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The Fate of the First Streams of Manaus: A Historical and Cartographic Analysis

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O destino dos primeiros igarapés de Manaus: análise histórica e cartográfica

RESUMO

Objetivo – Verificar o que aconteceu com os dez primeiros igarapés (cursos d'água) da cidade de Manaus.

Metodologia – Pesquisa qualitativa com base em levantamento histórico-documental, análise cartográfica comparada e observação da paisagem urbana.

Originalidade/relevância – O estudo preenche uma lacuna teórica ao relacionar os igarapés com os impactos da urbanização e das mudanças climáticas em cidades amazônicas.

Resultados – A maioria dos igarapés analisados foi aterrada e canalizada, e as áreas onde fluíam coincidem com locais inundáveis durante cheias extremas. Os igarapés maiores perdem a navegabilidade nas secas extremas.

Contribuições teóricas/metodológicas – A pesquisa evidencia a importância de incorporar a memória hidrológica ao planejamento urbano, propondo uma releitura das intervenções sobre os igarapés em Manaus.

Contribuições sociais e ambientais – Reforça a necessidade de políticas públicas que valorizem os igarapés como elementos ecológicos, culturais, paisagísticos e funcionais para uma cidade mais resiliente às mudanças climáticas.

PALAVRAS-CHAVE: Igarapé. Manaus. História.

The Fate of the First Streams of Manaus: A Historical and Cartographic Analysis

ABSTRACT

Objective – To investigate what occurred to the first ten streams in the city of Manaus.

Methodology – Qualitative research based on historical-documentary survey, comparative cartographic analysis, and observation of the urban landscape.

Originality/Relevance – The study fills a theoretical gap by relating the transformation of streams to the impacts of urbanization and climate change in Amazonian cities.

Results – Most of the streams analyzed were filled in and canalized, and the areas where they once flowed now coincide with flood-prone zones during extreme flood events. The larger streams lose navigability during extreme droughts.

Theoretical/Methodological Contributions – The research highlights the importance of incorporating hydrological memory into urban planning, proposing a reinterpretation of the interventions on streams in Manaus.

Social and Environmental Contributions – Reinforces the need for public policies that value streams as ecological, cultural, scenic, and functional elements for a city more resilient to climate change.

KEYWORDS: Streams. Manaus. History.

El destino de los primeros arroyos de Manaus: análisis histórico y cartográfico

RESUMEN

Objetivo – Verificar qué ocurrió con los diez primeros arroyos de la ciudad de Manaus.

Metodología – Investigación cualitativa basada en el levantamiento histórico-documental, análisis cartográfico comparado y observación del paisaje urbano.

Originalidad/Relevancia – El estudio llena una laguna teórica al relacionar los arroyos urbanos con los impactos de la urbanización y del cambio climático en ciudades amazónicas.

Resultados – La mayoría de los arroyos analizados fueron rellenados o canalizados, y las zonas por donde fluían coinciden con áreas susceptibles a inundaciones extremas. Los arroyos más grandes pierden su navegabilidad en épocas de sequía extrema.

Contribuciones Teóricas/Metodológicas – La investigación evidencia la importancia de incorporar la memoria hidrológica a la planificación urbana, proponiendo una relectura de las intervenciones sobre los arroyos en Manaus.

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

ISSN 2318-8472, v. 14, n. 91, 2026

Contribuciones Sociales y Ambientales – Reafirma la necesidad de políticas públicas que valoren los arroyos como elementos ecológicos, culturales, paisajísticos y funcionales para una ciudad más resiliente al cambio climático.

PALABRAS CLAVE: Arroyo. Manaus. Historia.

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GC Revista Nacional de Gerenciamento de Cidades
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1 INTRODUCTION

In the 19th century, in pursuit of modernization, numerous cities around the world underwent intensive urban redevelopment processes that significantly altered their natural systems, particularly watercourses (Winiwarter et al., 2016; Napieralski & Carvalhaes, 2016). In Manaus, this phenomenon accompanied the economic growth of the Rubber Cycle and manifested itself through the filling in and channeling of waterways to create roads and urban spaces (Grobe, 2014). These interventions followed the model of urban reforms in cities such as Paris, London, and New York, where rivers and streams were filled in to expand urban space and improve public health (Melosi, 2008). In Paris, under Haussmann's administration (1853–1870), secondary rivers were buried to make way for boulevards (Collins, 1971). In New York, waterways such as Minetta Brook and Collect Pond were concealed beneath the urban grid as the city grew (Spirn, 1984). Although these projects were associated with progress, they caused significant environmental damage. In the Amazon, where there are vast rivers such as the Rio Negro, smaller waterways are traditionally called igarapés (Matta, 1916). In Manaus, beginning in the 19th century, many igarapés were channeled and filled in, with the aim of bringing the city into line with European standards of modernity (Mesquita, 2019). Given this, this article aimed to investigate the fate of the first ten igarapés mapped in Manaus in 1852, using a historical and cartographic approach, placing the city within the debate on urbanization and its hydrological impacts in the context of climate change.

2 BACKGROUND

This study focuses on the period beginning in the mid-19th century, although the history of Manaus's origins dates back to the construction of the Fortaleza da Barra do Rio Negro, around 1669. In the mid-19th century, the city was still a small settlement, with most homes built from local materials such as wood and clay, and nature, with its streams and rugged terrain, shaped the urban landscape (Mesquita, 2019). The urban rivers played a significant role in the city's layout and the culture of its population (Souza, 2010; Lyra; Constantino; 2024). In 1857, the then-provincial governor, Ângelo Tomás do Amaral, built Brasileira street and Epaminondas avenue, initiating landfills and excavations to level the terrain and improve the roads (Grobe, 2014). The Igarapé da Ribeira was the first to be filled in, between 1868 and 1869, to make way for the pier and Praça da Imperatriz (Aranha, 1897). Due to the economic prosperity of the Rubber Boom, beginning in 1870, these interventions intensified. During the Republican period, then-Governor Eduardo Ribeiro, through Law No. 12 of October 1, 1892, authorized the filling of three central igarapés: São Vicente, Espírito Santo, and Aterro, allowing for the construction of roads and the restructuring of public spaces. Urban planning aligned with the European model, particularly the Parisian one. Governor Eduardo Ribeiro's plan (1892–1896) aimed to transform Manaus into a modern city, including: street grids, paving, sewer systems, lighting, water supply systems, tree planting, bridges, urban cleaning, and telephone services (Mesquita, 2019).

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

ISSN 2318-8472, v. 14, n. 91, 2026

It should be noted that, in 1897, journalist Bento Figueiredo Tenreiro Aranha sent a document to Governor Fileto Pires, with the aim of providing an overview of what the State of Amazonas—and, in particular, the city of Manaus—was like up until the day the province was established (Aranha, 1897). This document contains a description of the city area, as well as a sketch from the time when his father, João Baptista de Figueiredo Tenreiro Aranha, served as the province's first president. It is noteworthy that Bento Aranha structured his account to enable the listing and location of the igarapés of Manaus from 1852 to 1897, as shown in Table 1.

Table 1 – Igarapés (streams/creeks) mentioned by Bento Aranha and shown on the 1852 Map of Manaus.

Nº	IGARAPÉ (Stream name)	DESCIPTION
1	Ribeira (Seminário)	Downstream from the S. Vicente stream, another stream known as Seminário flowed into the Rio Negro; its source was on Brazileira Street, which was later renamed Praça da Imperatriz.
2	Espírito Santo	It also flows into the same river [Rio Negro], whose source was near the site where the Amazon theater now stands.
3	Remédios (Aterro)	The city of Barra, as I knew it in 1852, was bisected to the north [...] and by the Remédios Creek (Aterro), at a place called Mocó, whose waters flow into the Rio Negro. This last stream divided the neighborhoods of República and Remédios. [...] At the eastern end of Henrique Martins Street, it formed a basin in its bed, so full of water that even during the Amazon's worst droughts, it was always overflowing. This basin was called Pitiú, and at that time, the street did not extend beyond the Espírito Santo neighborhood.
4	Bica	[...] and that of the Bica, its tributary [a tributary of the S. Vicente stream], which originates on 10 de Julho Street—which did not yet exist at that time [1852]—and whose bed extends along Largo da Pólvora, forming, together with the Cachoeira Grande stream, the suburb known as Corneta and Sacco do Alferes.
5	São Vicente	It flows into the Rio Negro at two points and forms the island of São Vicente, where the military infirmary is located. [...] whose fountain was located at the western end of Palma Street, now called Saldanha Marinho.
6	Monte Cristo	Downstream from this stream [Remédios] lies Monte-Christo, which flows into the Cachoeirinha stream.
7	Manáos	Above it [Monte Cristo], the Manáos River flows into this other one [Cachoeirinha].
8	Cachoeirinha	The area of the capital of Amazonas was confined to a small area bounded on the east by the Cachoeirinha stream.
9	Castelhana	The town of Barra, as I knew it in 1852, was bordered to the north by the Castelhana stream, which flows into the Cachoeira Grande stream.
10	Cachoeira Grande	The area of the capital of Amazonas was confined to a small, limited area [...] and to the west by the Cachoeira Grande stream.

Source: Compiled by the author using information from Aranha, 1897, pp. 15–16.

Bento Aranha provided a historical overview of Manaus at the turn of the 19th to the 20th century, noting that the old fortress "stood where the new houses now face the tax office, and where the Conceição Church and cemetery are located, on the site of Tenreiro Aranha Square" (Aranha, 1897, p. 21). He also mentioned that the first normal school in Amazonas was founded by his father, with the seminarian Sanches Fialho as a teacher, in a house near the Seminary, next to the Igarapé do Seminário. The only igarapé from the 1852 Map that does not appear in his account is Ribeira, whose description matches that of Igarapé do Seminário, indicating that both are the same watercourse. This detailed description of the

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

ISSN 2318-8472, v. 14, n. 91, 2026

first igarapés of Manaus is the starting point of this research. Furthermore, the author's description of Manaus's boundaries is also notable:

> The area of the capital of Amazonas was confined to a small territory bounded to the east by the Cachoeirinha stream, to the west by the Cachoeira Grande stream, and to the north by the forests, which were then known as Campinas, extending in an east-west line from the headwaters of the S. Vicente stream until it met the Remedios (Aterro) stream, and to the south by the Rio Negro (Aranha, 1897, p. 15).

It should be noted that Matta's studies (1916) served as an important reference for this research, particularly with regard to watercourses and the maps used in this work. He described the boundaries of old Manaus as follows: "the old city of Manáos is almost an island bounded to the north by the Castelhana River, to the east by the Manáos and Cachoeirinha rivers, to the south by the Negro River, and to the west by the Manahú River" (Matta, 1916, p. 13). This description corroborates that made by Aranha (1897). Matta (1916) also reported that the Igarapé da Cachoeira Grande was called Manahú by the indigenous people and Teiú by the former residents. He identified the headwaters of almost all the streams mentioned by Aranha (1897) that appear on the 1852 Map of Manaus, with the exception of three: the Ribeira, which had already been filled in decades earlier; the Espírito Santo, occupied by Eduardo Ribeiro Avenue; and the Monte Cristo, which was not mentioned. Table 2 shows the headwaters described by Matta (1916).

Table 2 – The headwaters of the streams mentioned by Matta and shown on the 1852 Map of Manaus.

IGARAPÉ (Stream name)	DESCIPTION
Remédios	Its spring is located at the intersection of Tapajós and Leonardo Malcher streets, behind the Benjamin Constant Institute.
Bica	Behind the houses on General Ozorio Square and the surrounding area, there is a spring—the Bica Spring.
São Vicente	Another, called S. Vicente, originates from filled-in areas where Governador Victorio Street meets Dr. João Antony's land; it flows through all the courtyards of the houses on Independência Street, joins its waters with those of the former, and flows directly into the Rio Negro, above the now-extinct island of S. Vicente, where the Military Hospital is located.
Manáos	The Manáos stream originates in a low-lying area with some buriti palms between Barcellos Avenue and the extension of part of 13 de Maio Avenue; it winds around a section of Nhamundá and Japurá Avenues and flows down a valley.
Cachoeirinha	It originates from various springs along the Telegraph Road to the east and from the forest to the north and northeast, which converge and, tracing a large winding course, receive the waters of the Ponte de Ferro from the northwest. All the east-west cross streets end at this Cachoeirinha River, according to the property numbering system established by the municipality.
Castelhana	One of its springs is located on the slope of Barcellos Avenue, directly opposite the source of the Manáos [stream].
Cachoeira Grande (Teiú e Manahú)	The Manahú River completes the series: it has the greatest water volume and originates from distant springs, the Flores neighborhood, the former Colônia Maracajú, and other more remote locations.

Source: Prepared by the author using information from Matta (1916, pp. 11–14).
Note: Matta (1916) suspected that a single spring—located along the extension of 13 de Maio and Barcelos avenues—fed the Manaus and Castelhana streams.

ISSN 2318-8472, v. 14, n. 91, 2026

As such, the reports by Bento Aranha (1897) and Alfredo da Matta (1916) were fundamental to the historical and environmental understanding of the igarapés of Manaus, as they revealed connections between water resources and the urbanization process.

2.1 The Importance of Economic Cycles for Urban Expansion in Manaus city

The first Rubber Boom transformed Manaus, driving infrastructure projects such as the city's port. Due to competition from Asia, the cycle began to decline around 1915, reducing public revenues and investments in the capital (Mesquita, 2019). In this context, the Floating City emerged in the 1920s—a settlement of low-income wooden homes built on buoys (tree trunks), located on the Rio Negro and its tributaries. This settlement housed low-income populations until it was dismantled by the military government in 1967, forcing migration to outlying areas (Souza, 2010). During World War II, the Second Rubber Cycle revived the Amazonian economy through the "Washington Agreement," which guaranteed rubber supplies to the Allies. Thousands of people from the Northeast were recruited as "rubber soldiers" and sent to the region, but the cycle was brief and ended with the abandonment of the workers (Benchimol, 2010). Another significant cycle was that of jute, which began in the 1930s. Well-suited to the floodplains, it flourished in municipalities such as Manacapuru, Itacoatiara, and Parintins, reaching its peak between 1950 and 1970. With the rise of synthetic fibers, it began to decline in the 1980s (Homma, 1995). Established by Decree-Law No. 288/1967, the Manaus Free Trade Zone (ZFM) drove strong population growth in the 1970s and 1980s, when the population rose from 600,000 to over 1 million inhabitants (IBGE, 2024). In contrast to the Rubber and Jute cycles, which kept the population in the interior, the ZFM attracted people from the interior, stimulating rural exodus. Without adequate infrastructure, Manaus faced irregular occupations (squatting) and the expansion of substandard housing, especially along the banks of the igarapés (Heimbecker, 2014). The occupation of urban riverbanks was a phenomenon experienced by several Brazilian cities in the 20th century (Santos; Souza; Silva, 2022).

Economic cycles have shaped the urban fabric of Manaus, as in the case of Monte Cristo Island, which survived until the mid-20th century. In 1953, during the worst flood of the 20th century, the island was submerged by the waters of the Rio Negro, flooding the Estrela rubber processing plant that operated there (IBGE, 1953). By the 1970s, the island was home to a large import store (Rocha, 2012). In 1983, Gilberto Mestrinho took office as governor-elect and appointed Amazonino Mendes as mayor of Manaus. This partnership resulted in the Manaus Moderna Project, launched in 1986 and financed by the World Bank. The project included the construction of Beira Rio Avenue (now Lourenço da Silva Braga), connecting the Port to the Industrial District, as well as an extensive retaining wall bordering the Rio Negro and the Igarapé do Educandos. To make the project feasible, Monte Cristo Island was completely filled in (Jornal do Commercio, 1986).

The Manaus Moderna Project called for improvements to the city's waterfront and was carried out in several phases by different administrations. In 1994, during his second term as mayor, Amazonino Mendes inaugurated the Manaus Moderna Market, considered at the time to be the largest in Latin America. The market benefited vendors who had been forcibly

ISSN 2318-8472, v. 14, n. 91, 2026

removed from the old Banana Market (Jornal do Commercio, 1994). The old market was dismantled in 1991 by order of the previous mayor, Arthur Neto, on the grounds of poor hygiene during a cholera epidemic (Silva, 2011), and was soon after destroyed by a fire (Jornal do Commercio, 1991). Also in 1994, Amazonino resigned from the mayor's office to run for state governor, being replaced by his deputy, Eduardo Braga, who served as mayor from 1995 to 1999. In partnership with the state government, Braga inaugurated the new covered Banana Market in 1995 (Jornal do Commercio, 1995). Thus, on the site of the former Monte Cristo Island stands the Manaus Moderna complex, including Lourenço da Silva Braga Avenue, part of the markets, and sections of Barão de São Domingos, dos Barés, Miranda Leão, and dos Andradas streets.

The state government launched the Manaus Waterways Social and Environmental Program (PROSAMIM) in 2003, during the administration of Eduardo Braga (2003–2010), with funding from the Inter-American Development Bank (IDB) and coordination by the Special Projects Management Unit (UGPE, 2025). The program aimed to rehabilitate areas degraded by informal settlements along the banks of urban igarapés, prioritizing housing, sanitation infrastructure, mobility, and urban planning. The first actions began in 2006 in Igarapé do Educandos, expanding to Mestre Chico, São Raimundo, and Cajual, across various neighborhoods. In three phases, it resettled approximately 29,000 people, benefited more than 600,000 residents, and delivered thousands of housing units, parks, sewage systems, drainage systems, roads, and recreational areas. PROSAMIM was concluded in 2021, giving way to PROSAMIN+ (Social and Environmental Program for Manaus and the Interior), currently underway (UGPE, 2025). Despite the social and health advances of Manaus Moderna and PROSAMIM, both treated the igarapés merely as drainage channels, following the traditional paradigm of canalization and containment, without fully integrating them into urban life and the city's mobility.

3 MATERIALS AND METHODS

This study focused on the urban center of Manaus, the capital of Amazonas, covering the period from 1852 to 2025. The starting point was the following question: what happened to the city's first ten igarapés? The objective was to verify the current status of these igarapés, identified on the 1852 Map of Manaus and described by Aranha (1897). This is a qualitative study based on historical and documentary research. Documentary and cartographic sources were analyzed, particularly the records of Aranha (1897) and Matta (1916), comparing plans and maps from 1852, 1915, and 2025. Digital maps from OpenStreetMap contributors, Google Maps, and Street View were also consulted, in addition to field photographs. The approach considered the historical dynamics of the processes of channeling, filling, and containing these streams, as well as the environmental impacts of urban expansion on these water bodies in the context of climate change. Figure 1 shows the 1852 Map of the City of Manaus.

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

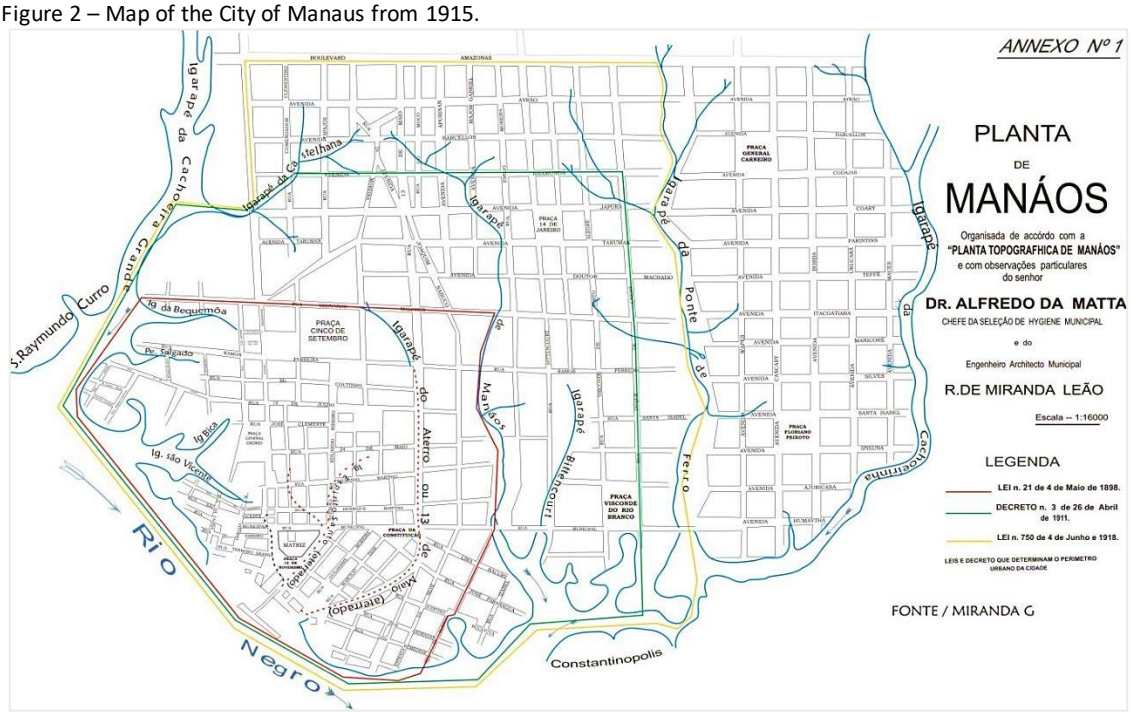
ISSN 2318-8472, v. 14, n. 91, 2026

Figure 1 – Map of the City of Manaus from 1852.

Source: Aranha (1897), reprinted in 1990. The original scale is 1:10.000.

Figure 2 shows a map of Manaus, based on the "Topographic Map of Manaus" from 1915 (Matta, 1916). Since this is an old image, we chose to reproduce it faithfully, as it offers better resolution (Bentes, 2008).

Figure 2 – Map of the City of Manaus from 1915.



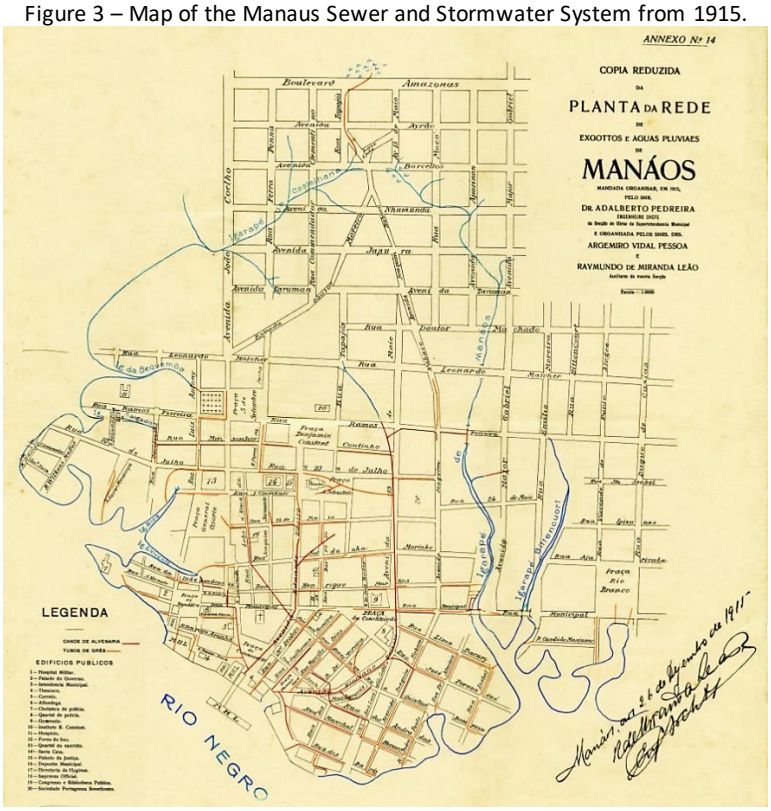
Source: BENTES (2008, p. 166), a faithful reproduction of MATTA (1916, p. 95). The original scale is 1:16.000.

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

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 3 shows the 1915 Map of the Manaus Sewer and Stormwater Network.

Figure 3 – Map of the Manaus Sewer and Stormwater System from 1915.



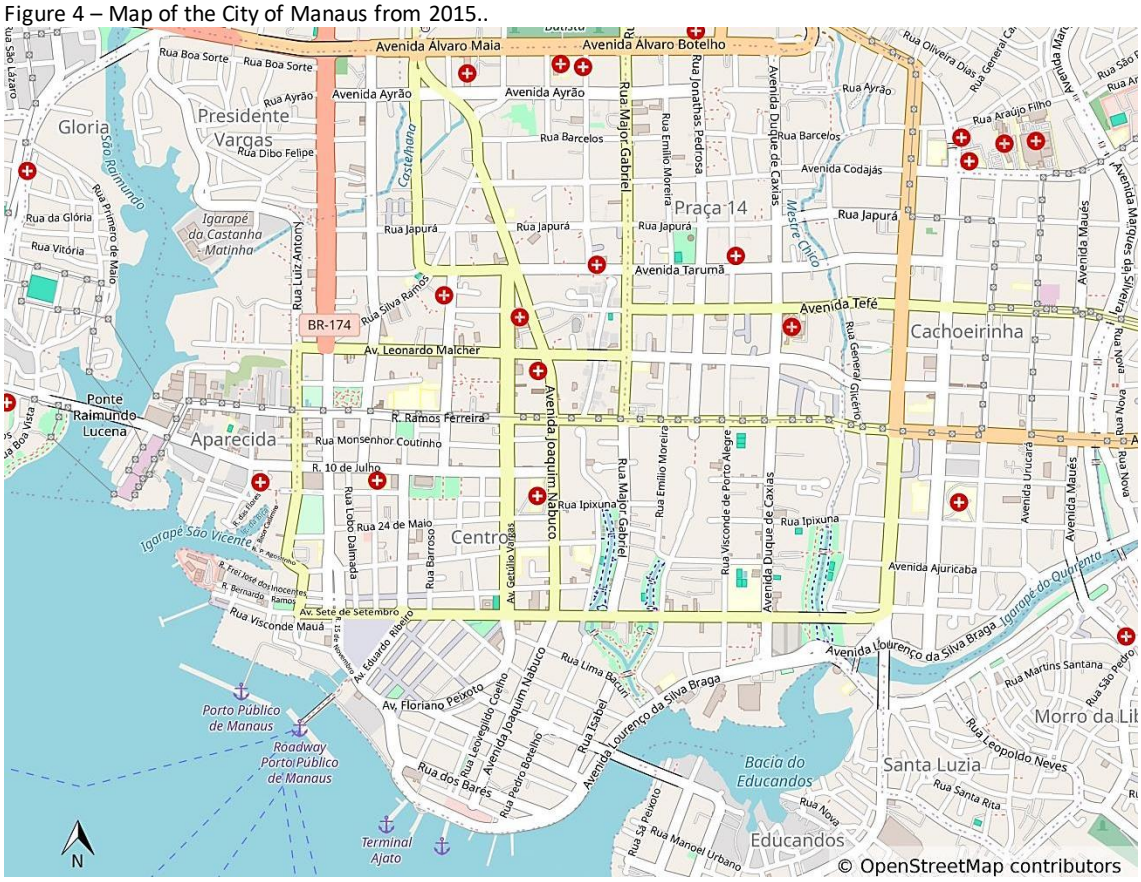
Source: Durango Duarte Institute/Samuel Benchimol Library Collection, 2025. The original scale is 1:8.000.

Figure 4 shows a current map of Manaus (2025), obtained from the OpenStreetMap contributors website. The area covered by the 1915 city plan now encompasses only three neighborhoods: Centro, Nossa Senhora Aparecida, and Praça 14 de Janeiro, all located in the South Zone. In total, Manaus has 63 neighborhoods, according to Law No. 1.401/2010.

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

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 4 – Map of the City of Manaus from 2015..



Source: OpenStreetMap contributors, Manaus, 2025. Original scale 1:17.000.

Thus, an analysis of Figures 1 through 4, combined with a comparison of documents and field images, allowed for a more in-depth study of the urban fabric and the igarapés of Manaus.

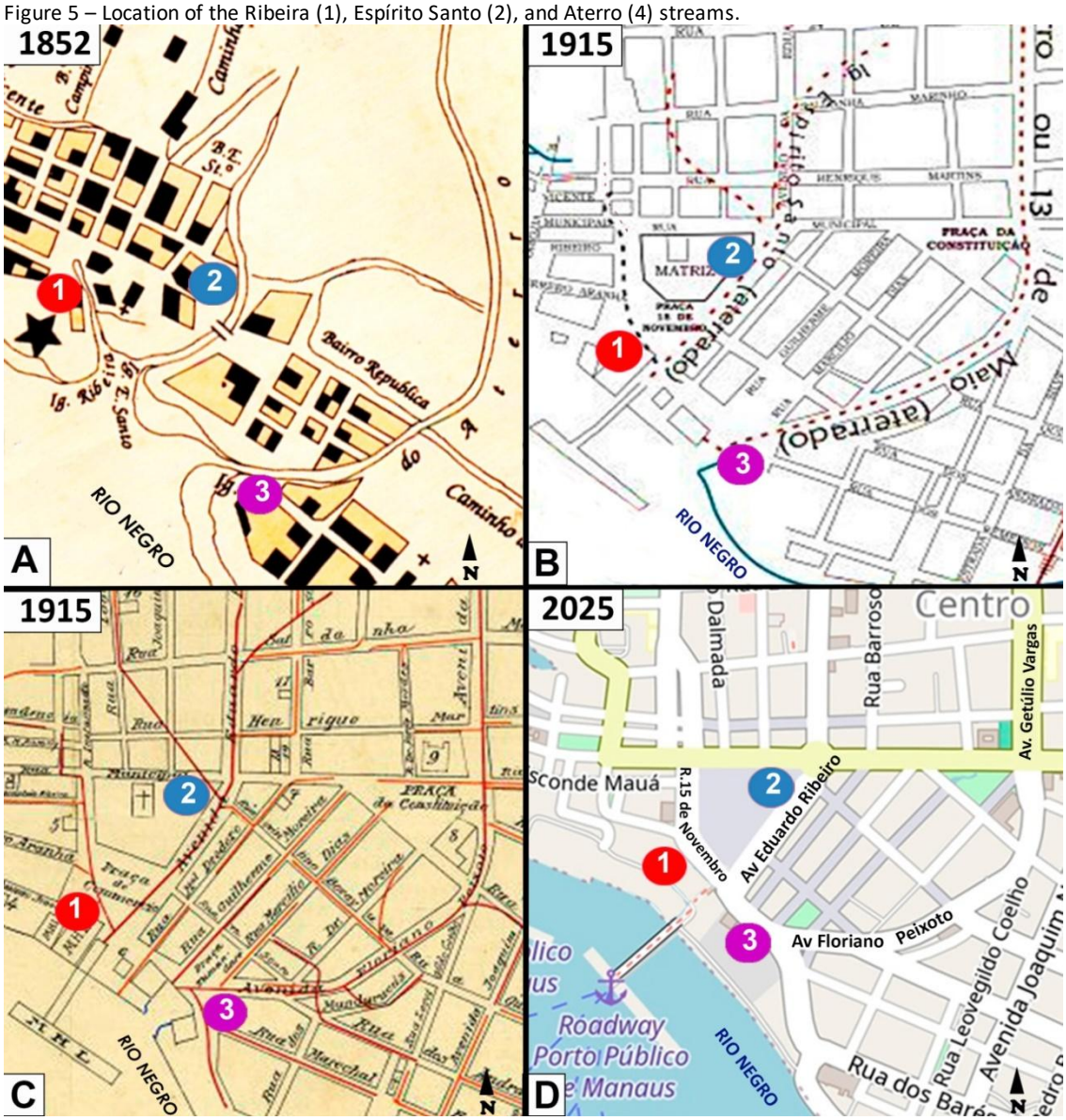
4 RESULTS AND DISCUSSION

The first stream to be filled in was the Ribeira, between 1868 and 1869 (Aranha, 1897). In 1873, it appears filled in a drawing of the Manaus waterfront made during naturalist James Orton's second expedition to the region (Orton, 1875) and no longer appears on maps after the 1874 map (Paião, 2012). It is worth noting that, with the first Rubber Boom, there was an increase in the flow of vessels in Manaus, which required improvements to the wharf, and this likely led to the silting up of this stream. In Figure 5, it can be seen that its mouth was located near the old fortress (marked with a star), in the detail of the 1852 Map of Manaus (A). Its course (1) appears dotted on the 1915 Map of Manaus (B) and channeled on the 1915 Sewer and Stormwater Network Map (C). Based on these representations and the 2025 Map (D), it is evident that this stream was channeled and filled in. Furthermore, it is noted that the route of Rua 15 de Novembro resembles that of the Igarapé da Ribeira, with this road having been builtover its former bed. Figure 5 shows details of the 1852, 1915, and 2025 Maps of Manaus.

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

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 5 – Location of the Ribeira (1), Espírito Santo (2), and Aterro (4) streams.



Source: Prepared by the author based on maps of Manaus from 1852 (A), 1915 (B and C), and 2025 (D).
Note: Former channels of the Ribeira (1); Espírito Santo (2); and Igarapé dos Remédios/Aterro (3) streams.

It is worth noting that when the Rio Negro experiences extreme flooding, sections of Rua 15 de Novembro near the Port of Manaus become flooded. This occurs because, in addition to the flood causing increased water volume in the tributaries, there is also a higher incidence of rainfall during this period (SGB, 2021). Furthermore, there is also the phenomenon of hydraulic blocking, that is, when a larger watercourse, such as the Rio Negro, ends up damming up and hindering the flow of a smaller tributary, such as a stream (Yan et al., 2024). Thus, during extreme flooding, overflow occurs due to the large volume of water and inefficient drainage. Rua 15 de Novembro has heavy traffic and is home to the main bus stop in the city center. However, when flooded, traffic on the street is temporarily interrupted, disrupting logistics in the Amazonian capital. Figure 6 shows Rua 15 de Novembro built over

ISSN 2318-8472, v. 14, n. 91, 2026

the former, filled-in, and channeled bed of the Igarapé da Ribeira. The photographs show the same section of the road, both under normal conditions in 2024 and during the extreme flooding of 2021.

Figure 6 – 15 de Novembro Street, built over the bed of the Igarapé da Ribeira.

Source: Hebe Sol. A) View of 15 de Novembro Street in 2024; and B) The same location during the 2021 flood.

The second stream analyzed was the Espírito Santo, also known as the Correio Stream (Frisch, 1865). An initial section of this stream was filled in between 1880 and 1881 (Aranha, 1897). The remainder of the filling was authorized during the administration of Eduardo Ribeiro, through Law No. 12, dated October 1, 1892. In 1893, the Cadastral Map of the City and Suburbs of Manaus was drawn up, in which the Espírito Santo Creek does not appear, having been replaced by an avenue. However, it is important to note that this map not only depicted what existed at that time but also included what was planned for the city. It should be noted that the Espírito Santo stream still flowed in open sections until the end of the 19th century, so much so that Aranha (1897) reported in his document that the stream was still being filled in.

In 1900, the Espírito Santo stream was being channeled, as shown in an image captured by the German photographer Huebner (1900). Between 1901 and 1902, Eduardo Ribeiro Avenue appears to have been completed, as seen in photographs included in the "Álbum do Amazonas de 1901-1902," by Portuguese photographer Fidanza (1902). Furthermore, refer to Figure 5, which shows that the Espírito Santo stream had a slight curve, as can be seen in the 1852 Map of Manaus (A). The 1915 Maps of Manaus (B and C) demonstrate that the channelization of the stream has a more pronounced curve. By comparing the earlier city maps with the 2025 Map (D), it is evident that Eduardo Ribeiro Avenue was built on the Espírito Santo Creek embankment. It is worth noting that a section of this avenue floods during extreme high water. Figure 7 shows Eduardo Ribeiro Avenue under normal conditions in 2024 and during the extreme flood of 2021.

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

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 7 – Eduardo Ribeiro Avenue, built over the bed of the Igarapé do Espírito Santo.

Source: Hebe Sol. A) View of Eduardo Ribeiro Avenue in 2024; and B) The same location during the 2021 flood.

The third stream analyzed was the Remédios Stream, also known as Aterro (Aranha, 1897), whose filling was authorized by Governor Eduardo Ribeiro through Law No. 12, dated October 1, 1892. This igarapé had navigable stretches, as shown in a photograph by Huebner (1890). According to Aranha (1897), this igarapé had abundant water, to the point that it did not dry up even during the most severe droughts. It was also larger, both in length and volume, than the Ribeira and Espírito Santo igarapés. The Igarapé dos Remédios underwent a long process of filling and channeling, carried out in several stages and by various administrators, from the late 19th century through the 1930s (Manaus de Antigamente, 2020). The delay in intervening on this stream drew criticism, including from public health physician Alfredo da Matta (1916). According to Rocha (2025), the company Manáos Harbour Limited provided railcars capable of transporting large quantities of fill material, enabling the project to be fully completed in the early 1930s.

Based on Figure 3, the 1915 Plan of the Manaus Sewer and Stormwater Network, it can be seen that the headwaters of the Igarapé dos Remédios were located at the corner of Leonardo Malcher and Tapajós streets. According to the 2025 Map (Figure 4), the current location of the headwaters encompasses the stretch between the traffic light and the Anaíra Building. According to Rocha (2025), the Igarapé dos Remédios still flows in the open in some sections, such as behind the Anaíra Building, between Tapajós Street and Ramos Ferreira Avenue. The stream then passes through Vila Paraíso, where it is contained by gabion walls, until it reaches Ramos Ferreira Avenue, where it continues through a culvert. Referring to Figure 5 and comparing the 1852 and 1915 Maps of Manaus with the 2025 Map, it can be seen that the roads built over the bed of the Igarapé dos Remédios were Avenida 13 de Maio (now Getúlio Vargas) and Avenida Floriano Peixoto. Furthermore, it should be noted that a section of Floriano Peixoto, near the Customs building (Figure 8), is subject to flooding during extreme high water.

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

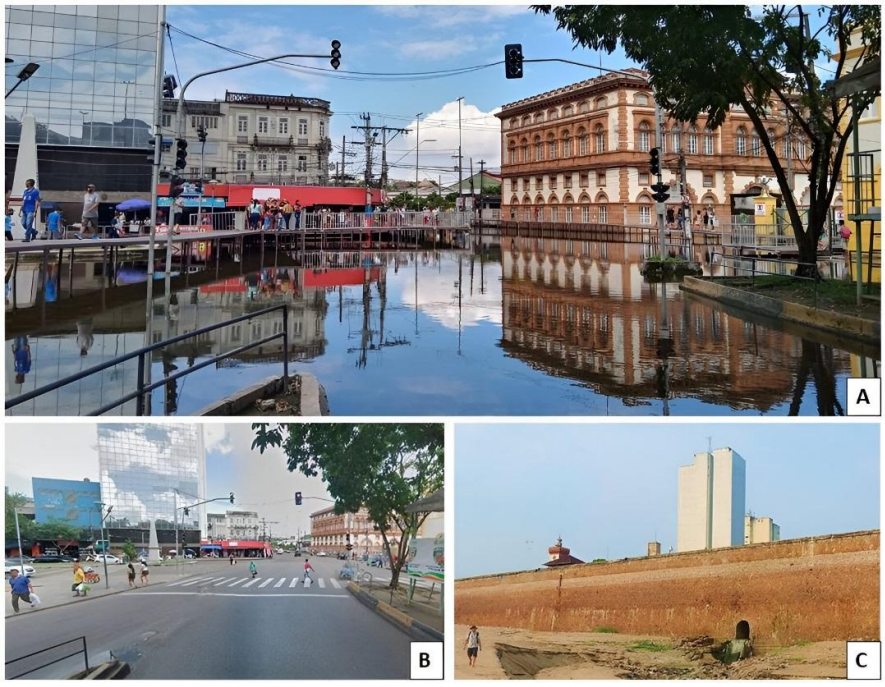
ISSN 2318-8472, v. 14, n. 91, 2026

Figure 8 – Floriano Peixoto Avenue, built over the bed of the Igarapé dos Remédios.

Source: Hebe Sol. A) Floriano Avenue in 2024; B) The same location during the 2021 flood.

Examining Figure 5, which shows a detail of the 1852 Map of Manaus, one can see that the Ribeira, Espírito Santo, and Aterro streams converged at the point where they flowed into the Rio Negro, forming a small bay. It should be noted that this area was filled in, in stages, between the 19th and 20th centuries (Grobe, 2014). However, during extreme floods, this area is inundated by the waters from the three streams, which, by covering the asphalt, cause the once-filled-in bay to resurface, as shown in Figure 9. Also noteworthy is the existence of underground galleries in the historic center of Manaus, whose exits become visible only during extreme droughts. Rainwater and streams, such as those of Espírito Santo and Remédios, flow through these galleries, which drain into the Rio Negro, as can be seen in Figure 9.

Figure 9 – Site of the former bay formed where the Ribeira, Espírito Santo, and Remédios rivers meet.



Source: Hebe Sol. A) Intersection of 15 de Novembro Street with Eduardo Ribeiro and Floriano Peixoto Avenues during the 2021 flood; B) Same location in 2024; C) View of the outlet of a storm drain during the 2023 drought.

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

ISSN 2318-8472, v. 14, n. 91, 2026

The fourth stream analyzed was the Bica Stream. On the 1852 Map of Manaus (Figure 1), it is evident that the area near this stream was virtually undeveloped. However, examining the 2025 Map of Manaus reveals that the area is now inhabited, despite being a flood-prone zone (SGB, 2021). Surrounding the Bica Creek are Rua das Flores, a short stretch of Rua José Clemente, and Beco Casimiro, the latter located behind Rua Luiz Antony. It should be noted that access to the stream is difficult because it is not open, as it lies behind the houses on the aforementioned streets. Igarapé da Bica flows into the São Vicente, which, in turn, empties into the Rio Negro.

The fifth stream analyzed was the São Vicente. According to Aranha (1897), this stream flowed into the Rio Negro through two mouths and formed the Island of São Vicente, as shown in the 1852 Map of Manaus, Figure 1. The landfilling was authorized by Governor Eduardo Ribeiro through Law No. 12, dated October 1, 1892. The island already appears integrated into the city in the 1893 Cadastral Map (Grobe, 2014), indicating that the landfilling and channeling likely occurred in the 1890s. In the 1915 Map of Manaus, Figure 2, the island is already incorporated into the urban grid. The 1915 Sewer and Stormwater Network Map, Figure 3, confirms that the filled-in mouth of the stream was also channeled. The former island is now a Brazilian Navy military area. In Figure 4, it can be seen that the São Vicente Creek lies behind Frei José dos Inocentes, Padre Agostinho, and Gabriel Salgado Streets, as well as part of Beco Casimiro. During extreme floods, these areas become inundated. Figure 10 shows the location of the Bica and São Vicente creeks and the former São Vicente Island, highlighted in pink.

Figure 10 – Igarapé da Bica and São Vicente.

Source: A) OpenStreetMap contributors, São Vicente and da Bica streams, 2025; B) Hebe Sol. Navy Military Area, Frei José dos Inocentes Street during the 2019 flood.

The sixth stream analyzed was the Monte Cristo Stream, which separated the city of Manaus from the island of the same name. The stream began to be filled in, and the island was connected to the city via an isthmus that was gradually constructed between the 1960s and 1970s. However, this island was completely filled in during the implementation of the Manaus Moderna Project, which began in 1986, pursuant to Decree-Law No. 9,688 of August 21, 1986. It is worth noting that, even with a large retaining wall, during severe floods some sections are inundated, particularly in areas where more landfilling occurred, as water seeps beneath the

ISSN 2318-8472, v. 14, n. 91, 2026

ground. Notably, Rua dos Barés is the first street in the Historic Center to flood when the Rio Negro reaches a level of 29 meters (SGB, 2021). Figure 11 shows a detail of the project plan published in the Jornal do Commercio on September 14, 1986, but with additions by the author in blue to indicate the layout prior to the construction of Avenida Beira Rio (now Lourenço da Silva Braga), and the red markings of the former island (1) and the Igarapé de Manaus (2). Furthermore, highlighted in black is Beira Rio Avenue, which was built as part of this project. It can be observed that Miranda Leão Street already extended onto the island, while Barão de São Domingos, dos Barés, and dos Andradas streets required a large volume of fill to integrate the area into the new urban complex. Parts of the Manaus Moderna Market and the Banana Market were built in this area.

Figure 11 – The Igarapé of Monte Cristo Island and Modern Manaus.

Source: A) Jornal do Comércio. Detailed map of Manaus Moderna, 1986, with annotations by the author; B) Hebe Sol. Manaus Moderna Market during the extreme flooding of 2021.

The seventh igarapé analyzed was the Manaus Igarapé, the first branch of the northeast-bound fork shown on the 1852 Map of Manaus, as depicted in Figure 1. The second branch is the Bittencourt Igarapé, as shown on the 1915 maps, Figures 2 and 3. It should be noted that this study focuses on the Manaus Creek, mentioned by Aranha in 1897. The Manaus Creek underwent several significant interventions beginning in 1986, with the construction of Beira Rio Avenue (now Lourenço da Silva Braga Avenue), as part of the Manaus Moderna Project. The mouth of the Igarapé de Manaus was closed off through canalization, backfilling, and also containment by a large retaining wall. It is noteworthy that residents of the area were removed by the state government and relocated to other parts of the city (Jornal do Commercio, 1986). Further significant changes took place under PROSAMIM between 2006 and 2009, including the construction of Jefferson Péres and Desembargador Paulo Jacob parks, Igarapé de Manaus Avenue, as well as channeling, drainage, and bank reinforcement. Sports courts, boardwalks, a bike path, gardens, and a plaza were also built. The stream was lined with stilt houses in poor condition. However, to resettle these residents, one of PROSAMIM's controversial solutions was the construction of housing complexes over channelized riverbeds, as occurred along a stretch of the Igarapé de Manaus, over which the Manaus Residential Park was built on Ipixuna Street (UGPE, 2025). Figure 12 shows the Manaus Creek.

Figura 12 – Manaus Igarapé.

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

ISSN 2318-8472, v. 14, n. 91, 2026

Source: A) Manaus of Yesteryear. Igarapé de Manaus in 1962; B) Hebe Sol. Igarapé de Manaus and Desembargador Paulo Jacob Park in 2021.

The eighth stream analyzed was the Cachoeirinha, which, on the 1852 Map of Manaus, marked the eastern boundary of the city (Aranha, 1897). Today, it is known as Igarapé do Educandos, although it is called Igarapé do Quarenta in the section upstream of the Governador Ephigênio Salles Bridge. This bridge, inaugurated in 1929, was the first to connect the Educandos neighborhood to the city center. Other important bridges include the Juscelino Kubitschek Bridge, inaugurated in 1959, and the Padre Antônio Plácido de Souza Bridge, inaugurated in 1975. The headwaters of this stream lie between Rio Servine Street and Armando Mendes Street, in the Armando Mendes neighborhood, in the city's East Zone, as verified on digital maps from OpenStreetMap contributors, Google Maps, and Street View. The main modifications to the Igarapé do Educandos began in 1986 with the Manaus Moderna Project.

The project faced delays, contract amendments, and a lengthy execution period, extending into the 1990s (Silva, 2011). Landfills, dredging, drainage, and retaining structures were carried out to make Avenida Beira Rio (now Lourenço da Silva Braga) viable, in addition to the landfill on Monte Cristo Island, located at the mouth of the Igarapé do Educandos. Starting in 2006, PROSAMIM brought about further changes: drainage, flood control, road construction, the creation of parks and recreational areas, as well as the construction of housing complexes to resettle residents living along the banks of the stream and its tributaries, such as the Gilberto Mestrinho, Mestre Chico I and II, Jefferson Péres, Cachoeirinha, and Liberdade housing projects. There are still stilt houses in areas not covered by the program, which are prone to flooding during severe high water. The stream is navigable year-round, but its mouth becomes an extensive sandbar during extreme droughts. In Figure 13, the Igarapé do Educandos is visible in the foreground, with the Jefferson Péres Residential Park in the background in 2021; in the other image, taken from the Rio Negro, a sandbar at the mouth of the stream can be seen during the 2024 drought, with the Padre Antônio Plácido de Souza Bridge in the background.

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

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 13 –Cachoeirinha Igarapé (now known as Educandos).

Source: Hebe Sol. A) Igarapé do Educandos and Residencial Jefferson Péres in 2021; and B) The sandbar at the mouth of Igarapé do Educandos during the 2024 drought, as seen from the Rio Negro in 2024.

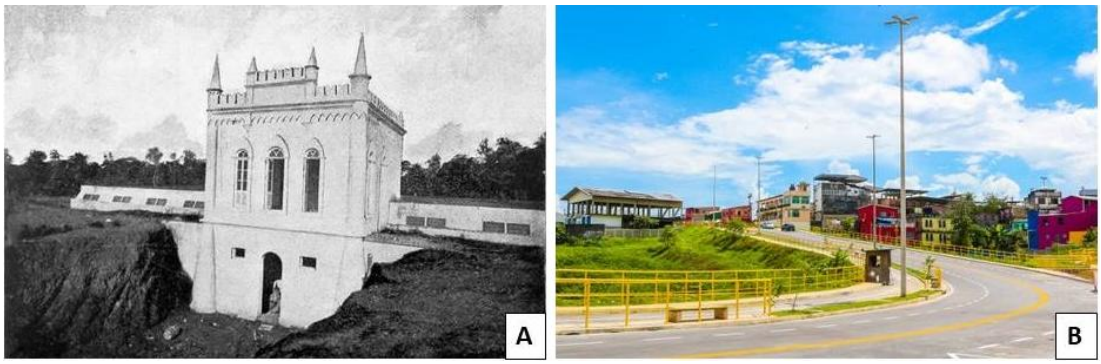
The ninth stream analyzed was the Castelhana. This stream was part of the Cachoeira Grande water supply system, the first in Manaus, built in the late 19th century. Also noteworthy is the construction of the Castelhana Reservoir, which was part of this supply system and was also built in the 19th century, remaining in operation for more than half of the 20th century. The Castelhana Reservoir building is located near the intersection of Constantino Nery Avenue and Álvaro Maia Boulevard. It was designated a historic landmark by the state government during the administration of Amazonino Mendes, through Decree No. 11,187, dated June 14, 1988.

It should be noted that, with the advance of urbanization, the banks of the Igarapé da Castelhana were occupied irregularly, resulting in environmental degradation and social risks. Starting with the third phase of PROSAMIM, this stream was included in a broad urban revitalization project that encompassed the construction of the Luiz Antony Road Link, the creation of Castelhana Park, the installation of sewer networks and pumping stations, and the resettlement of families living in high-risk areas. These projects, completed between 2019 and 2021, have reshaped the urban landscape by integrating road infrastructure, sanitation, and recreational areas (UGPE, 2025). Today, the Castelhana Creek has sections of its course with and without retaining walls along its banks. This creek flows in the open until Rua Luiz Antony, in the Presidente Vargas neighborhood. However, some sections have been filled in and channeled, such as the section that crosses Avenida Constantino Nery and Rua Ferreira Pena, in the Centro neighborhood. It should be noted that the headwaters of this stream are located near Avenida Airão, in the section between Rua Ferreira Pena and Rua Comendador Clementino, also in the Centro neighborhood. Figure 14 shows a photograph of the Castelhana Reservoir from the 1893 album *The City of Manáos and the Country of Rubber Trees*, presented at an exhibition in Chicago, United States; and also Castelhana Park (UPGE, 2025).

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

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 14 – Castelhana Igarapé.



Source: A) The City of Manáos and the Land of Rubber Trees, 1893. Castelhana Reservoir; B) UPGE, Castelhana Park, 2025.

The tenth stream analyzed was Cachoeira Grande, currently known as Igarapé São Raimundo. On the 1852 map of Manaus, it marked the city's western boundary (Aranha, 1897). Manaus's first water supply system was established on this stream, operating from the 1880s until the 1970s, when it was gradually replaced by larger systems, such as the one at Ponta do Ismael (COSAMA, 1991). Furthermore, it features important bridges, such as the Presidente Dutra Bridge, inaugurated in 1951, and the Senador Fábio Lucena Bridge, inaugurated in 1987; in addition to the overpasses on Brasil and São Jorge avenues (Duarte, 2009). The stream was the focus of the PROSAMIM program between 2012 and 2021, with the removal of approximately 1,500 informal dwellings and the resettlement of residents, some of whom were relocated to the São Raimundo Residential Park. Other projects included the Cacimbas, Kako Caminha, and Castelhana parks, as well as Rio Negro Park, which combines landscaping, culture, and recreation. However, there are still residents living along the banks of the stream.

At the same time, drainage and sanitary sewer works were carried out, including more than 31 km of sewer networks, six pumping stations, and the first wastewater treatment plant to be inaugurated since the creation of PROSAMIM, serving part of the networks from the initial phases. To integrate the stream into the urban fabric, roads such as the Luiz Antony and Presidente Dutra connections were built, and new public spaces were created (UGPE, 2025). Digital maps from OpenStreetMap Contributors, Google Maps, and Street View indicate the headwaters of the Igarapé Cachoeira Grande on Jupurutu Street, near house no. 429, in the Alvorada neighborhood, close to Beco da Paz and the Firme na Fé School. Although this stream is navigable year-round, during extreme droughts, such as that of 2024, its water level dropped drastically, forming a large sandbar at its mouth, as shown in Figure 15.

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

ISSN 2318-8472, v. 14, n. 91, 2026

Figure 15 – Igarapé da Cachoeira Grande (now São Raimundo).

Source: Hebe Sol. A) View of the São Raimundo stream and the Senador Fábio Lucena Bridge in 2021; B) The same location as seen from the Rio Negro during the extreme drought of 2024.

Table 3 provides an overview of the current status of each of the streams (igarapés).

Table 3 – Summary of the current status of the 10 igarapés listed on the 1852 Map of Manaus.

Nº	IGARAPÉ (STREAM)	CURRENT SITUATION
1	Ribeira (Seminário)	It was filled in and channeled, giving way to 15 de Novembro Street in the city's Historic District. It should be noted that a section of the street floods during extreme flooding.
2	Espírito Santo	It was filled in and channeled, giving way to Eduardo Ribeiro Avenue in the city's Historic District. It should be noted that a section of the avenue floods during extreme flooding.
3	Remédios (Aterro)	It was filled in/channeled and gave way to Av. Floriano Peixoto and Av. Getúlio Vargas, in the city center. Its headwaters are located between Rua Tapajós and Rua Leonardo Malcher, near the traffic light and the Anaíra Building. It should be noted that a section of Av. Floriano Peixoto floods during extreme floods.
4	Bica	Surrounding the Igarapé da Bica are Rua das Flores, a short section of Rua José Clemente, and Beco Casimiro, the latter located behind Rua Luiz Antony. Sections of these streets flood during extreme flooding.
5	São Vicente	Partially filled in/channeled. Today, the stream runs behind Frei José dos Inocentes Street, Padre Agostinho Street, Gabriel Salgado Street, and part of Casimiro Alley, in the city center. Sections of these streets flood during extreme high water. The area where the island of São Vicente once stood has been filled in and is now a Brazilian Navy military zone, making it susceptible to flooding during extreme high water.
6	Monte Cristo	It was filled in, as was the case with Monte Cristo Island, to make way for the construction of Lourenço da Silva Braga Avenue and Manaus Moderna. This section floods during extreme high water.
7	Manaus	Partially filled in/channeled. The mouth of the stream was closed off through channeling/filling and by a large retaining wall for the construction of Lourenço da Silva Braga Avenue as part of the Manaus Moderna Project. As part of the PROSAMIM project, Jefferson Péres Park and Desembargador Paulo Jacob Park were built in the surrounding area. Igarapé de Manaus Avenue was also constructed. Of particular note is the construction of Manaus Residential Park on a section of the filled-in/channeled stream.
8	Cachoeirinha (Educandos)	It is currently known as Igarapé do Educandos, although the stretch upstream of the Governador Ephigênio Salles Bridge is also referred to as Igarapé do Quarenta. Parts of its banks were altered by the Manaus Moderna Project, including the complete filling in of Monte Cristo Island. It has undergone PROSAMIM projects, such as retaining walls, drainage, the construction of avenues along the stream, residential parks, and recreational areas. Its headwaters are located in the area between Rio Servine Street and Armando Mendes Street, in the Armando Mendes neighborhood. It is navigable year-round; however, during extreme droughts, the mouth is blocked by a large sandbar.

ISSN 2318-8472, v. 14, n. 91, 2026

9	Castelhana	Partially filled in/channeled. It is located in the area between Luiz Antony Street, Constantino Nery Avenue, and Ferreira Pena Street. Its headwaters are near Airão Avenue. It has benefited from PROSAMIM projects, such as the construction of Castelhana Park.
10	Cachoeira Grande (São Raimundo)	It is currently known as Igarapé do São Raimundo. It has undergone PROSAMIM projects, such as a retaining wall, drainage, the construction of avenues along the stream, residential parks, and recreational areas. Its headwaters are located in the area between Jupurutu Street and Beco da Paz, in the Alvorada neighborhood. It is navigable year-round; however, during extreme droughts, the mouth is blocked by a large sandbar.

Source: Compiled by the author.

5 CONCLUSION

It was found that most of the streams surveyed had been filled in and channeled. Although hidden by urban development, these waterways persist underground and resurface during extreme flooding, when the drainage system cannot handle the volume of water, causing the original hydrological course to reassert itself over the urban landscape. Roads such as Eduardo Ribeiro Avenue, Floriano Peixoto Avenue, and 15 de Novembro Street flood in the sections where the Espírito Santo, Remédios, and Ribeira streams once flowed, temporarily recreating the ancient bay that once existed there. During extreme floods, the water covers the asphalt, causing the water surface to resurface as a persistent reminder that this has always been its place. It is worth noting that the larger streams—the Educandos and the São Raimundo—face navigability difficulties during extreme droughts due to the obstruction of their mouths by sandbars. Floods and droughts have intensified in recent years as a result of climate change (Marengo et al., 2024), increasing the city's vulnerability and highlighting the need for policies that reconcile urban infrastructure and environmental preservation.

These interventions, guided by ideals of modernization since the 19th century and continued in projects such as Manaus Moderna and PROSAMIM, have —despite improvements in sanitation—reinforced a reductionist view of waterways as elements to be controlled. This approach has obscured their ecological, cultural, and tourism value, while ignoring their potential as natural corridors for urban mobility, contributing to the loss of environmental and social identity. Thus, the history of Manaus's first ten igarapés remains part of urban daily life, particularly due to the risks associated with the occupation of their former channels. Reintegrating their memory and logic into urban planning is essential for a city better adapted to current and future environmental realities.

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DECLARAÇÕES

CONTRIBUIÇÃO DE CADA AUTOR

Ao descrever a participação de cada autor no manuscrito, utilize os seguintes critérios:

- **Concepção e Design do Estudo**: Hebe Souza de Oliveira.
- **Curadoria de Dados**: idem.
- **Análise Formal**: idem.
- **Aquisição de Financiamento**: idem.
- **Investigação**: idem.
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DECLARAÇÃO DE CONFLITOS DE INTERESSE

Eu, Hebe Souza de Oliveira, declaro que o manuscrito intitulado "**O destino dos primeiros igarapés de Manaus: análise histórica e cartográfica**":

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