

# Evaluating the intelligibility of cartographic representation techniques used for water quality monitoring framework in Brazil.


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Brazil




## What is Water Quality Monitoring Framework?

- The Brazilian water quality monitoring framework (WQMF) is a tool (law 9.433/97) used for land and water zoning revealing the establishment of qualitative biochemical and physical parameters according to water uses.
- Intelligible maps are essential for WQMF as social participation is constant during all the process.



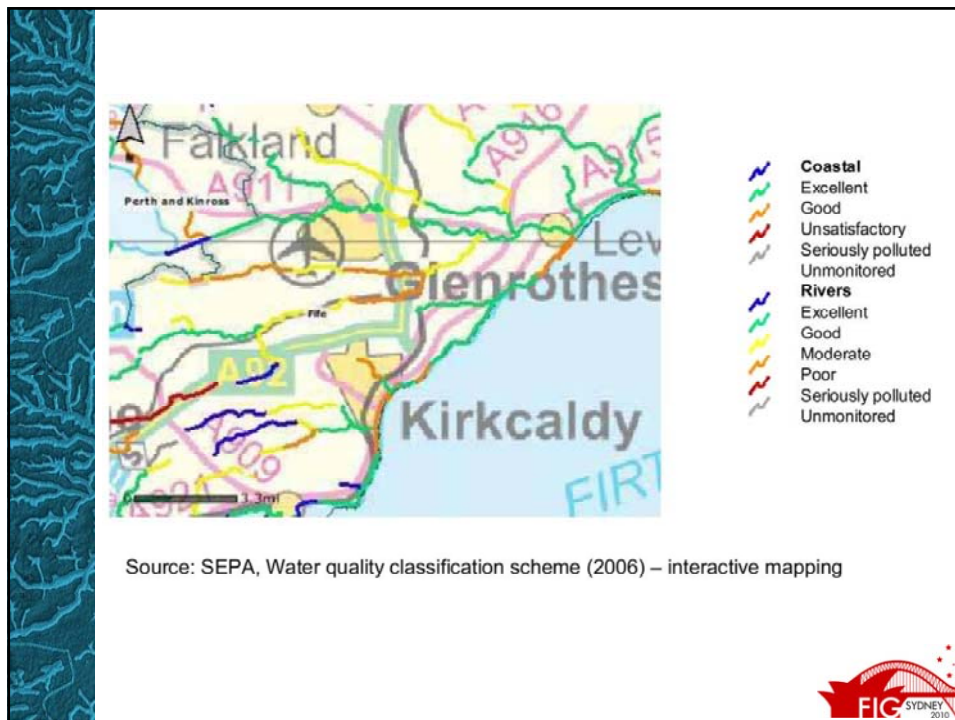
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- The water classes (categories) were disciplined by CONAMA resolution number 357 /2005 (CONAMA - Brazilian National Environmental Council).
  - These classes mentioned are separated in terms of water quality objectives and environmental goals.
  - The water classes represent mainly the water quality aimed for each water body or water body segment.
  - There are several water classes established, for continental superficial freshwater there are 5 classes (special, class 1, class 2, class 3 and class 4)
  - The cartographic ways of representing these classes, in Brazil, are not yet standardized, what incurs is the use of all sorts of different semiology in maps regarding Water Quality Framework.



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- The absence of guidelines and consensus among professionals when representing categories of water quality in maps imposes comparison difficulties amongst studies







## Methodology

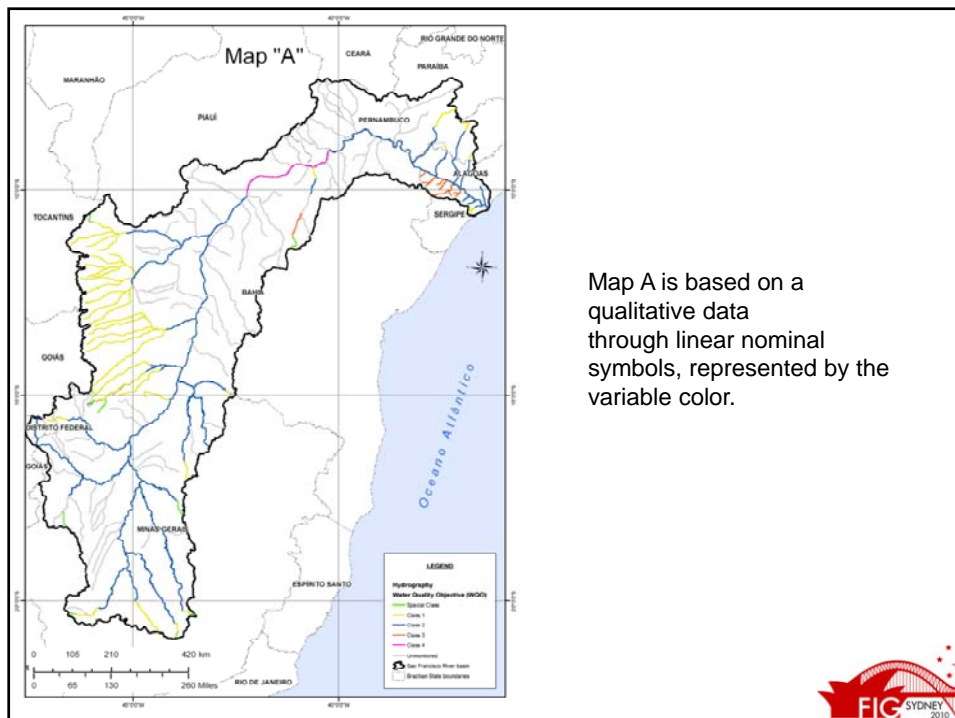
Evaluating public perception of WQMF maps consisted in offering 5 different maps to 25 professionals and asking them to classify these according to their understanding of 3 main aspects:

- understanding of map purposes,
- continuity of water bodies and,
- visual accuracy of the border between water categories



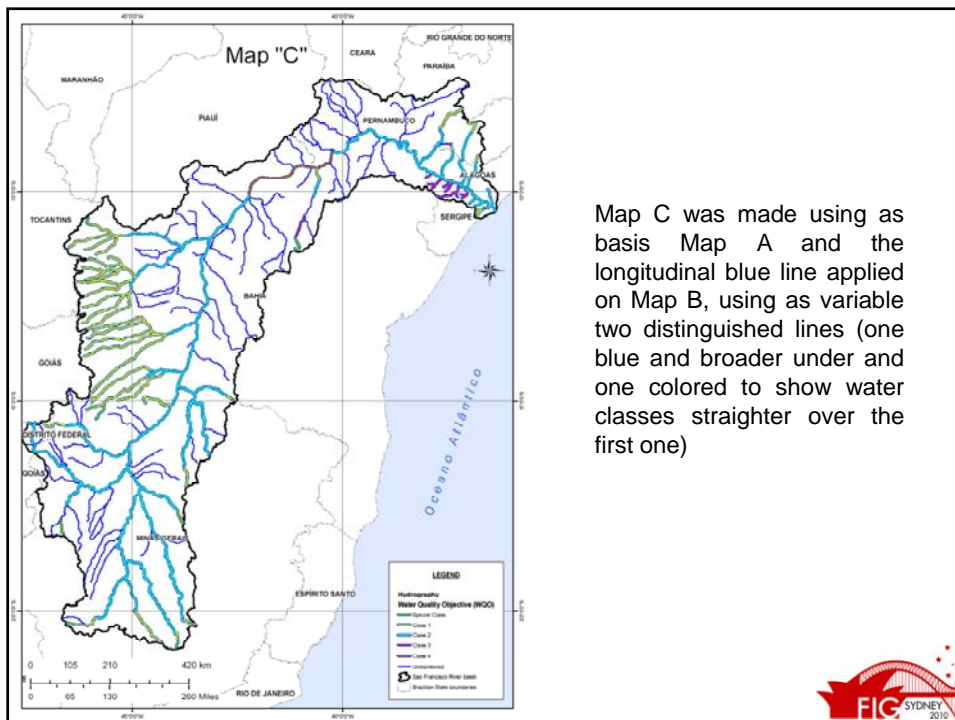
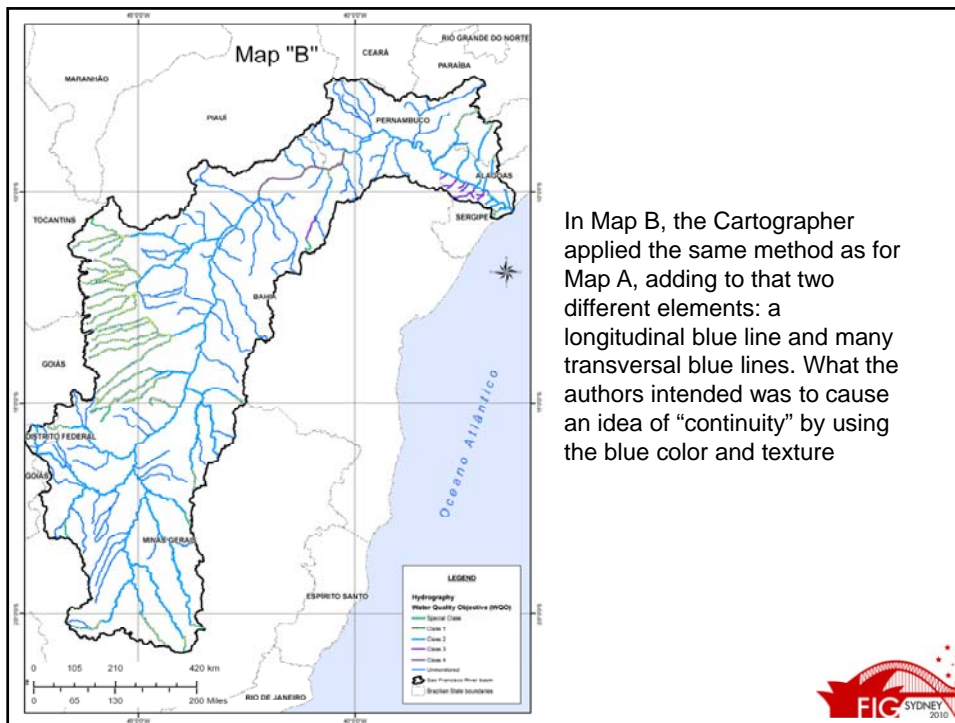
The Technicians interviewed were:

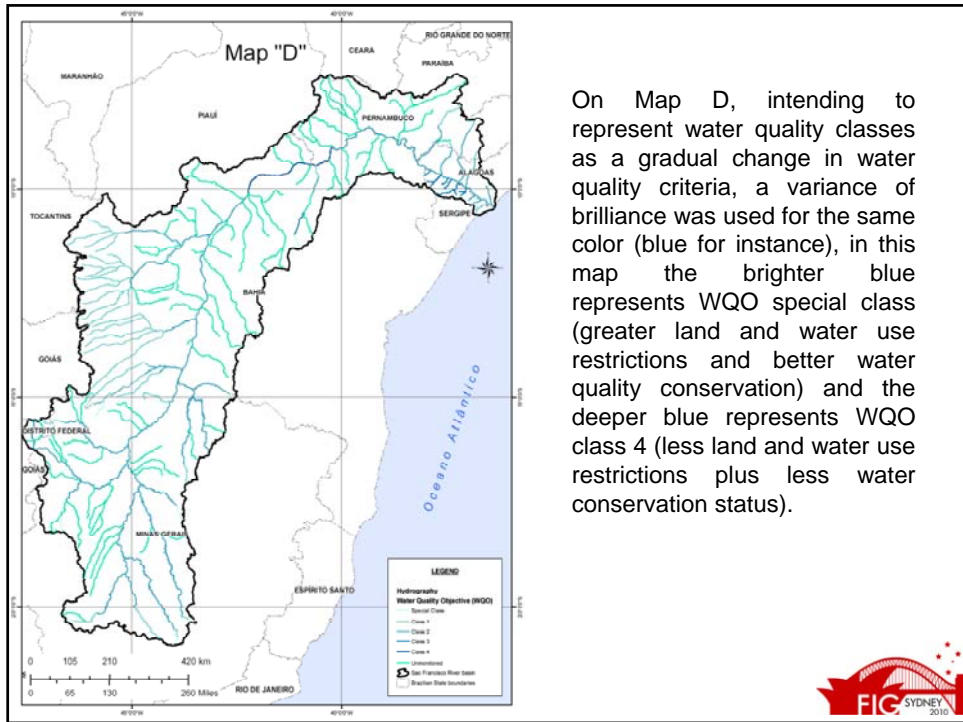
- 7 Geography undergraduate students taking GIS as a chair in Santa Catarina Federal University
- 11 Water Resource Management Technicians that serve the Sustainable Economic Development State Secretariat (Santa Catarina State) in Florianopolis
- 5 Multi professional Technicians of the Regional Development Policy Secretariat of the National Integration Ministry of Brazil in Brasilia
- 2 Technicians from an Enterprise specialized on Environmental Planning in Brasília.



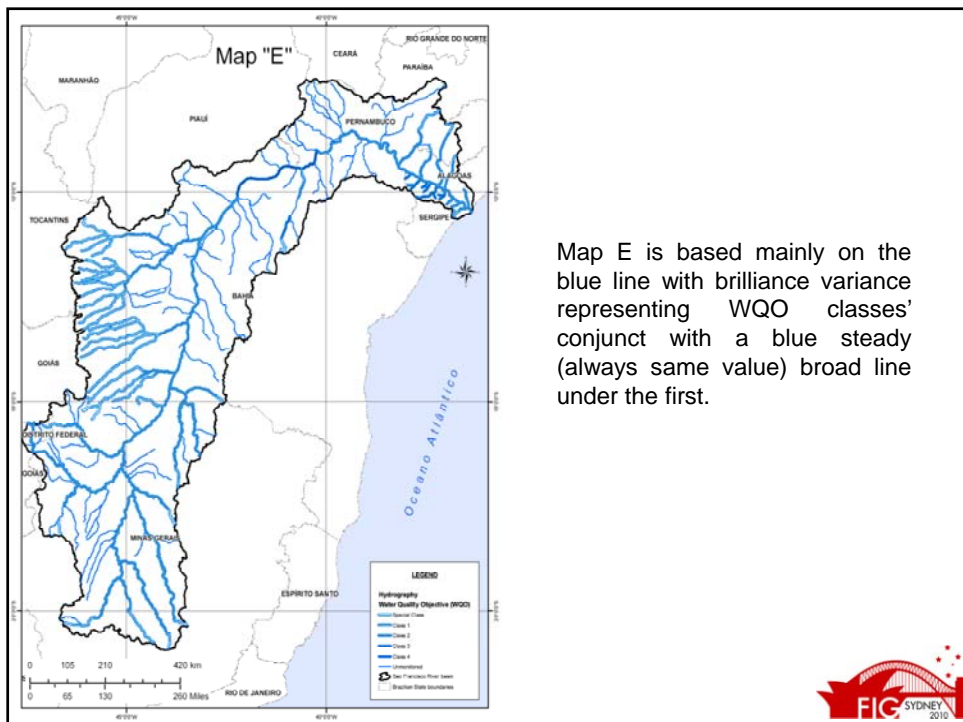
Map A is based on a qualitative data through linear nominal symbols, represented by the variable color.







On Map D, intending to represent water quality classes as a gradual change in water quality criteria, a variance of brilliance was used for the same color (blue for instance), in this map the brighter blue represents WQO special class (greater land and water use restrictions and better water quality conservation) and the deeper blue represents WQO class 4 (less land and water use restrictions plus less water conservation status).



Map E is based mainly on the blue line with brilliance variance representing 'WQO classes' conjunct with a blue steady (always same value) broad line under the first.

# Evaluation

- Maps received grades from a to e in which
- Grade a represented qualitatively Excellent comprehension and quantitatively 10,00 points
- Grade b represented qualitatively Very Good comprehension and quantitatively 7,50 points
- Grade c represented qualitatively Good comprehension and quantitatively 5,00 points
- Grade d represented qualitatively Poor comprehension and quantitatively 2,50 points
- Grade e represented qualitatively unsatisfactory comprehension and quantitatively 0,00 points

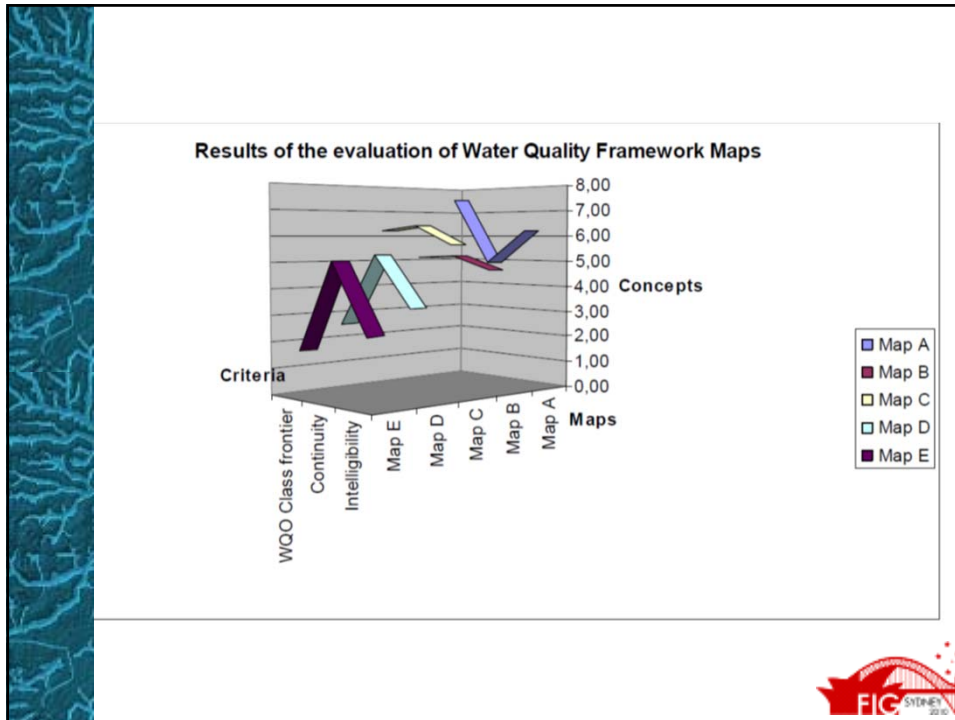


Table 1 – Results of the tests run to perceive the understanding of WQO Maps.

CRITERION	MAP				
	A	B	C	D	E
General Intelligibility	6,2	4,7	5,7	3,4	2,5
Continuity of the water body represented	4,9	5,2	6,4	5,3	5,1
Visibility of the frontier between Water Quality Objectives	7,5	5,1	6,2	2,6	1,7
Average value	6,2	5,0	6,1	3,7	3,1
extent of inequality among the 3 criteria	2,6	0,5	0,7	2,7	3,4







## Results

- There was a better understanding of the map “C” composed by two different lines: one blue and continuous external line representing the water bodies and a color-variable internal line representing the water quality categories.



## Conclusion

Observing public preferences and cognition aspects, we suggest that further research is done, taking in account some aspects observed on this paper:

For water quality representation colors are good semiology attributes, especially because they lead to a better understanding of category changes such as WQO classes and makes the border among them clearer.



Blue border on water bodies may be a good attribute thus it makes the interpretation of Hydrography easier and show the continuity of the river or freshwater body system.

Additional research involving brackish and salty Waters should be complementary and important.

Water Quality Cartographic Representation Standards and Guidelines could be established based on research on cognition and intelligibility of maps on many national or international bases, preferably international, after more research and work is done.



## BIOGRAPHICAL NOTES

### Thobias Leonicio Rotta Furlanetti

Thobias achieved a bachelor in science degree in Cartographic Engineering (2003) in the São Paulo State University (UNESP) and Master in science degree by Civil Engineering program (2005) in the Federal University of Santa Catarina (UFSC) in Florianópolis. His master studies were based the development of Web Mapping for ecotourism purposes. The researcher worked previously as a Cartographer in many enterprises and his own Rotta Engenharia LTDA with his associates and is a former temporary professor on the Federal University of Santa Catarina (UFSC) where he was responsible for the GIS chair between 2007 and 2009. Since 2008 Thobias works at the Sustainable Economic Development Secretariat of Santa Catarina State –SDS (Florianopolis, Brazil) at the Water Resource Management department as a Cartographer Engineer focused on Water Resources.

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### Marina Christofidis

Marina is a Bachelor in Biological Sciences since 2001 by the University of Brasilia (UnB) and a Master in Science in Environmental Engineering (2006) by the Federal University of Santa Catarina (UFSC) in Florianopolis. The Researcher has published many studies on Water Quality Monitoring Framework and water management. She has worked as an Environmental Consultant in Brazil and for Global Water Partnership (GWP) and is a former temporary professor at the Santa Catarina State University (UDESC) where she taught Ecology and Urban Forestry among other themes. In the present, Marina is a Water Infrastructure Analyst at the Brazilian National Integration Ministry and is a Professor for the chairs of Water Resources Management and Ecology for the Brazilian National Environmental Guard, serving the Justice Ministry when required.

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