European Geosciences Union | General Assembly 2013

| Vienna, Austria. 8th April 2013 |

Water Resources management and environmental flows under physicochemical and ecological considerations

Funded by:

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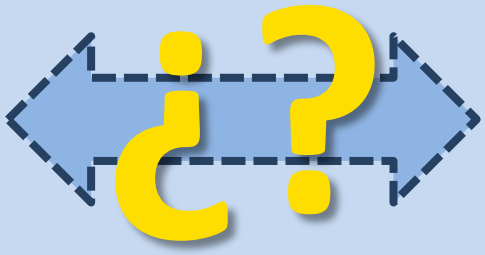
A MULTI-CRITERION PROBLEM

WFD
GOOD STATUS OF WATER BODIES

- Chemical status
- Quantitative status
- Ecological status



JUST DO IT

EXPERTISE JUDGEMENT

DECISSION SUPPORT SYSTEMS (MODELS)

Previous Legal principles & Water rights

- Water quality requirements
- Demands reliability
- Environmental flows

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NEED FOR TOOLS AND MODELS

Process of making good decisions: information must be managed and analyzed about

feasible alternatives,
their impact on the multiple objectives,
the tradeoffs among them, as well as
risks associated with them.

To elaborate and analyze such information sound science, technology, and expertise have to be involved.

Tools for data management and analysis, and models are needed to cope with the complexity, the basin scale scope, and the huge amount of information, alternatives, and scenarios.

DECISION SUPPORT SYSTEMS

A unique and user friendly interface that provides easiness of **data management**, **model use** and **results analysis**

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AQUATOOL

DSS SHELL FOR WATER RESOURCES PLANNING AND MANAGEMENT

J. Andreu, J. Capilla, y E. Sanchis, "Generalized decision support system for water resources planning and management including conjunctive water use", *Journal of Hydrology*, Vol. 177, pp. 269-291, 1996.

http://www.upv.es/aquatool

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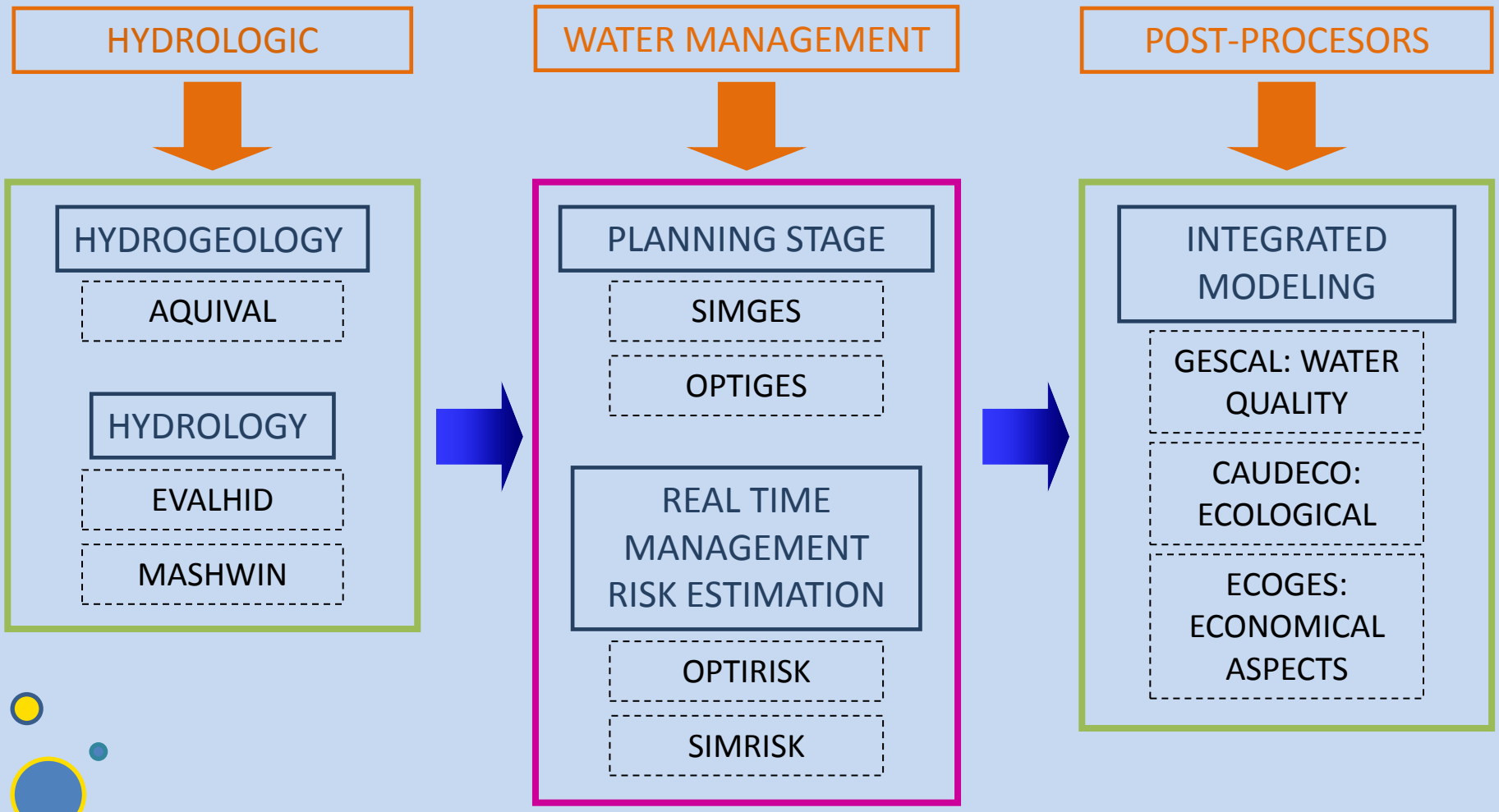
AQUATOOL MODULES



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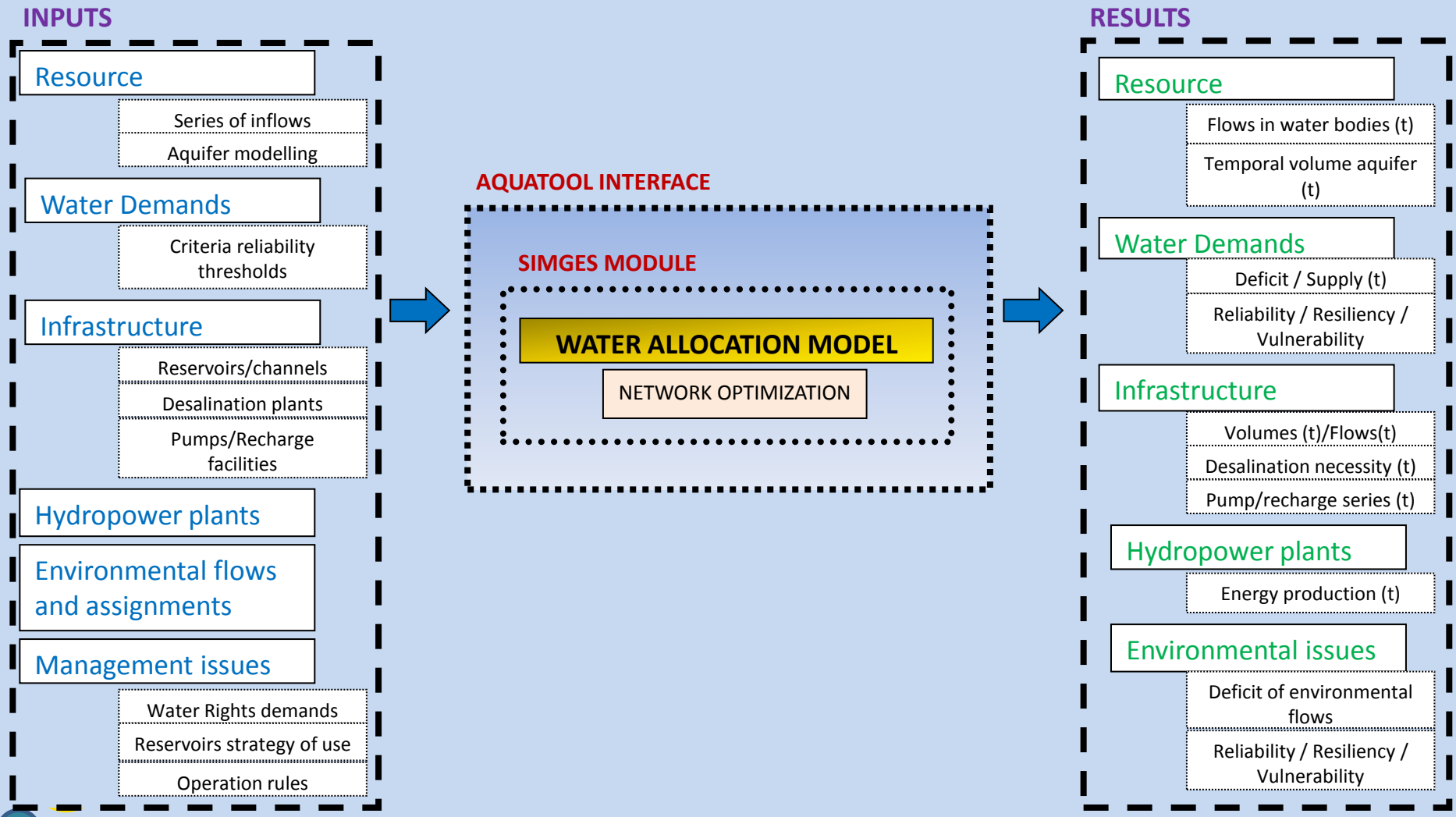
AQUATOOL: SIMGES MODULE



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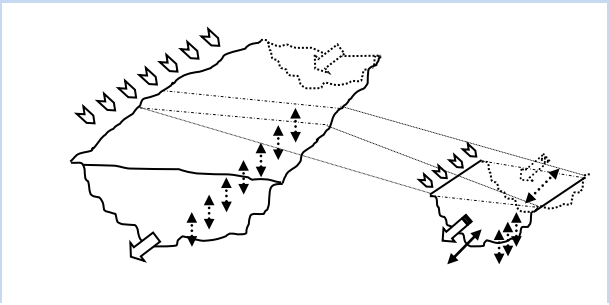
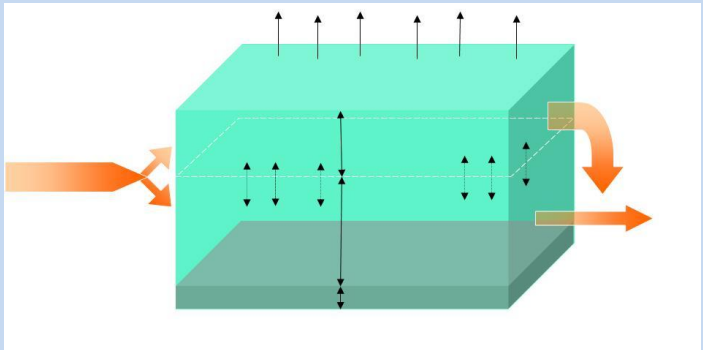
AQUATOOL: GESCAL MODULE

Water quality model coupled with a simulation model.

- Mechanistic model for rivers and reservoirs.
- Conventional constituents.
  - Temperature
  - Arbitrary constituents
  - Disolved Oxigen + Organic Matter
  - Nitrogen cycle
  - Eutrophication problems





$$0 = \frac{d}{dx}\left(E\frac{dC}{dx}\right) - \frac{d(uC)}{dx} + \frac{S_d + C_e q_e - C q_s + \sum W_i}{V}$$

$$V_1\frac{dC_1}{dt} + C_1\frac{dV_1}{dt} + C_{1/2}\frac{dV}{dt} = Q_{1e}C_e - Q_{1s}C_1 + E'_{12}(C_2 - C_1) + \sum W_i$$

$$V_2\frac{dC_2}{dt} + C_2\frac{dV_2}{dt} - C_{1/2}\frac{dV}{dt} = Q_{2e}C_e - Q_{2s}C_2 + E'_{12}(C_1 - C_2) + Sed + \sum W_{i2}$$

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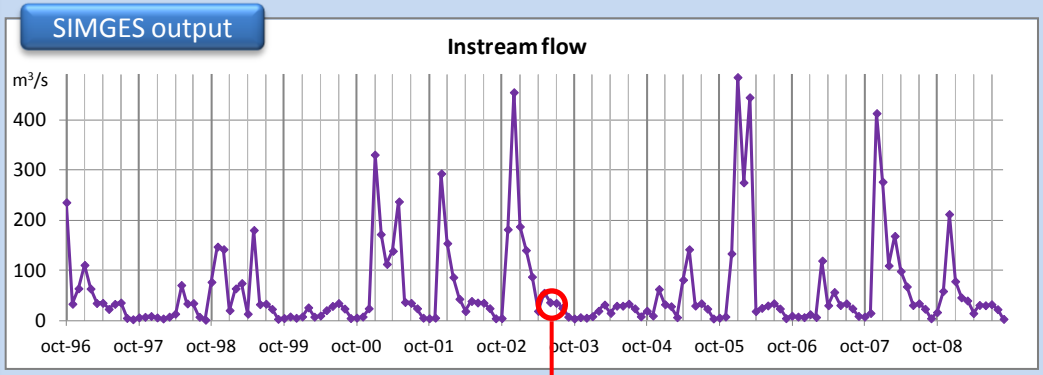
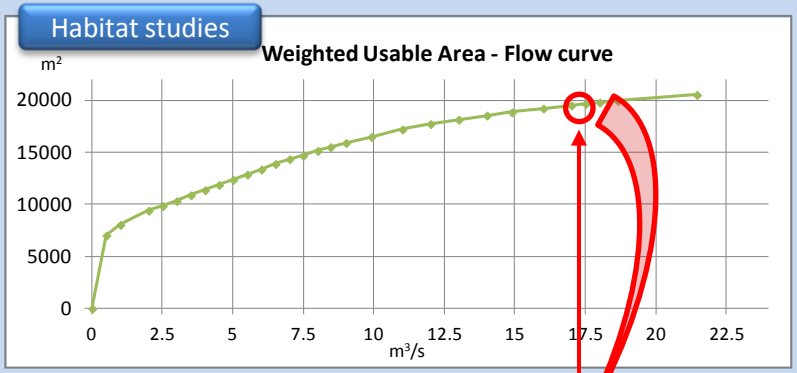
AQUATOOL: CAUDECO MODULE

CAUDECO inputs

SIMGES output



Habitat studies

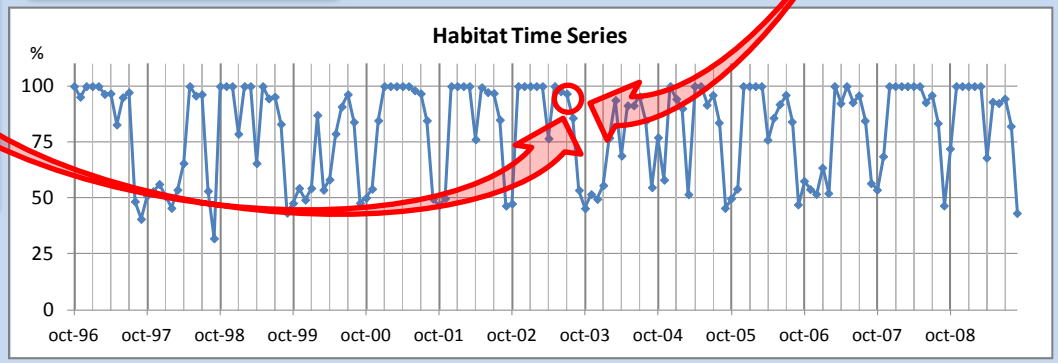


Habitat studies

Bio Periods

Species	Size	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Luciobarbus b.	Large												
Luciobarbus b.	Small												
Squalius c.	Large												
Squalius c.	Medium												
Squalius c.	Small												

CAUDECO output



Other outputs
- Habitat Duration Curves
- Cumulated Habitat Time Series
- Other habitat availability indicators

(Bovee et al. 1998) (Milhous et al. 1990, Capra et al. 1995, Parasiewicz 2008)

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PROPOSED METHODOLOGY

STEP 0. CONSTRUCTION OF WATER MANAGEMENT & HABITAT MODEL

INPUT DATA

Water Resources	Water Demands
Physical Habitat Simulation (WUA vs. Flow curves)	Groundwater inputs (river-aquifer, pumping, artificial recharge)
Management Rules	Infrastructure (dams, channels, etc.)

Quality of natural runoff

Pollutants load in discharges

Weighted Usable Area – Flow curves

AQUATOOL INTERFACE

SIMGES
Water allocation model

GESCAL
Water quality model

CAUDECO
Stream habitat model

WATER MANAGEMENT MODEL

- Flows in water bodies (t)
- Water volume reservoirs (t)
- Supply or Deficit (t)

- Pollutants in water bodies (t)
- Habitat Time Series (t)
- Habitat Duration Curves

STEP 1. ASSESMENT OF E-FLOWS EFFECTS

PUBLIC PARTICIPATORY PROCESS

STEP 2. E-FLOWS OPTIMIZATION INCLUDING OPERATION RULES

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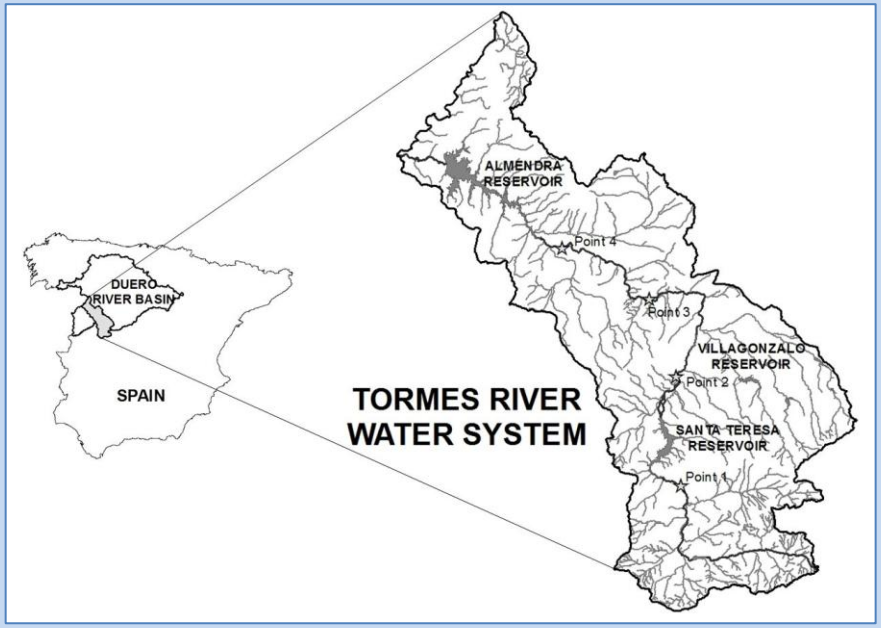
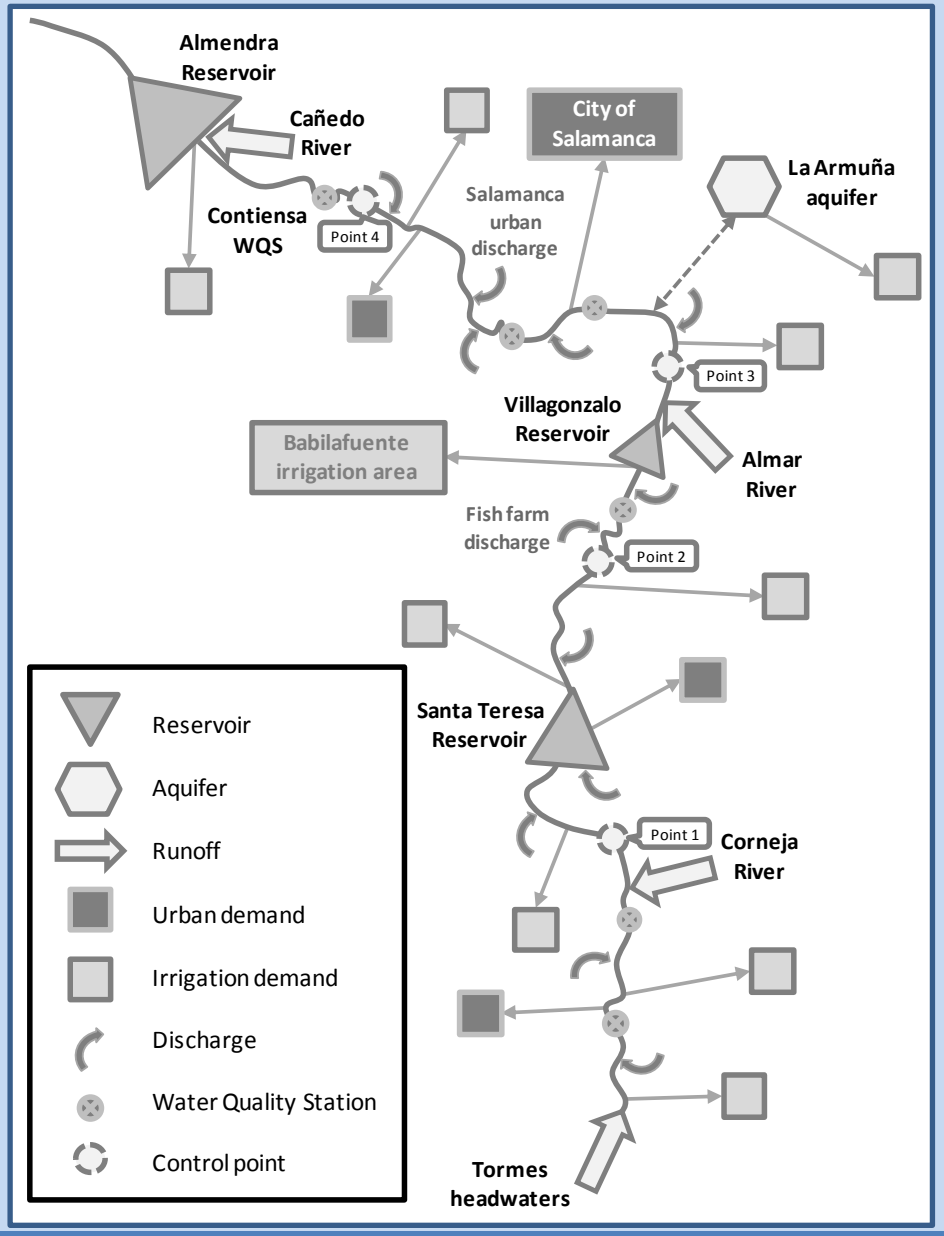
CASE OF APPLICATION:
THE TORMES RIVER WATER SYSTEM - SPAIN





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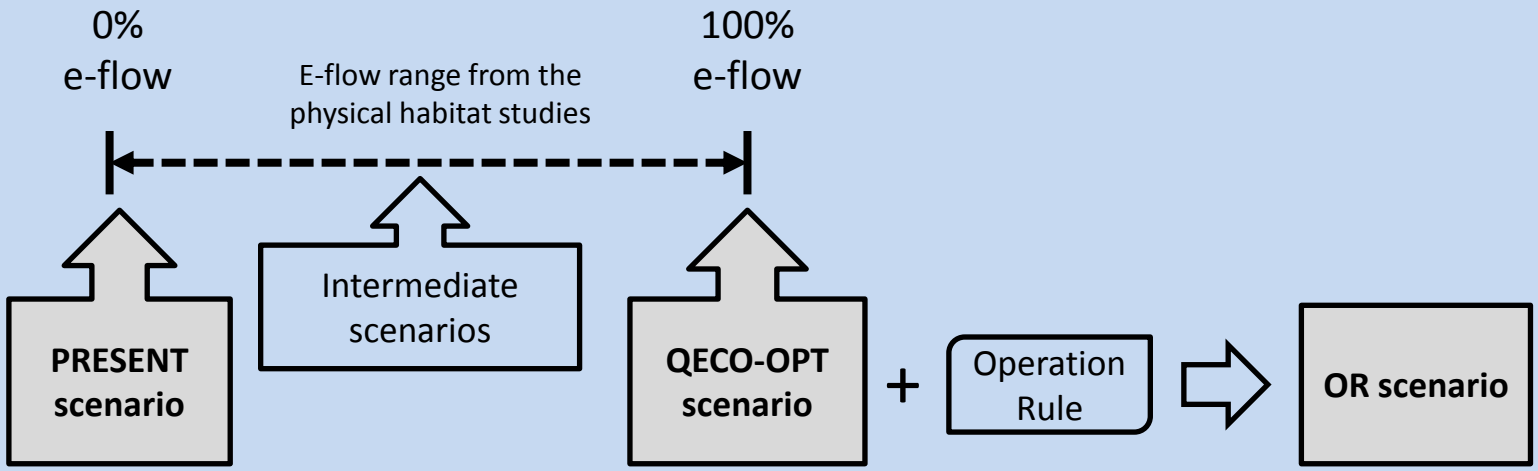
CASE OF APPLICATION: SCENARIOS



Simulation indicator
Habitat Time Series of the most affected species of the river segment
Percentage of agricultural demand deficits
Dissolved Oxygen concentration
Ammonium concentration

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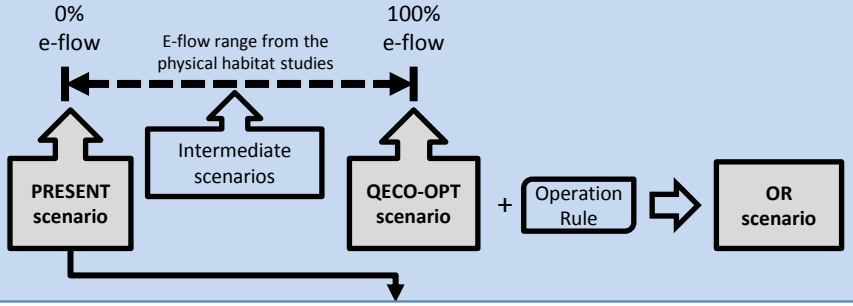
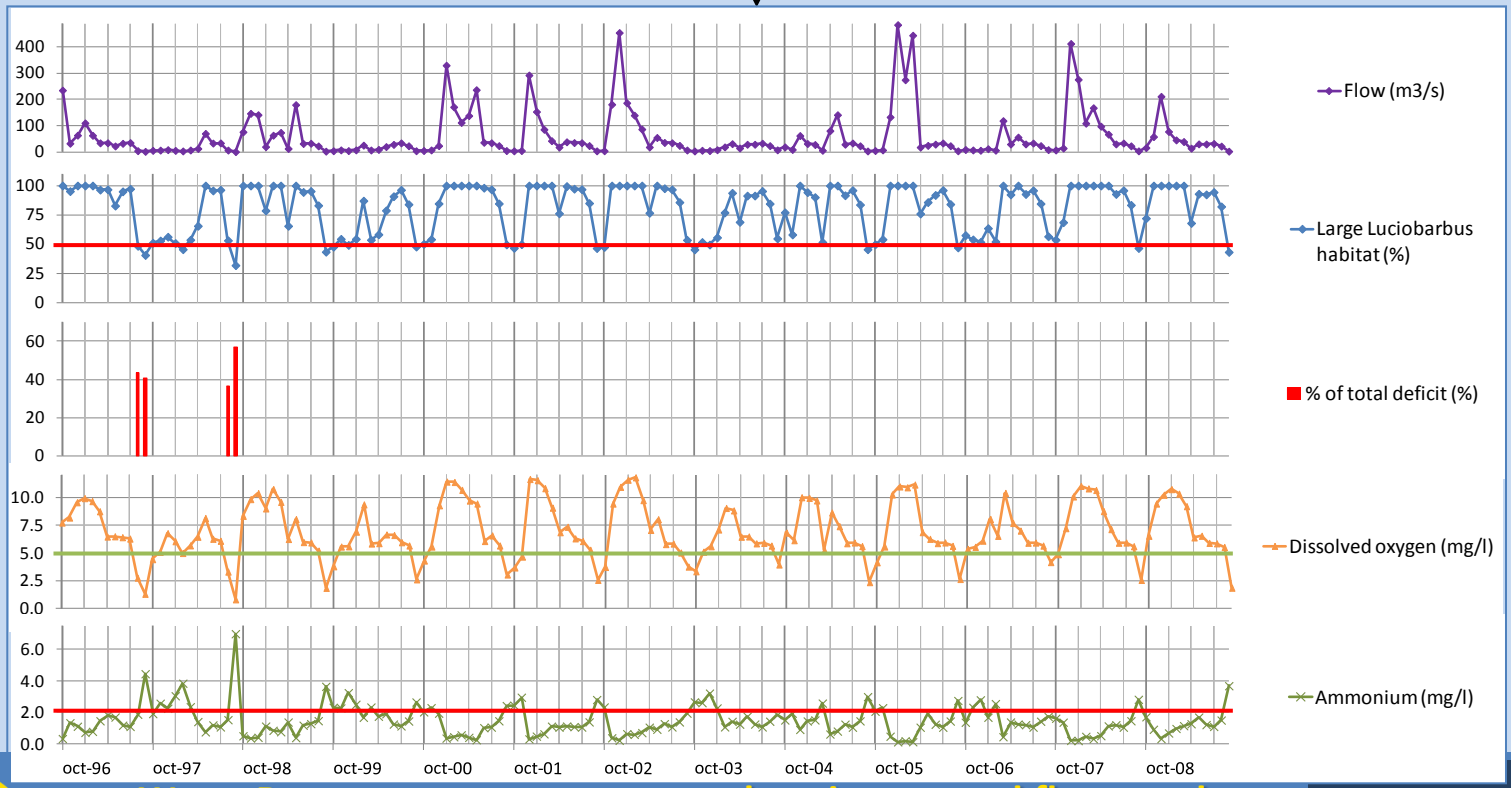
CASE OF APPLICATION: PRESENT scenario





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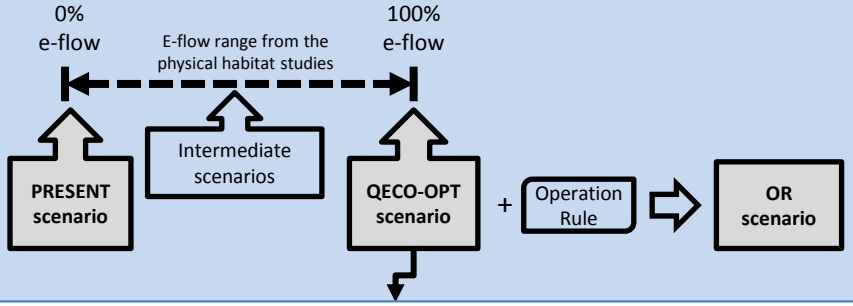
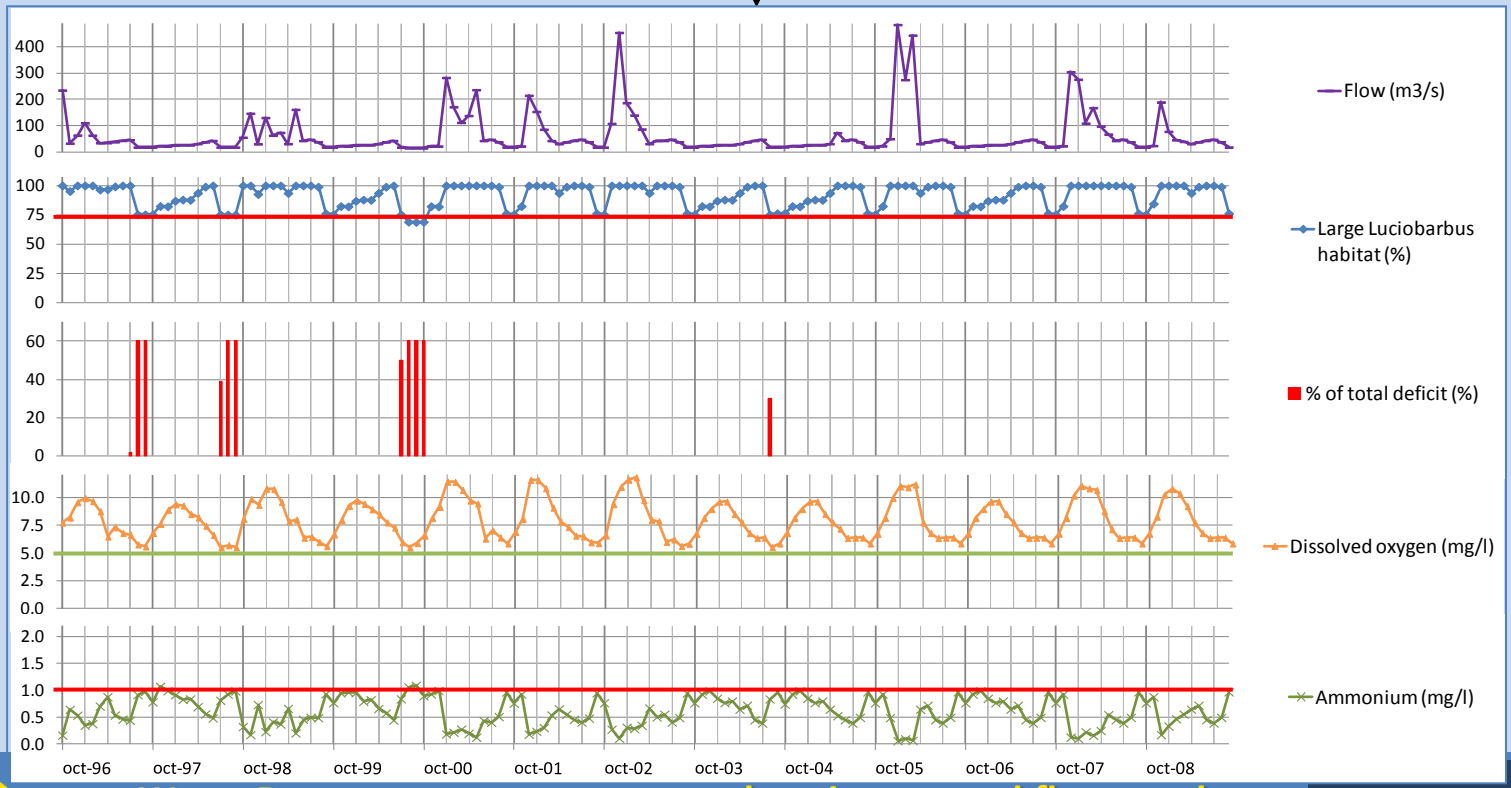
CASE OF APPLICATION: QECO-OPT scenario





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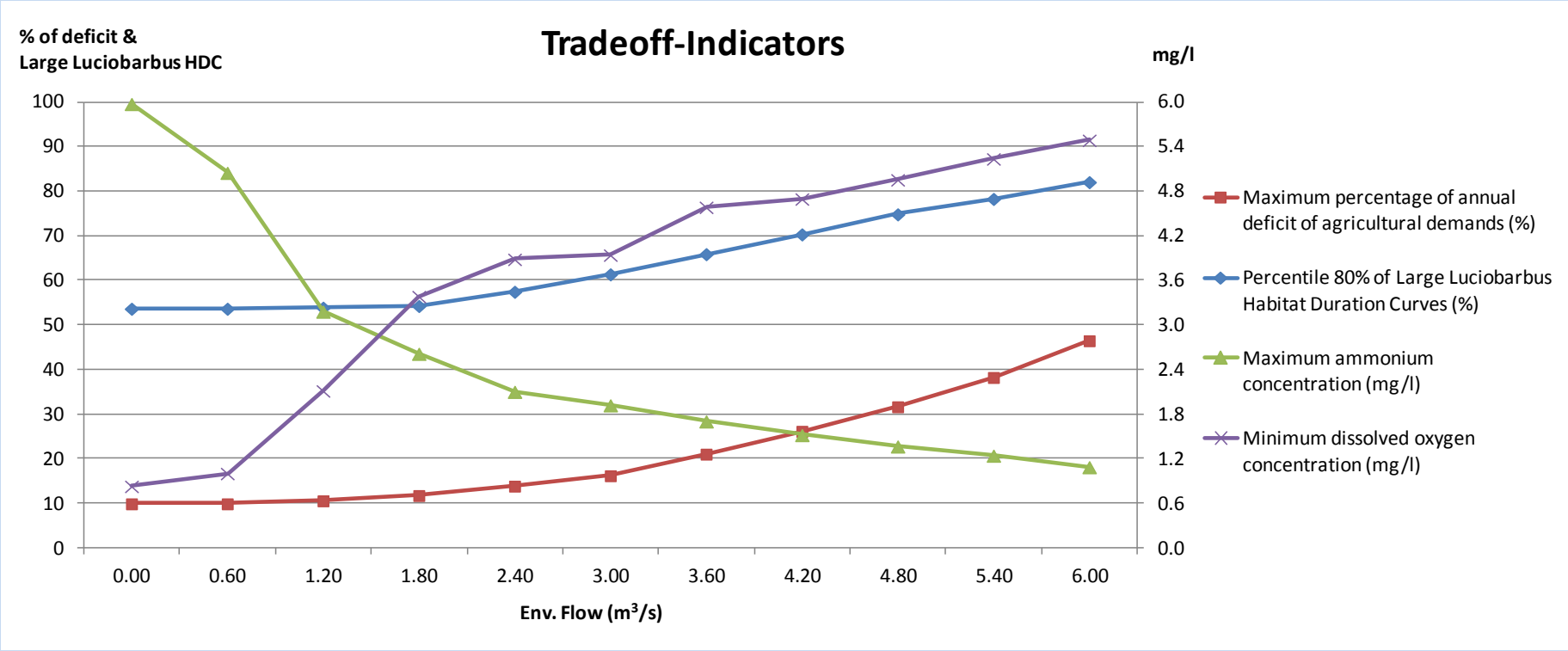
CASE OF APPLICATION: PUBLIC PARTICIPATORY PROCESS



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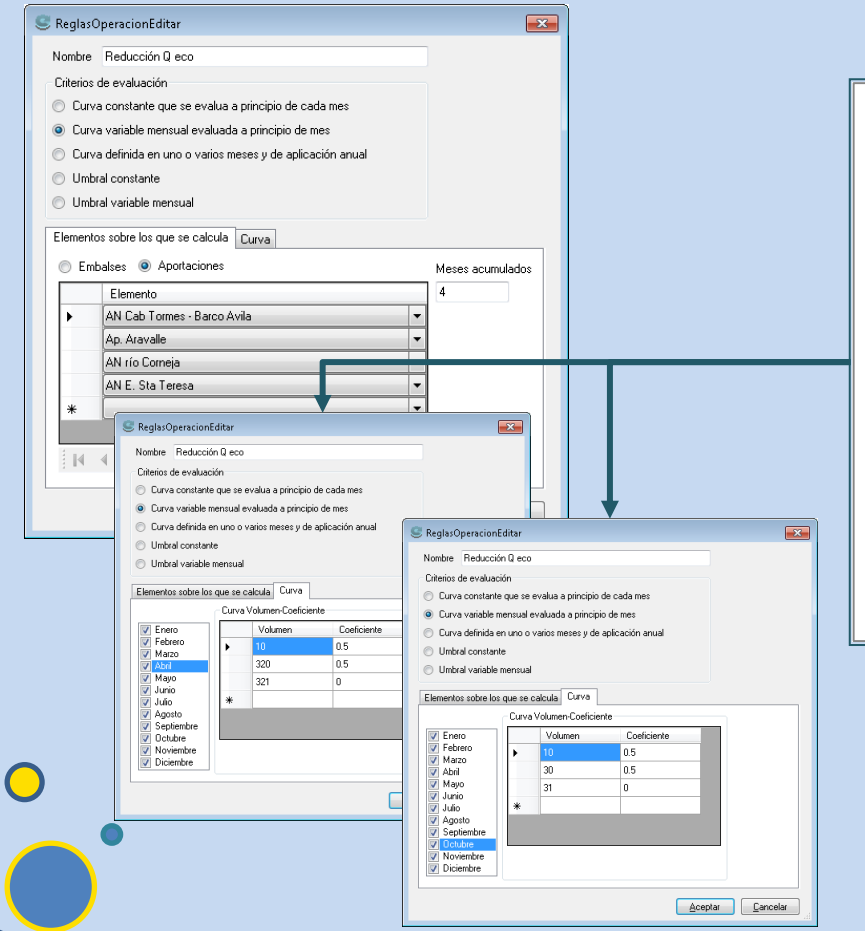
CASE OF APPLICATION: OR scenario



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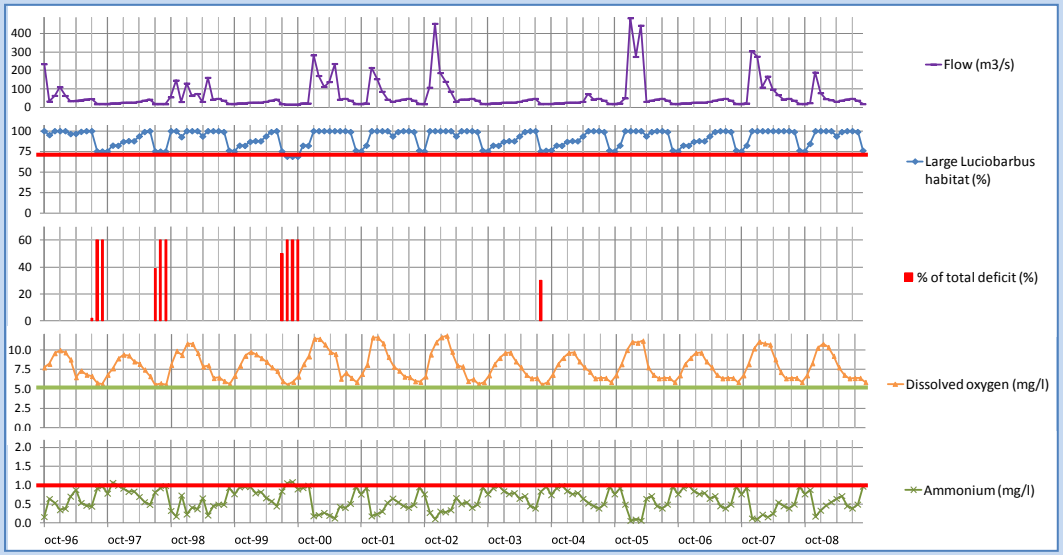
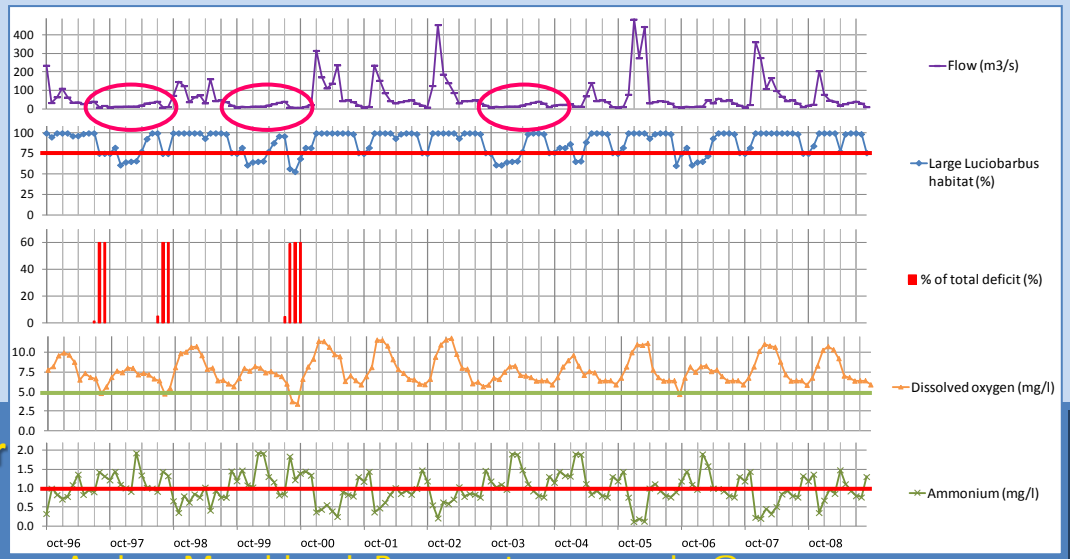
CASE OF APPLICATION:
QECO-OPT scenario vs. OR scenario

QECO-OPT scenario



OR scenario



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CASE OF APPLICATION: CONCLUSIONS

The joint application of allocation, quality and e-flow models allows managers and stakeholders to **fully and comprehensively make decisions**.

We demonstrate that the OR maintains a **greater habitat level while maintaining the demand reliability** in this study.

We show that the optimization of the water management can **improve the ecological conditions**.

E-flow regimes require monitoring and appraisal to provide feedback and improvements for river management.

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THANKS FOR YOUR ATTENTION

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