

## **Environmental interventions in urban river channels: For urban and environmental planning purposes**

**Ionara Santos Siqueira<sup>1</sup>, Érico Gaspar Lisboa<sup>2</sup>, Educélio Gaspar Lisboa<sup>3</sup>.**

### **ABSTRACT**

Rapid urbanization, without planning and control of urban land use, with the occupation of areas at risk of flooding and landslides, combined with population densification and exacerbated use of natural resources, generate a set of environmental, social, economic and cultural impacts that directly interfere with the well-being of the population (ZANANDREA, 2016; SANTOS, RUFINO, BARROS FILHO, 2017).

**Keywords:** Environmental interventions, Urbanization, Risk areas.

### **INTRODUCTION**

Rapid urbanization, without planning and control of urban land use, with the occupation of areas at risk of flooding and landslides, combined with population density and exacerbated use of natural resources, generate a set of environmental, social, economic and cultural impacts that directly interfere with the well-being of the population (ZANANDREA, 2016; SANTOS, RUFINO, BARROS FILHO, 2017).

The inadequate disposal of solid waste directly contributes to the deterioration of environmental quality (physical, biotic and anthropic) in water bodies that cut through the urban area, which can be exemplified by visual pollution, soil contamination, water contamination, proliferation of vectors, presence of odors, alteration of the landscape, reduction of habitats, risk to the population's water supply and others (ALVES et al., 2012; SOARES et al., 2016; PIMENTA et al., 2016).

With the poor management of solid waste, the population ends up using the water bodies included in the urban area, as solid waste deposits on its banks and bed, which can cause several impacts on the environment, (POLASTRI et al., 2015; PIMENTA et al., 2016; PINTO et al., 2020).

In view of this scenario, one of the mitigating measures to alleviate the problem of solid waste disposal on the banks and riverbed of the basin would be the training of local residents, the implementation of more regular collection points, greater supervision by the municipal government, and others (MARQUEZINI et al. 2014; SOARES et al. 2016; SARDINHA and GODOY, 2016).

---

<sup>1</sup> Dr. student in the Graduate Program in Development and Urban Environment, University of the Amazon – PA

<sup>2</sup> Effective Professor of the Graduate Program in Development and Urban Environment - University of the Amazon – PA

<sup>3</sup> Adjunct Professor I - State University of Pará – PA



Thus, floods are treated as isolated problems, so the priority of interventions in open river channels and marginal areas to reduce the impacts of urban flooding requires the approach of criteria of a diverse nature, which environmental issues are some of the issues that need to be considered in the planning of interventions in watercourses.

## **OBJECTIVE**

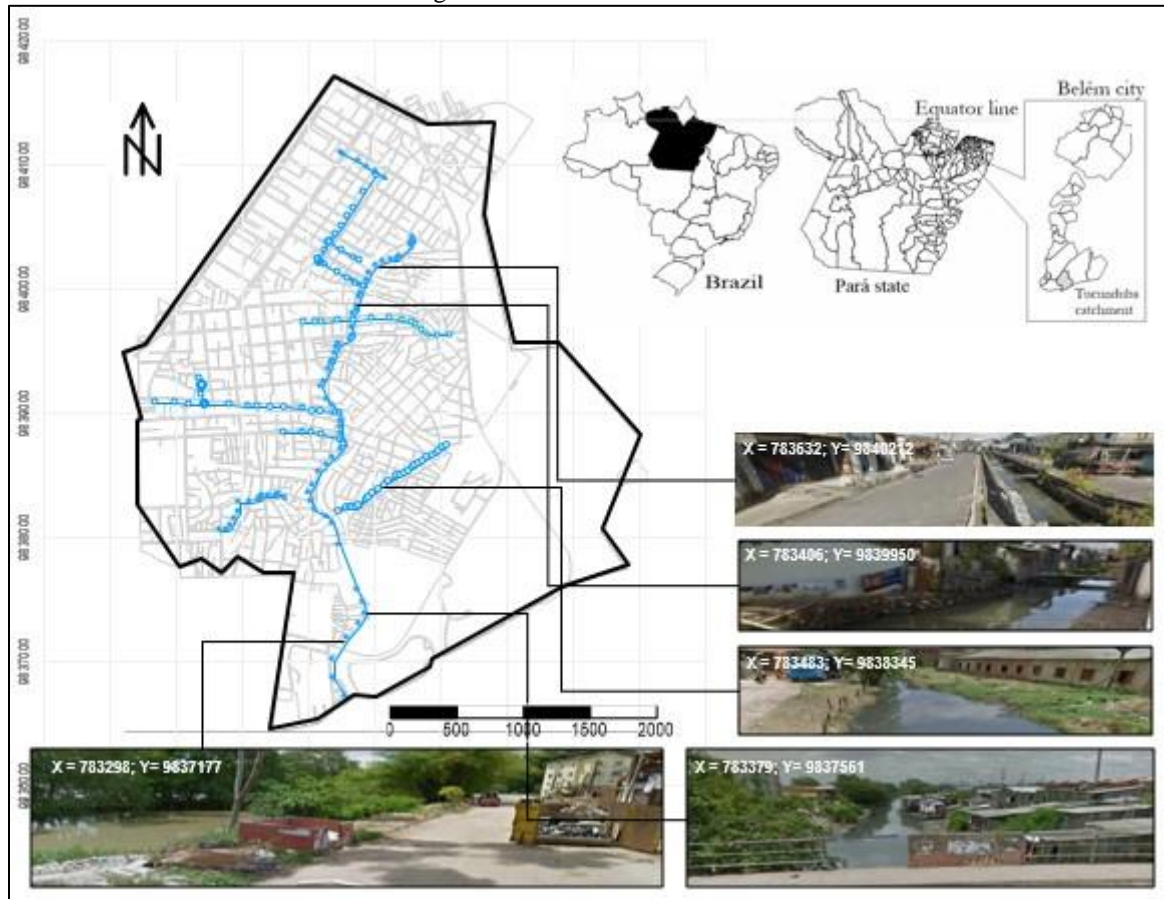
In this sense, the objective of the work is based on the relevance of measures that can minimize the environmental impacts on the population, providing subsidies for future public interventions, through better sustainable alternatives, in order to mitigate the effects caused by floods and flooding in urban areas and provide support to public management.

## **METHODOLOGY**

The methodology applied in the stretches of the open river channels of the Tucunduba basin, belonging to the hydrography of the city of Belém, Pará, Brazil, located at 1° 26' 4.7" latitude and 48° 27' 20.9" longitude and has approximately 1,055ha. The basin holds about 575ha of "lowland" areas, corresponding to 21.02% of the floodplain areas of Belém (PMB, 1999).

The Tucunduba basin is the second largest urban basin in the city of Belém, the area is characterized by a large population density. This densification process transformed the streams into channels for the flow of the city's waste, altered the headwaters and beds of the watercourses through density urban constructions, rectifications, alteration of vegetation cover, soil sealing, garbage and sewage disposal" (FERREIRA, 1995), figure 1.

Figure 1 – Tucunduba watershed.

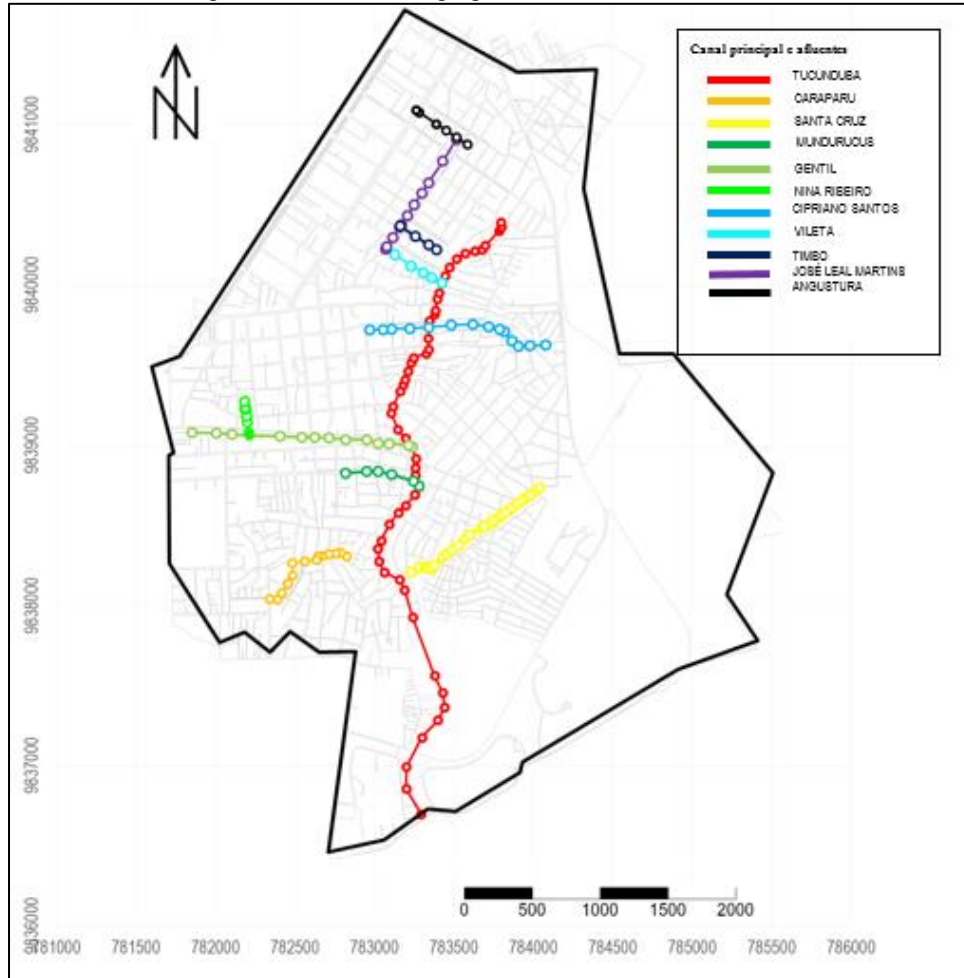


Source: Authors (2023)

The study area is an urbanized basin that drains into the Guamá River and the Guamá River into the bay of Guajará. This bay is located in an estuarine region, that is, a fluvial environment with important marine influence, with typical mesotidal oscillation with an average range of 3m. The continental terrains adjacent to the bay, where the study area is located, are divided into two physiographic units, Terra Firme and Várzeas (PARÁ, 2002). In the floodplains, the tides are the main transporter of sediments and suspended organic material (PINHEIRO, 1987).

The Tucunduba basin is composed of 13 channels, namely: Tucunduba, Lago Verde, Caraparu, Dois de Junho, Mundurucus, Gentil Bittencourt, Nina Ribeiro, Santa Cruz, Cipriano Santos, Vileta, União, Leal Martins and Angustura, figure 2.

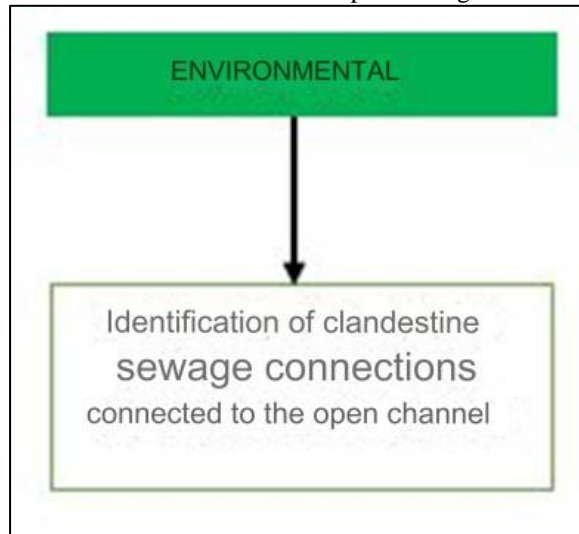
Figure 2 - Canals belonging to the Tucunduba watershed.



Source: Authors (2023)

Initially, the survey of environmental issues to be considered should be considered as an essential element in the identification of solid waste disposed of on the banks of the canal under study, identified in figure 3.

Figure 3 - Definition of the environmental criterion for prioritizing interventions in the open channel.



Source: Authors (2023)

## DEVELOPMENT

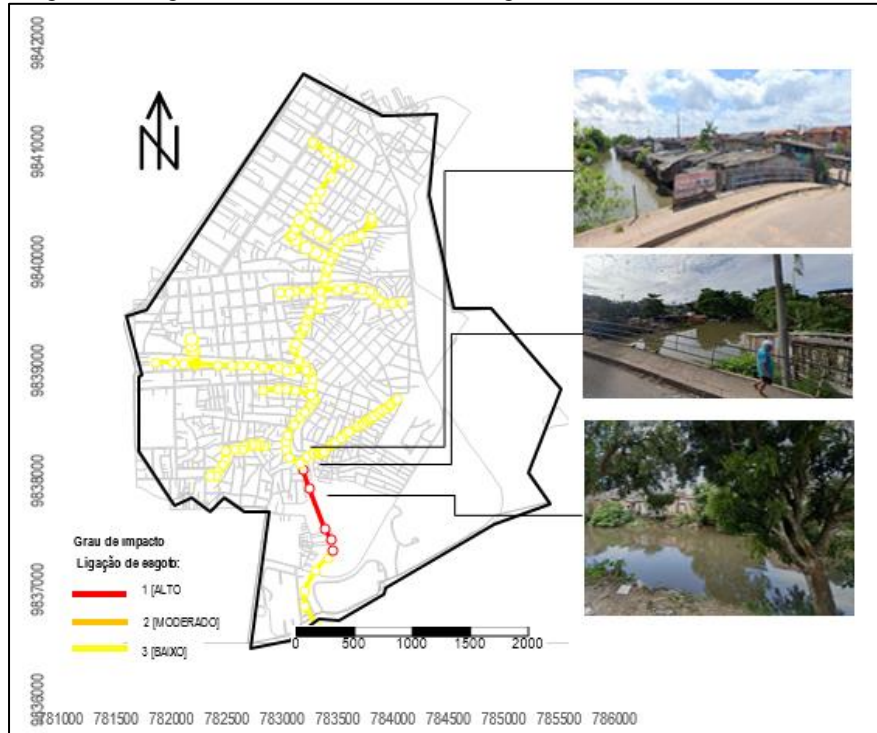
Most of the communities do not receive the sanitary sewage service, and the waste is discharged on the land itself or in the Tucunduba stream, in the open air, which compromises the sanitary and environmental quality of the occupations, configuring the condition of high disposition of sewage connection to the banks of the canal in most of the length of the canal, Table 1, Figure 4. This factor facilitates the infiltration of contaminated water, compromising the water quality of households supplied by artesian wells.

No disposal of waste on the banks and no accumulation of waste in the bed of the canals.

Solid Waste  Associated with the degree of waste disposal on the banks and their accumulation in the canal bed.		Disposal of waste on the banks.
		Accumulation of waste in the canal bed.
		Disposal of waste on banks without appropriate temporary deposits.
		Disposal of waste on the banks with appropriate temporary deposits.
		No disposal of waste on the banks and no accumulation of waste on the canal bed.

Source: Authors (2023)

Figure 4 - Degree of risk of clandestine sewage connection in urbanized canals.



Source: Authors (2023)

In this way, the cycle of contamination in cities is produced when sewage is not treated, drainage pollution is not controlled, producing erosion and contamination along with solids. This pollution contaminates water sources that loses water availability due to water quality. This is a problem of almost all Brazilian cities. The main factor in this problem has been the lack of sewage treatment, and in Brazilian cities this factor is no exception to the rule (TUCCI, 2005).

Therefore, the determining factors such as the garbage deposited on the banks of the canal, which intensify the consequences of flooding, increasing the risk of transmission of waterborne diseases, such as leptospirosis, hepatitis, dermatitis, and the proliferation of vectors, such as mosquitoes that cause dengue, malaria or yellow fever, are evidenced in figure 5.

Figure 5 - Garbage deposited on the banks of the Tucunduba channel.



Source: Authors (2023)



It is important to note that the large amount of waste comes, in part, from the residents of the surroundings of the canal, domestic garbage, and waste from the most diverse establishments such as markets, butchers, fairs.

The intrinsic relationship between sanitation and health has been discussed and reiterated by several studies, and the benefit that sanitation policies exert on the health conditions of the population is evident, especially with regard to infectious and parasitic diseases. In the early 2000s, FUNASA defined these diseases as Diseases Related to Inadequate Environmental Sanitation (DRSAI) (FONSECA and VASCONCELOS, 2011).

## **FINAL THOUGHTS**

The present work is an aid in the activation of an action plan integrated to urban and environmental planning and management, therefore the Urban solid waste management is essentially a public health decision and requires the integration of policies that involve economic, social and environmental issues, since the complex challenge that large cities face in solid waste management at the beginning of this century is faced through the formulation of public policies aimed at eliminating risks to health and the environment.

Therefore, selective collection should be improved to make it more effective, improving its reach and reducing costs, encouraging the participation of society in the separation of organic and recyclable waste, given the importance in the environmental context of the region studied, it is suggested:

- i) The implementation of an environmental management plan in order to preserve watercourses;
- ii) The creation of environmental education projects aimed at the sustainable use of rivers;
- iii) The creation of monitoring programs for the region studied, in which there is community integration.



## REFERENCES

- Alves, T. L. B., Lima, V. L. A., & Farias, A. A. (2012). Impactos ambientais no rio Paraíba na área do município de Caraúbas–PB: região contemplada pela integração com a bacia hidrográfica do Rio São Francisco. *Caminhos de Geografia*, 13(43), 160-173.
- Ferreira, C. F. (1995). *Produção do espaço e degradação ambiental: um estudo sobre a várzea do igarapé Tucunduba*. (Dissertação de Mestrado em Geografia). São Paulo: USP/FFLECH.
- Fonseca, F. R., & Vasconcelos, C. H. (2011). *Análise espacial das Doenças Relacionadas ao Saneamento Ambiental Inadequado no Brasil*. Cadernos Saúde Coletiva. Universidade Federal do Rio de Janeiro – UFRJ. Instituto de Estudos em Saúde Coletiva – IESC.
- Marquezini, L. C., Spatti Junior, E. P., & Panher, A. M. (2014). Aplicação da Avaliação Ambiental Simplificada (ASS) em função do uso da terra em bacia hidrográfica urbana. *Boletim de Geografia*, 32(3), 138-150.
- Pará. Governo do Estado. (2002). *Plano diretor de mineração em áreas urbanas: região metropolitana de Belém*. Belém: IBGE.
- Pimenta, R. H. O., Reis, S. P., & Fonseca, M. (2016). Diagnóstico ambiental em três trechos distintos do Córrego Capão, Regional Venda Nova, Município de Belo Horizonte/MG. *Revista Petra*, 2(1), 153-173.
- Pinheiro, R. V. L. (1987). *Estudo hidrodinâmico e sedimentológico do estuário Guajará – Belém/PA*. Dissertação (Mestrado em Geociências) - Universidade Federal do Pará, Belém.
- Prefeitura Municipal Belém. (1999). *Programa de Gestão dos Rios Urbanos: Projeto de Recuperação e Urbanização da Bacia do Tucunduba*. Belém: PMB.
- Santos, K. A., Rufino, I. A. A., & Barros Filho, M. N. M. (2017). Impactos da ocupação urbana na permeabilidade do solo: O caso de uma área de urbanização consolidada em Campina Grande – PB. *Engenharia Sanitária e Ambiental*, 22(5), 943–952.
- Sardinha, D. S., & Godoy, L. H. (2016). O crescimento urbano desordenado e o impacto nos recursos hídricos superficiais de Uberaba (MG). *Revista Nacional de Gerenciamento de Cidades*, 4(23), 1-20.
- Soares, T. S., Cortes, M. A. S., Freitas, A. D., & Vasconcelos, F. C. W. (2016). Avaliação dos impactos ambientais na área de influência direta do córrego da Estiva, município de Betim, MG, Brasil. *Ciência e Natura*, 38(2), 620-636.
- Tucci, C. E. M. (2005). Desenvolvimento institucional dos recursos hídricos no Brasil. *REGA*, 2(2), 81-93.
- Zanandrea, F. (2016). *Avaliação de técnicas de baixo impacto no controle de impactos*.