GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

Analysis of environmental conditions in the Baixotes stream, in the lower Tietê river basin, in Birigui (São Paulo, Brazil)

Stephanie Campos Gonçalves
Mestranda no Programa de Pós-Graduação em Geografia
Universidade Estadual Paulista "Júlio de Mesquita Filho", Brasil
stephanie.campos@unesp.br
0009-0005-8435-6032

Clélia Rosilene Bergo Martins
Mestranda no Programa de Pós-Graduação em Geografia
Universidade Estadual Paulista "Júlio de Mesquita Filho", Brasil
cleliabergo@prof.educacao.sp.gov.br
0000-0003-6446-8710

Danielli Cristina Granado Romero
Professora Doutora PPGG-MP
Universidade Estadual Paulista "Júlio de Mesquita Filho", Brasil
danielli.granado@unesp.br
ORCID iD: 0000-0002-8458-4124

Fernando Sérgio Okimoto
Professor Doutor PPGG-MP/FCT/UNESP, PPG-EC/FEIS/UNESP e PRoASaS/FSP/USP
Universidade Estadual Paulista "Júlio de Mesquita Filho", Brasil
fs.okimoto@unesp.br
ORCID iD: 0000-0003-1385-8316

Submissão: 02/02/2025
Aceite: 15/04/2025
GONÇALVES, Stephanie Campos; MARTINS, Clélia Rosilene Bergo; ROMERO, Danielli Cristina Granado; OKIMOTO, Fernando Sérgio. Análise das condições ambientais no Ribeirão Baixotes, na bacia hidrográfica do baixo Tietê, em Birigui (São Paulo, Brasil). **Revista Nacional de Gerenciamento de Cidades**, *[S. l.]*, v. 13, n. 89, 2025. DOI: 10.17271/2318847213892025617 1. Disponível em: https://publicacoes.amigosdanatureza.org.br/index.php/gerenciamento_de_cidades/article/view/6171.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

Análise das condições ambientais no Ribeirão Baixotes, na bacia hidrográfica do baixo Tietê, em Birigui (São Paulo, Brasil)

RESUMO

Objetivo - analisar as condições ambientais de trechos do Ribeirão Baixotes de Birigui/SP.

Metodologia - aplicação de um Protocolo de Avaliação Rápida (PAR), em dois períodos climáticos distintos: um no período de estiagem e o outro na época das chuvas regulares do ano de 2023, na região.

Originalidade/relevância – o Protocolo de Análise Rápida (PAR), apesar de metodologia consolidada no meio acadêmico e científico tem sido pouco explorado e sua facilidade, baixo custo tecnológico e precisão permitem análises ambientais contundentes.

Resultados - os resultados mostraram alterações antrópicas em diferentes graus de intensidade nos quatro trechos alisados nas duas épocas amostradas. As áreas mais impactadas foram a que estavam próximas da zona urbana e o trecho onde se encontra o ponto de captação de água para abastecimento do município. Em seguida, o instrumento de avaliação apontou várias alterações ambientais no trecho à montante da captação e, por fim, apontou que a área após o lançamento do efluente da Estação de Tratamento de Esgoto, está em melhores condições ambientais. Os resultados registrados são alarmantes e requerem intervenções urgentes para sua recuperação.

Contribuições teóricas/metodológicas – o estudo reflete as condições do Ribeirão Baixotes, mas reflete a grande maioria, se não a totalidade dos corpos hídricos urbanos e as análises realizadas podem ser utilizados pelos órgãos gestores dos municípios e das águas.

Contribuições sociais e ambientais – a metodologia em si, permite entender as variáveis importantes para manter ou restaurar o ambiente vizinho dos corpos hídricos promovendo a sensibilização e a consciência necessárias para ações proativas e reflexos positivos no ambiente.

PALAVRAS-CHAVE: Escassez Hídrica. Mananciais de Abastecimento Urbano. Protocolo de Avaliação Rápida. Eventos Climáticos.

Analysis of environmental conditions in the Baixotes stream, in the lower Tietê river basin, in Birigui (São Paulo, Brazil)

ABSTRACT

Objective - To analyze the environmental conditions of sections of the Ribeirão Baixotes in Birigui/SP.

Methodology - Application of a Rapid Assessment Protocol (RAP) in two distinct climatic periods: one during the dry season and the other during the regular rainy season of 2023 in the region.

Originality/Relevance - The Rapid Assessment Protocol (RAP), despite being a consolidated methodology in the academic and scientific community, has been little explored. Its ease of use, low technological cost, and precision allow for robust environmental analyses.

Results - The results showed anthropic alterations of varying degrees of intensity in the four sections analyzed in both sampling periods. The most impacted areas were those close to the urban zone and the section where the water intake point for the municipality's supply is located. Subsequently, the assessment tool indicated several environmental changes in the section upstream from the intake. Finally, it is pointed out that the area after the effluent discharge from the Sewage Treatment Plant is in better environmental condition. The recorded results are alarming and require urgent interventions for recovery.

Theoretical/Methodological Contributions - The study reflects the conditions of the Ribeirão Baixotes, but it also mirrors the vast majority, if not all, of urban water bodies. The analyses performed can be used by municipal and water management agencies.

Social and Environmental Contributions - The methodology itself allows for an understanding of the important variables for maintaining or restoring the environment surrounding water bodies, promoting the awareness and consciousness necessary for proactive actions and positive environmental impacts.

KEYWORDS: Water Scarcity. Urban Water Supply Sources. Rapid Assessment Protocol. Climatic Events.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

Análisis de las condiciones ambientales del arroyo Baixotes, en la cuenca baja del río Tietê, en Birigui (São Paulo, Brasil)

RESUMEN

Objetivo - Analizar las condiciones ambientales de tramos del arroyo Ribeirão Baixotes en Birigui/SP.

Metodología - Aplicación de un Protocolo de Evaluación Rápida (PER) en dos períodos climáticos distintos: uno en el período de estiaje y otro en la época de lluvias regulares del año 2023 en la región.

Originalidad/Relevancia - El Protocolo de Evaluación Rápida (PER), a pesar de ser una metodología consolidada en el medio académico y científico, ha sido poco explorado. Su facilidad, bajo costo tecnológico y precisión permiten análisis ambientales contundentes.

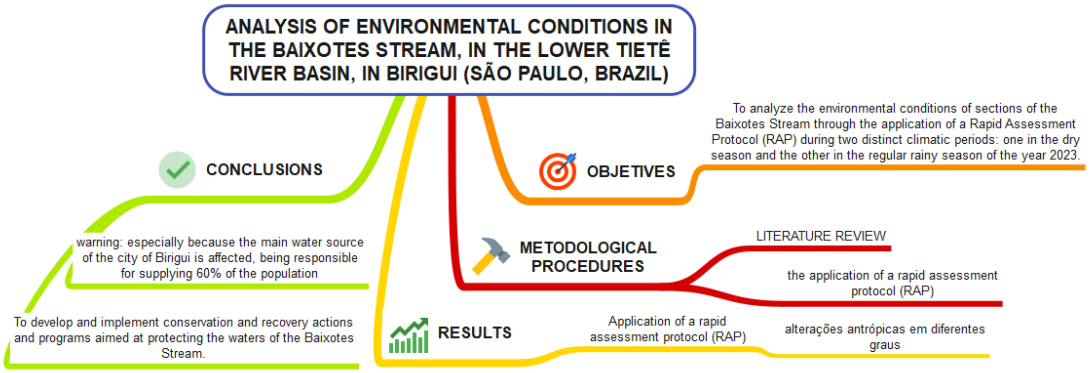
Resultados - Los resultados mostraron alteraciones antrópicas en diferentes grados de intensidad en los cuatro tramos analizados en ambas épocas de muestreo. Las áreas más impactadas fueron las cercanas a la zona urbana y el tramo donde se encuentra el punto de captación de agua para el abastecimiento del municipio. A continuación, el instrumento de evaluación señaló varias alteraciones ambientales en el tramo aguas arriba de la captación y, finalmente, indicó que el área después del vertido del efluente de la Estación de Tratamiento de Aguas Residuales se encuentra en mejores condiciones ambientales. Los resultados registrados son alarmantes y requieren intervenciones urgentes para su recuperación.

Contribuciones Teóricas/Metodológicas – El estudio refleja las condiciones del arroyo Ribeirão Baixotes, pero también refleja a la gran mayoría, si no a la totalidad, de los cuerpos de agua urbanos, y los análisis realizados pueden ser utilizados por los órganos gestores de los municipios y de las aguas.

Contribuciones Sociales y Ambientales – La metodología en sí misma permite entender las variables importantes para mantener o restaurar el ambiente vecino a los cuerpos de agua, promoviendo la sensibilización y la conciencia necesarias para acciones proactivas y reflejos positivos en el ambiente.

PALABRAS CLAVE: Escasez Hídrica, Fuentes de Abastecimiento Urbano, Protocolo de Evaluación Rápida, Eventos Climáticos.

SUMÁRIO GRÁFICO



GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

1 INTRODUCTION

The world is going through an era of rapid technological and social changes, but paradoxically we are facing significant challenges which affect the quality of life at a global level. The planet faces complex issues ranging from socioeconomic inequalities to health and, above all, environmental crises. Climate change tops this list of contemporary global concerns. The occurrence of extreme events that do not respect national borders is becoming increasingly frequent, whether due to high volumes of rain that fall in a short space of time or longer and more severe periods of drought, which have become more common in many regions. These latter consequences of global climate change are added to the pressures of urbanization, increased demand of resources, inefficiency of basic sanitation services (Schueler; Carvalho, 2024) and pollution from different sources to trigger the current water crisis (Braga, 2003; Tucci, 2008; Tundisi, 2008; 2009).

Another factor that can be added to this discussion is the necessity of vegetation in the surrounding area of water bodies (Rosin, 2019). The lack of riparian vegetation leads to silting, strongly impacting the aquatic ecosystem and affecting the multiple uses of water, including human supply. In cities, the problem is even more serious, according to Baptista et al. (2021, p. 88) "vegetation is removed and watersheds become impermeable. The few remaining fragments of green areas are generally associated with riparian vegetation, which is pressured by the surroundings".

Like many municipalities in the Southeastern region of Brazil, the city of Birigui has been suffering from water shortages. This situation has become more acute during the dry seasons, especially since the last decade. This fact has been reported by local and regional media, which has drawn attention to the increased frequency, regularity and intensity of the lack of water in recent years. The main reason given by the city officials in the news is the reduction in the water level of the Baixotes Stream, due to the lack of rain. This watercourse is the only surface water source in the city, and it is responsible for approximately 60% of the water that reaches the homes of the residents of Birigui. And its volume of water has currently affected the public water supply. In this context, studies that analyze the environmental conditions of the Baixotes Stream are essential to support programs aimed at its conservation and recovery, especially since it is a water source intended for public supply. Therefore, identifying stressors on the aquatic ecosystem beyond the lack of rain is crucial, because there is much that can be done in relation to this condition. But there are possible actions, especially related to the use and occupation of the river basin, and to the improvement of the coverage and efficiency of basic sanitation. Moreover, there can also be more specific interventions on the banks of the water body, such as recovery of the permanent preservation area (PPA), removal of waste, and containment of erosion on the banks, among others.

In order to assist in monitoring the health of water environments and their banks, as in the case of the Baixotes Stream, the tool known as Rapid Assessment Protocol (RAP) has been applied and adapted in different studies and for different biomes in the country, and these studies have been widely disseminated among the scientific community. This is a method aimed at quickly obtaining information on the physical conditions of the aquatic environment and its surroundings, and it also has a low cost for monitoring. Its results can support plans and actions

ISSN 2318-8472, v. 13, n. 89, 2025

aimed at the conservation and restoration of the entire area close to water bodies. According to Bizzo et al. (2014, p. 6), "RAP was developed with the objective of facilitating access to and understanding of water systems and can be applied by both specialists and trained volunteers, in addition to its application being low cost."

This protocol was originally applied by the Ohio Environmental Protection Agency in the United States - EPA (1987), modified based on a proposal by Hannaford et al. (1997) and adapted by Callisto et al. (2002) for Brazilian regions. The original idea was conceived based on the need for rapid responses to environmental analyses of aquatic systems. Thus, the study, which was previously only quantitative, began to use a qualitative perspective: "qualitative assessment methods were defined by environmental agencies in order to reduce the high cost and delay of quantitative research" (Bizzo et al., 2014, p. 6).

For each context, adaptations may be necessary, consisting of adjustments to meet the great diversity of ecosystems, that is, environmental reference systems, which differ from place to place. Thus, "the protocols are adapted since the river ecosystem studied may present different types of vegetation, climate, soil, relief, among other aspects" (Bizzo et al., 2014, p. 7).

In this context, the present work aims to analyze the environmental conditions in the Baixotes Stream, which is the main water source and the only surface spring in Birigui, through the application of a Rapid Assessment Protocol (RAP), in two distinct climatic periods: one in the dry season and the other in the regular rainy season of the year 2023, in the region.

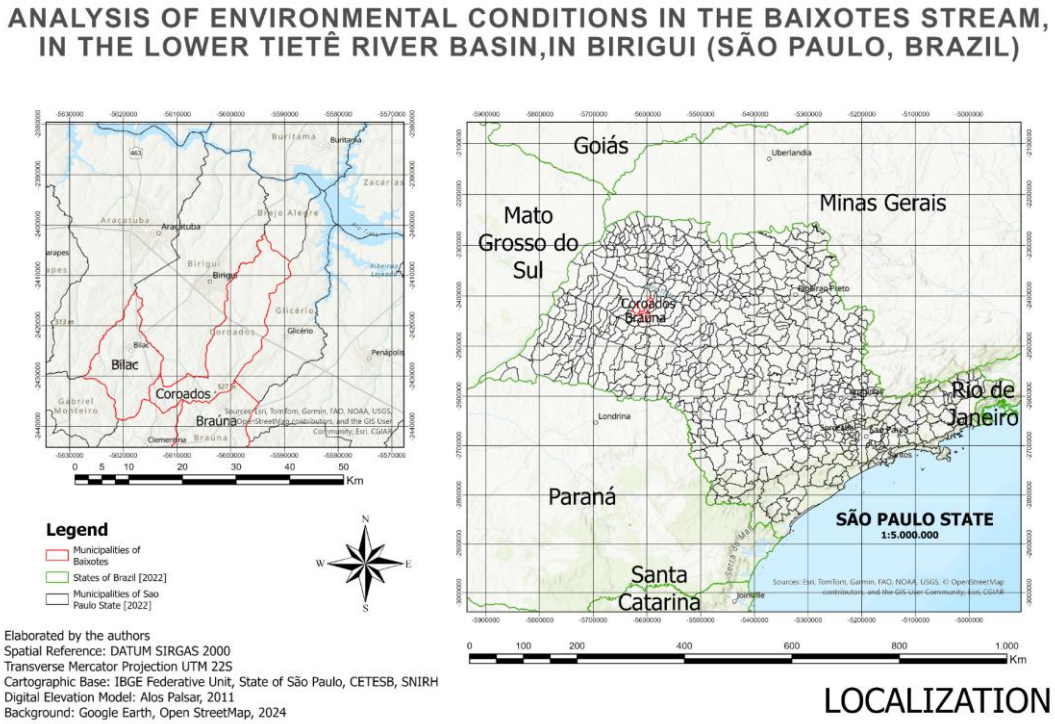
2 CHARACTERIZATION OF THE AREA UNDER STUDY

Birigui is in the northwest region of the state of São Paulo (Image 1). In the last census, carried out in 2022 by the Brazilian Institute of Geography and Statistics, the count was 118,979 inhabitants. On the Institute's website, the Municipal Human Development Index (MHDI) has remained at 0.780 since 2010. The economic activity of great significance for job creation is the footwear industry, generating around 13,000 jobs (Silva, 2020).

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

Image 1 – Location of the city of Birigui (and its neighboring cities in the Baixotes Stream river basin) in the state of São Paulo



Source: Authors' own elaboration, 2024.

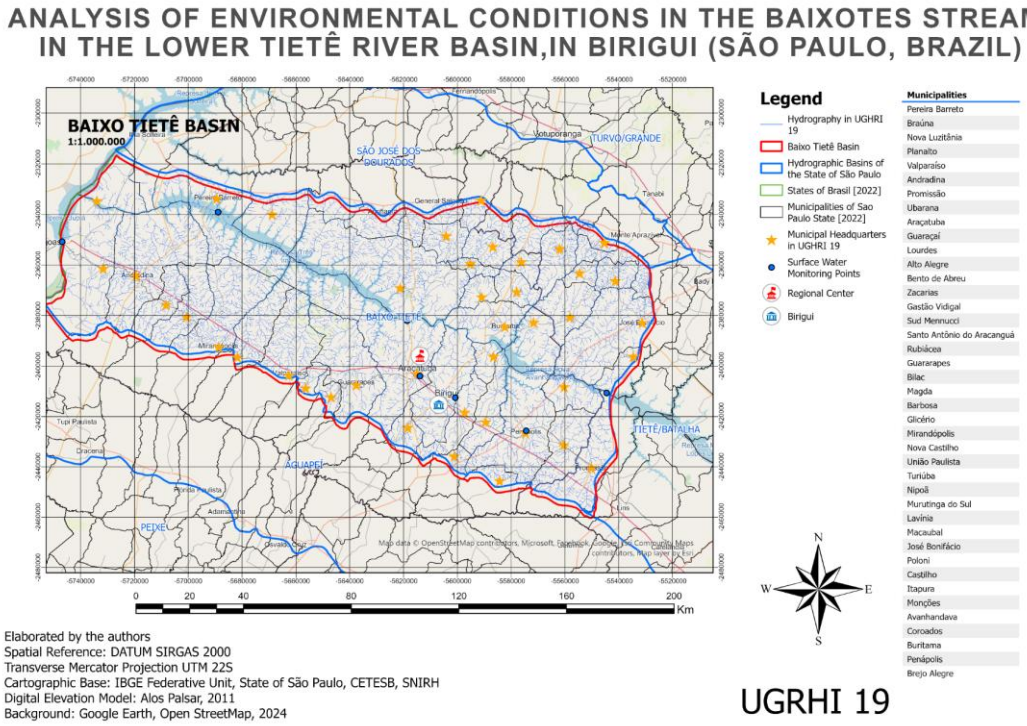
The municipality of Birigui is located in the Lower Tietê Hydrographic Basin belonging to the Hydrographic Unit for Water Resources Management No 19 of the State of São Paulo, as it is shown in image 2.

Image 2 shows the 42 municipalities that are grouped together in the management of the Lower Tietê. The Committee of the Lower Tietê Hydrographic Basin was created in 1994, and its headquarters is in Birigui. The Baixotes Stream (Image 3) is a tributary of the Tietê River of great importance for supplying more than half of the population of Birigui.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

Image 2: The Lower Tietê Hydrographic Basin, representing the Unit for Water Resources Management No 19, in the state of São Paulo.



Source: Authors' own elaboration, 2024

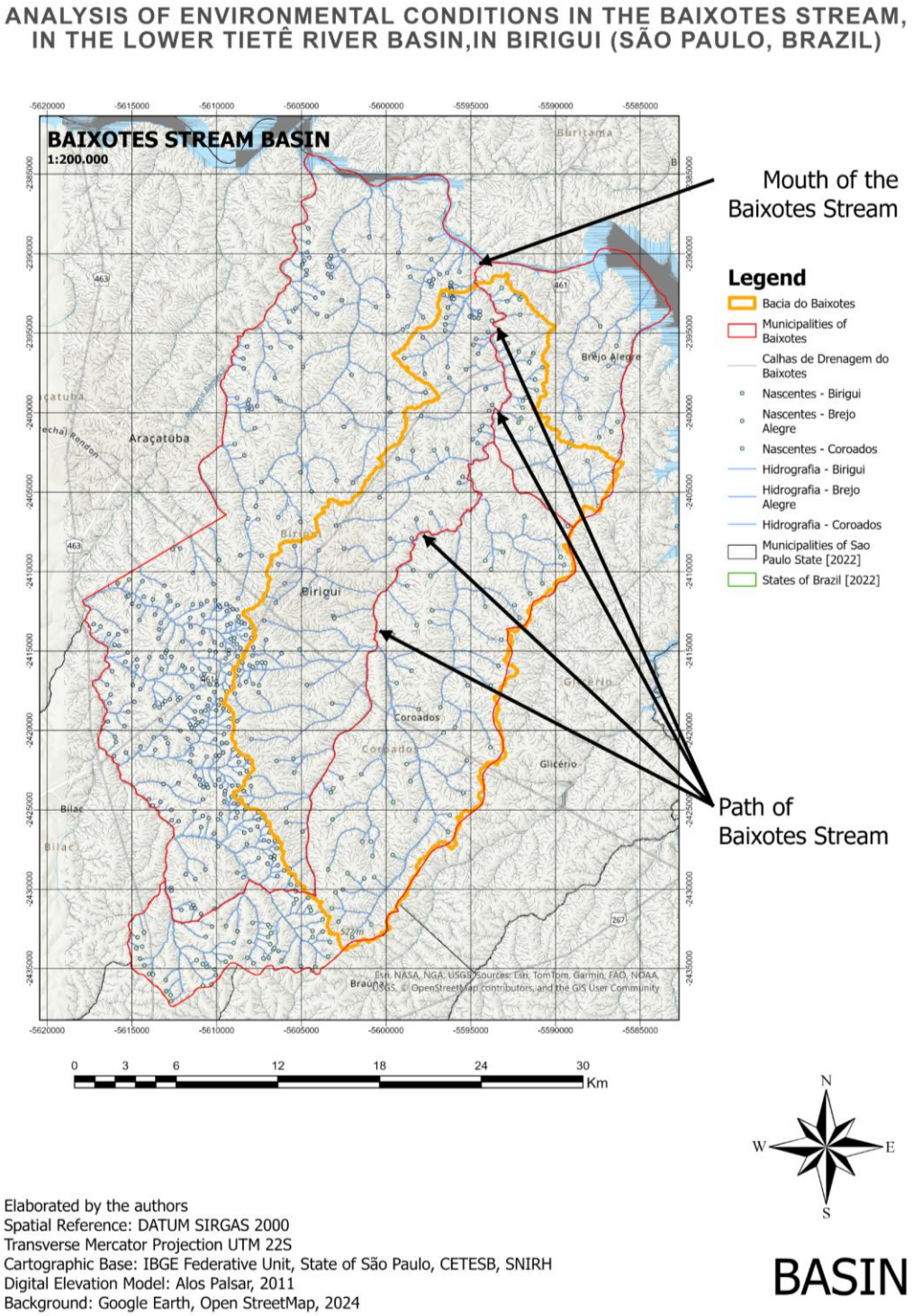
In the map shown in Image 3, it is possible to visualize the Baixotes Stream Basin and the course of the Baixotes from the city limits between Birigui and Coroados to its mouth in the Tietê River, following the limit between Birigui and Brejo Alegre.

The Baixotes Stream is the only surface spring in the city of Birigui, playing a crucial role in the water supply for its urban population. This watercourse represents approximately 60% of the water supplied to Birigui's homes, highlighting its importance for the region's water security. The municipality's dependence on this water source makes it clear that there is a need for effective management, restoration and conservation strategies. Given its status as the main source of water supply, conserving the quality and quantity of water in the Baixotes Stream is essential to meet the population's growing demand. Any change in the environmental conditions of this watercourse can directly impact public water supply, compromising not only the health of the population, but also the sustainability of the local water system. Therefore, it is imperative that actions aimed at the recovery, restoration and protection of this water source be prioritized, ensuring a safe and quality water supply for the entire population of Birigui.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

Image 3 – Baixotes Stream Hydrographic Basin



Source: Authors' own elaboration, 2024

Regarding sewage collection and treatment, data provided by the National Water Agency indicate that the municipality of Birigui collects 100% of the sewage generated in the urban area. However, the efficiency of the treatment system is alarmingly low, with rates below 70%. This situation raises concerns, since the treated sewage, which should be returned to the

ISSN 2318-8472, v. 13, n. 89, 2025

Baixotes Stream in a safe and environmentally appropriate manner, often does not meet the established quality standards. Inefficiency in sewage treatment poses significant risks to public health and to the quality of the water in the Baixotes Stream. The return of inadequately treated effluents to the water source can worsen the already fragile water quality, compromising the ecosystem and the multiple uses of water.

In September 2024, the municipal government had to draft an emergency decree in response to a worrying drop in the average water level of the Baixotes Stream. In this decree, the state of emergency is due to the dry season combined with recent fires in the state of São Paulo. The decree provides for actions that can range from the adoption of rotational water supply to the use of private wells. In addition, the decree informs that there are irregular dams that were inspected by the environmental police together with the Department of Water and Electric Energy of the state of São Paulo (Birigui, Decree No. 7,629, 2024). Cases like this make it clear to society in general the need for constant care and monitoring of water sources.

3 OBJECTIVES

The general objective of this study was to analyze the environmental conditions of the Baixotes Stream through the application and the analysis of a Rapid Assessment Protocol (RAP) in two different weather periods: one in the dry season and the other in the regular rainy season in the year 2023, in the area.

4 METHODOLOGY

To achieve this objective, bibliographic surveys and documentary research were carried out, in addition to fieldwork.

The first fieldwork was carried out on a day during the dry season and the second on a day during the rainy season. Four location points were selected for the application of the RAPs (Table 1).

Table 1 – Naming and georeferencing of the studied sections in the Baixotes Stream

Acronym	Meaning	Latitude and Longitude
BC	Before Catchment	-21.312893, -50.311596
AST	After Sewage Treatment	-21.255703, -50.265299
C	Catchment	-21.310034, -50.311647
UA	Urban Area	-21.290490, -50.304419

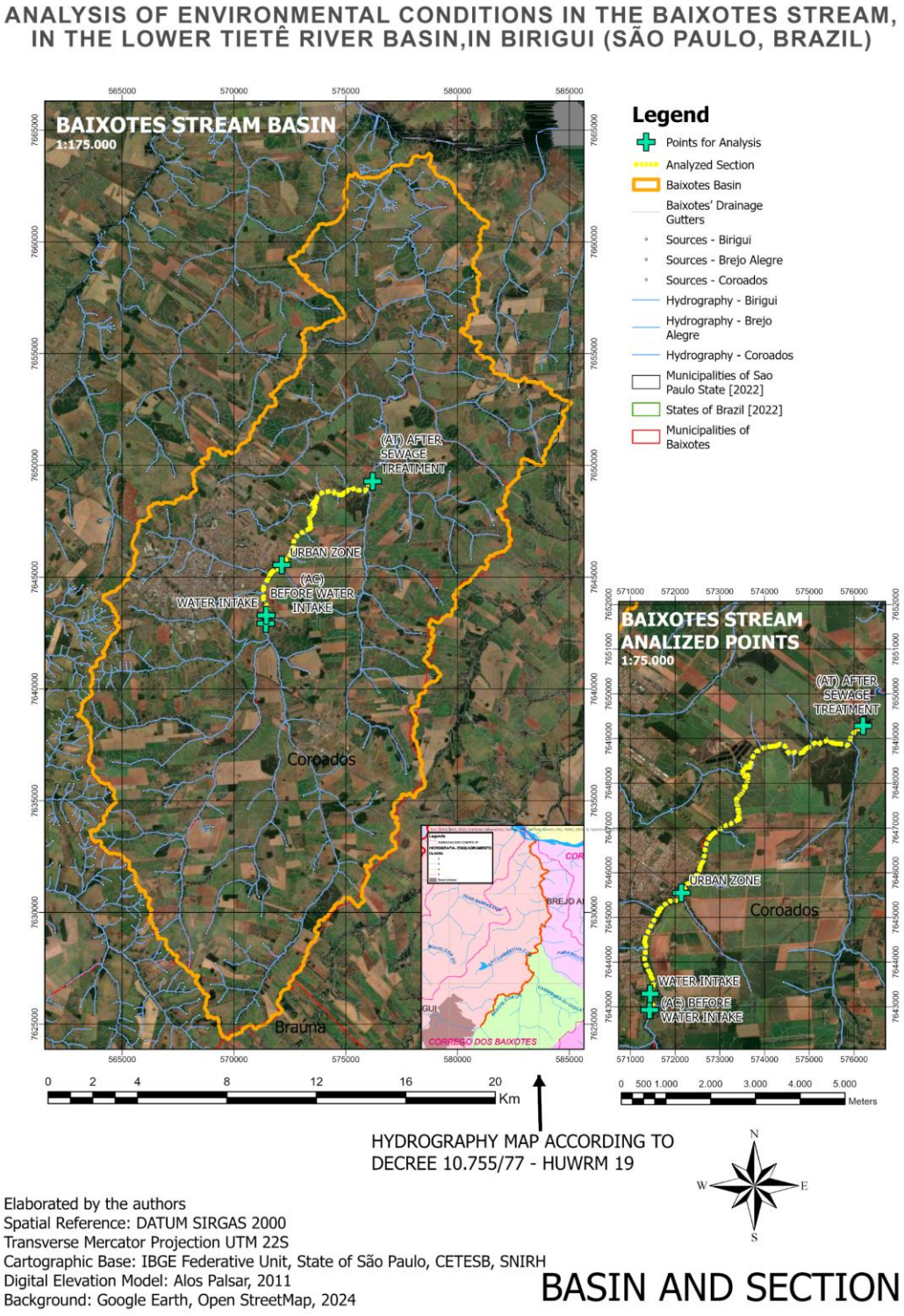
Source: Authors' own elaboration, 2024

To illustrate these points, the map in Image 4 was created, based on the georeferencing above and which can be analyzed below.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

Image 4 – Section studied in the Baixotes Stream in the city of Birigui.



Source: Image from Google obtained in cartographic base from the Brazilian Institute of Geography and Statistics with Google Earth background obtained from OpenStreetMap, 2024.

ISSN 2318-8472, v. 13, n. 89, 2025

The water body under study is adjacent to the urban area of Birigui. The acronyms represent the point before water catchment (BC) and after sewage treatment (AST). This section is considered to belong to class 3 (detail indicated in Image 4), as set out in State Decree No. 10.755, attached: "Baixotes Stream downstream from the water collection for Birigui to the confluence with the Tietê River, in the municipality of Birigui" (São Paulo, 1977).

The point analyzed before water catchment is seven hundred meters away from the catchment area. The objective was to analyze how the water comes to the city (BC) and how it is collected for treatment (Catchment). The point where the stream is closest to the urban area and has the greatest impact on the population (Urban Area) was used and, finally, it was analyzed how the municipality returns the water to its supplier (AST), which is closer to the mouth of the Tietê. The criterion for delimiting the points was based on locations with greater and lesser degrees of anthropic influence, where the point with the lowest was adopted as a reference point for comparison.

Regarding the research framework, this is fieldwork, which means that, when analyzing the data collection obtained from direct observation of the surroundings of the selected water body, "the object/source is approached in its own environment. Data collection is done in the natural conditions in which the phenomena occur, thus being directly observed, without any intervention or handling by the researcher" (Severino, 2017, p. 123).

As previously highlighted, we used the rapid assessment protocol adapted from Callisto et al. (2002) as a basis for data collection, through which we analyzed the physical characteristics of the site – type of substrate, changes in the river channel, erosion on the banks, extension of the permanent preservation area, presence of residues – and even sensory perspectives – such as color and smell of the water. The items are assessed with three different scores – zero, five and ten – in which zero represents the highest degree of impact, and ten a lower degree of interference.

When the scores are added together, we have a classification for each section of the stream, which follows the following order: from zero to sixty (0 - 60), it is an impacted section; from sixty-one to ninety (61 - 90), it represents an altered section; and greater than ninety-one (> 91) indicates a natural section.

5 RESULTS

The fieldwork took place on September 10, 2023, and December 10, 2023. Through the application of the rapid assessment protocol, it was possible to detect levels of anthropogenic interference in the four sections studied in the path of the Baixotes Stream for the fieldwork carried out in September and December 2023. The score indicated by the RAP and the respective classification for each section is presented in Table 2.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

Table 2 – Framing obtained for each point studied based on its score.

	BC	C	UA	AST
Score in September/2023	80	60	40	105
Classification	Altered	Impacted	Impacted	Natural
Score in December/2023	65	60	40	105
Classification	Altered	Impacted	Impacted	Natural

Source: Authors' own elaboration, 2024.

The section before the catchment (BC) was evaluated in both periods as "Altered Section". In the first sampling, the RAP score revealed a total of 80 points and in the second period, the total was 65 points. The parameters with the greatest change were the type of occupation of the banks (which was found to be irregular by Decree No. 7624) and the stability of the banks.

The section underwent a dredging process, a procedure published in the regional newspaper "*Hoje Mais"* and *Liberal Regional* (Hoje Mais; 2024, LR1, 2024). The procedure was part of the actions of Birigui City Hall in dealing with the water crisis experienced in the municipality, due to the drastic reduction in the volume of the water source, as a result of the drought and inadequate uses and occupations in the hydrographic basin. This situation resulted in the enactment of Municipal Decree No. 7629, of September 11, 2024 (Birigui, 2024). Image 5 shows the area of the analyzed section, during the application of the RAP in the first study period, that is, before the intervention.

Image 5 – Picture of the Baixotes Stream at the section under study in the area before catchment during the first application of the RAP

Source: authors' own photograph.

Image 6 shows the section in the second period. The increase in the watercourse channel due to the dredging carried out is evident. However, despite the intervention, therewas little change in relation to the previous protocol score, except for the significant increase in macrophytes, as shown in Image 6.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

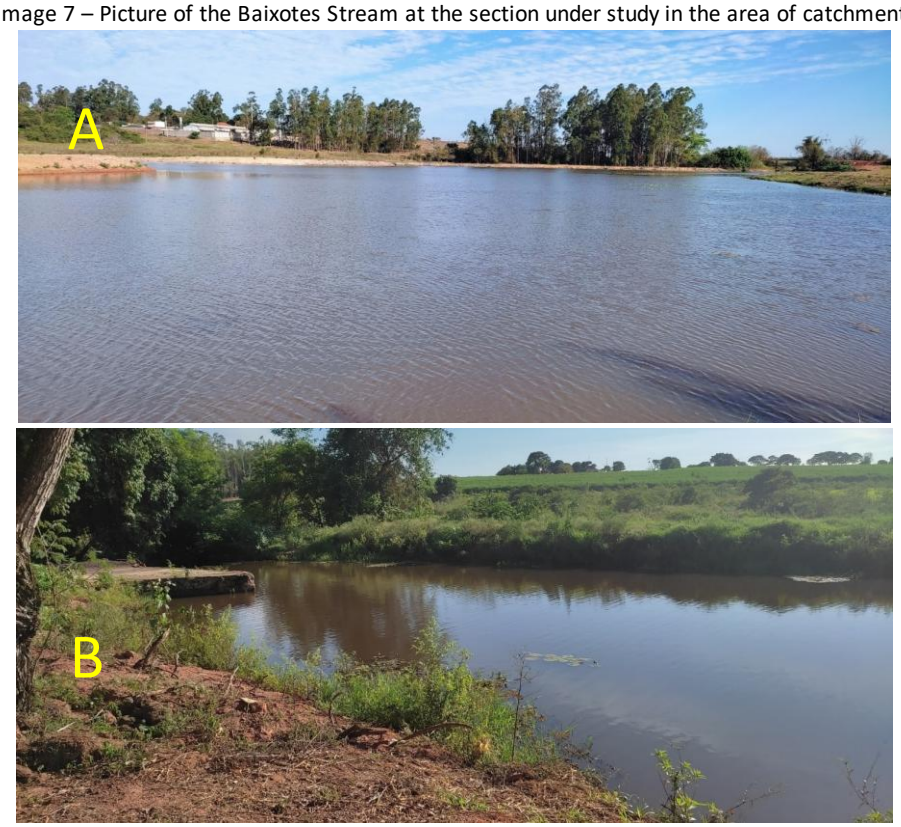
Image 6 – Picture of the Baixotes Stream at the section under study in the area before catchment during the second application of the RAP

Source: authors' own photograph.

Another condition highlighted in Image 6 that deserves to be highlighted is the absence of vegetation in the Permanent Preservation Area (PPA) and the presence of pastures and livestock, which reach the edge of the water source.

At the collection point for the municipality's supply (Catchment), a score of 60 points was obtained for the two periods analyzed, which resulted in the classification of the site as an "Impacted Section". This condition is mainly due to the lack of PPA, changes in the river course and the instability of the banks, as shown in Image 7, which presents the two sampling moments.

Image 7 – Picture of the Baixotes Stream at the section under study in the area of catchment.



Source: authors' own photographs (Caption: Photo A shows the stretch of the Baixotes Stream, where the catchment point for supplying the municipality is located, in the sampling carried out in September 2023. Photo B shows the same stretch, in December 2023.).

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

In the image, it is possible to identify some seedlings to recover the PPA. These actions have been carried out by the Birigui Department of the Environment and were publicized by the digital journalism page "*Hoje Mais"* (Hoje Mais, 2024).

The third section of the Baixotes Stream that was analyzed, called Urban Area (UA), is in the João Crevelaro neighborhood, near a state school. Its score was forty for both samples taken in 2023. This is an "Impacted Section," which is the lowest score observed by the RAP, indicating the most compromised area of the four. A lot of debris was found at the site, which reveals that this point is treated by the population as a solid waste dumping site. In addition, dead animals and a sewage odor were noticed in this area.

The most significant parameters for classifying this location were the bad smell, color of the water and debris, silting of the bed, the lack of diversity of bottom habitats, the extent of the permanent preservation area, the condition of the water depth and erosion of the banks showing a very critical situation as shown in Image 8.

Image 8 – Picture of the Baixotes Stream at the section under study in the Urban Area

Source: authors' own photographs, 2024 (Caption: Photo A and B were taken during the first sampling, while photo C was taken during the second sampling).

Photo A highlights the dark color of the water in the area, and a dead animal can be seen. Photo B shows the condition of the banks and the water depth. Photo C shows that the waste problem persisted during this period, in addition to indicating the lack of stability of the banks and the silting of this stretch of the stream.

The fourth section analyzed, called After Sewage Treatment (AST), also received a similar score for both periods. The score of 105 points resulted in the classification as a "Natural Section". The section is in a rural area. It is possible to notice some presence of vegetation in the permanent preservation area, in relation to the other sections analyzed. Improvements were also observed in the parameters related to habitat diversity, due to the presence of gravel and rocks, in addition to greater stability of the banks and less presence of solid waste in the

ISSN 2318-8472, v. 13, n. 89, 2025

environment, as shown in Image 9. However, there is the presence of an odor, which can be compared to the smell of sewage; this fact influenced the score, despite its classification as a natural section.

Image 9 – Picture of the Baixotes Stream at the section under study in an area after sewage treatment

Source: authors' own photographs, 2024 (Caption: photo A shows the section during the first analysis, and photo B shows the section during the second analysis).

The very similar conditions observed at this collection point in both periods of the year are evident - the first collection on the left and the second collection on the right. In addition, it is possible to observe only the positive aspects of the parameters, such as the condition of the water depth, the presence of riparian vegetation, the stability of the banks and the absence of residues.

The anthropogenic changes observed in the studied stretches of the Baixotes Stream, especially in the areas where the city's water catchment is located, the stretch approximately 700 meters upstream, and the region close to the urban area are worrying. And they would deserve the attention of the government and society if found in any body of water. But the situation becomes even more critical because the Baixotes is the main water source of the city of Birigui, responsible for supplying 60% of the population and the only surface water source (Birigui, 2024). Authorities tend to blame climate change for the decrease in the volume of regular rainfall and the severe droughts faced in several regions for the water crisis that has occurred. And in fact, the increasingly long periods of drought have altered the regime, metabolism and dynamics of aquatic ecosystems, which have triggered ecological damage and compromised fundamental ecosystem services.

However, global climate change is compounded by inadequate water resource management, which subjects aquatic systems to pressures from urbanization and crop monocultures that do not respect permanent preservation areas, increased demand, and inefficient basic sanitation services that generate waste and pollution, in addition to other

ISSN 2318-8472, v. 13, n. 89, 2025

sources of contamination from different sources. The effects of this combination of anthropogenic factors are reflected in the unprecedented water crisis that affects society, through the compromise of water uses, including human supply, considered the most noble of uses by Law No. 9433 of January 31, 1997, which establishes the National Environmental Policy (Brazil, 1997).

This situation of water scarcity is a reality seen in more and more municipalities in the country, in addition to those in the semiarid region of Brazil. In the state of São Paulo, the situation is critical in many cities, which have already been living with water supply rationing for several years. In Birigui, Municipal Decree No. 7629, of September 11, 2024, provides for the emergency due to water production and supply shortages for the population and provides other measures. This regulation was published after the observation of a drastic reduction, in relation to the historical average, in the level of the Baixotes Stream. And it provides for measures such as contingency, supply rationing, temporary suspension of water supply to non-essential and/or non-priority sectors, among other measures to alleviate the problem (Birigui, 2024).

5 CONCLUSIONS

The results showed anthropogenic changes of varying degrees of intensity in the four sections analyzed in the Baixotes Stream, in the two sampling periods. The sections where the water catchment for the city of Birigui are located and the one that is approximately 700 meters upstream, in addition to the location close to the urban area, were those that registered the greatest interference. In three sections, there was no difference in the score between the dry season and the beginning of the rainy season. The first two were classified as “Impacted”, and the most compromised environmental conditions were: the lack of a permanent preservation area, instability of the banks and silting. And in the Urban Area section, there was still a large amount of solid waste deposited. The only section that received a different score between the periods was the one called Before Catchment, but the difference did not alter its classification as an Altered Section.

The section entitled After Sewage Treatment, located downstream from the effluent inlet of the municipal station in the water body, was the only one classified by the applied instrument as “Natural”. This condition was attributed mainly to the presence of some vegetation in the permanent preservation area, improvements in the parameters related to habitat diversity, due to the presence of gravel and rocks at the bottom of the watercourse, which characterized greater habitat diversity for aquatic biota, in addition to greater stability of the banks and less presence of solid waste.

The results recorded are alarming, especially because the body of water in question is the main source of water in the city of Birigui, supplying 60% of the population. The decrease in the volume of regular rainfall and severe droughts triggered by increasingly longer dry periods, because of climate change, have significantly affected the level of the Baixotes Stream. Added to the aggravating factors of anthropogenic pressures are the rapid increase in water demand, the absence or incipience of permanent preservation areas, because of urbanization and monocultures, which invade the floodplain of the watercourse, as well as the intensive use and occupation of the entire river basin. These situations reflect the inadequate management of

ISSN 2318-8472, v. 13, n. 89, 2025

water resources and trigger the water crisis. It is urgent to develop and implement conservation and recovery actions and programs aimed at protecting the waters of the Baixotes Stream, in quantity and quality, to guarantee water security and thus, the well-being and quality of life of the population of Birigui.

6 REFERENCES

AGÊNCIA NACIONAL DE ÁGUA E SANEAMENTO. Ministério do Meio Ambiente. **Atlas esgotos: despoluição de bacias hidrográficas**. Brasília: ANA, 2017.

BAPTISTA, Maria Vitoria; SCARPINELLA, Gustavo D'Almeida; MENEZES, Denise Balestrero. **Idas e vindas do processo de degradação e recuperação de um córrego urbano**. In: III SIMPÓSIO NACIONAL DE GESTÃO E ENGENHARIA URBANA: SINGEURB, 2021, Maceió. ANTAC, 2021. p.87 - 95.

BIRIGUI. Decreto nº 7.629 de 11 de setembro de 2024. **Dispõe sobre a emergência por escassez de produção e abastecimento de água à população e dá outras providências**. Birigui: Prefeitura Municipal, [2024]. Disponível em: http://www.birigui.sp.gov.br/birigui/controle/arquivo/decreto_7.629.pdf. Acesso em: 23 out. 2024.

BIZZO, Myrella Rodrigues de Oliveira; MENEZES, Juliana; DE ANDRADE, Sandra Fernandes. PROTOCOLOS DE AVALIAÇÃO RÁPIDA DE RIOS (PAR). **Caderno de Estudos Geoambientais**-CADEGEO, 2014.

BRAGA, Roberto; CARVALHO, Pompeu F. C. **Recursos hídricos e planejamento urbano e regional**. Rio Claro: Laboratório de Planejamento Municipal-IGCE-UNESP. 2003. p. 113-127 - ISBN 85-89154-04-01.

CALLISTO, Marco et al. Aplicação de um protocolo de avaliação rápida da diversidade de habitats em atividade de ensino e pesquisa (MG-RJ). **Acta Limnologica Brasiliensia**, 2002.

HOJE MAIS. GRUPO AGITTA DE COMUNICAÇÃO. **Publicada lei que prevê a preservação do ribeirão Baixotes**. Disponível em: <https://www.hojemais.com.br/aracatuba/noticia/politica/publicada-lei-que-preve-a-preservacao-do-ribeirao-baixotes>. Acesso em: 9 set. 2024.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA - IBGE. **Censo Demográfico 2022: resultados**. Rio de Janeiro: IBGE, 2023. Disponível em: https://censo2022.ibge.gov.br/. Acesso em: 29 maio 2025.

LR1. JORNAL LIBERAL REGIONAL. Ribeirão Baixotes passa por desassoreamento com investimento de R$ 2 milhões do Estado. Disponível em: <https://lr1.com.br/cidades/ribeirao-baixotes-passa-por-desassoreamento-com-investimento-de-r-2-milhoes-do-estado/>. Acesso em: 9 set. 2024.

Relatório ECO. Relatório Técnico do **Contrato Nº 033/2012 - Fundo Estadual de Recursos Hídricos (FEHIDRO) e a Associação dos Engenheiros e Arquitetos de Penápolis (AEAP) através do Comitê da Bacia Hidrográfica do Baixo Tietê (CBH-BT).** 14PG. 2016.

ROSIN, Jeane Aparecida Rombi de Godoy. Áreas de mananciais: desafios dos programas de intervenções urbanas em áreas protegidas da sub-bacia da Billings, São Bernardo do Campo. **Revista Nacional de Gerenciamento de Cidades**, [S. l.], v. 7, n. 50, 2019. DOI: 10.17271/2318847275020192131.

SÃO PAULO (Estado). **Sistema Integrado de Gerenciamento dos Recursos Hídricos – SIGRH**. Comitê da Bacia Hidrográfica do Baixo-Tietê. São Paulo: Governo do Estado de São Paulo, [ano]. Disponível em: https://sigrh.sp.gov.br/cbhbt/apresentacao. Acesso em: 03 de abril de 2025

ISSN 2318-8472, v. 13, n. 89, 2025

SÃO PAULO. (Estado). Decreto nº 10.755, de 22 de novembro de 1977. **Dispõe sobre o enquadramento dos corpos de água receptores na classificação prevista no Decreto nº 8.468, de 8 de setembro de 1976 e dá providências correlatas**. São Paulo, 1977.

SCHUELER, Adriana; CARVALHO, Thereza. Emergências Climáticas x Saneamento. **Revista Nacional de Gerenciamento de Cidades**, [S. l.], v. 12, n. 86, 2024. DOI: 10.17271/23188472128620245305.

SEVERINO, Antônio Joaquim. **Metodologia do trabalho científico**. Cortez editora, 2017.

SILVA, Alessandra Fagundes da. **Expansão urbana e mudanças no uso e ocupação da terra: o caso da cidade de Birigui/SP**. 2020.

TUCCI, C.E.M. Águas urbanas. **Estudos avançados.** V. 22 (63), 2008.

TUNDISI, J.G. **Água no século XXI: enfrentando a escassez**. 3a. ed. São Carlos, SP: RIma, 2009.

TUNDISI, José Galizia. Recursos hídricos no futuro: problemas e soluções. **Estudos avançados**, v. 22, p. 7-16, 2008.

GC Revista Nacional de Gerenciamento de Cidades
National Journal of City Management

ISSN 2318-8472, v. 13, n. 89, 2025

STATEMENTS

CONTRIBUTION OF EACH AUTHOR

- **Concepção e Design do Estudo**: Danielli Cristina Granado Romero, Stephanie Campos Gonçalves e Clélia Rosilene Bergo Martins.
- **Curadoria de Dados**: Stephanie Campos Gonçalves, Clélia Rosilene Bergo Martins, Danielli Cristina Granado Romero e Fernando Sérgio Okimoto.
- **Análise Formal**: Danielli Cristina Granado Romero e Fernando Sérgio Okimoto,
- **Aquisição de Financiamento**: Não foram obtidos financiamento para este estudo.
- **Investigação**: Stephanie Campos Gonçalves e Clélia Rosilene Bergo Martins.
- **Metodologia**: Danielli Cristina Granado Romero e Fernando Sérgio Okimoto.
- **Redação - Rascunho Inicial**: Stephanie Campos Gonçalves e Clélia Rosilene Bergo Martins.
- **Redação - Revisão Crítica**: Danielli Cristina Granado Romero e Fernando Sérgio Okimoto.
- **Revisão e Edição Final**: Danielli Cristina Granado Romero e Fernando Sérgio Okimoto.
- **Supervisão**: Danielli Cristina Granado Romero e Fernando Sérgio Okimoto.

DECLARAÇÃO DE CONFLITOS DE INTERESSE

We, **Stephanie Campos Gonçalves, Clélia Rosilene Bergo Martins, Danielli Cristina Granado Romero e Fernando Sérgio Okimoto**, declare that the manuscript entitled " **ANALYSIS OF ENVIRONMENTAL CONDITIONS IN THE BAIXOTES STREAM, IN THE LOWER TIETÊ RIVER BASIN, IN BIRIGUI (SÃO PAULO, BRAZIL)**":

1. **Financial Ties: Has no financial ties that could influence the results or interpretation of the work.**
2. **Professional Relationships: Has no professional relationships that could impact the analysis, interpretation, or presentation of the results.**
3. **Personal Conflicts: Has no personal conflicts of interest related to the manuscript's content.**