

## Environmental assessment of a stream located in Novo Hamburgo, RS

Aline B Machado<sup>1</sup>, Gabriela Z. P. Rodrigues<sup>2</sup>, Fernanda G. de Souza<sup>3</sup>, Rafael Linden<sup>4</sup> and Daniela M. M. Osorio<sup>5</sup>

<sup>1,2,3,4,5</sup> Environmental Quality Post Graduation Program, University Feevale, Novo Hamburgo, RS, Brazil.

### Article informations

Received: Novembro 01, 2017

Accepted: Dezembro 21, 2017

Published: Abril, 2018

Todos autores contribuíram de forma igualitária

### ABSTRACT

The Luiz Rau stream is one of the main tributaries of the lower reaches of the Sinos River basin and receives a large part of the city's domestic waste, being recognized by its typical odor and its dark coloration. Thus, the objective of the study was to evaluate the water quality of this water resource. For this, physical-chemical and microbiological analyzes of water were carried out, and to better support these results, the Rapid Habitat Assessment Protocol (RAP) was applied at the same sampling site. The results showed values of coliforms, BOD and OD above the limits established by current legislation. A high caffeine value was also identified in the collected sample, which characterizes the presence of domestic discharge in the water. The RAP revealed the presence of anthropic interference at the site, corroborating with the results obtained in the quantitative analysis of the sample. However, other studies are necessary to better evaluate the water quality of this stream.

Keywords: Luiz Rau, Rapid Habitat Assessment Protocol, Water quality

## Introduction

The populational growth associated with the intensification of anthropogenic activities end up generating impacts on the water systems, such as a greater demand for water for the public supply and an increase of pollutant loads due to the launching of these in the aquatic biota (MERLO et al., 2011).

The Sinos River Basin, located in the eastern region of the State of Rio Grande do Sul, has an area of 3,800 km<sup>2</sup> in which there are 32 municipalities with approximately 1.3 million inhabitants (PETRY et al., 2016). The most important economic activities in this basin are linked to the leather-footwear segment, which accounts for 40% of the Brazilian production of this sector, as well as the chemical, textile and metallurgical industries (FEPAM, 2016). The main river of the basin is the Sinos River, which has as one of the main tributaries in its lower section the Luiz Rau stream, located in

the municipality of Novo Hamburgo, which, over its 14 km long receives intensive domestic and industrial sewage, being called "Black stream" due to the coloration of its water (PMNH, 2016).

The quality of water resources can be assessed by means of quantitative measures, such as physicochemical and biochemical determinations (biochemical oxygen demand (BOD), series of solids, phosphorus, nitrogen and others) (ARAUJO et al., 2010; TAVARES et al., 2018). These microbiological and physicochemical parameters determine the potability characteristics required for water to be favorable to human consumption (SANTOS and MOHR, 2013). However, the diversity of substances present in water, ends up making the analysis of water resources complex (NUNES et al., 2011; GABRIEL et al., 2016), once the identification of individual pollutants does not consider the additive, synergistic or antagonistic effects of their combinations in the environment (MERLO et al., 2011).

Thus, the assessment of habitat diversity provides data on the levels of anthropogenic impacts in stretches of river basins (GALDEAN et al., 2000), consolidating itself as an important instrument in environmental monitoring programs (CALLISTO et al., 2001a). Studies of rapid assessment of habitat quality have been developed aiming at a general and qualitative description of the various attributes of habitats that are punctuated along an optimum to bad gradient (CALLISTO et al., 2001b). In this context, the objective of this study was to evaluate the water quality of the Luiz Rau stream by analyzing physicochemical and microbiological parameters and applying the Rapid Assessment Protocol (RAP).

In this context, the objective of the study was to evaluate the water quality of the Luiz Rau stream by analyzing physicochemical and microbiological parameters and applying the Rapid Assessment Protocol (RAP).

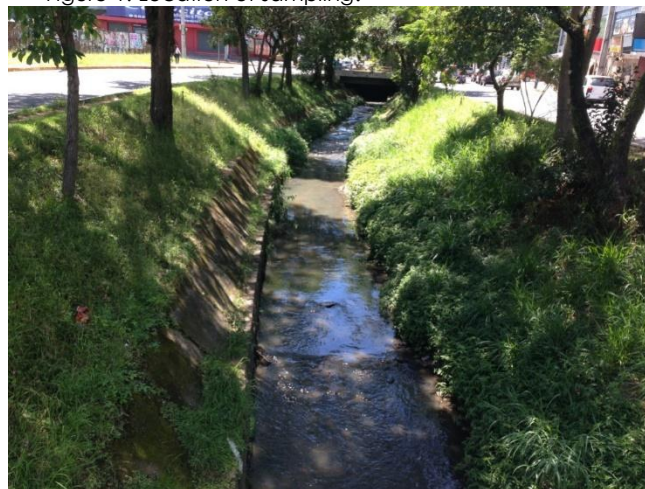
## Material and Methods

Single samples of water were collected in Luiz Rau stream (29 ° 40 '53.27 "S and 51 ° 07' 49.13" W) in October 2016 (Figure 1). The samples were transported under refrigeration (4°C) to the laboratories of the Analytical Center and Toxicological Analysis of the University Feevale where they were later processed.

The following physicochemical parameters were analyzed according to the Standard Methods for the Examination of Water and Wastewater (APHA, 1998): BOD, Oxygen dissolved (OD), pH, turbidity and conductivity. For the microbiological evaluation, the Commercial Kit Colilert® was used and the quantification of caffeine was according to Linden et al. (2015).

To complement the aforementioned assessment of the sampling site, the Rapid Assessment Protocol for Habitat Diversity was also applied, according to Callisto et al. (2002), with modifications made at the time of evaluation.

Figure 1: Location of sampling.



Source: Authors, 2016.

## Results

The values of physicochemical and microbiological parameters are expressed in Table 1. The results of the physicochemical and microbiological parameters analyzed demonstrated that BOD, OD and fecal coliforms were above the limits established by the current legislation for Class III waters (National Council for the Environment - CONAMA 357/2005).

The rainfall data in the Porto Alegre region during the month of October are demonstrated in the Figure 2, it was obtained from the National Institute of Meteorology (INMET). Only on day 27 (day of collection) there was an increase in the amount of rain, not giving time to dilute the sample, which may justify the high number of coliforms detected.

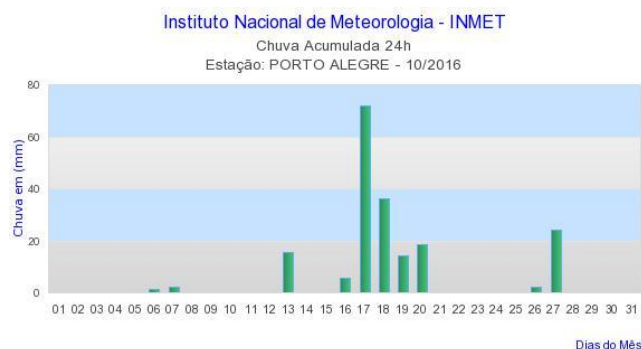
The Rapid Assessment Protocol evidenced the presence of oiliness, odor and turbid appearance of the water, the depth of the stream was approximately of 30 centimeters, presenting rocks and sand in the bottom. The banks were modified to obtain a channeling in most part of the water course.

Table 1: Psysicochemical and microbiological parameters evaluated

Parameter	Value	CONAMA 357/ 2005 Class III
BOD	30 (mg O <sub>2</sub> /L)	0 - 10 mg O <sub>2</sub> /L
OD	0,08 (mg/L)	≥4 mg/L
pH	8,14	6,0 a 9,0
Turbidity	24,8 (NTU)	0 - 100 NTU
Conductivity	373 (μS/cm)	
Caffeine	166,2 (ng/L)	/
Thermotolerant coliforms	24,2 X10 <sup>6</sup> MPN/100 mL	200 MPN/100 mL

Source: Authors, 2016

Figure 2: Rain accumulated at the Porto Alegre station.



Source: INMET.

## Discussion

The results obtained demonstrated that the physicochemical parameters analyzed showed a possible impact generated by anthropic action, but they are not enough when analyzed alone to characterize the real water body quality profile, since they do not provide data on the interaction of contaminants and the environment and their effects.

The values of BOD and OD were according to another work carried out in the Sinos River Basin by Blume et al. (2010), in which the BOD values increased according to the population density, and higher values are found in regions where there is greater deposition of effluents, or while OD decreased, as found in the present study. Scalon et al. (2013) also discovered values above that allowed in the middle and lower part of the basin, indicating a high concentration of organic matter, with a decrease in the quality of the water captured for consumption in the region in recent years.

Along with the physicochemical analysis, coliform analysis can help to indicate fecal contamination due to effluent discharge and high population density in the studied region. The presence of high concentrations of coliforms evidences the discharge of domestic sewage and human activities as main source of contamination, also found in works of Steffens and collaborators (2015), being observed mainly higher concentrations in rainy periods being easily carried through the stream. The microbiological analysis determined coliform concentrations above the limits allowed by CONAMA Resolution 357/2005. Thermotolerant coliforms indicate contamination both by humans, through domestic effluents, as well as by warm-blooded animals (BLUME et al., 2010).

Caffeine has been studied as a parameter for the evaluation of human contamination in water due to its presence in various beverages and foods being consumed, theoretically, exclusively by humans. Its determination is possible due to its

stability in environmental conditions (VERENITCH and MAZUMDER, 2008).

The concentration of caffeine found in the Luiz Rau stream was 166.2 ng / L, which suggests the contamination of the water by human sanitary sewage. This result differs from previous studies in different regions of the Sinos River, which found lower concentrations of caffeine (LINDEN et al., 2015). Therefore, the determination of this parameter along with the determination of total and thermotolerant coliforms helps to identify the possible sources of contamination of the stream.

The Rapid Assessment Protocol (RAP) is used to carry out a qualitative visual analysis of a given environment aiming at the impact presented at the site. According to the score proposed by Callisto et al (2002) a range between 0 and 40 points is characteristic of an impacted environment and, therefore, the Luiz Rau stream fits in this range, since it obtained a total of 34 points, which is the effect of actions, mostly anthropic, that have hampered the conservation status of the natural habitat.

The parameters analyzed in relation to the water of the Luiz Rau stream presented results of presence of oiliness, odor and turbid appearance of the water, results of the impacts caused by humans through the occupation of the soil, and mainly by the disposal of domestic effluents (SOUZA et al., 2014). The moment of the analysis, no household waste deposited in the stream was evidenced, with only sanitary sewage disposal resulting in the contamination of the Luiz Rau stream.

The conductivity is a parameter that indicates the concentration of ions in the water (ZHANG et al., 2012), that is, the water's capacity to conduct electric current (SILVA et al., 2008). The value found in this study is within the limits established by Ayers and Westcot (1985), which describes a problem-free environment for irrigation purposes.

Rubio and his collaborators (2015) carried out the integrated evaluation of streams along the Sinos River basin and in one of the analyzed points (Schmidt) the value of turbidity found was close to that of the present study. In situations where the turbidity is high, and the water volume is low, there may be an increase in organic matter, coliforms and pollutants (CUNHA et al., 2013).

## Conclusions

Based on the results obtained it is observed that some parameters analyzed are above the limits established by CONAMA (Resolution 357/2005) for class 3 waters, therefore considering these results, the Luiz Rau stream can be classified in class 4 of the same resolution (for navigation and landscaping). The protocol for the rapid evaluation of habitat diversity carried out at the site corroborates with the physico-chemical and microbiological analysis, revealing the effects of anthropic actions. However, it is necessary to carry

out other studies with more refined parameters (such as metals) to better evaluate the water quality of the Luiz Rau stream.

## Acknowledgments

We thank the Environmental Quality Post Graduation Program of Feevale University, RS for the institutional support.

## References

- ARAUJO, C.S.T.; MARCIONILIO, S.M.L.O.; CUNHA, A.H.N.; SILVA, A.S.F.; AMORIM, D.J.; OLIVEIRA, E.F.; OLIVEIRA, E.L.; NABOUT, J.C. Literatura científica do uso de adsorventes na remoção de contaminantes. *Revista de Biotecnologia & Ciência*, 3 (1), 14-24, 2010.
- APHA- American Republic Health Association, American water works association, water environmental federation. Standard Methods for the examination of water and wastewater. 20 th Ed. Washington, D.C.; AWWA, WEF, 1157, 1998.
- AYERS, R.S.; WESTCOT, D.W. Water quality for agriculture. Rome: Food and Agriculture Organization of the United Nations, 1985.
- BLUME, K.K.; MACEDO, J.C.; MENEGUZZI, A.; SILVA, LB; QUEVEDO, D.M.; RODRIGUES, M.A.S. Water quality assessment of the Sinos River, Southern Brazil. *Brazilian Journal of Biology*, 70 (4), 1185-1193, 2010.
- BRASIL, Resolução CONAMA nº 357, de 17 de março de 2005. *Classificação de águas, doces, salobras e salinas do Território Nacional*. Publicado no D.O.U.
- CALLISTO, M.; MORENO, P.; BARBOSA, F.A.R. Habitat diversity and benthic functional trophic groups at Serra do Cipó, Southeast Brazil. *Revista Brasileira de Biologia*, 61 (2), 259-266, 2001a.
- CALLISTO, M.; MORETTI, M.; GOULART, M. Macroinvertebrados bentônicos como ferramenta para avaliar a saúde de riachos. *Revista Brasileira de Recursos Hídricos*, 6 (1), 71-82, 2001b.
- CALLISTO, M.; FERREIRA, W.R.; MORENO, P.; GOULART, M.; PETRUCIO, M. Aplicação de um protocolo de avaliação rápida da diversidade de habitats em atividades de ensino e pesquisa (MG-RJ). *Acta Limnologica Brasiliensia*, 14 (1), 2002.
- CUNHA, R.W.; GARCIA JR., M.D.N.; ALBERTONI, E.F.; PALMA-SILVA, C. Qualidade de água de uma lagoa rasa em meio rural no sul do Brasil. *Revista Brasileira de Engenharia Agrícola e Ambiental*, 17(7), 770-779, 2013.
- FUNDAÇÃO ESTADUAL DE PROTEÇÃO AMBIENTAL HENRIQUE LUIS ROESSLER - FEPAM. Qualidade ambiental – região hidrográfica do Guaíba. Available at: [http://www.fepam.rs.gov.br/qualidade/qualidade\\_sinos/sinos.asp](http://www.fepam.rs.gov.br/qualidade/qualidade_sinos/sinos.asp).
- GABRIEL, F.A.; LORENA, E.M.G.; BEZERRA, P.X.G.; DOS SANTOS, I.G.S.; MORAES, A.A.; NETO, C.R. Pollution by heavy metals: Environmental Implications and key strategies for remediation. *GEAMA*, 2 (4), 456-465, 2016.
- GALDEAN, N.; CALLISTO, M.; BARBOSA, F.A.R. Lotic ecosystems of Serra do Cipó, Southeast Brazil: water quality and a tentative classification based on the benthic macroinvertebrate community. *Aquatic Ecosystem Health & Management*, 3 (4), 545-552, 2000.
- KIELING-RUBIO, M.A.; BENVENUTI, T.; COSTA, G.M.; PETRY, C.T.; RODRIGUES, M.A.S.; SCHMITT, J.L.; DROSTE, A. Integrated Environmental Assessment of streams in the Sinos River basin in the state of Rio Grande do Sul, Brazil. *Brazilian Journal of Biology*, 75 (2), 105- 113, 2015.
- LINDEN, R.; ANTUNES, M.V.; HEINZELMANN, L.S.; STAGGEMEIER, R.; FABRES, R.B.; VECCHIA, A.D.; NASCIMENTO, C.A.; SPILKI, F.R. Caffeine as an indicator of human fecal contamination in the Sinos River: a preliminary study. *Brazilian Journal of Biology*, 75 (2), 81-84, 2015.
- MERLO, C.; ABRIL, A.; AMÉ, M.V.; ARGÜELLO, G.A.; CARRERAS, H.A.; CHIAPPERO, M.S.; HUED, A.C.; WANNAZ, E.; GALANTI, L.N.; MONFERRÁN, M.V.; GONZÁLEZ, C.M.; SOLÍS, V.M. Integral assessment of pollution in the Suquía River (Córdoba, Argentina) as a contribution to lotic ecosystem restoration programs. *Science of the Total Environment*, 409, 5034-5045, 2011.
- NOVO HAMBURGO. Prefeitura Municipal - PMNH. Novo Hamburgo: passado e futuro. Available at: [http://www.novohamburgo.rs.gov.br/modules/cat\\_asg/novohamburgo.php?conteudo=70](http://www.novohamburgo.rs.gov.br/modules/cat_asg/novohamburgo.php?conteudo=70).
- NUNES, E. A.; LEMOS, C.T.; GAVRONSKI, L.; MOREIRA, T.N.; OLIVEIRA, N.C.D; SILVA, J. Genotoxic assessment on river water using different biological systems. *Chemosphere*, 84(1), 47-53, 2011.
- PETRY, C.T.; COSTA, G.M; BENVENUTI, T.; RODRIGUES, M.A.S.; DROSTE, A. Avaliação integrada da qualidade química e da genotoxicidade da água do arroio Luiz Rau, no trecho inferior da Bacia do Rio dos Sinos, no Sul do Brasil. *Revista Ambiente e Água*, 11(4), 2016.

SANTOS, R.S.; MOHR, T. Saúde e qualidade da água: Análises microbiológicas e físico-químicas em águas subterrâneas. *Revista contexto e saúde*, Rio Grande do Sul, 13 (24/25), 26- 53, 2013.

SCALON, M.C.S.; RECHENMACHER C.; SIEBEL, A.M.; KAYSER, M.L.; RODRIGUES, M.T.; MALUF, S.W.; RODRIGUES, M.A.S.; SILVA, L.B. Genotoxic potential and physicochemical parameters of Sinos River, Southern Brazil. *The Scientific World Journal*, 2013, 1-6, 2013.

SILVA, A.E.P.; ANGELIS, C.F.; MACHADO, L.A.T.; WAICHAMAN, A.V. Influência da precipitação na qualidade da água do Rio Purus. *Acta Amazonica*, 38 (4), 2008.

STEFFENS, C.; KLAUCK, C.R.; BENVENUTI, T.; SILVA, L.B.; RODRIGUES, M.A.S. Water quality assessment of the Sinos River – RS, Brazil. *Brazilian Journal of Biology*, 75 (4), 62-67, 2015.

SOUZA, A.C.; DOS REIS, T.D.F.; DE SÁ, O.R. Comparação entre o índice de qualidade da água (IQA) com o protocolo de avaliação rápida de habitats no córrego liso, município de São Sebastião do Paraíso, Minas Gerais. *Periódico Eletrônico Fórum Ambiental da Alta Paulista*, 10 (2), 2014.

TAVARES, B.S.; CORRÊA, M.M.; SOUZA, R.V.C.C.; SCARIOTTO, M.M.; MENDES, I.S.; MEDEIROS, L.R.S. Water quality in Una River Basin – Pernambuco. *GEAMA*, 4 (1), 26- 32, 2018.

VERENITCH, S.S.; MAZUMDER, A. Development of a methodology utilizing gas chromatography ion-trap tandem mass spectrometry for the determination of low levels of caffeine in surface marine and freshwater samples. *Analytical and Bioanalytical Chemistry*, 391 (7), 2635-2646, 2008.

ZHANG, B.; SONG, X.; ZHANG, Y.; HAN, D.; TANG, C.; YU, Y.; MA, Y. Hydrochemical characteristics and water quality assessment of surface water and groundwater in Songnen plain, Northeast China. *Water research*, 46 (8), 2737-2748, 2012.