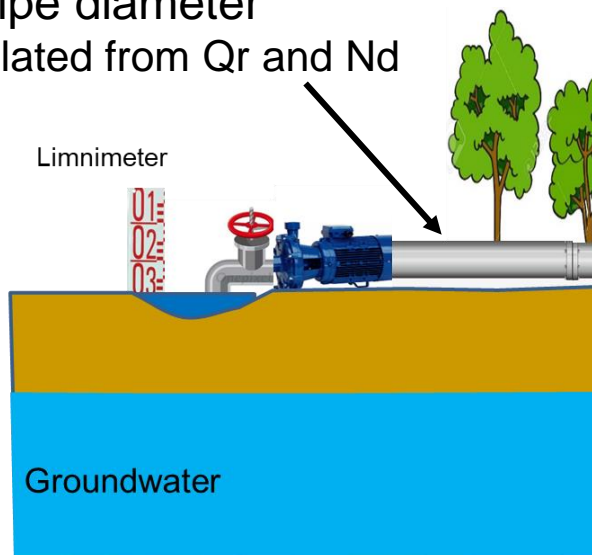
SIZE OF AN INFILTRATION BASIN: REFERENCE EXAMPLE


- ✓ $Q_r = 1 \text{ Mm}^3/\text{yr}$
- ✓ $N_d = 243 \text{ days}$
- ✓ $i = 1 \text{ m/d}$

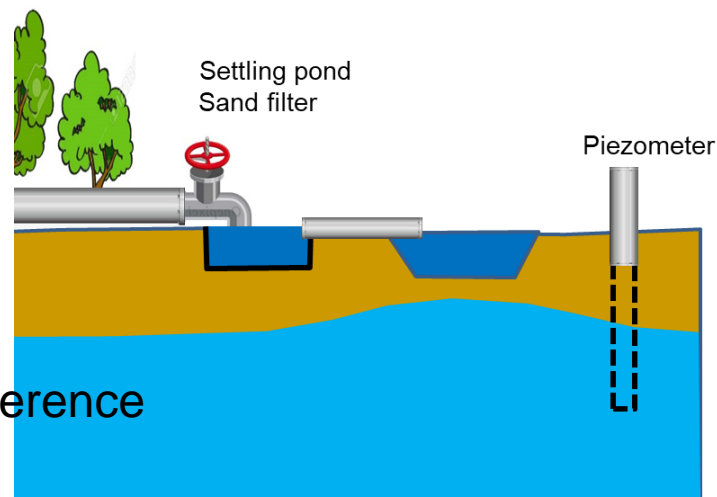

S_b infiltration basin surface area



d_i: pipe diameter
calculated from Q_r and N_d

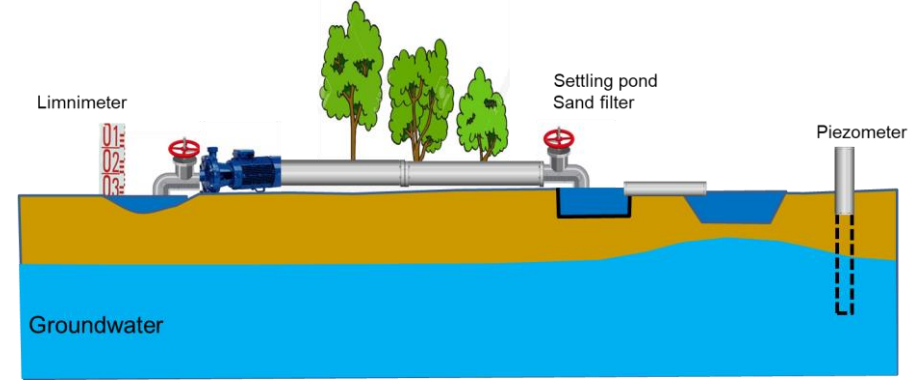



H: Head difference



COSTS FUNCTION

CAPITAL COSTS (CC) - €



CC1 – Engineering studies

x 10%

CC2 – Pumping system

Water Agency Cost Observatory = $f(Q_r)$

CC3 – Water transfer

Water Agency Cost Observatory = $f(D, di)$

CC4 – Pretreatment

According to water quality = $f(Q_r)$

CC5 – Land purchase

Land value LV = $f(S_b)$

CC6 – Basin building

Water Agency Cost Observatory = $f(S_b)$

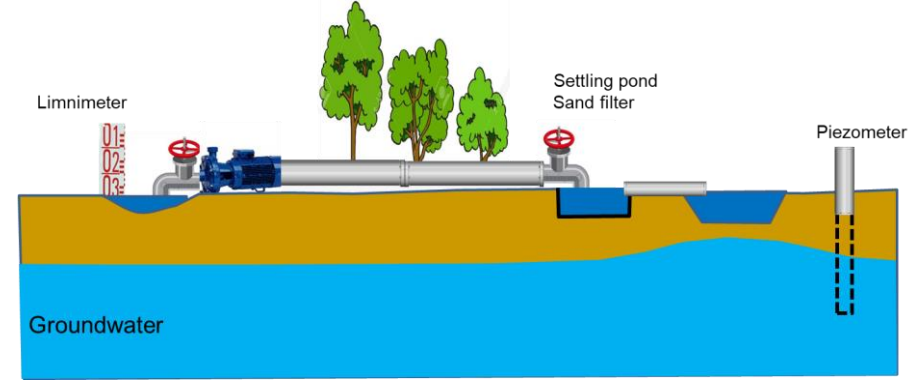
CC7 – Monitoring

Estimate (piézometers, protection, water sampling and analysis...)

Total Capital Costs

COSTS FUNCTION

OPERATIONAL COSTS (OC) - €/YEAR



OC1 – Water purchase Water companies prices = $f(Q_r)$ **not always**

OC2 – Pumping maintenance Part of CC2

OC3 – Energy Electricity rates = $f(Q_r, Nd, H)$

OC4 – Pretreatment According to water quality, = $f(Q_r)$

OC5 – Basin maintenance (scraping...) Guide BBP, NORPAC et IDDR (entretien bassin de rétention), = $f(S_b)$

OC6 – Monitoring Estimation (2 to 4 monitoring campaigns/yr)

x 10%

OC7 – Yearly operational costs

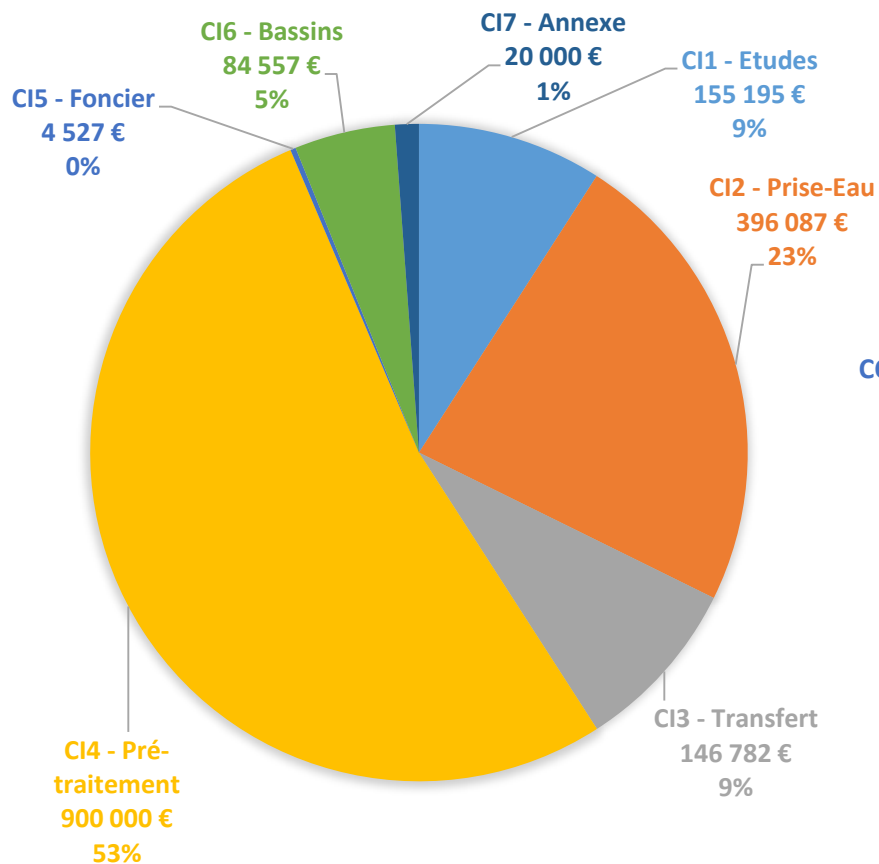
Total Operational Cost

COSTS ANALYSIS AND LEVELISED COST

REFERENCE EXAMPLE

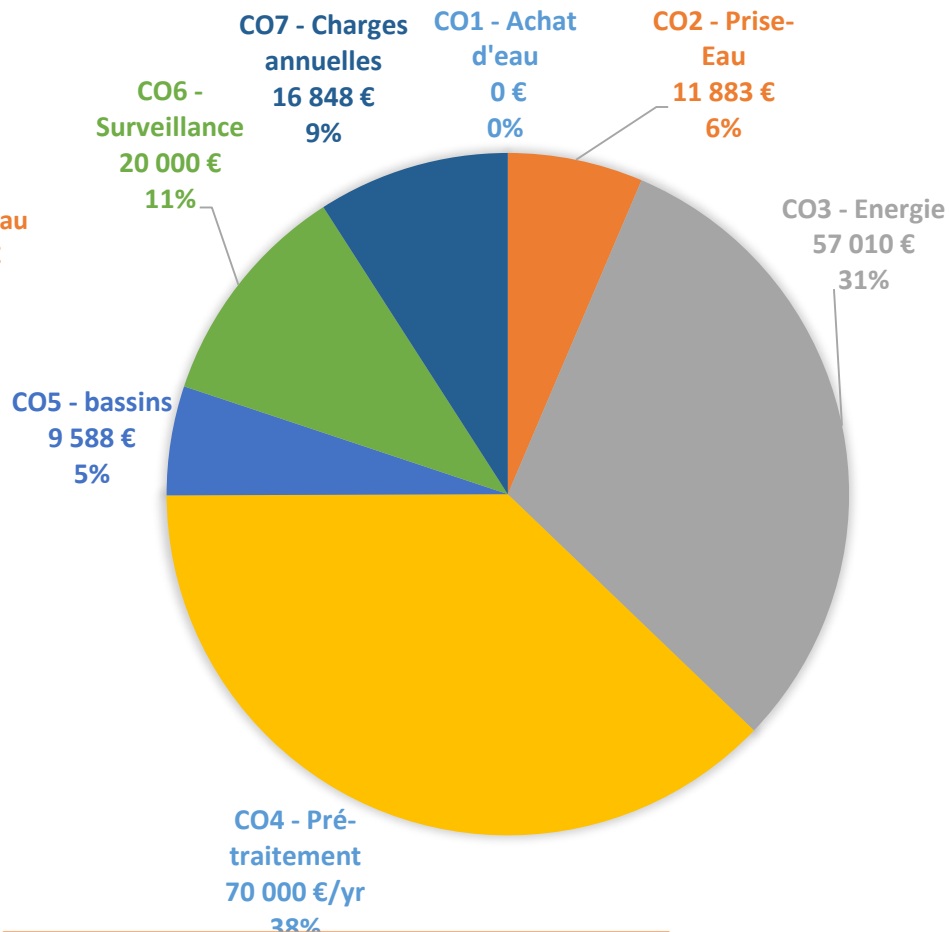
Capital Costs (CC)

= 1 700 000 €



Operational Costs (OC)

= 180 000 €/yr



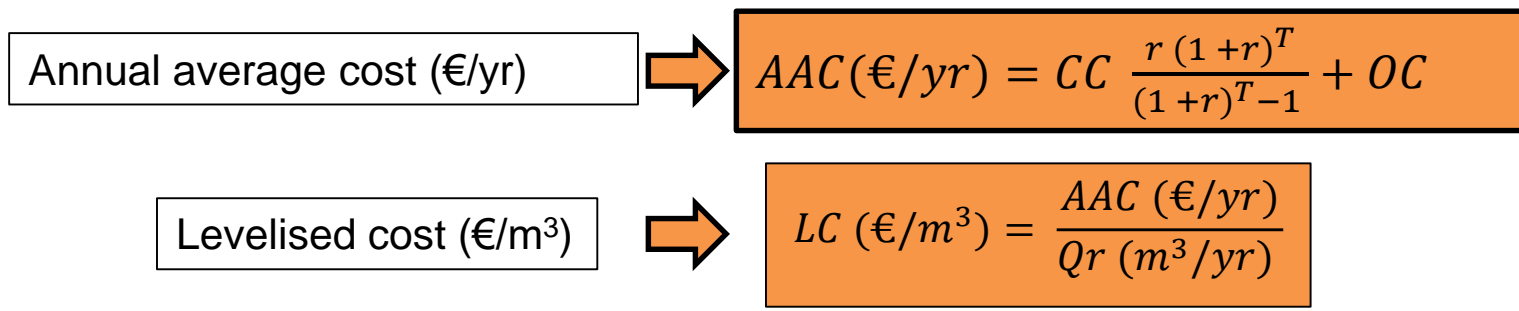
Qr = 1 Mm³/yr
Nd = 243 days
i = 1 m/d

H = 100 m
D=1000 m

Pre-treatment: 0.1 €/m³

LEVELISED COST

REFERENCE EXAMPLE



= Capital costs + Operating costs per m³ of water recharged

$$= 0.10 + 0.18 = 0.28 \text{ €/m}^3$$

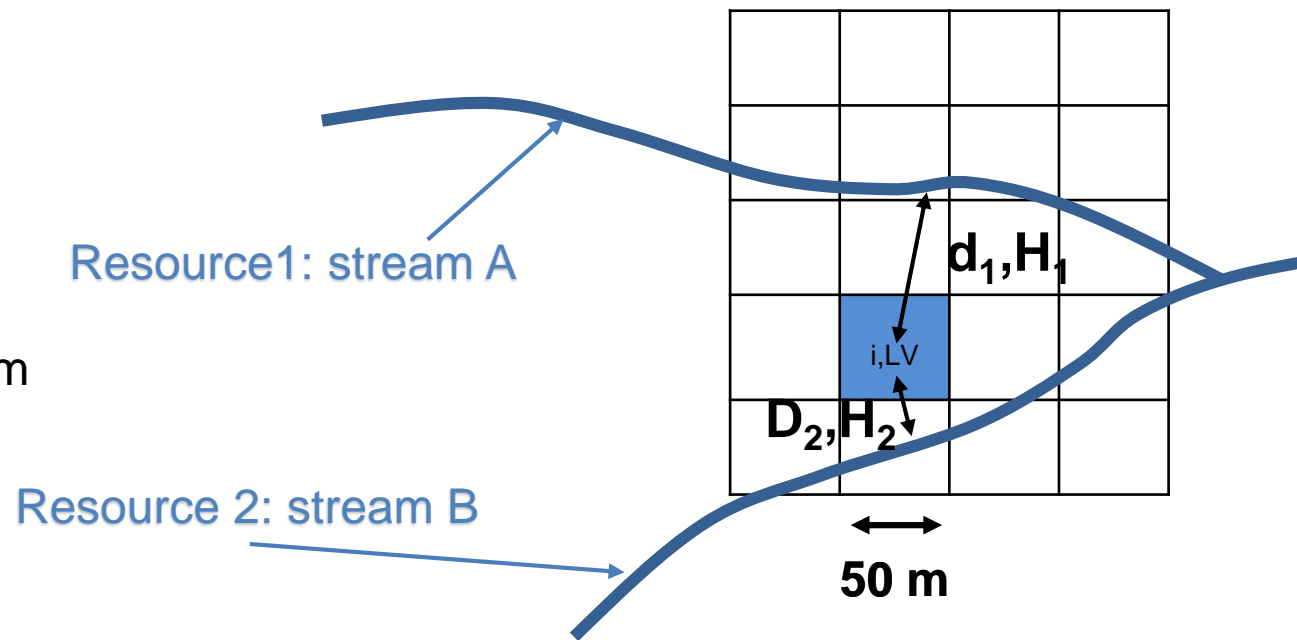
$Q_r = 1 \text{ Mm}^3/\text{yr}$
 $N_d = 243 \text{ days}$
 $i = 1 \text{ m/d}$

$H = 100 \text{ m}$
 $D = 1000 \text{ m}$

T : useful life duration = 30 years
 r : discount rate = 4 %
Pre-treatment: 0.1 €/m³

COSTS MAPPING

Cell gridding: 50 m X 50 m



Extraction of following distributed data for each cell:

- Distance D between cell – nearest surface water point;
- Head change H between cell – nearest surface water point (using DEM);
- Infiltration rate i on the cell (value obtained from permeability maps)
- Land value (distributed according to «Small Agricultural regions» data).

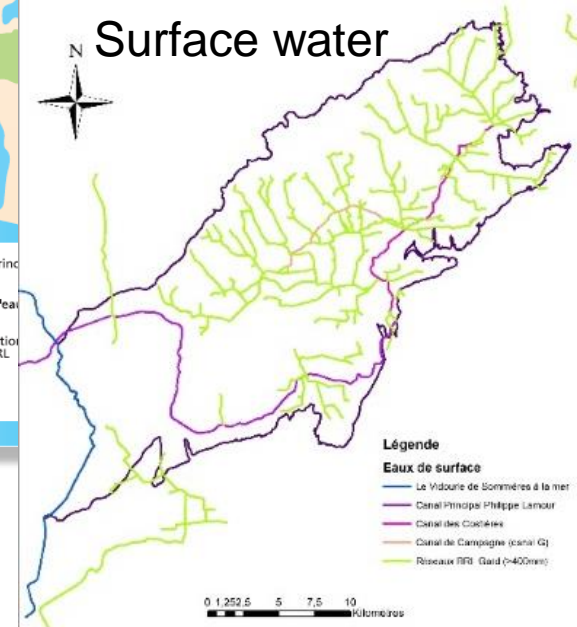
Other parameters are not distributed and are then fixed.

In each cell, LC is computed for each surface water resource:

the lowest LC is kept

APPLICATION TO A CASE STUDY

VISTRENQUE ET COSTIÈRES AQUIFER (SOUTH OF FRANCE)



Qr	Nd	Surface water resource
		Le Vidourle river
		Canal Philippe Lamour (BRL)*
		Canal des Costières (BRL)*
		Canal de Campagne (BRL)*
		Untreated water network (BRL)*
1 Mm ³ /yr	243 days	

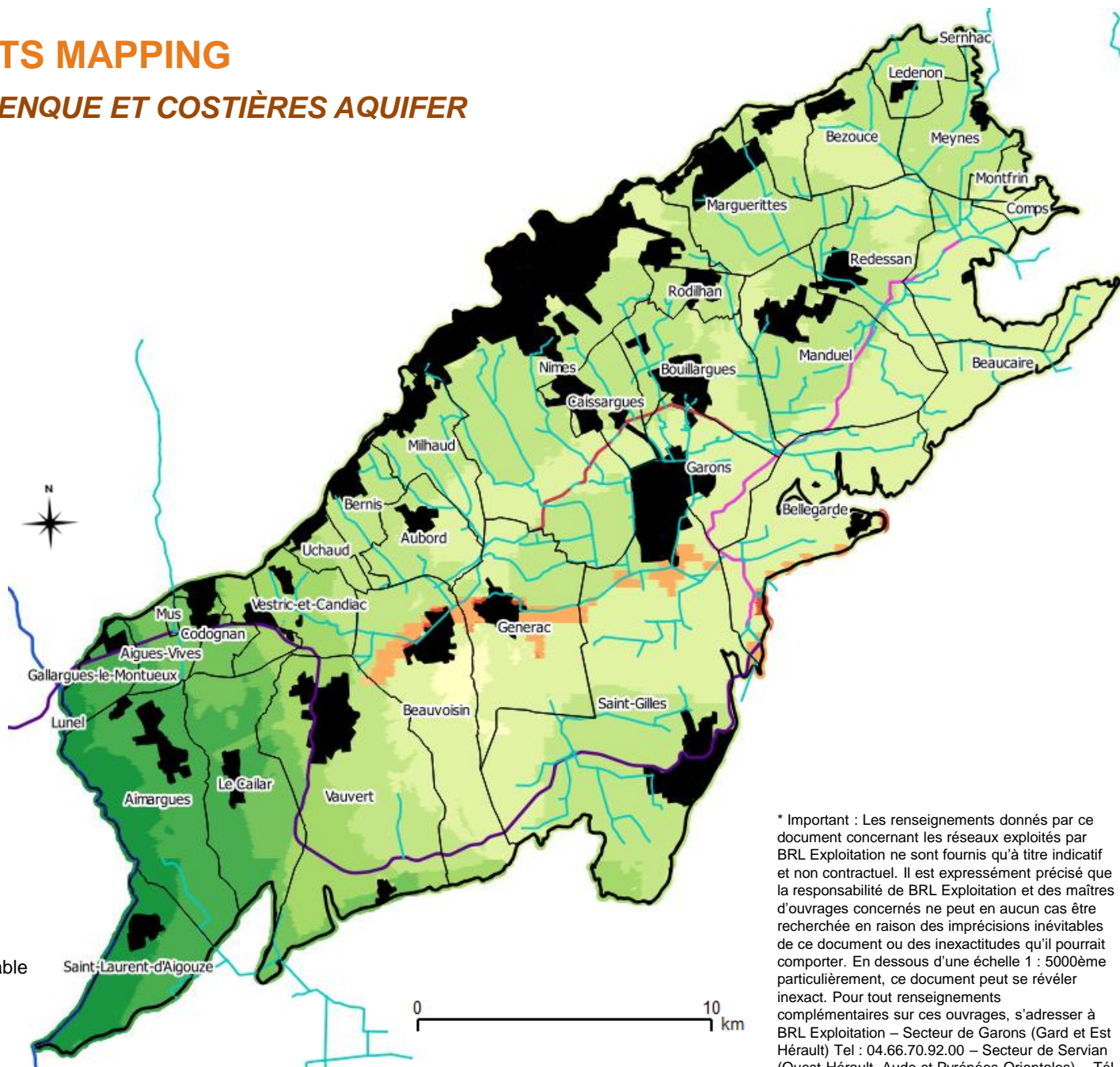
LEVELISED COSTS MAPPING

APPLICATION: VISTRENQUE ET COSTIÈRES AQUIFER

LC (€/m³)

- 0.1353 - 0.1500
- 0.1500 - 0.2000
- 0.2000 - 0.2500
- 0.2500 - 0.3000
- 0.3000 - 0.3500
- 0.3500 - 0.4000
- 0.4000 - 0.4500
- 0.4500 - 0.5000
- 0.5000 - 0.5500
- 0.5500 - 0.6000
- 0.6000 - 0.6500
- 0.6500 - 0.7000
- 0.7000 - 0.7059

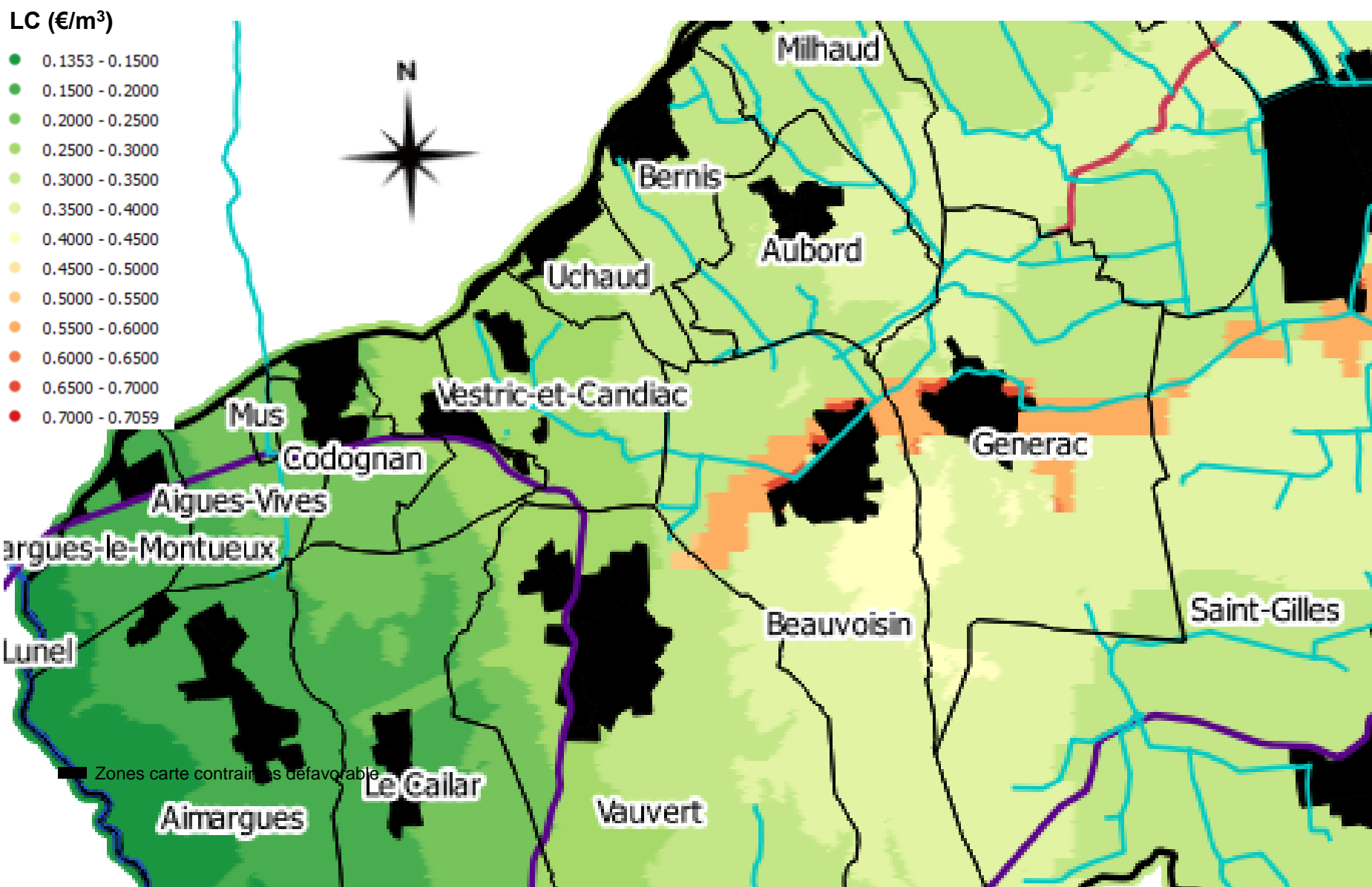
■ Zones carte contraintes défavorable



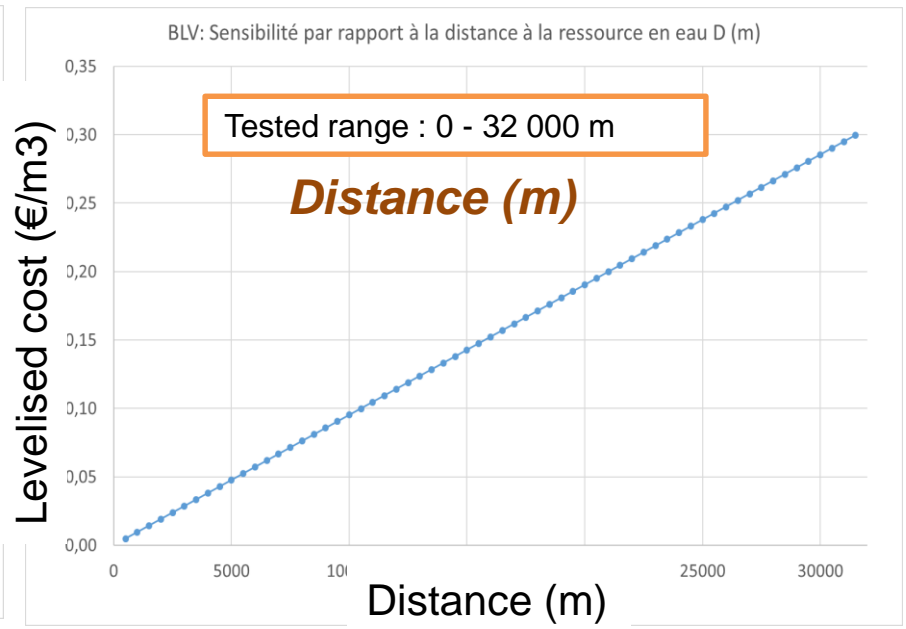
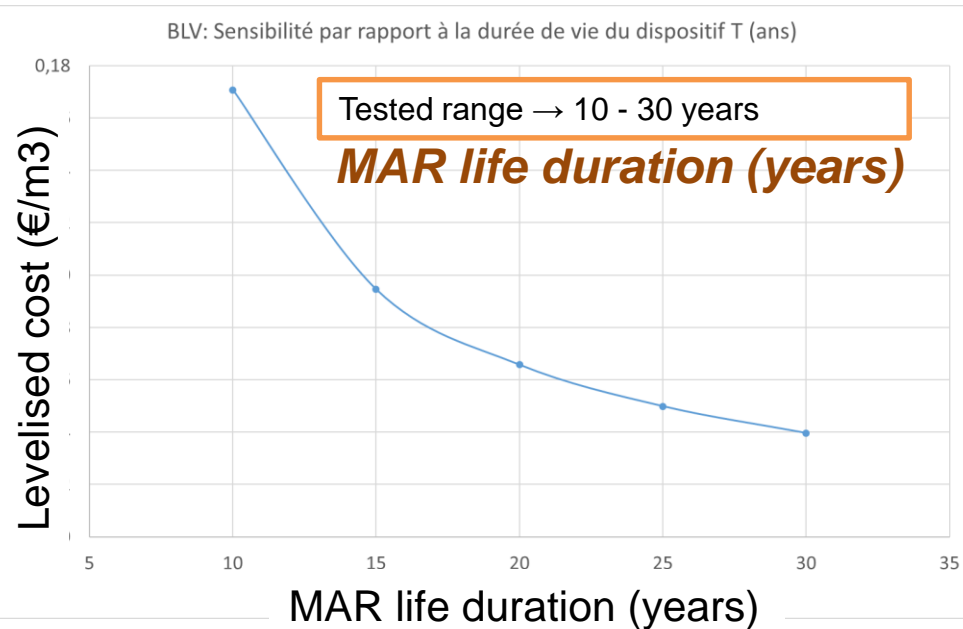
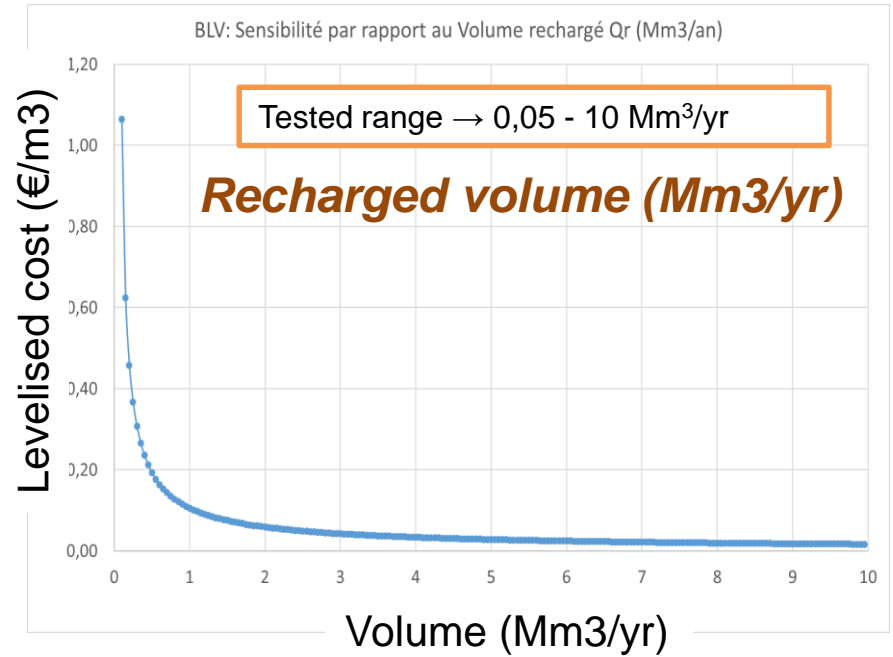
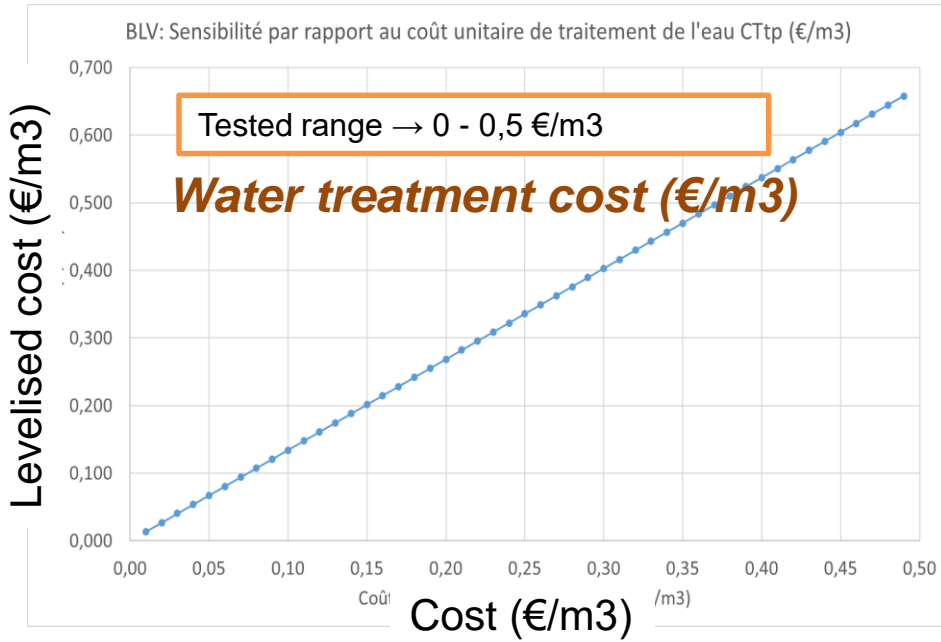
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COSTS MAPPING (ZOOM)

APPLICATION: VISTRENQUE ET COSTIÈRES AQUIFER



LEVELISED COSTS SENSITIVITY ANALYSIS



LEVELISED COSTS SENSITIVITY ANALYSIS

SUMMARY TABLE

Impact of various parameters on levelised costs:

Qr	Annual water recharged volume (Mm ³ /year)	VVT	Land value (€/ha)
Nd	Annual recharge duration (days)	p	Infiltration basin depth (m)
D	Distance ressource – basin (m)	CO1	Water price (€/m ³)
H	Head difference ressource – basin (m)	N	Duration between 2 basin maintenance servicing (years)
i	Soil infiltration rate (m/day)	Hc	Clay thickness to scrab (m)
Para_CI1	Part of engineering studies in the total capital cost (%)	r	Discount rate (%)
CTtp	Water treatment cost (€/m ³)	T	MAR scheme life duration (years)

	High impact on LC (> 0.10 €/m ³)
	Moderate impact on LC (> 0.05 €/m ³)
	Low impact on LC (< 0.05 €/m ³)

CONCLUSION

A cost function is fully distributed in order to map the levelised costs of recharged water in a given study area

The cost function can be used in order to illustrate the various parameters impacting the total costs.

The costs map can be mixed with other types of suitability maps in order to identify the most suitable location for a MAR scheme

Perspective:

- Applying such a method to other type of recharge schemes
- Computing the levelised cost of recovered water