AN INDICATOR SYSTEM FOR SURFACE WATER QUALITY IN RIVER BASINS

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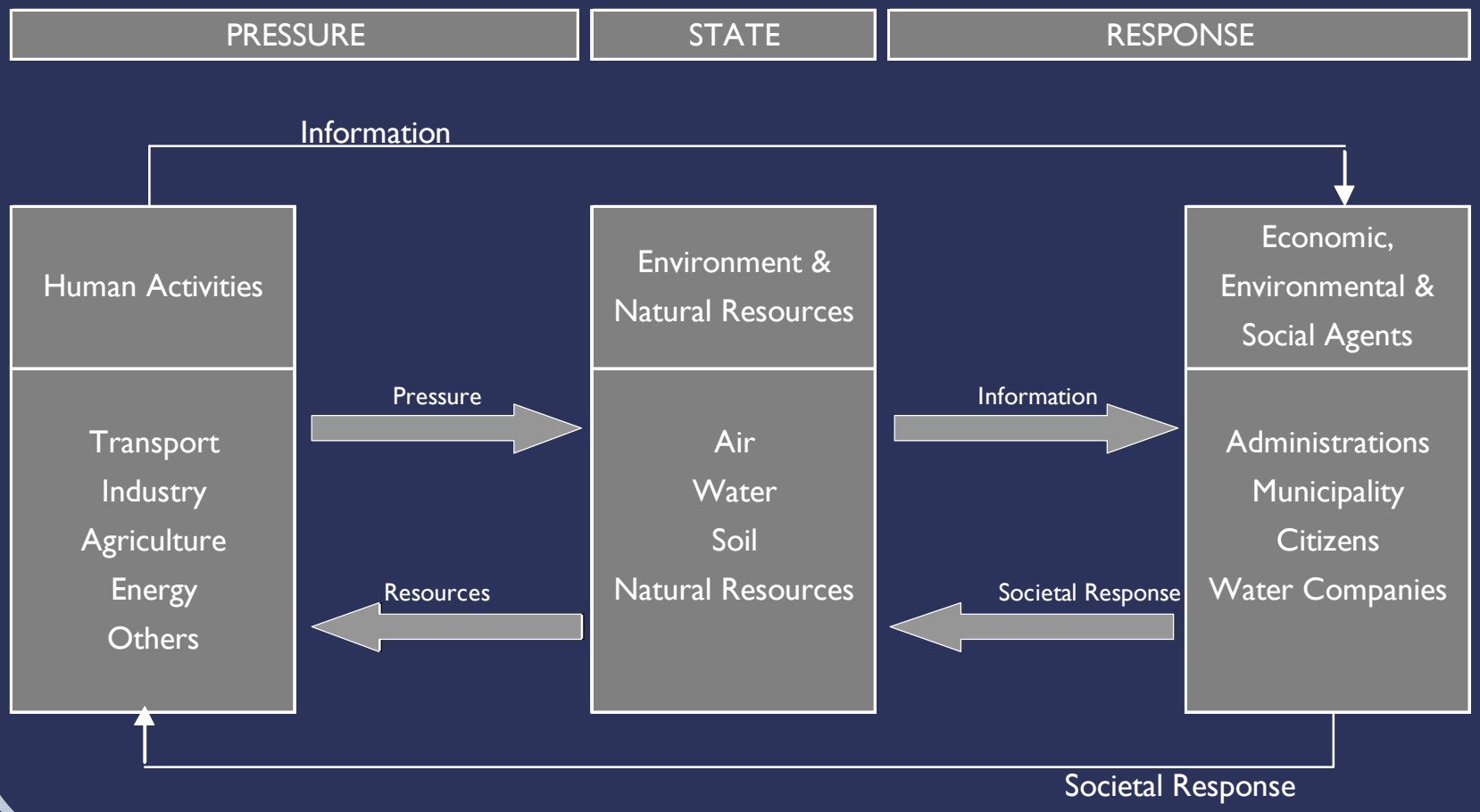
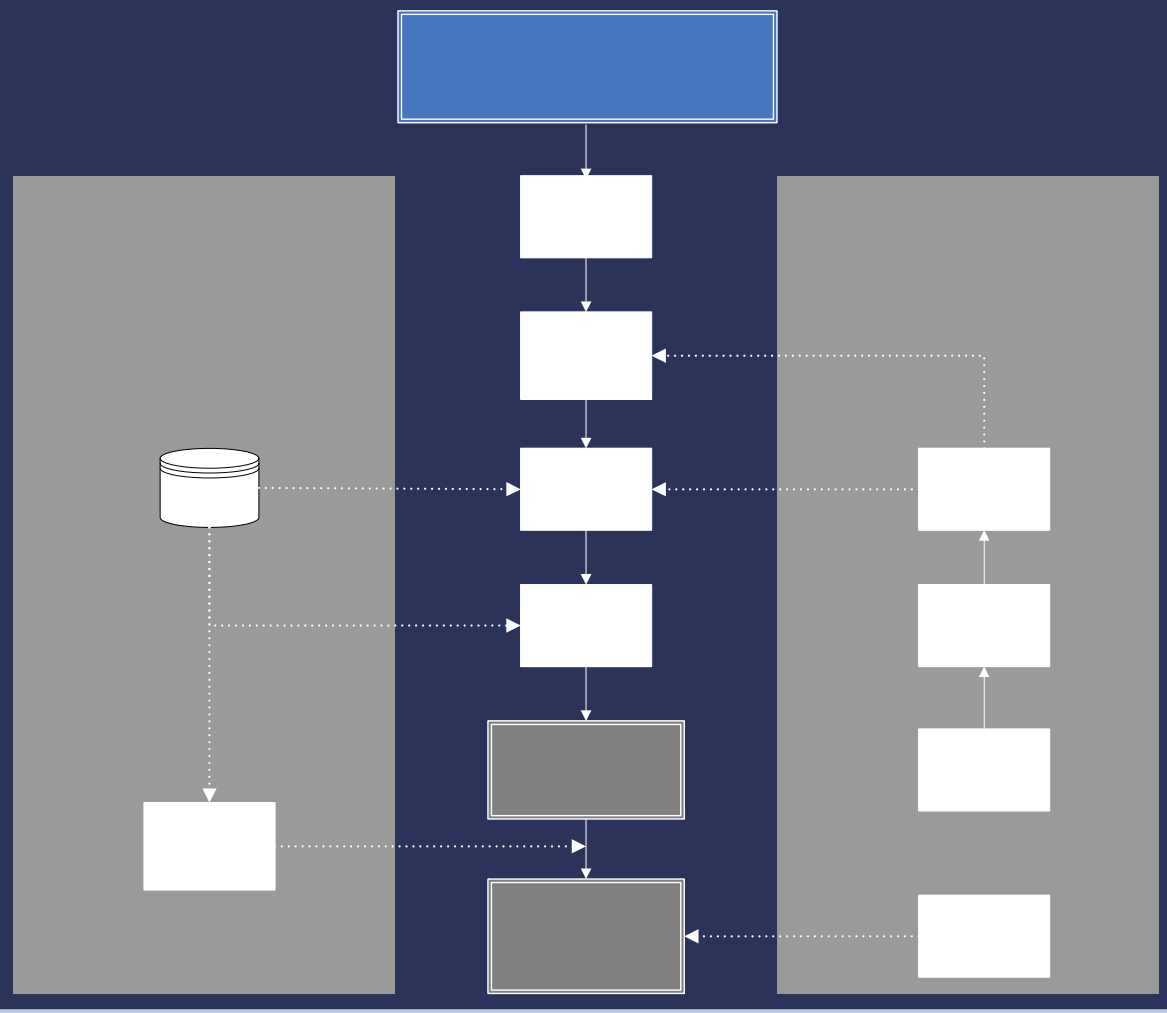
OBJECTIVES

- The EWFD requirements, water demands and key surface water pollution problems identified in a river basin, lead to the need of developing a surface water quality indicator system
- This tool allows the assessment of the pressure-state-impact of human activities on natural waters
- This presentation describes the methodology used for the development and application of an indicator system in the portuguese river Ave basin, based on the PSR (***P**ressure, **S**tate, **R**esponse*) conceptual model. A sub-set of the state indicators was characterized
- This assessment tool may be used to evaluate three main types of quality variables: biological, chemical and hydro-morphological

PSR CONCEPTUAL MODEL



METHODOLOGY



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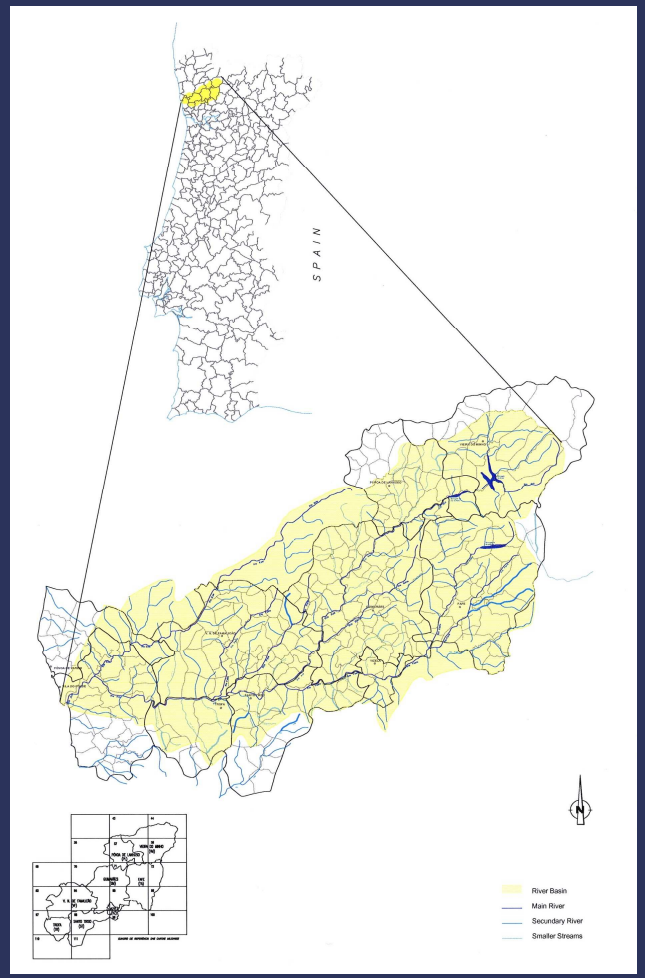
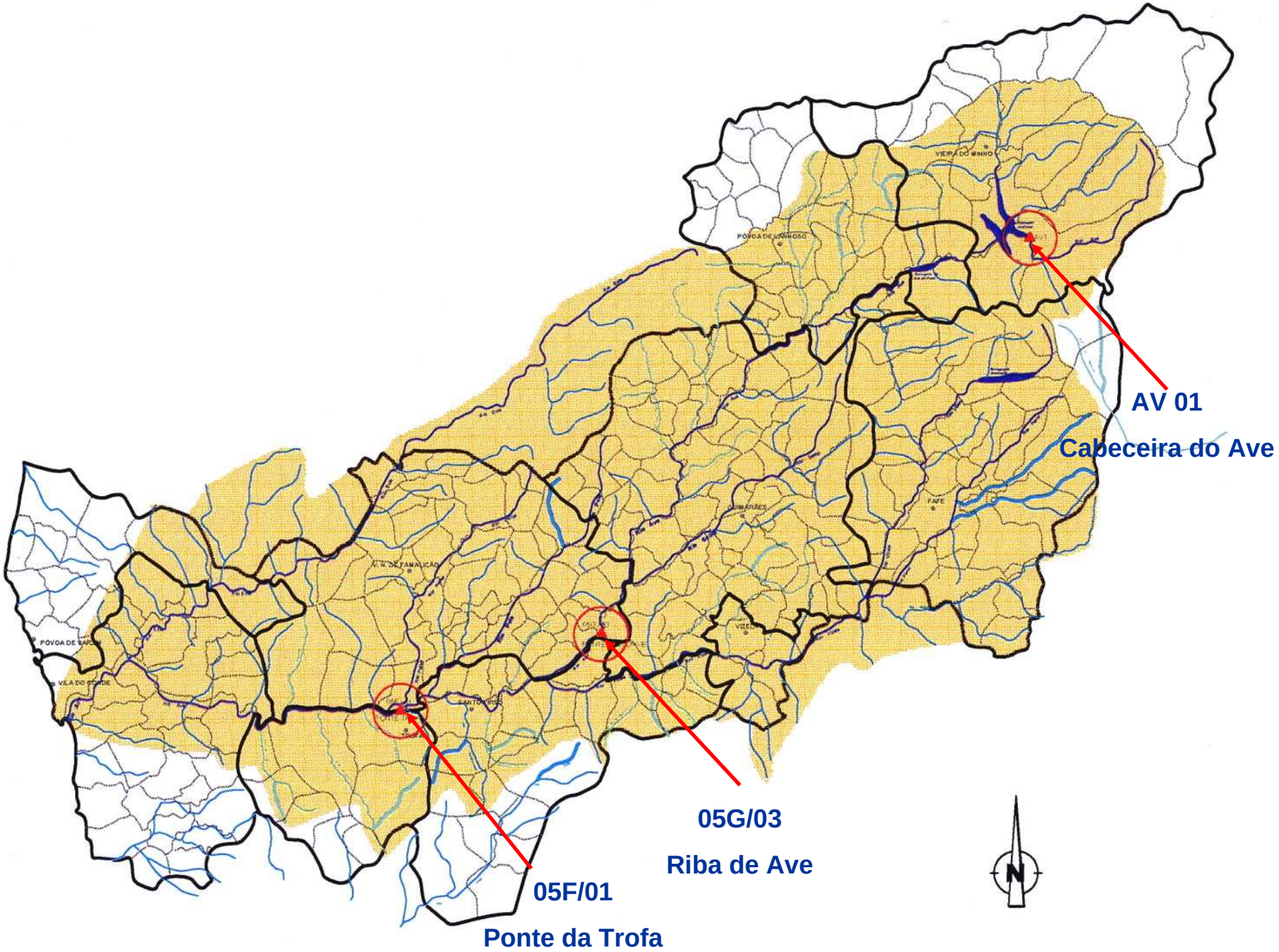
CASE STUDY – THE RIVER AVE BASIN

Study Area



- Northwest of Portugal
- Area of about 1390 km^2 (River Este and River Vizela are the most tributaries in this river basin)
- "Reference Zone" Northeast part
- "Most polluted Zone" Central part


AV 01
Cabeceira do Ave
05G/03
Riba de Ave
05F/01
Ponte da Trofa
N

CASE STUDY – THE RIVER AVE BASIN
Water Quality Index

Definition of the Water Quality Index obeys to a number of criteria, related with legal obligation and its relation with ecologial status, aquatic life and public health

CASE STUDY – THE RIVER AVE BASIN
Water Quality Index

CRITERIA	WQI			
	Eutrophication	Contamination by Bacteria	Oxidation State	Emissions of Organic Matter
Legislation	+	+	+	+
Ecological Relevance	+	-	+	+
Public Healthy Relevance	-	+	-	-
Available Data	+	+	+	+
FINAL RESULT	+	+	+	+

CASE STUDY – THE RIVER AVE BASIN
Water Quality Index

CRITERIA	WQI			
	Heavy Metals Emissions	**Esthetic Quality (Colour)**	**Habitats Integrity**	**Hydrological Regime and Morphological Conditions**
Legislation	+	+	+	+
Ecological Relevance	+	+	+	+
Public Healthy Relevance	+	-	-	-
Available Data	+	-/+	-	+
FINAL RESULT	**+**	**-**	**-**	**+**

CASE STUDY – THE RIVER AVE BASIN
Variables and Indicators proposed

WQI	PRESSURE	STATE	RESPONSE
Eutrophication and Trophic Level	Total nutrient: Total N Total P	Dissolved Oxygen Nitrate, Nitrite Nitrogen Phosphate Chlorophyll-a	↑Rate of Wastewater (Domestic & Industrial) Treatment; ↑Efficiency of Treatment ↑ Relation Water collected / Water Treated
Oxygen Balance	Biochemical Oxygen Demand	BOD DO	
Organic Matter	Biochemical & Chemical Oxygen Demand	Oxidable Organic Matter	

CASE STUDY – THE RIVER AVE BASIN
Reference and Objective Values

WQI	PARAMETER	STATION	
		AV 01	05G/03 and 05F/01
Eutrophication and Trophic Level	DO (% Sat)	50 (MAV)	50 (MAV)
	Nitrites (mg NO_2/L)	0,03 (MRV)	---
	Ammonia (mg NH_4/L)	1 (MAV)	1 (MAV)
	Phosphorus (mg P/L)	---	1 (MAV)
	SST (mg /L)	25 (MAV)	---
Oxygen Balance	DO (% Sat)	50 (MAV)	50 (MAV)
	BOD_5 (mg O_2/L)	6 (MRV)	5 (MAV)
Organic Matter	BOD_5 (mg O2/L)	6 (MRV)	5 (MAV)
Auxiliar Variable	pH (Soeresen)	6,0 – 9,0 (MAV)	5,0 – 9,0 (MAV)

Reference Values: MRV (Maximum Recommended Value)
Objective Values: MAV (Maximum Admitted Value)

RESULTS AND DISCUSSION

Calculation processes: Approaches A and B

- Approach A: the process it's applied to each WQI, resulting in a disaggregated classification and information about water quality, as well as the differences between the real state of water quality and the expected water quality state. This approach allows associating the real state of water quality of part of the River Ave Basin to a determinate class boundary or quality state

- Approach B: is a general classification of River Ave Water Quality, which takes into account all the WQI considered. This classification was possible by aggregating all WQI, which were selected according with the actual European and Portuguese legislation

RESULTS AND DISCUSSION

- Approach A: 2 indicators were evaluated for the year of 2002: Monthly Indicators – MI – and Annual Indicators – AI, for each WQI
- Approach B: 2 indicators were evaluated for the year of 2002: Montly General Indicators – MGI – and General Annual Indicators – GAI
- The class boundaries, were based on normalized state indicators, and defined according:

CLASS BOUNDARIES	QUALITY STATE
All Indicators = 100	EXCELLENT
More than ½ of Indicators = 100 and all ≥ 50	GOOD
Less than ½ of Indicators = 100 and all ≥ 50	DEGRADED
At least one Indicator ≤ 50	BAD

RESULTS AND DISCUSSION

STATION	AV 01			O5G/03			05F/01		
QUALITY STATE: *APPROACH A*									
WQI	$EAI_{Partial}$	OBAI	OMAI	$EAI_{Partial}$	OBAI	OMAI	$EAI_{Partial}$	OBAI	OMAI
AI	G	E	E	G	D	D	G	D	D

QUALITY STATE: *APPROACH B*			
WQI	GAI		
AI	G	G	G

Legend:
E – Excellent; D – Degradaded; G – Good

CONCLUSIONS

- The construction of an indicator system and its application to a river basin requires the development of an adequate methodology to characterize its surface waters:

  - The adoption of the *PSR* Conceptual Model
  - The characterization of the study area
  - The identification of the WQI
  - The selection of correct variables and indicators
  - Definition of the quality state class boundaries

CONCLUSIONS

- Results show that approach B is a general classification, while approach A enables a more accurate and disaggregated classification
- The adopted methodology reveals only the minimal water quality state, specially in case of stations 05G/03 and 05F/01
- Results obtained with approach A show better compliance with the observed water quality in River Ave

ÁGUAS DO AVE

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