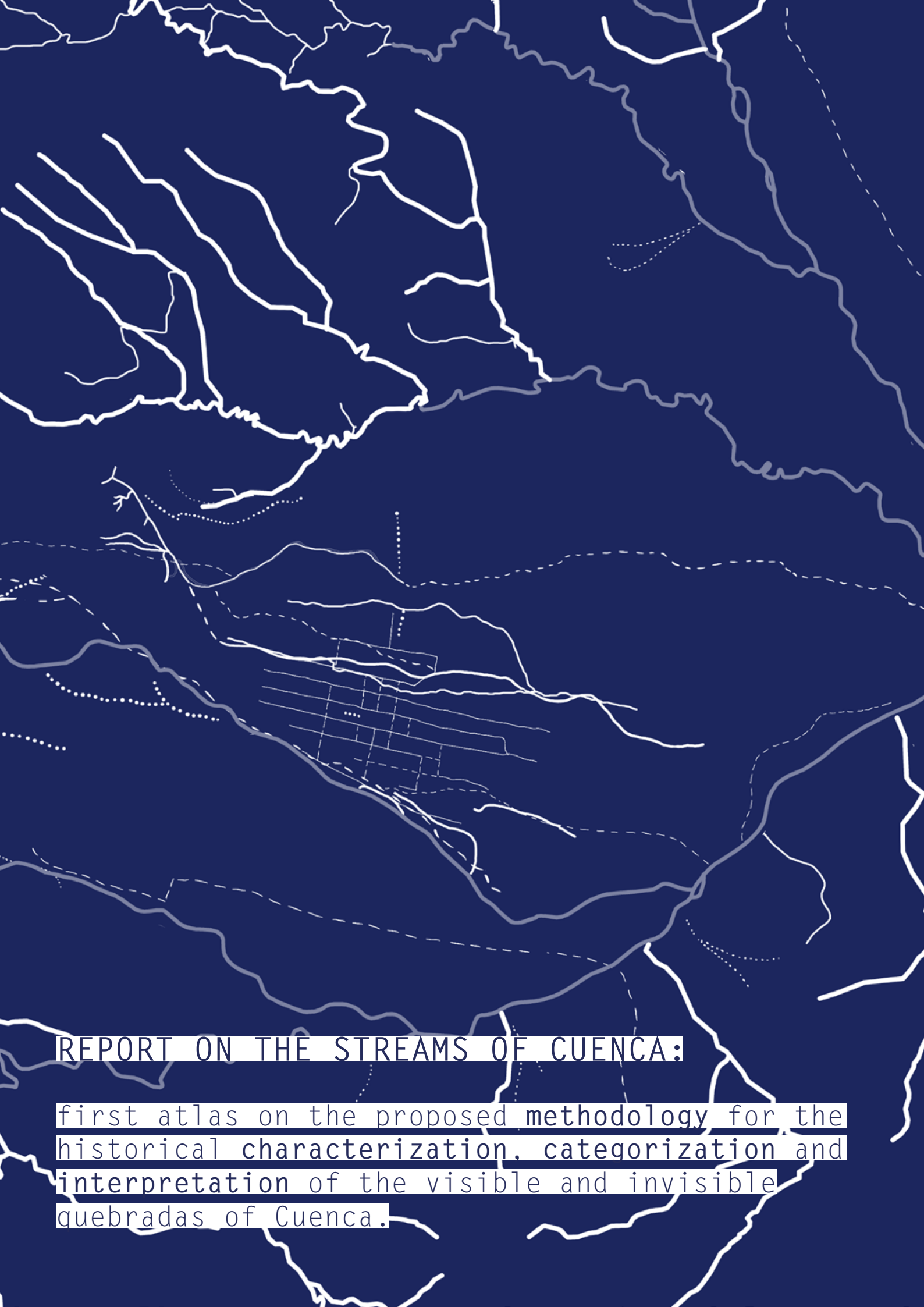

REPORT ON THE STREAMS OF CUENCA:

first atlas on the proposed **methodology** for the historical **characterization, categorization** and **interpretation** of the visible and invisible quebradas of Cuenca.

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LLACTA lab CIUDADES SUSTENTABLES
UCUENCA ARQUITECTURA Y URBANISMO
viruos
KU LEUVEN FACULTEIT ARCHITECTUUR

COLOPHON

Publication of the summer 'Global Development Project in the South'

Report on the streams of Cuenca - first atlas on the proposed methodology for the historical characterization, categorization and interpretation of the visible and invisible quebradas of Cuenca.

The project is supported by the research group 'Urban Projects, Collective Spaces and Local Identities' of KU Leuven faculty of Architecture for the elective course 'Participation in an International Project'.

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ABSTRACT

Located in Andean mountains in the south of the country, Cuenca is one of Ecuador's fastest growing cities. This leads to new challenges in the economic, social, and environmental development of the city. Part of these urban challenges for the 21st century is city planning, and how water will have a big influence on it. Cuenca contains four big rivers and a lot of streams. These streams are mainly covered and no longer visible in the urban tissue. They never played a big role in the planning of the city, but more and heavier problems, related to water, occur since Cuenca is growing rapidly. In the framework of this research, the analysis, location and categorization are of high importance for the future of the Andean city.

This is an investigation of a six week internship with the main ambition of creating a base atlas on the network of streams in Cuenca. It is the foundation for a starting research project of LlactaLAB. As part of this three-year project, the aim is to create an overview of the location of the streams via two extensive maps. One focused on the precise localization of the streams. Where the current names and categorization are pivotal. The other one, the 'memory map', is constructed based on stories of locals, antique photos, and drawings. The map has the old - often related to the Incan time - names of the streams. These two maps work together, and focus on the understanding and importance of the streams. They are an easier readable version of the complex history the city of Cuenca contains.

ACKNOWLEDGEMENT

We would like to thank the people who have helped us during our stay. Thank you to all the people of LlactaLAB for inviting us to events and helping make our stay memorable. Especially to Natasha Eulalia Cabrera for being our mentor and supervisor throughout this entire internship. To Andrea Sangurima, with whom we worked closely. Thank you to José Luis Espinoza, for sharing all this highly valued information, and taking us on informative field trips. To Yves Schoonjans from KU Leuven for organizing the project and guiding us in writing this publication. Finally thank you to all the people we met on this journey, for making it possible and unforgettable.

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1. INTRODUCTION

This publication is the result of an initiative from the collaboration between the research group Urban Projects, Collective Spaces and Local Identities (KU Leuven) and the research group LlactaLAB (University of Cuenca). We are Elle, Iman, Justyna and Sofia, master's students of the Faculty of Architecture, KU Leuven. During the summer of 2023, we participated for six weeks in a funded VLIR-UOS internship project in Latin America.[1] We actively took part in the Global Development Program[2] of Cuenca, Ecuador. This program is an integral component of the LlactaLAB-research group[3], operating under the aegis of the University of Cuenca's Interdisciplinary Department of Space and Population. LlactaLAB's overarching mission is to 'advance scientific knowledge that addresses the profound challenges confronting 21st-century urban environments, including urban expansion, climate change, resource scarcity, energy depletion, urban disparities, information management, and public health'.
The internship is part of a three-year research project LlactaLAB is initiating. Head of this project is Natasha Eulalia Cabrera, doctor in Architecture and Urbanism.[4] She introduced us to the project and followed our approach throughout. As we were part of the LlactaLAB group, we could count on the knowledge of a diverse group of professionals, including; researchers, architects and experts in different fields going from history, to social science and biology.

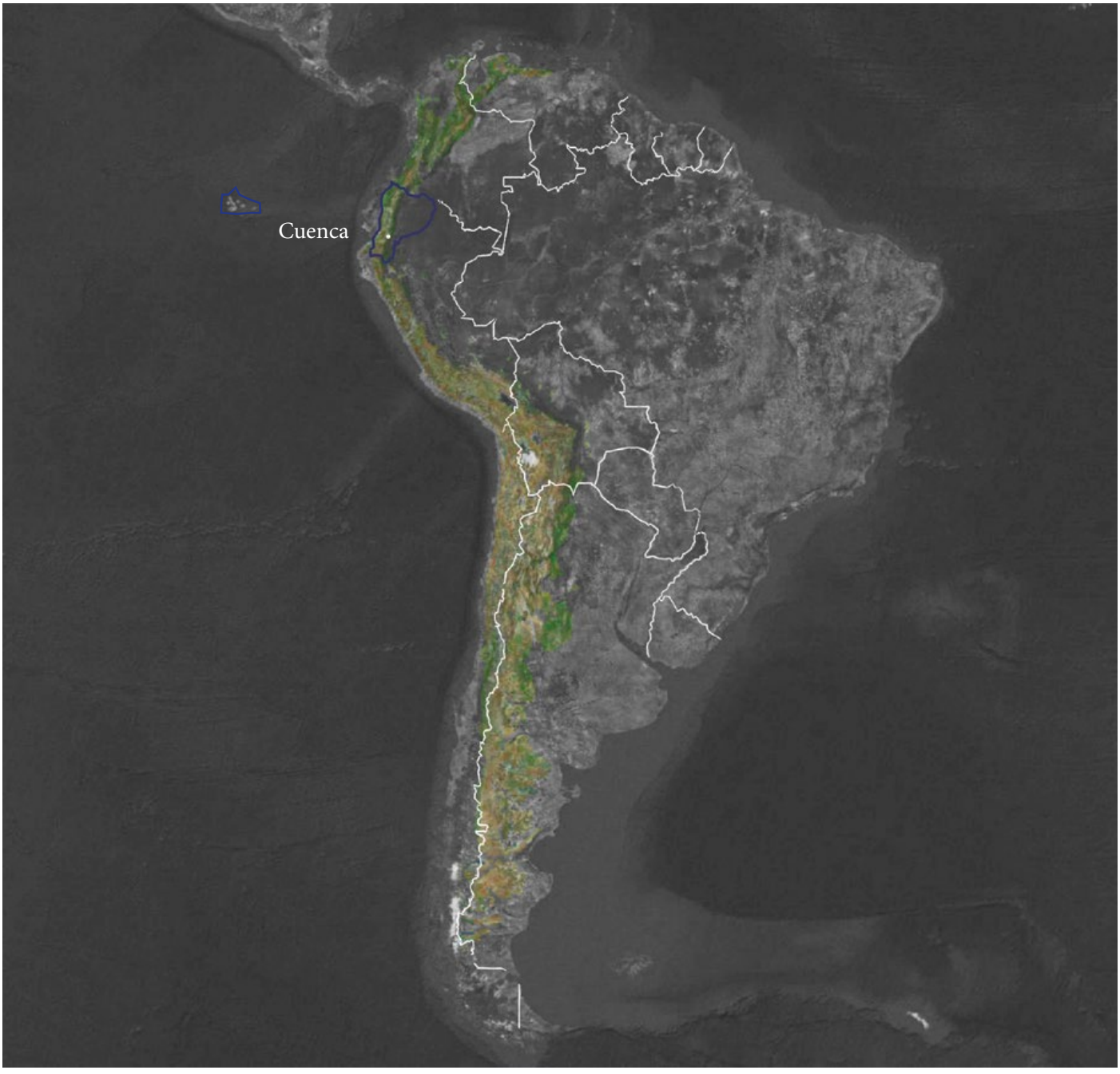
The core of this research discusses the impact of streams in the urbanization process of Cuenca: historical characterization, categorization and interpretation of the visible and invisible quebradas of Cuenca. Cuenca is defined by many streams, which are covered over the years, without considering the consequences. These streams never had a high value in the city regulation; there are no protection laws, nor environmental education and documentation. Now that the city is growing faster and denser than ever before, 2.2% increase of the population every year[5], it is necessary to consider the streams significant in the rapid growth of the urban tissue, as they can be a – and already are – a recipe for flooding, droughts, and collapse of buildings in the suburban parts. This investigation is meant as a base for further research, and in second phase as a tool for the (future) city planners to know where there are vulnerable and risky areas, all related to water.

The research goes beyond the five rivers associated with the Andean city: Tomebamba, Yanuncay, Tarqui, Milchichig and Machángar, but focuses more on the network of streams related to those rivers. The goal was to map and name these streams, which are often hidden under the urban tissue of Cuenca. It was important to create a methodology of mapping. This included studying old and new maps and texts, carrying out physical observations in the city, having conversations with local people in different neighborhoods and mapping carefully all the information we collected on two different maps. The first outcome is a rather imprecise map, based on stories and oral information. The second outcome is a precise map in QGIS, as it is intricately correlated with the accurate identification of each stream's respective name and location. As they are very diverse and vary in size, morphology, and age, we conclude our research with the categorization of these streams.

1. VLIR UOS. (2023).
2. KU Leuven Global. (2023).
3. LlactaLAB. (2024).
4. Cabrera, N. E. (2016).
5. WorldOMeter. (2024).

2. SITUATION

Cuenca, Ecuador



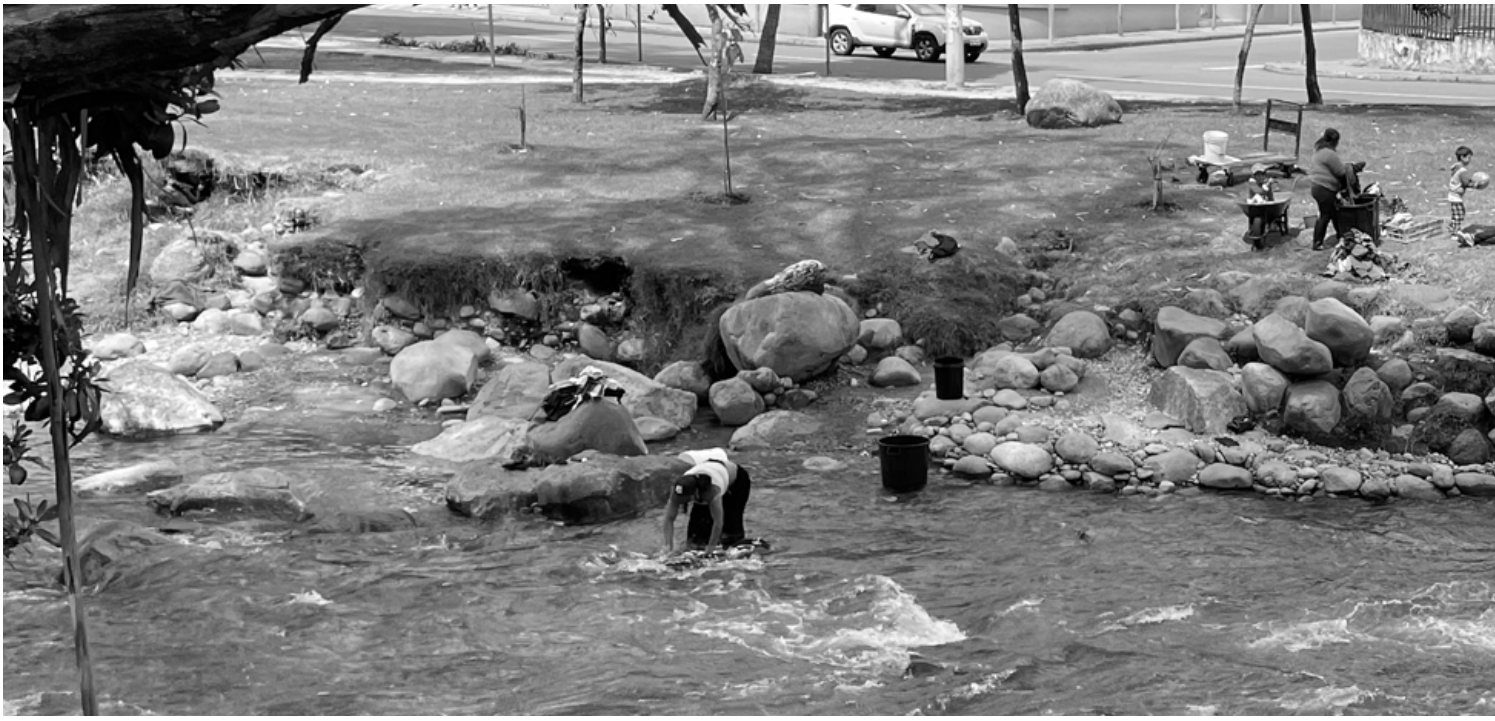
graphic 1: The Andean mountains in South America.

The Republic of Ecuador is a country in South America, with a rapidly growing population (1.05% increase per year) of 18.2 million people. The country is named after the equator, which cuts right through the middle. The country has three main landscapes: the coast, the Andean mountains and the Amazon forest.[6]

6. Wikipedia-bijdragers. (2023).

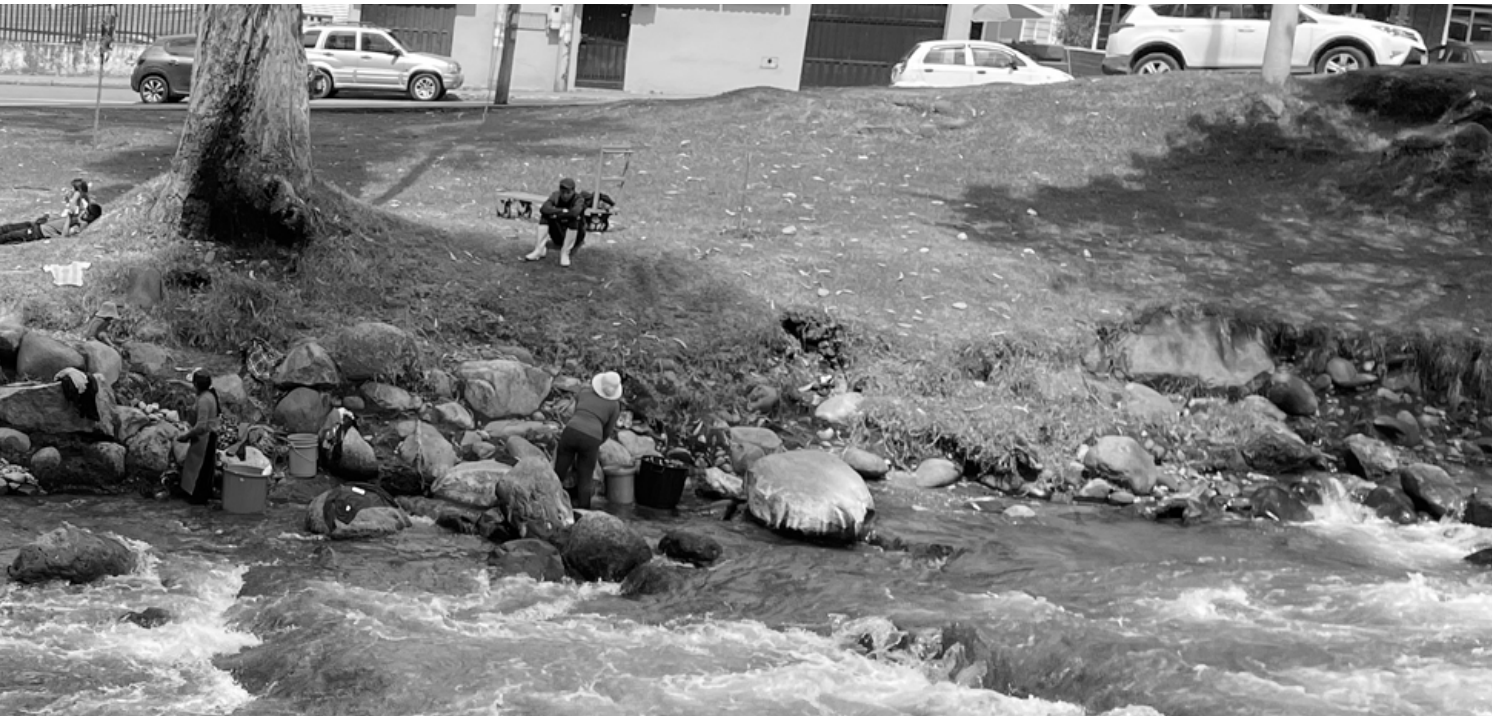
A. Río Yanuncay
B. Río Tomebamba
C. Río Machángara
D. Río Tarqui

graphic 2: Santa Ana de los Ríos de Cuenca with its four major rivers.



graphic 3: Women doing their laundry in the Río Tomebamba.

graphic 4: Washing of the traditonal *sombreros* from Cuenca between the years 1910 and 1920.



Santa Ana de los Ríos de Cuenca is located in a valley surrounded by the Andean mountains, in the southern part of Ecuador. This inland colonial town, now the country's third important city, was taken over in 1557, by the Spanish colonizer. [7] Cuenca still observes the formal orthogonal town plan from 400 years ago. Its full name comes from the four big rivers: río Tomebamba, Yanuncay, Tarqui, and Machángara. The rivers play until today an important role in the city, on an economical, political, and mostly social level.

7. Vargha, S. (2023).

Introducing the notion of stream

{stream} : In a geographical or environmental context, a stream refers to a small, narrow river or brook. It is a flowing body of water that is smaller than a river. Streams are typically characterized by their shallower depth and lower flow rates compared to rivers.[8]

{quebrada} : The word "quebrada" translates to "ravine" or "gully" from Spanish. In some Latin American countries, especially in regions with rugged terrain, the term "quebrada" is often used to describe a small, steep-sided valley or a dry creek bed that may become a torrent during heavy rain.

8. National Geographic Society. (2023).

We based our own definition of a stream on these two meanings. A stream for us is a small body of flowing water. It has a start and an ending, (often) related to one of the four rivers in Cuenca. We do not define a specific typology for a stream, since it may vary from stream to stream, but also from location within that stream. A stream is not the same as a sewer or drain, but often the sewage system comes out to the stream. This stems from colonial times, when the sewage water that ran down the canals flowed into the rivers. Today, citizens of Cuenca still refer to the water in the streams as Agua Negra; dirty water.

3. METHODOLOGY

The main starting point was the definition of a methodology. Subsequently, it proved essential to comprehend the historical framework of the city and its streams. The intention of this preliminary phase of a three-year research was, therefore, to provide a general overview of the current state of art through reliable sources. This required the combination of sources of different nature, distinguishing the process on multiple layers.

The adopted methodology was structured into three main methods: (1) literature review of primary and secondary sources (analysis on digital academic archives, the selection of historical photographs and maps in libraries, physical and digital archives, confronting ourselves with secondary sources on methodologies as well on water systems in the Andes), 2) on-site observation of the physical urban structures, and (3) semi-structured interviews with local residents and privileged witnesses. The different approaches were simultaneously integrated in a constant triangulation. These three research methods led to the localization (as precise as possible) of the network of streams, the analysis of that network, and the partial understanding of the city's water system in different historical periods and various urbanization processes.

symposium on space, population and sustainability

A central moment for the research was the second edition of the Symposium on Space, Population, and Sustainability called "Between vulnerability and risk: territorial resilience." Spread over two days, conferences and workshops took place in four thematic tables: sustainable production and consumption, built environment and urban resilience, social care, social risks and vulnerabilities, and interdisciplinary approaches and methodologies for territory studies. During this event, it was possible to identify reference points, mentioned by academics and researchers, for the investigation of streams in Cuenca.
During the second table, Jorge Andrade, a professor at the School of Architecture of Puce based in Ibarra (Ecuador), presented the research on the underground Rio Ajavì. The mentioned talk proved to be extremely connected. Subsequently, an interview with Jorge was conducted to delve into the methodology adopted by his research group. A topic of particular interest was analysing the perception associated with watercourses. In the case of the Rio Ajavì, the local population associated a sense of dirt and unhealthiness with the river, often overlooking its existence beneath the city.
Similarly, in the case of Cuenca, the streams, although loaded with meaning and value, are subtly forgotten in the eyes of residents and administrations. Yet, when remembered, they evoke both positive and negative connotations.

In this perspective, the aim of the research in Cuenca is to reverse the scale of importance from the concept of primary and secondary watercourses, proposing a switch of focus from main rivers to streams.

During the interview with the researcher and later in the literature review, an aspect of particular attention was the approach of mapping a "river memory". Sofía Astelarra writes:

> *"Mapping a river memory involves making sense of meanings, experiences, practices, and, therefore, subjects who have been made invisible and portrayed as absent in dominant narratives, accounting for the relationship they have built with it, the ways of intervening in it, and how the river has conditioned or marked their lives."*[9]

This approach guided the research towards the heritage of memory. Through oral stories, a map was assembled in parallel with primary sources, such as literature, maps, and photographs. It was the most effective method given the layered nature of the research and the limited time of the preliminary phase. Furthermore, this position provides a clear basis for directing subsequent research with more sophisticated and elaborated technical tools, described in the chapter 7 "Conclusion" about the "Future of the project".

9. Astelarra, S. (2017). p. 3

In addition, during the symposium[10], a workshop on mapping the resistance in the El Vado neighborhood was conducted. The area was divided into four sections. Each group, after a thorough exploration of the area, created a collage on a base map, pinpointing locations of significance for the residents and the neighborhood's history.

This mapping exercise not only documented the physical layout of the neighborhood but also encapsulated the collective memory and lived experiences of its inhabitants. By identifying crucial landmarks and historical nuances, the collages served as a representation of the community's narrative. This participatory mapping approach played a pivotal role in the ongoing process, contributing to a more comprehensive appreciation of the cultural and historical fabric.

10. U Cuenca. (2023)

graphic 5: Resistance in the El Vado neighborhood map.

secondary sources: literature review

The examined secondary sources cover methodologies and analyses undertaken by other researchers in similar topics in the South American continent. The rapid urbanization process is a typical dynamic phenomenon in this geographical context. Therefore, it becomes essential to refer to literature capable of understanding the subject from a local perspective. The texts, written in English or Spanish, reference sociological, urban planning, architectural, biological, and spatial knowledge. Paragraphs of particular interest for the research were extracted from each text. Each extract was recorded in an Excel file to simplify subsequent and external consultations.[11] This process is called systematization of the literature review and it is a methodology commonly used by the research group at LlactaLAB. This procedure is crucial for tracking and building up the bibliography throughout the three years of research and across different teams.

The keywords allow an understanding of the nature of the texts and provide relevant insights. The keywords of the texts are subsequently listed and divided into thematic categories.

Water and Cultural Context:
Water culture
Social representations
River Culture
Social connectivity
Social meanings and appropriations

Hydrological Elements and Management:
Hydrological elements of the territory
Sustainable management

11. The texts are divided in the Excel file under the headings: responsible, author, year, title, APA 7th edition referencing, type, abstract/ summary, keywords, systematization of the extracts into categories.The Excel file is available at the following link: https://shorturl.at/pPRV7

Management strategies

Quality conditions
Scientific knowledge
Water management
Water supply
Urban Water Vulnerability
Adaptive Capacity
Southern Urban Hydrosystem Syndrome

Climate and Environmental Impacts:
Climate Variability
Climate Change, and Impacts
Environmental impacts
Restoration
Urban sprawl
Ecosystem services
Climate change
Environmental flows
Environmental water allocations
Freshwater
Tropical

Urban Development and Infrastructure:
Water Infrastructure
Urban stream syndrome
Urban development
Revaluation
Waterfront
Segregation
Urbanization
Urban spot change land use
Development
Regional
Resilient Cities
Urban Green Space
Urban Waterfonts
Pluvial Landscape

Urbanization

River Dynamics and Assessment:

River dynamics
Geomorphological changes
Artificialized drainage network
Peri-urban
Watershed condition assessment
Rio Tomebamba
Watershed condition index
Riparian corridors
Land use
GIS analysis
Surface runoff
Xiamen

Natural Elements and History:

Andean highland rivers Multi-metric index
Ecological status
Vegetation types
Riparian forest
Bahía Blanca
Arroyo
History
Nature
Rivers
Subjects
Under Delta of Paraná
Guzho - Part of the city of Cuenca located southeast of the same
Rotational landslide

Hazards and Risks:

Threat
Vulnerability
Risk
Geological faults

The systematization of the extracts was approached by dividing them into the following categories, added during the reading to organize the most significant extracts.

Climate change
Vulnerability
Social aspects
Urban transformation
Morphology
Restoration
Methodology
Wastewater
Protection of streams
Elements to take into consideration during the research
Pollution of the streams
(dis)Advantages of the streams
Floods
Biodiversity
Theory
Question
Mapping
Name and use of the streams

It was challenging to find information about streams, as most of the available data primarily focused on rivers. The texts provided a general overview of the topic and its complexity. Urban streams already have been studied in multiple contexts, and the readings highlighted the need for an interdisciplinary approach, likewise strongly mentioned referring to other issues in the "Symposium on Space, Population, and Sustainability" in Cuenca. The same need is addressed in the "Introduction to Effects of Urbanization on Stream Ecosystems. American Fisheries Society Symposium" where it is emphasized that the ecological preservation of watercourses is challenging and requires scientists in aquatic resources, managers, social sciences, engineers, and economists.[12]

Following the readings and understanding the vastness of the topic, a selection was made among various methodologies and insights to proceed with the analysis in the most suitable way for the context. Furthermore, considering the timelines and available tools, traces accessible by a team of architects during the preliminary research phase were identified. The streams of the city of Cuenca are invisible, rendering the reconstruction of a comprehensive map a complex and layered task. However, despite the challenges, this preliminary phase ultimately resulted in the creation of two maps: a digital map and a memory map.

In Rotger and López's (2019) research, reference is made to the case of La Plata, Argentina. This research has points of contact with the reality of Cuenca. In this case, streams are seen as obstacles to urban development.[13] Initially, they were not modified to limit the possibility of floods.[14] However, later on, covering or canalization procedures were initiated for the same reasons. The dynamics are very similar to those of the Andean city, requiring "an effort of imagination and thinking about how the city expanded

12. Postel (2000). Nilsson et al. (2003). mentioned by Brown, L. K., Gray, R., Gray, R., Hughes, R. M., & Meador, M. A. (2005). p. 4
13. Rotger, D. V., & López, I. (2019). p. 2
14. Rotger, D. V., & López, I. (2019). p. 5

starting from the founding people in the further areas, corresponding to the divisions of water between the different streams".[15] In the research on the city of La Plata, reference is made to the methodology, which undertakes a qualitative study based on bibliographic, cartographic, and photographic material obtained from various historical archives and field surveys.[16] In this preliminary research, the same approach was adopted, focusing the lens on the challenging social value, which is impossible not to consider.

"For numerous reasons, the modern conception of water as a substance abstracted from social, cultural, and religious context has come under heightened scrutiny. Consequently, there has been greater interest in addressing how water is not just natural, but also historical, political, and cultural. This interest has generated attention to approaches other than eco-hydrological methods to know and understand water and has led to increased recognition of the complexity of the relations between water, society, and ecosystem processes."[17]

Walteros and Ramirez, in their research, study urban streams "as components of the urban socio-ecological system. Streams are integrated within their urban landscapes and are affected by socio-economic and political decisions associated with the management of urban systems. Our understanding of the dynamics of urban streams would benefit from information about how they are affected by socio-economic factors."[18] Furthermore, in the article, they recognize the effects of climate change and rapid urbanization in Latin America on urban streams and the limited availability of information on this matter.[19] In the same research, a pattern is identified in the treatment of secondary water systems on the continent, which is also observable in the urban fabric of Cuenca. "Complete channelization is typical in urban areas, so much that several natural rivers features are disappearing entirely from urban landscapes.[20] However, we found that most of

15. Rotger, D. V., & López, I. (2019). p. 2
16. Rotger, D. V., & López, I. (2019). p. 4
17. Anderson, E. et al. (2019). p. 2
18. Walteros, J. M., & Ramírez, A. (2020). p. 23
19. Walteros, J. M., & Ramírez, A. (2020). p. 13

the urban rivers evaluated by respondents had mixed levels of channelization; sections still draining channels with natural substrate and some riparian vegetation. Channel alterations are common in urban areas, addressing specific issues related to flood control or maximizing land use.[21] Alterations associated with channelization are diverse, involving decreases in channel sinuosity, changes in geomorphology, and in streambed particle composition[22]."[23] Watercourses influenced by urbanization processes are analyzed by many researchers[24], and their alteration due to the impact of anthropogenic actions[25] is acknowledged. Especially the Andean highland region falls victim to human activities[26] such as agriculture, livestock, deforestation, road construction, and pollution from urban and industrial areas.[27]

The relationship between humans and streams is complex but allows us to trace the paths and changes of watercourses, which play hide-and-seek in various bibliographic materials. Sofia Stellara, previously mentioned, asserts, "the concept of articulation or modes of human-nature relationship allows us to understand it not as a static structure but as a dynamic, continuous, and conflictive movement. [...] Articulation can be defined at each historical moment by examining ways of using spaces, perceiving them, etc., alongside the 'ecological conditions,' the biogeophysical interactions present in ecosystems".[28]
This literature has strongly guided the mapping of streams memory, seeking traces in bibliographic material and on-site with residents.

20. Bremer et al. (2016). Anim et al. (2019). mentioned by Walteros, J. M., & Ramírez, A. (2020). p. 20
21. Lee (2000). Paul & Meyer (2001). de Jesús-Crespo & Ramírez (2010). mentioned by Walteros, J. M., & Ramírez, A. (2020). p. 20
22. Chin (2006). Anim et al. (2019). mentioned by Walteros, J. M., & Ramírez, A. (2020). p. 20
23. Walteros, J. M., & Ramírez, A. (2020). p. 20
24. González, M. A., Gentili, J. O., & Gil, V. (2020). p. 18
25. Zerega, A., Simões, N.E. & Feio, M.J. (2021). p. 1
26. Roldán (1999). Sarmiento & Frolich (2002). Carrera & Gunkel (2003). Jacobsen et al. (2007). mentioned by Villamarín et al. (2013). p. 79
27. Sarmiento & Frolich (2002). Carrera & Gunkel (2003). Segnini & Chacón (2005). Mena & Hofstede (2006). Prat et al. (2009). mentioned by Villamarín et al. (2013). p. 79
28. Astelarra, S. (2017). p. 3

primary sources: libraries and physical archives

Following the literature review, the search for bibliographic material and historical maps of the city proved to be crucial. The principal information was found at the Daniel Córdova Municipal Library and the Pumapungo Museum.

The key books for the research are as follows: "Diagnostico. Analisis fisico del area urbana. Informe definitivo. Volumen X"[29], "La ciudad de todas las orillas. Libro conmemorativo por el Bicentenario de la Independencia de Cuenca"[30], and "Planos e Imágenes de Cuenca" [24].
In the first text, maps related to an analysis of the state of Cuenca in 1982 are presented. Various maps were analyzed, providing a greater understanding of the city's urban fabric, administrative divisions, and lots, with particular attention to the city's flooding areas and the possible presence of a stream.
The following two texts contain maps and drawings from a broader timeframe. In addition to more technical and/or digital representations, maps from the mid-18th century are reproduced with technically and perceptively inaccurate illustrative characters. It is not possible to identify the instruments used for these drawings. Nevertheless, these images are meaningful and clearly show the presence of streams and their relationship with the human settlements.
Several volumes were considered; however, the aforementioned books provide more information.[31]

At the Pumapungo Museum, it was possible to see and analyze the canalizations of the ancient city and its ruins. Water from the Tomebamba River was channeled to irrigate agricultural areas of the celebratory complex and for purificatory rituals. It was possible to understand here how the relationship with water is extremely strong and laden with ancestral meaning.

29. Diagnostico. Analisis fisico del area urbana. Informe definitivo. Volumen X. (1982). Cuenca, Ecuador: Consulplan.
30. La ciudad de todas las orillas. Libro conmemorativo por el Bicentenario de la Independencia de Cuenca. (2020). Cuenca, Ecuador: Dirección General de Cultura, Recreación y Conocimiento del GAD Municipal de Cuenca.
31. Albornoz Vintimilla, B. (2008). Planos e imágenes de Cuenca. Quito, Ecuador: Sector Público Gubernamental. A scan of the most important pages within these three volumes is available at the following link: https://shorturl.at/uFMW2

primary sources: digital archives

The search for maps in digital archives allowed to analyze the current state of the most recent cartography on advanced systems. The main sources are OpenStreetMap servers and military archives. With the integration of data already researched by Andrea Sangurima, environmental engineer working at LlactaLAB, it was possible to create a QGIS by combining layers provided by various sources.

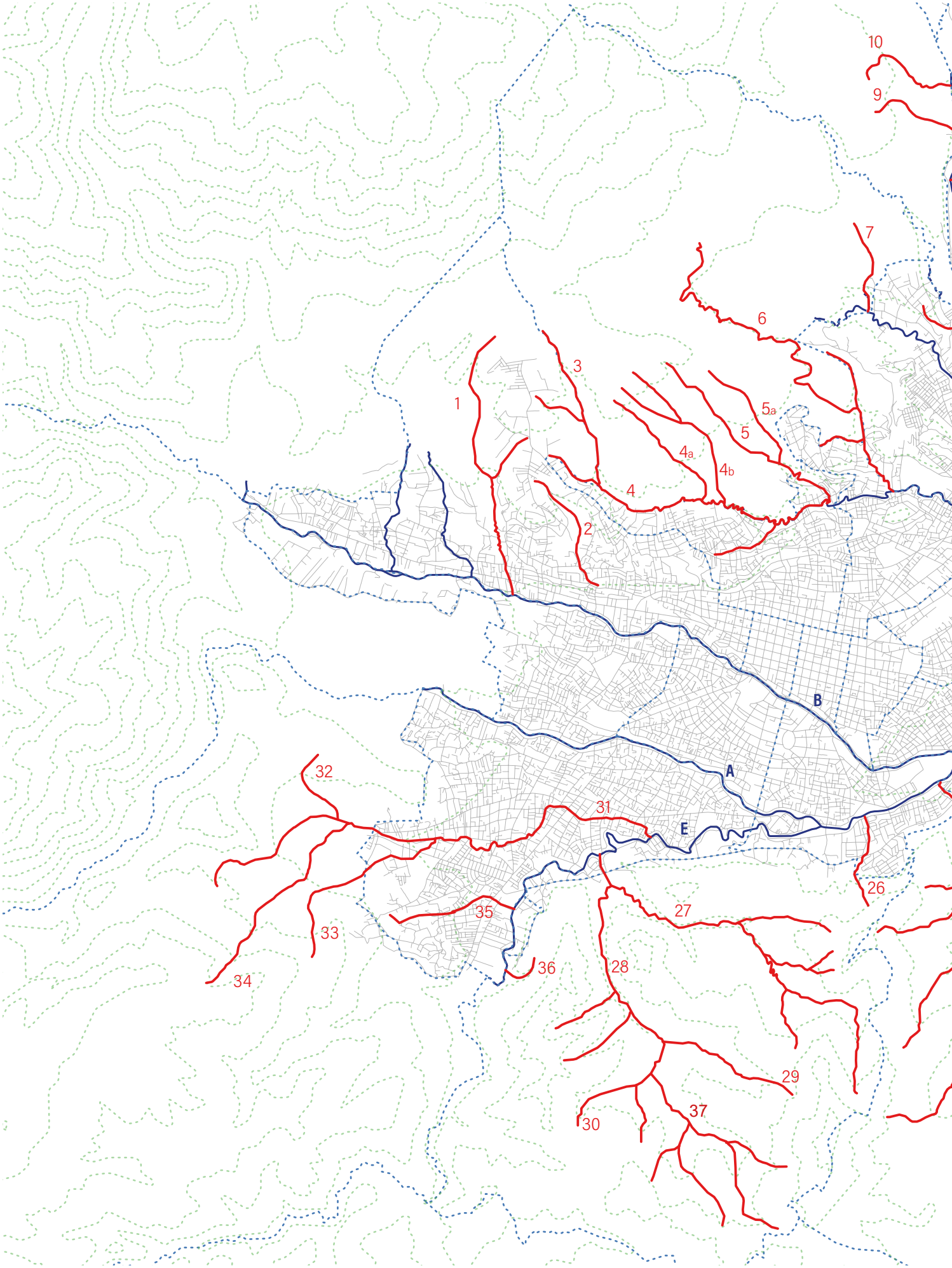
It is noted that almost all maps display natural streams characterized by the presence of water. However, the "quebradas," or ravines formed by water, but dry depending on the season, are not present. Furthermore, man-made channelization of the streams in the city centre from different periods of urbanization are not highlighted.

A legend has been included in the file with the names and dates of all the streams identified in the research and, if possible, their location on the map. However, the file is particularly complex, and its completion will occur in subsequent stages of the research from the LlactaLAB group research.

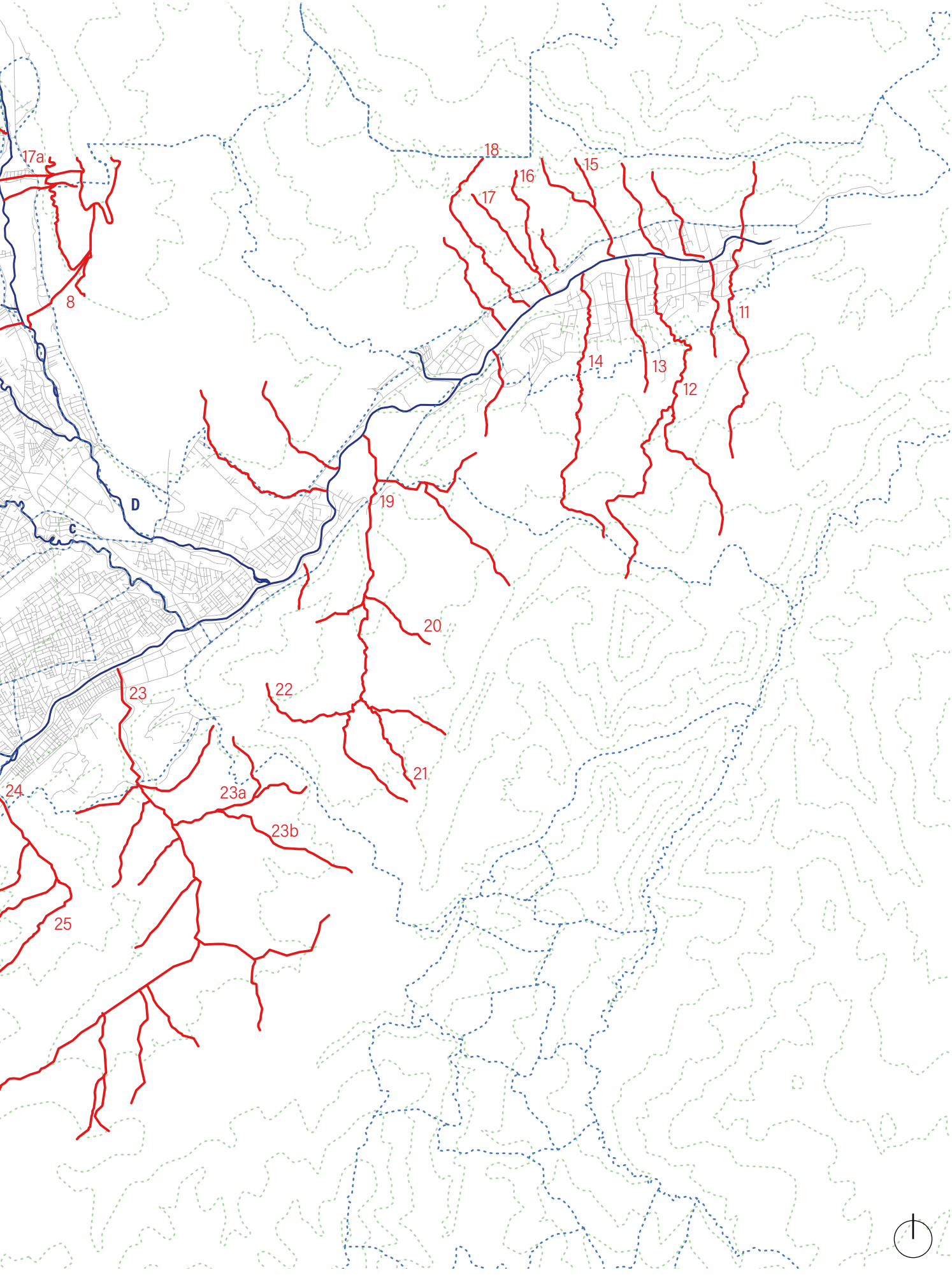
In the following section of this document, precisely in chapter 6 "Interpretation of mapping", the results obtained during the preliminary phase from the integration of various sources in the QGIS file are examined.

A. Río Yanuncay
B. Río Tomebamba
D. Rio Machángara
E. Río Tarqui

1. Quebrada Sacay
2. Quebrada Del Tejar
3. Quebrada Rambran
4. Quebrada Milchichig
4a. Quebrada El Cebollar
4b. Quebrada Pumayacu
5. Quebrada Verdillo
5a. Quebrada Miraflores
6. Quebrada Shirincay
7. No name
8. Quebrada Cachauco
9. Quebrada Tixán
10. No name
11. Quebrada Apangora
12. Quebrada El Coco
13. Quebrada Matove
14. Quebrada Allpayacu
15. Quebrada Pailahuaycu
16. Quebrada Arveja Urcu
17. Quebrada Guagua Shiquir
17a. Quebrada Guagua Shiquir
18. Quebrada Acana
19. Quebrada El Salado
20. Quebrada Michica
21. Quebrada Macas
22. Quebrada Monay
23. Quebrada Santa Catalina
23a. Quebrada Carapungo
23b. Quebrada Tenorio
24. No name
25. No name
26. Vía Mirador de Turi
27. Quebrada Mulahuaycu
28. Quebrada Solitario
29. No name
30. Quebrada Tres Marias
31. No name
32. No name
33. No name
34. No name
35. No name
36. No name
37. Quebrada Guaillo



graphic 6: QGIS.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primary sources: photography

Photography was a significantly important element in the research process. Photographs serve as tangible evidence of the presence of streams and the active or passive interaction of residents with them. Particularly interesting photographs were identified in the book "Planos e Imágenes de Cuenca"[32] and on the blog of the historian José Luis Espinoza.

The aforementioned historian is one of the most relevant oral and written sources in our research. One of the passions of the retired academic is the research and sharing of historical images of the city of Cuenca. Each photograph is accompanied by a caption providing its date, location, and historical facts.[28] The most relevant photographs were selected and categorized in an Excel file.[33]

32. Albornoz Vintimilla, B. (2007). Planos e imágenes de Cuenca. Quito, Ecuador: Sector Público Gubernamental.
These images are available on José Luis Espinoza's blog (https://cuencacultural.blogspot.com/) and Facebook groups Cuenca Antigua (https://shorturl.at/JQY09) and Historias y Personajes de Cuenca (https://shorturl.at/efLX8).

33. The selected and chategorized photoghaphs are available at the following link: https://shorturl.at/ltuJP.

on site observations and semi-structured interviews

As mentioned before, much of the accessible heritage has been transmitted orally on-site. Individuals who contributed their knowledge include Natasha Eulalia Cabrera, José Luis Espinoza, and spontaneous encounters with people on-site. All these stories are meaningful and closely tied to memory, ranging from everyday life to research. The only way to capture this knowledge was to combine oral history and anecdotes with photographic archives, categorized for each stream with its name, and manually drawn on a map. This map is called the 'Memory Map' and is the most comprehensive result of the research. Although it contains considerable errors due to the lack of data, - in a later phase this has to be double checked - it includes the majority of the streams, locating them in approximate areas.

The first memory map was developed in the first week. Following a guided tour by Natasha, three examples of different stream treatments were analyzed as references. All information was compiled in a preliminary map with photographs in paper format.

The map, brought to the subsequent on-site visits and updated based on data found in cross-research between maps and photographs, remained the same. José Luis Espinoza accompanied the research, navigating the city and providing his deep knowledge as a historian and researcher. During these visits, new pieces were identified and combined, creating a complex pattern of stream traces in the city of Cuenca. He knew many of the synonyms people had for the streams, what they used to do with the running water in the past and the present, and where the streams are located in the city.

The first three examples of different streams and treatments provided an initial understanding of stream categorization and the current state: Quebrada del Tejar, covered by an urban road; Quebrada del Sacay, partly left natural and partly bordered by houses; and Salado, partly left natural, partly channelized, generating multiple problems, and partly covered. Reference was also made to a stream beneath the building where she is living, likely related to the orthogonal canalizations of the city center during the Hispanic colony.

Furthermore, El Gallinazo is a clamorous example, probably before called Ullaguanga. It is a natural stream in the city center, historically canalized, and its traces are now lost. Natasha located the Mercado 9 de Octubre as a starting point, where remnants of the ancient canal are preserved by the municipality in a parking lot below the market. Additionally, José Luis Espinoza mentioned a poem referencing this stream, remembered in a time when it was dotted with bread mills and orchards. Unfortunately, it has been incorporated into the city sewage network. However, it is still possible to see the beginning of the natural stream, which is left to a green Quebrada.

The journey into Cuenca's memory provided by José Luis Espinoza begins with the Wisconsin glaciation when the valley was occupied by a vast lake. The Tahual area opens, and water flows eastward, gradually freeing the valley from this ancient water mass. The El Ejido area, once characterized by salt flats, swamps, and lagoons, still retains traces of an ancient water channel. Similarly, in the San Joaquin neighborhood, an ancient supplier of vegetables for the city, Inca-era retaining walls of the canals are noticed.

The canal initially known as Chanchaco and later renamed Guataná, with over several centuries of history,

meandered parallel to the Tomebamba River and ended in the Pumapungo site, today the ruins are preserved in the Pumapungo Museum of Cuenca.

The Putushio area, also known as Rio Amarillo, reveals ancient ceramic remains and presents traces of history related to gold and silver sources, giving its name.

In the El Tejar area, named for its tile production, two streams are present, Quebrada del Tejar, and Quebrada del Sacay, where an ancient canal crossed by a bridge is visible. The arch bridge dates back to the Spanish colonial era and is now the entrance to a house. However, it is highly likely that the Spaniards followed the path of the pre-existing Inca canal finishing at Pumpungo Museum. Therefore, the bridge, now walkable, in an undefined temporal space, was the course of a water channel. Residents encountered in this location highlighted the lack of maintenance of the natural stream. Additionally, direct discharge of dirty water damaging its cleanliness was observed.

In the Area of Parque de los Eucaliptos, a canal flowed, now it is hidden by recent urban intervention for park regeneration. In this place, residents, including a professional architect, confirmed the existence of a stream, visible until the regeneration works.

In the northest of Cuenca, Totoracocha, where the Colosseum now stands, was an area that housed a sacred lagoon

called Viracochabamba. This lagoon area fed the Culca water channel, previously known as El Regadío, descending through irrigated agricultural lands, carrying water to the central streets, and finally to the river.

In the same area, La Dolorosa Water Channel, originating in Checa, accompanies the Machángara River through the old Hacienda de Hortensia Mata, still irrigating the northeast part of Cuenca.

graphic 7: the physical memory map we brought to the on-site observations.


Quebrada de Shirnicay
LA COMPAÑIA
Quebrada de Mirtirafibres
Q. Arrayan
Rio Machangara
Quebrada el
TURI
Biblioteca

Qgis map
Open street map server
On site observation
Hyphotetical reconstruction of the stream path from oral stories
Datas from historical maps
Datas from digital maps_unsure

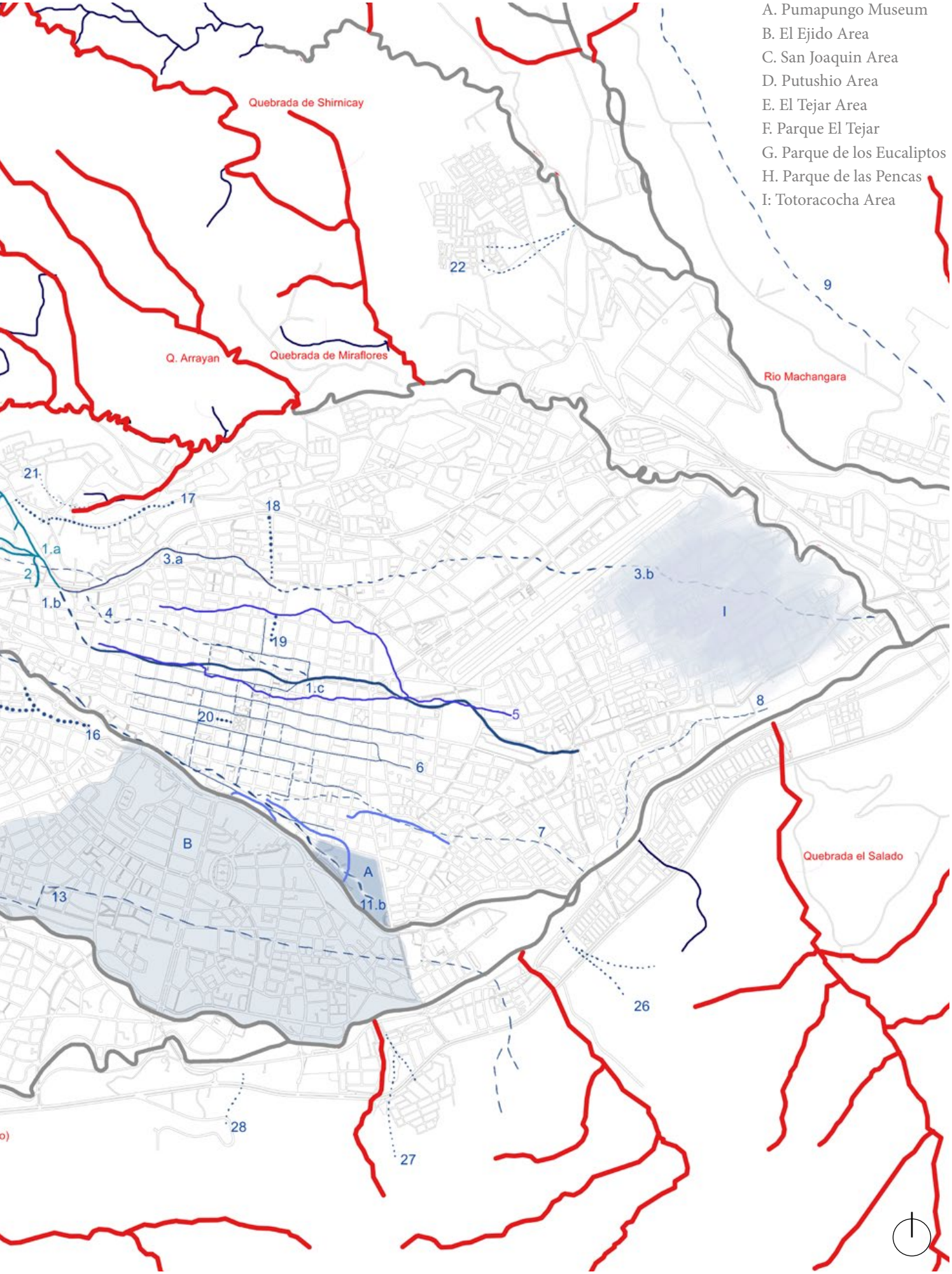
On site observation
1a. Beginning of la quebrada El Gallinazo
1c. Market 9 de Octubre, remains of the streams preserved by the municipality in the parking under the market
2. Quebrada del Molino (?)
11b. Canalization in the Pumpaungo site
20. Hyphotetical stream (or well)

Hyphotetical reconstruction of the streams path from oral stories
1b. Hypothetical continuation of El Gallinazo
3a. Quebrada de Cullca/ El Regadío
3b. Hypothetical continuation of Quebrada de Culca/ El Regadío
4. Hyphotetical stream
7. Hyphotetical stream
8. Hyphotetical stream
9. La Dolorosa (?)
10. Filtro
11a. Hyphotetical beginning of Quebrada Chanchaco-Guataná, finishing in the Pumapungo Area
12. Hyphotetical stream under the park_resident story
19. Hyphotetical stream (or canal) in the Manzana
22. Hyphotetical stream
23. Hyphotetical continuation of the stream
24. Hyphotetical stream
25. Hyphotetical continuation of Quebrada del Tejar

Data from historical maps
5. 1880 map streams
6. Spanish canalization in the city center

Data from digital maps_unsure
13. Canalization
14. Hyphotetical stream
15. Hyphotetical stream
16. Hyphotetical stream
17. Hyphotetical stream
18. Hyphotetical stream
21. Hyphotetical stream
26. Hyphotetical stream
27. Hyphotetical stream
28. Hyphotetical stream
29. Streams from map at page 18 in Oswaldo, A. Muñoz, M. J. (2013)

graphic 8: the memory map.


A. Pumapungo Museum
B. El Ejido Area
C. San Joaquin Area
D. Putushio Area
E. El Tejar Area
F. Parque El Tejar
G. Parque de los Eucaliptos
H. Parque de las Pencas
I: Totoracocha Area
Quebrada de Shirnicay
Q. Arrayan
Quebrada de Miraflores
Rio Machangara
Quebrada el Salado
22
9
21
17
18
1.a
2
3.a
3.b
1.b
4
19
1.c
5
20
16
6
8
7
B
A
11.b
13
26
28
27

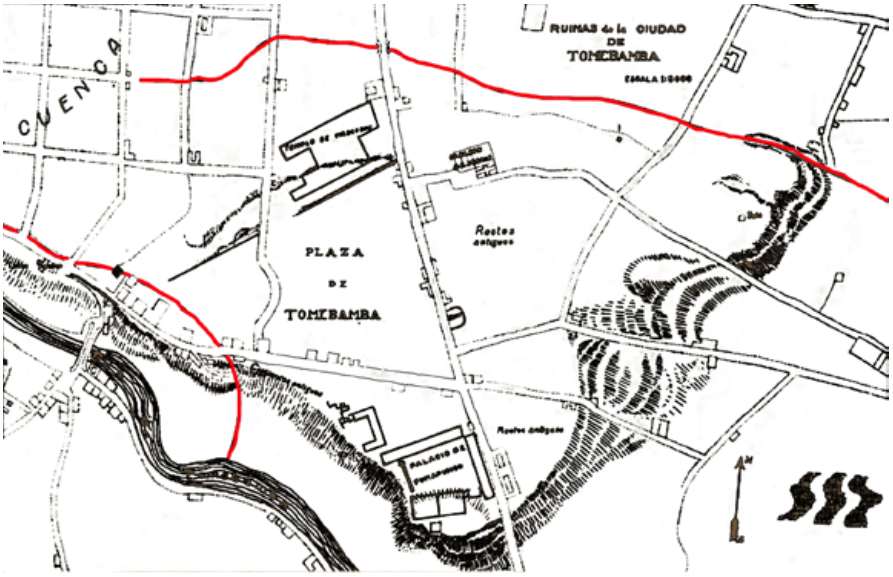
4. EXPLANATION OF STREAMS

The history of the streams in Cuenca is connected to the history of the city itself, which is complicated and tangled. The following chapter explains parts of this history; the ones relevant for our research. The chapter is not a linear timeline of Cuenca and is therefore incomplete in that sense.

The information used in this chapter comes from a variety of written sources. The maps are mainly found in two books[35,36] from the library of Cuenca; *Bibliotéca Municipal Daniel Córdova*. The books tell the history of Cuenca, via cartography. We focussed on the maps who displayed streams in -and around- the city center. Especially how and when they were portrayed is of great interest for the investigation.

35. Albornoz, B. (2008).
36. Rodriguez, R. Ochoa, G. Espinoza, I. (2020).

The initial empirical documentation of Cuenca dates back to the 16th century, before the Spanish colonization. This historical map provides a visual depiction of the city's configuration, capturing a moment during, or immediately following the Incan era. Notably; the prevailing road network and the strategic placement of significant Incan structures.[37]
The río Tomebamba is visible, as well as the oldest stream, the Gallinazo.



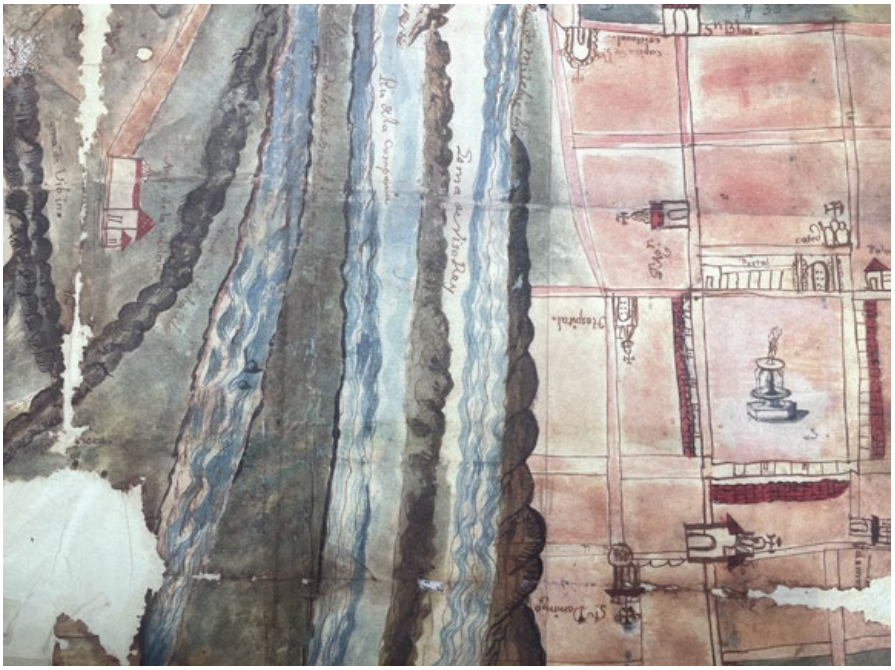
graphic 9: Ruins of the Tomebamban city.

37. Goldberg, M. (n.d.).

Of particular importance is the connection from the Incan city to the Río Tomebamba, highlighting the centrality of water resources in that urban landscape. This archival representation thus serves as a valuable resource to the historical note of Cuenca, shedding light on both its spatial organization and the cultural importance attributed to water management during this period. The remanence of these buildings is still visible in the Archeological park of Museo Pumapungo.

graphic 10: The prime relic: a canal built by the Incas to transport water from the río Tomebamba to the city.

With the colonization of the Spaniards, the landscape of the city changed drastically. The Spanish king Charles V changed the organic city plan to an orthographic one. In the cartography we can also see a big change. The main focus is put on the streets and the buildings. The rivers are always present, but the streams often get lost on the plans.[38]

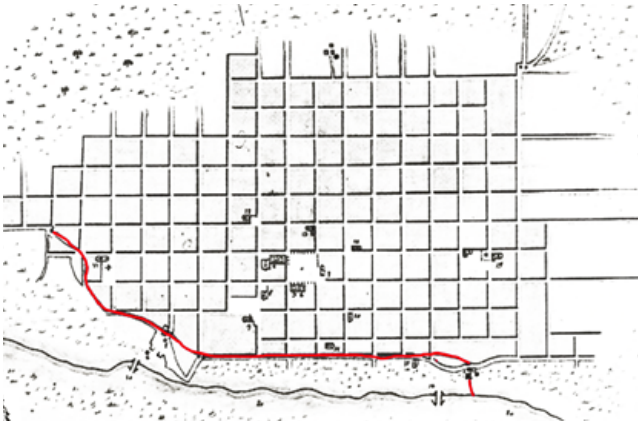


graphic 11: Representation of the lands in Sidcay, a parish in Cuenca (1538)

38. Albornoz, B. (2008).

On November 3, 1820, Cuenca gained its independence from Spain. Ten years later the Republic of Ecuador was born. With this great change, a lot happened for the city planning. The population almost sextupled within 40 years.[39]

This expansion is best visible in the north of the city. Remarkable is the big stream in the north of the center, the Gallinazo. It remains unclear why only the Gallinazo is drawn, and the other streams in the center are not (such as the Quebrada del Chanchaco).

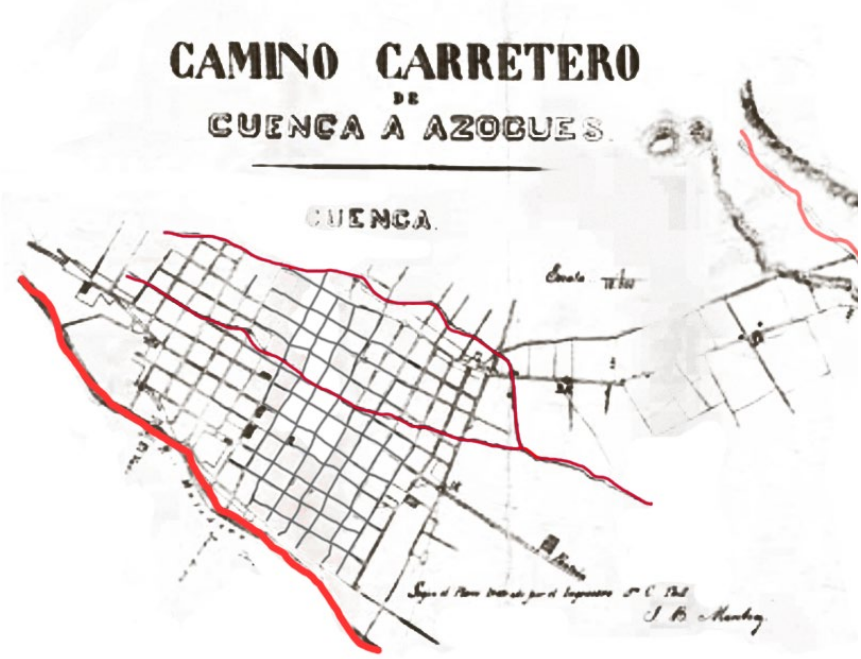


graphic 12: Cuenca during its big expansion. The grid is still dominant in the city planning.

graphic 13: Topographic plan of the city of Cuenca before the big expansion.

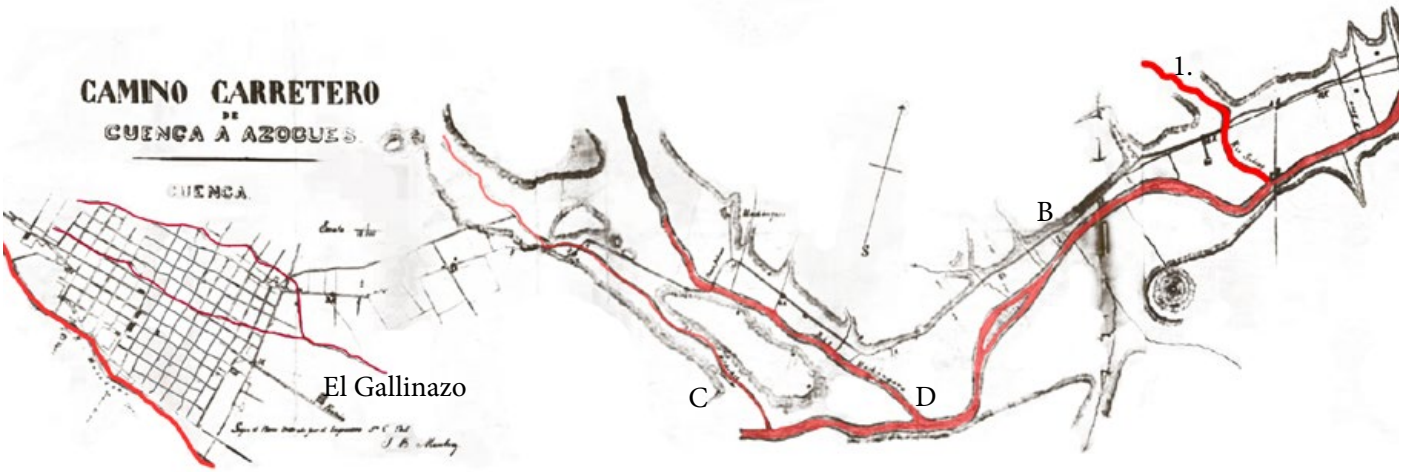
39. GK. (2011).

In the year 1880, only two years after the previous map, this significant cartograph was drawn. View through an urbanistic lens, this representation of Cuenca may be less intricate compared to its counterparts, lacking details. Nevertheless, there is one big stream visible which is not visible in any other map of that time period. It is unclear why they decided to put the stream this dominant in the picture, but left out the other ones.



graphic 14: Zoom-in of the engineering plan of Cuenca (1880).

1. Sidcay
B. Tomebamba
C. Milchichig
D. Machangara



graphic 15: Engineering plan of Cuenca (1880).

With the modernization of Cuenca, comes the need for running water and electricity in the beginning of the 20th century. The city dug canals and asphalted the streets. Remarkable are two streams, only half drawn. When the stream meets the street, it disappears.
Today these canals often form problems on construction sites. They are very old and can not always provide enough water for the need. Therefore they are sometimes enlarged and/or modernized.

On this historical map the old and modernized canals are visible. At first sight this does not appear an interesting map, but the very straight lines combined with the more organic lines is something unique. Probably they were not only canals, but also part of streams.

graphic 16: Zoom-in of the engineering plan of Cuenca (1880).

graphic 17: Construction site where an old canal is visible.

Around 1950, the city begins its complete modernization; construction of the airport, big highways and building blocks. The grid disappears in the new parts of the city, together with the streams, who have little to no importance left for the urban planners. In maps the streams are no longer visible inside the city center, only the rivers.

graphic 18: Plan of Cuenca today.

insight

Learning to understand the urban history of the city of Cuenca, helps with understanding the history of the dissapearance of the streams in the city. Investigating the unique and antique maps provided information on the names, and location of streams. Often these streams currently no longer extist, but they form a good base for a baselayer of information.

5. CATEGORIZATION

Following extensive research involving text analysis, examination of historical maps, on-site visits, and discussions with local residents, a substantial amount of information has been gathered. The focus now shifts towards developing a methodology for the systematic exploration of various streams, categorizing them on different characteristics to clarify their evolution over time in relation to the city's expansion. The analysis has unveiled three main categories: covered streams, channelized streams, and natural open streams.

natural streams

Natural streams, originating from the Andes mountains, follow a natural course on the outskirts of Cuenca. However, as they approach the city centre, these streams undergo transformation, gradually being covered or channelized to prevent contamination and diseases.

The expansion of the city has led to growing neighbourhoods around watercourses. Although the wastewater system in Cuenca is of a high quality, we noticed specific situations where the sewage drain goes directly into the natural streams. The first picture on the next page represents Quebrada Sacay and specifically a pipe from a residential unit intruding the natural flow of the stream. Despite this drawback of urbanisation on natural streams, it is necessary to recognise their inherent benefits. They play a crucial role as effective absorbers, especially during the rainy season. This function ensures that the soil can easily absorb excess water during times of possible flooding.

The interplay of these positive and negative aspects underscores the intricate challenges in managing and incorporating natural streams within urban settings.In essence, the evolving narrative of these natural streams reflects not only the adaptability of nature to urbanisation but also for thoughtful and strategic approaches in the coexistence of human settlements and the environment. It encourages us to consider innovative solutions that preserve the ecological intactness of these waterways while meeting the growing demands of a dynamic urban landscape.

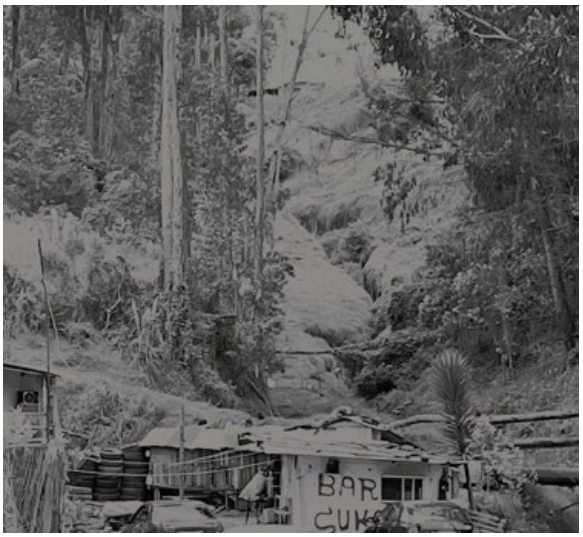
Quebrada Sacay: "*agua negra*", dirty water

Quebrada Sector Alejandro Nivelo

Quebrada Sector CEBCI

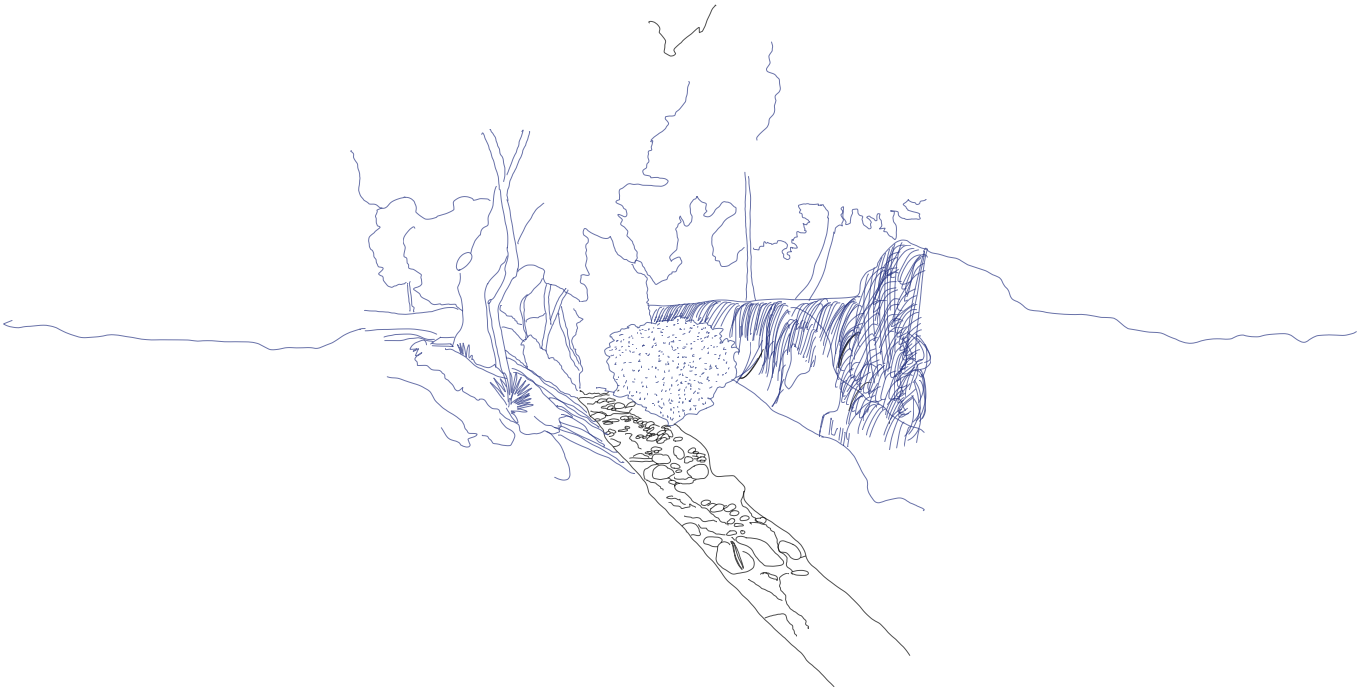
Quebrada Sector Monay Paccha

Quebrada Sector UDA

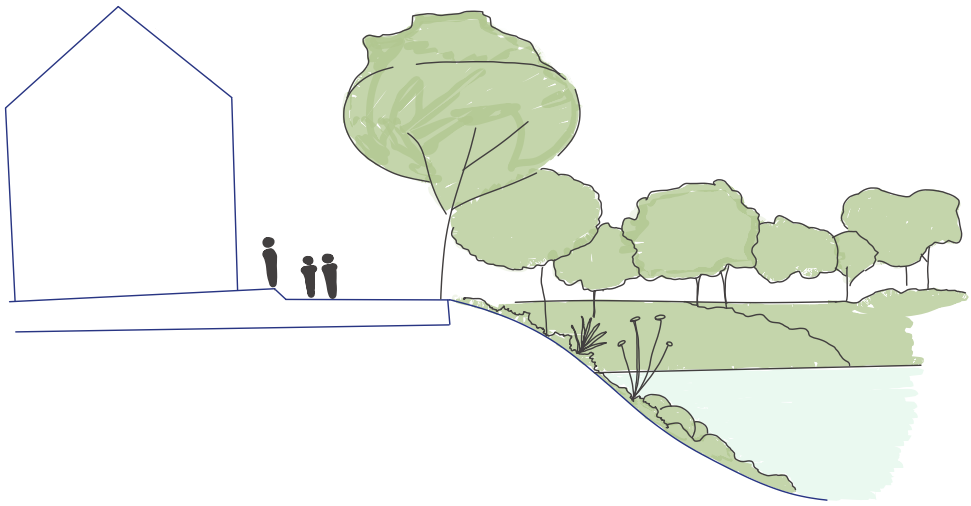


El Gallinazo

graphic 19: Natural stream.



graphic 20: Natural stream.



graphic 21: Natural stream.

covered streams

The second category involves streams that are completely covered and whose exact geographical location is unknown. Our understanding of these hidden waterways is based on historical sources, including texts, old maps, and oral accounts that vividly recount childhood experiences of playing along these hidden streams. Despite the wealth of historical knowledge, the present reality reveals these streams are hidden under asphalt roads, in uncertainty regarding their current flow status.

The lack of visibility raises questions about whether these watercourses still maintain their natural flow or whether they have collapsed over time and are just a leftover of their historical presence.

Observations draw attention to striking similarities between these fully covered streams and areas vulnerable to flooding, further indicating their historical significance in the hydrological dynamics of the city.

While mapping these fully covered streams involved considerable challenges, the acknowledgment of this category does not take this research further. The decision to hold up further research does not distract from the importance of these hidden waterways, but underlines the complexity and limitations inherent in uncovering the secrets of the urban landscape.

Quebrada Del Tejar

Quebrada Del Canchaco

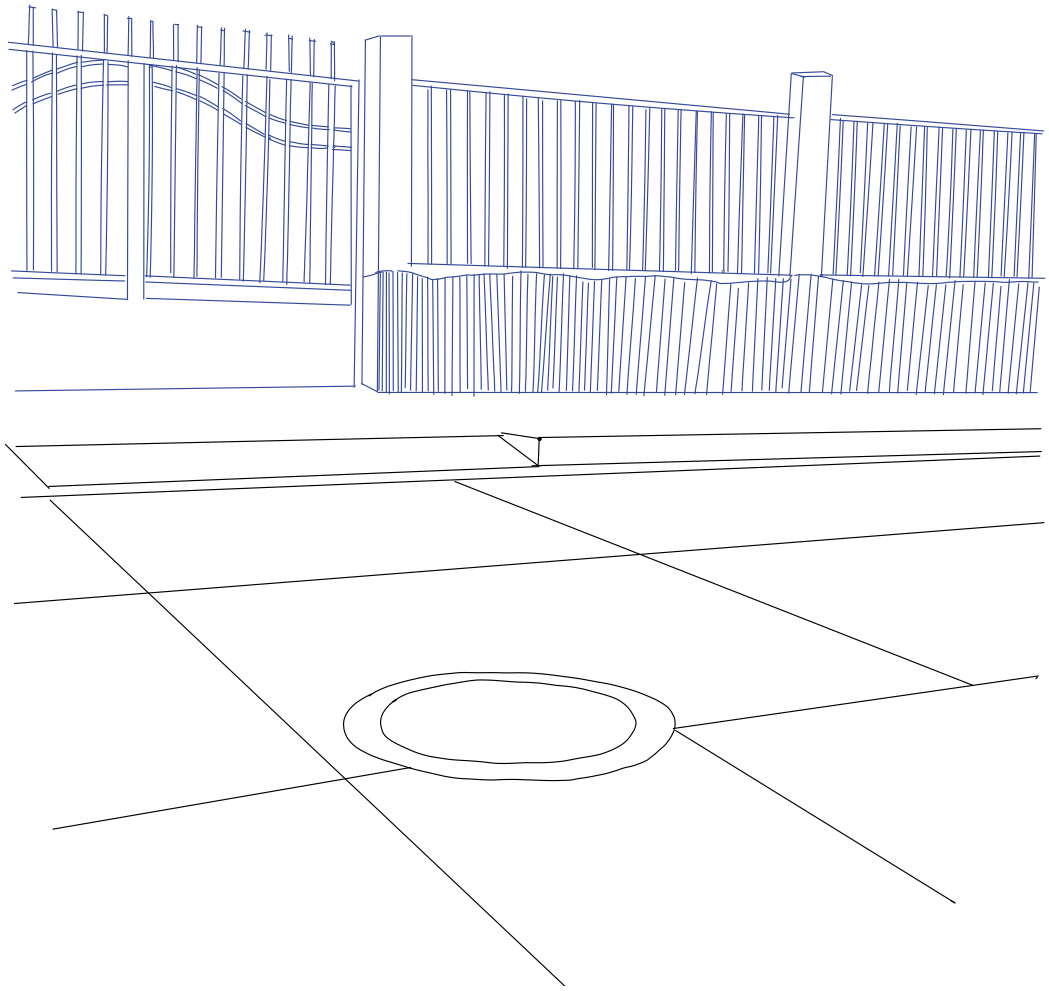
Caminos Sector Parque Los Eucaliptos

Quebrada Sector Subida al Valle

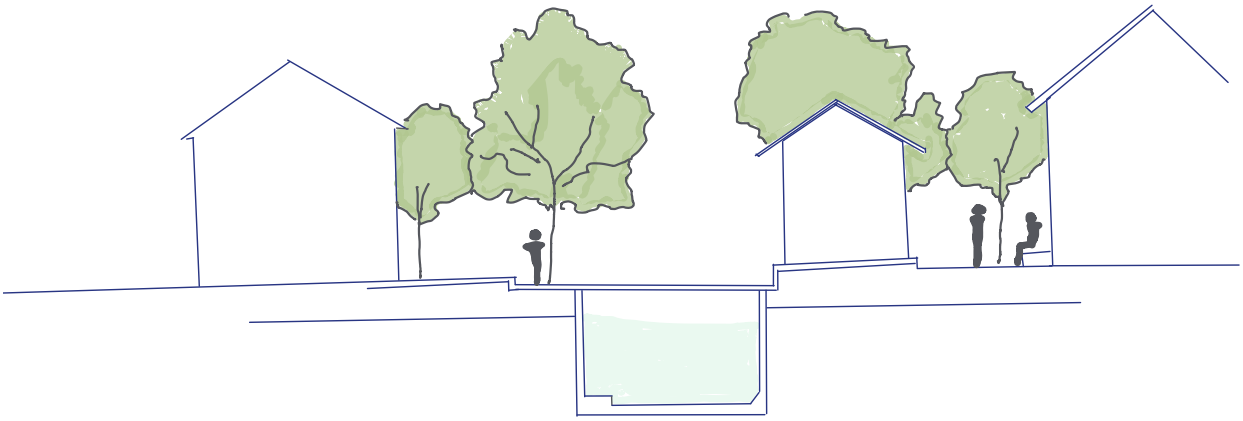
Quebrada de Cullca

El Salado

graphic 22: Covered stream.



graphic 23: Covered stream.



graphic 24: Covered stream.

The third category involves channelized streams, characterised by the application of concrete surfacing, thereby introducing specific challenges, particularly during the rainy season. The deliberate diverting of the natural stream's flow into a structured, rectangular channel initiates a process that, unfortunately, results in elevated water pressure, subsequently leading to a spectrum of water-related issues, most notably flooding.

In the complicated interplay of urban development and water management, the decision to channelise streams is an important intervention. An illustrative example of this deliberate diversion can be found in El Salado, a stream originating 'from Baños and strategically closed off from De Las Américas Avenue'.[40] What was initially intended as a solution to reduce potential problems has ironically, over time, contributed to worsening water-related issues in the region.

The consequences of channelisation extend beyond direct technical considerations. By forcing a rigid structure on the natural course of streams, the city unintentionally amplifies the challenges posed by natural elements, especially during periods of high rainfall. The seemingly simple solution of concrete channelisation, implemented with the intention of directing the flow of water, ultimately leads to a scenario where the inflexibility of infrastructure clashes with the dynamic nature of water, with unintended consequences.

Moreover, the decision to channelise streams reflects broader patterns in urban planning, illustrating the historical path of decision-making in response to growing urbanisation. The irony lies in the unintended outcomes resulting from these interventions, which highlight the need for a more nuanced and forward-thinking approach to water management in urban landscapes.

40. Mendieta. (2022).

El Salado

Quebrada Sacay

Quebrada Sector CEBCI

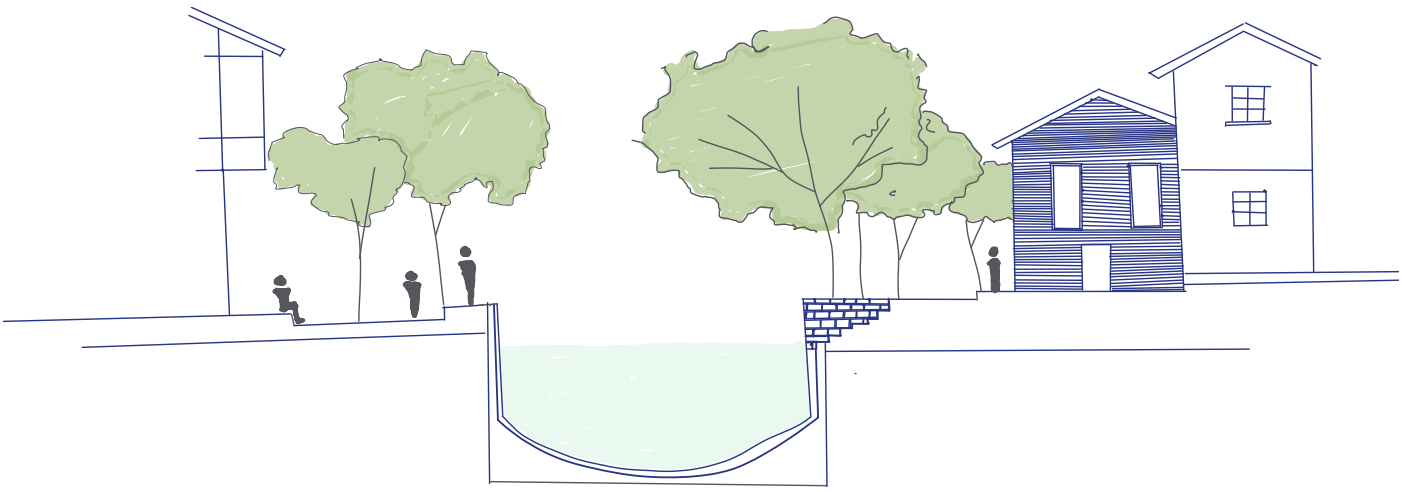
Quebrada Sector Monay

Quebrada Sector Ángel Paredes

El Salado

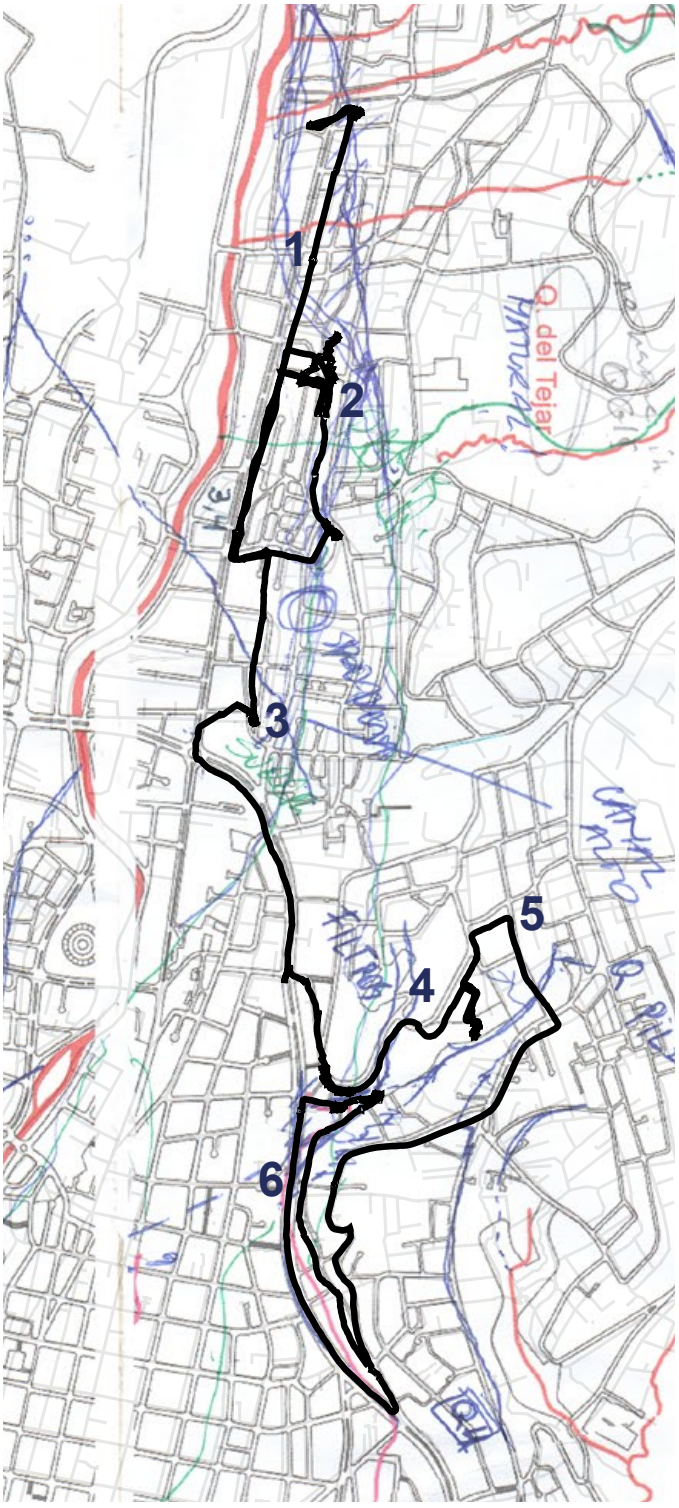
graphic 25: Channelized stream.

graphic 26: Channelized stream.



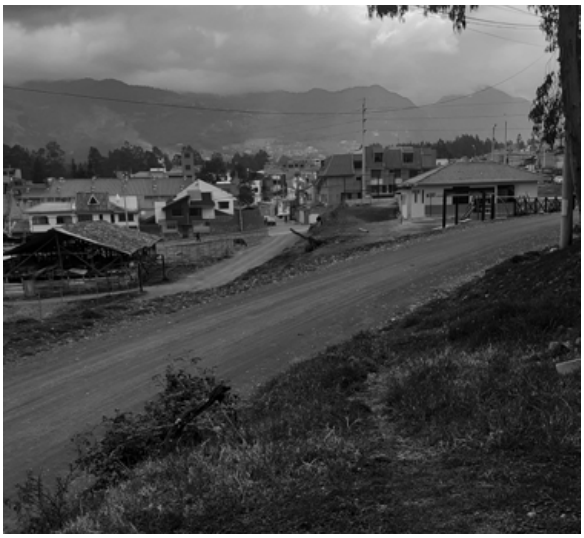
graphic 27: Channelized stream.

exploring and observing diverse streams



graphic 28: Registered route from the on-site visit

1. Quebrada Sacay
Channelized



2. Quebrada del Tejar
Covered

3. Caminos sector Parque los Eucaliptos
Covered

4. Quebrada del Molino
Natural

5. El Gallinazo
Natural

6. Quebrada del Molino
Natural

graphic 29: Observing different streams.

6. INTERPRETATION OF MAPPING

The structured distinctive categories within the methodological chapter, consist of arranged classified maps that rely on our author's interpretation of all the information collected during our research. Based on this information we have plotted our choice and extracted our focus on the categories we consider first in terms of the range of influence associated with "quebradas", such as:

Floods
Climate change
Watershed condition
Name and use of the streams
Geomorphological changes
Artificialized drainage network
Urban spot change land use
Vulnerability
Urbanization

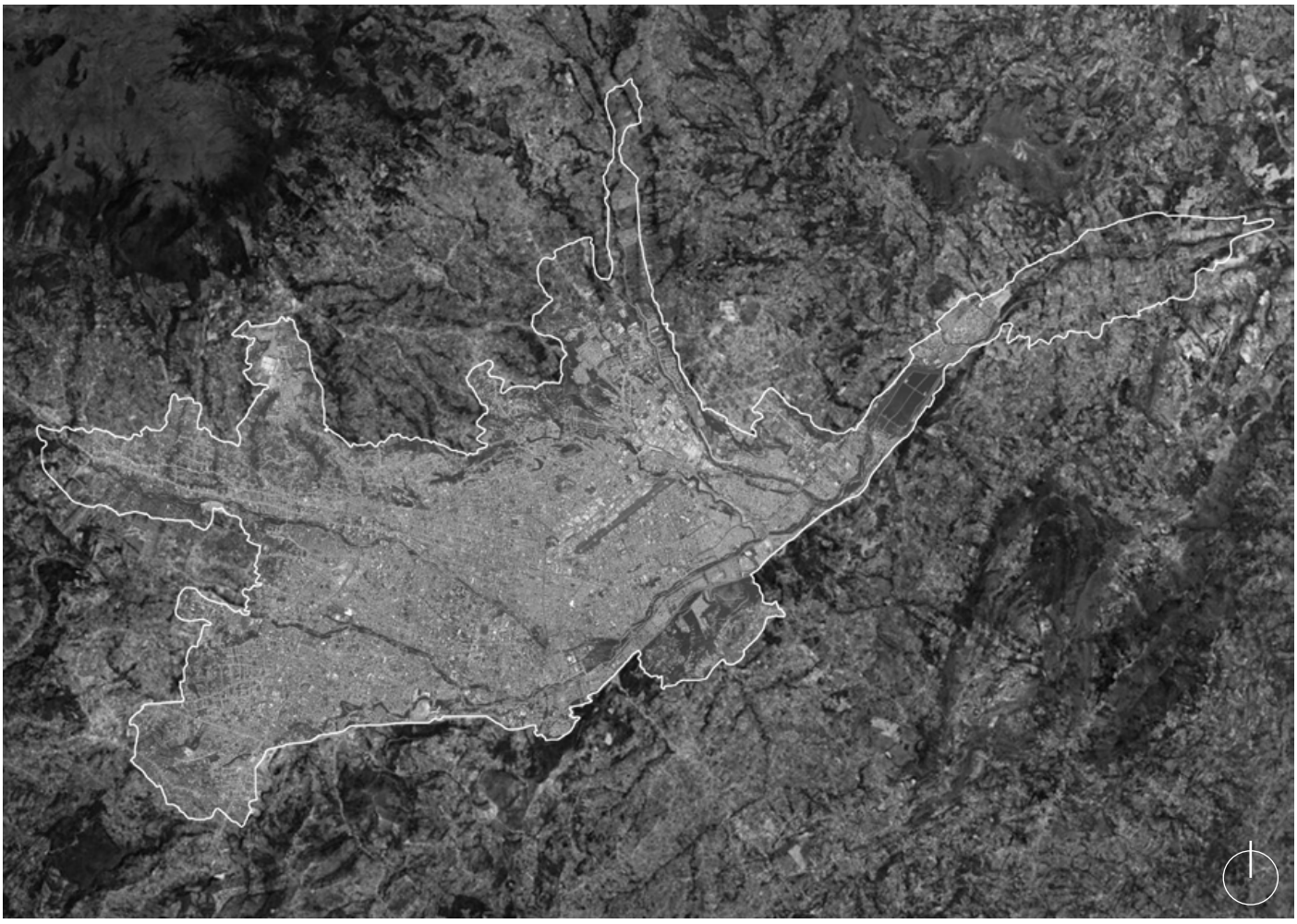
The information considers the primary (libraries, physical archives, digital archives, photography, on-site observations, local testimonies) and secondary sources (literature review). We delved into books, perused original maps, and immersed ourselves in the visual narratives captured by historical photographs. Moreover, to enrich our understanding, we engaged with indispensable oral stories shared by locals. However, due to the limited time of our presence in Cuenca, we were not able to make all the necessary on-site visits to recall all the traces we found on historical maps. Expanding our knowledge beyond the historical archives, we implemented online sources. The integration of QGIS precision allowed us to unravel the intricate layers of Cuenca's urban fabric, overlaying it with an anecdotal "Memory Map".

The following chapter represents our understanding of the aforementioned sources and consequently, extracted what we found valuable to be taken into account in the next actions of the research group LlactaLAB with other professionals.

This holistic approach enabled us to synthesize a comprehensive understanding of the profound influence water wields over Cuenca's fragile urban landscape including its waterways. Armed with this newfound knowledge, we embarked on the creation of interpretive maps, overlaying together the data collected from our internship experience with insights from a diverse array of existing maps. The result is a visual atlas to the symbiotic relationship between water and urbanism in Cuenca, a narrative born from the fusion of historical information and contemporary mapping possibilities, including the memory of its locals.

We have made a distinction between the "Memory Map" and the QGIS Map, considering among others potential streams that existed in the past but which we are unsure of. We take this as the basis for our division into 8 subsections of the mapping interpretation.

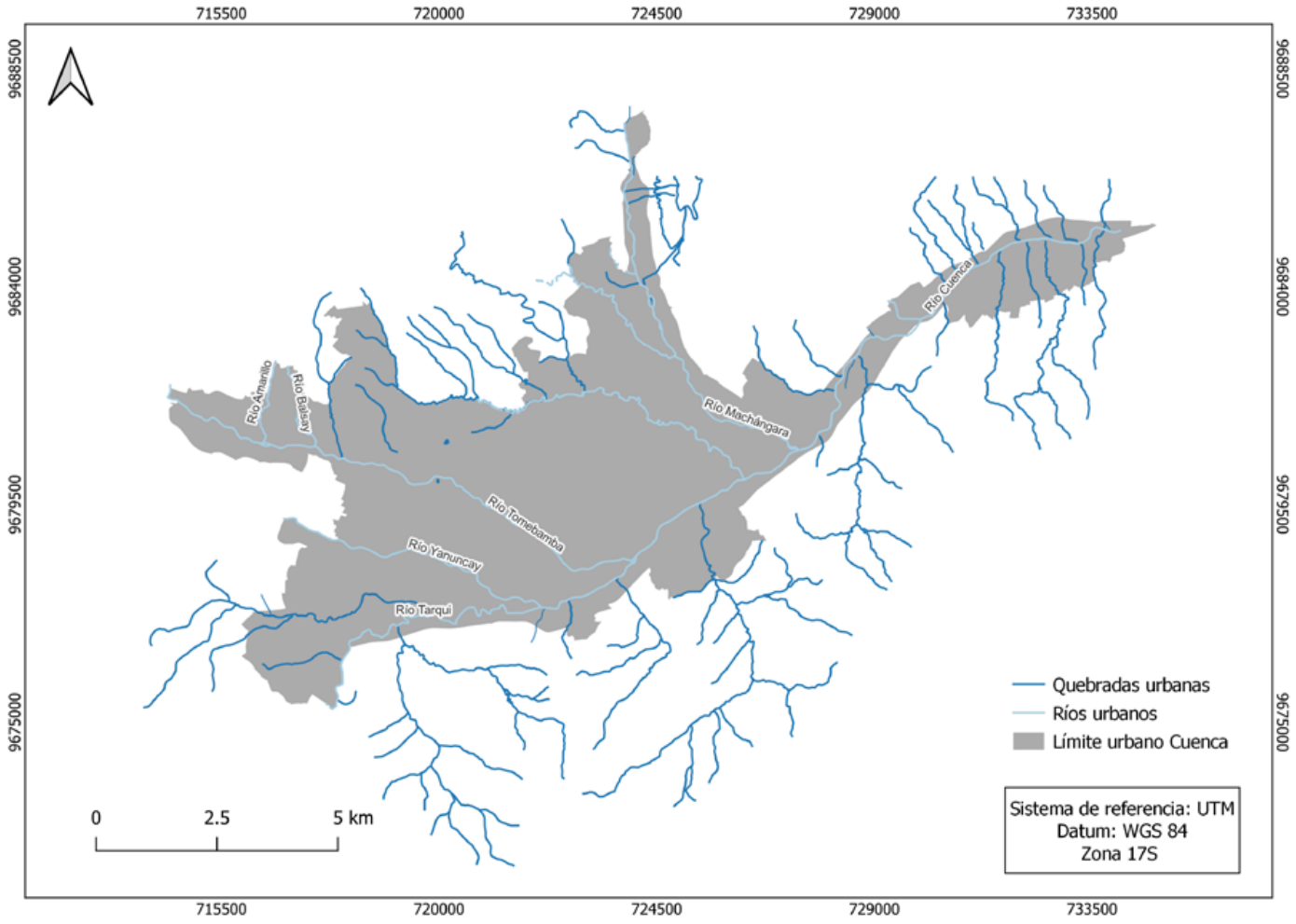
Our understanding concluded in an interpretative mapping, which is an overview of general observation combined with the collected cartography on macro- and micro-scale, the oral stories and the on-site visits. This comprehends the city's expansion, clashing urbanization approaches, the canalization processes, and flooding areas affected by the waterways and it ends with retracing of the stream El Gallinazo.



graphic 30: City of Cuenca

shift in perspective on Cuenca's water system streams

We proceeded from the map on page 77, provided by LlactaLAB, which showcases the water system within and outside of the urban limit of the city. This was our output data concerning the amount of information they collected as of June 2023. What we noticed was the proportion of streams to rivers in Cuenca revealing a significant presence of streams in the overall waterway system. Notably, the map highlights that much of the accessible information pertains to streams outside the urban core of Cuenca. The map serves as a valuable tool in redirecting focus toward streams. Despite their substantial presence, urban reconfigurations and development plans predominantly center around rivers. This emphasizes a potential oversight in urban planning, as streams, although forming a crucial part of the hydrological network, often receive less attention in official strategies. It underscores that the prevailing focus on rivers may not fully capture the complexity and importance of the entire waterway system, especially within the urban fabric.

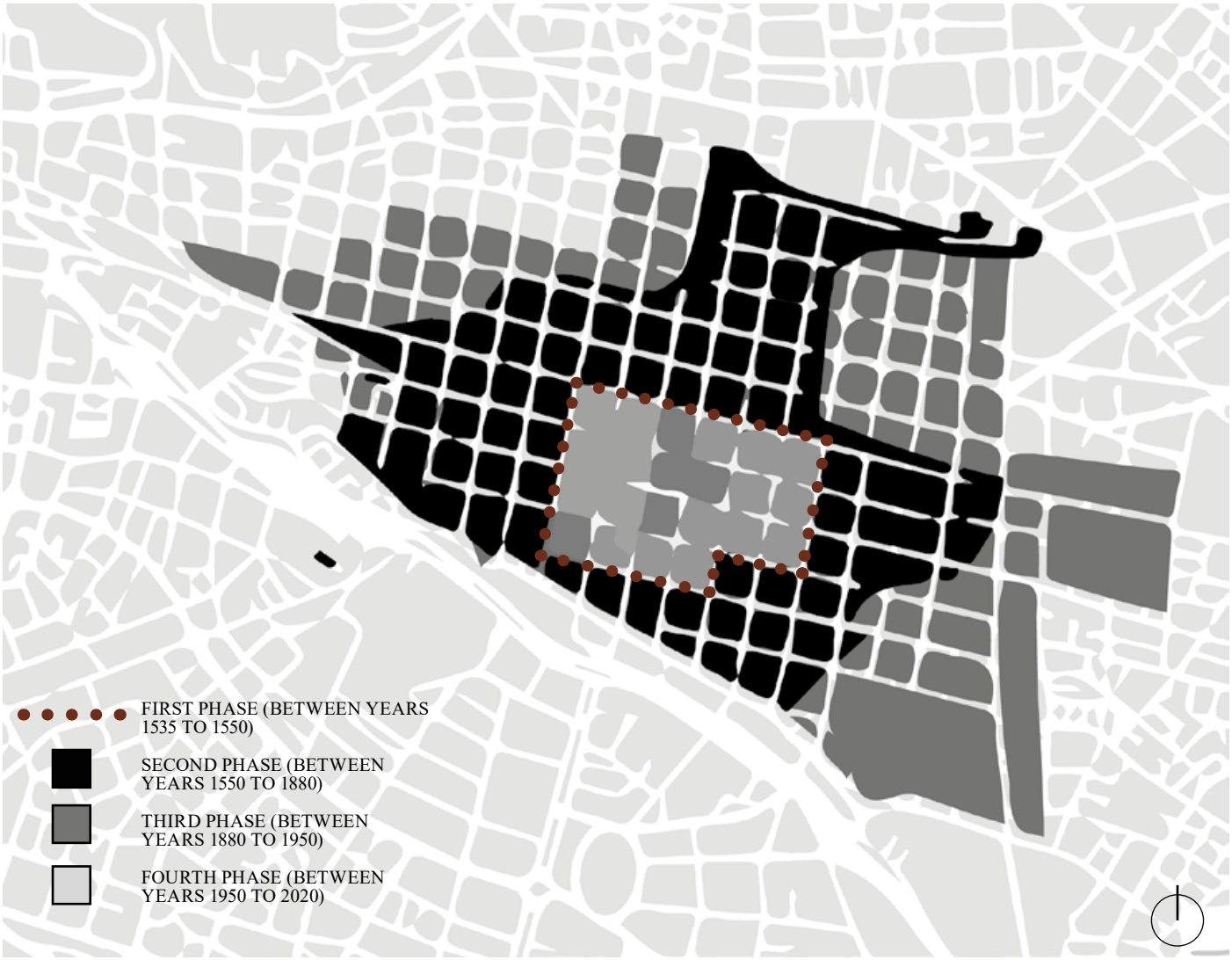


graphic 31: Registered streams outside of city boundaries created by LlactaLAB, June 2023.

urban expansion of Cuenca

To begin an atlas of Cuenca, it is necessary to understand the state of urbanization of the city. This involves recognizing that Cuenca has undergone significant expansion throughout the years. Accordingly, the map on page 79 shows its phases covering the period from 1535 to 2020. Progressive changes to the urban fabric include its inevitable densification. Breaking down the layers of expansion allows further research to provide a nuanced understanding of the city as a dynamic whole shaped by the convergence of historical events and contemporary influences. Page 79 contains a map combining the information depicted from maps of the urbanization process, which is based on a website created by the Investigation group. It involves universities such as – Universidad Católica de Santiago de Guayaquil, Universidad Católica de Cuenca, Universidad del Azuay and Ecuadorian National Research and Education Network.[41] They cooperated in organizing and generating an online website of historical maps of not only Cuenca, but also Guayaquil and Azogues, showing their urbanization process in centuries from the 16th to the 21st.

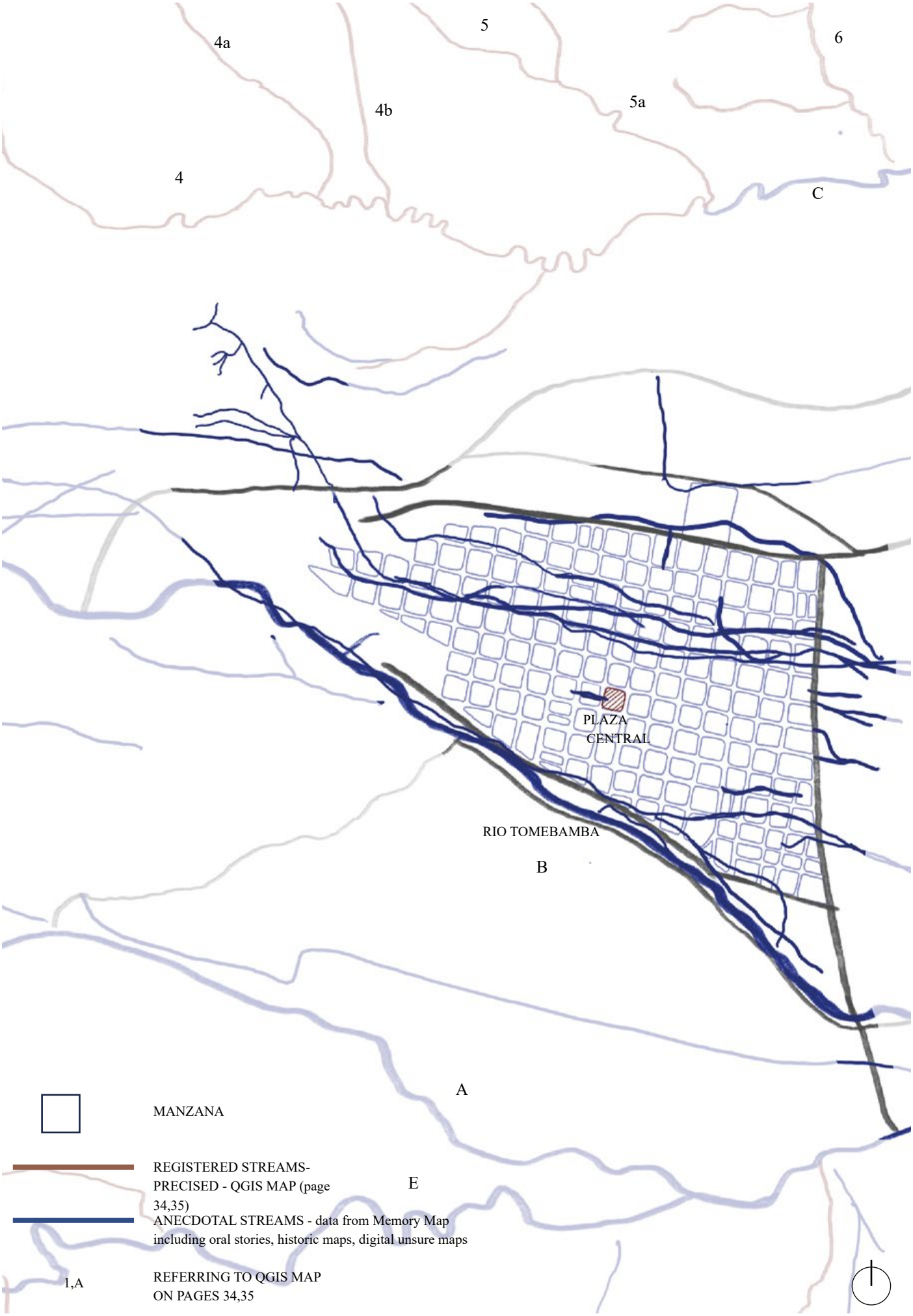
41. The created website is under the link: https://cedia.edu.ec/cartografia-historica-urbana-del-eje-guayaquil-cuenca-azogues-siglos-xv-xxi/#



graphic 32: Urban expansion in stages from years 1535 to 2020.

tracing urban patterns - “manzanas” and streams

While analyzing the map from page 81, it is noticeable that the depicted pattern of “manzanas”, which refers to “city block”, is distinguished within the historical center. Focusing on the categories, we first consider the extent to which they affect the importance of the streams. Thus, on that page, you can find a complex pattern of stream traces in the city of Cuenca incorporated within manzanas in the current state. The distinction that can be seen on the map is between streams with exact locations and those whose presence is anecdotal.

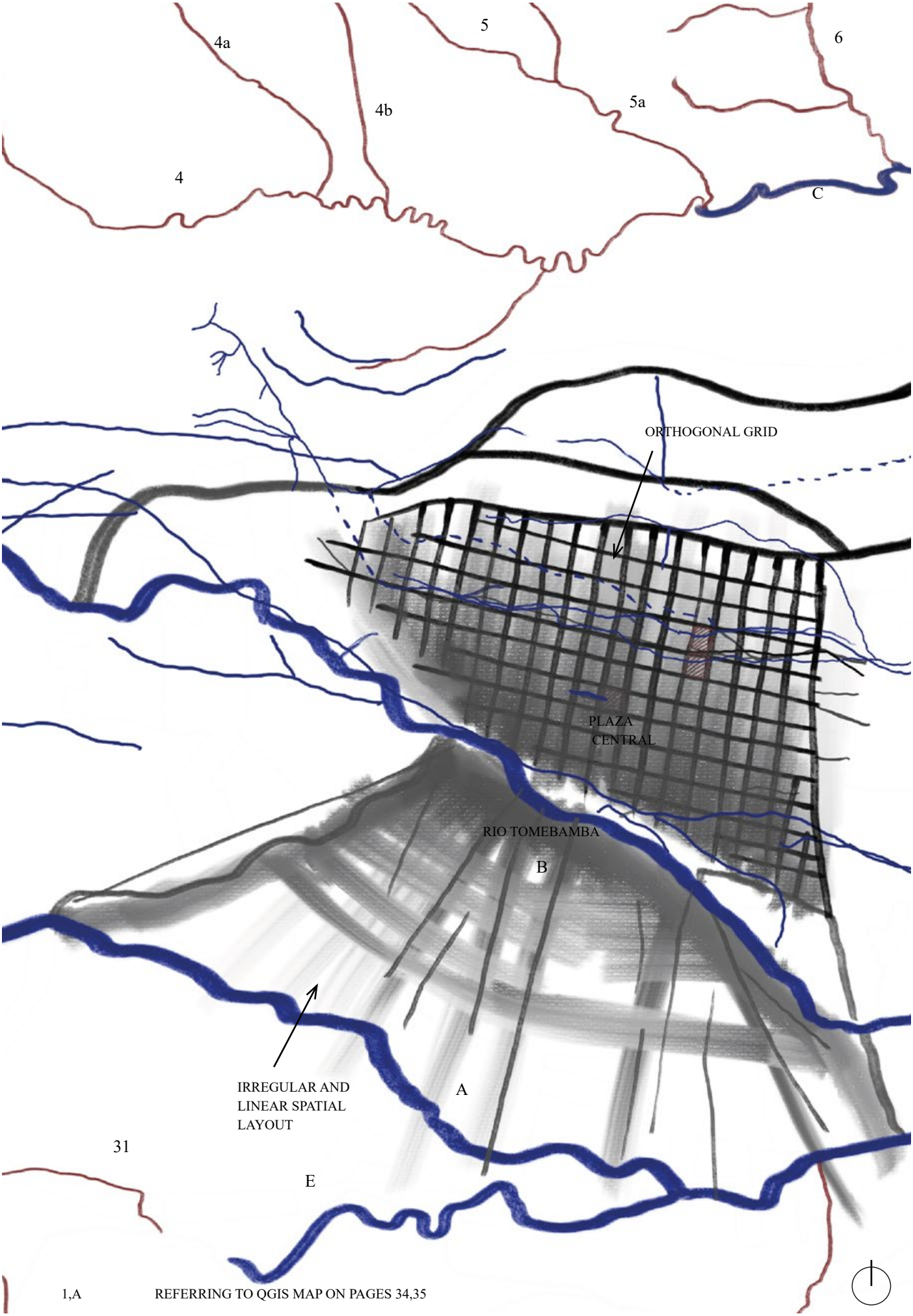


graphic 33: Streams interfering the "manzanas".

the clash of Cuenca's spatial layout

The next presents the establishment of a grid between manzanas, extending towards suburban areas. The drawing on page 83 enhances the zone of greatest condensation of this transit, where irregular south from Tomembamba River meets the orthogonal grid of the historic core of the city. This is the area where the Tomebamba River arises, but also the parallel irrigation canal that once provided the city's agricultural purposes. As highlighted within chapter 4, "Explanation of streams", the centrality of water resources in the urban landscape enhances the Tomebamba River in an urban context.

From the map the different processes of urban expansion are evident, terminating in the clash of different spatial approaches, such as linear and irregular with organized, orthogonal ones. One of our assumptions is the presence of urban streams in Cuenca could play a pivotal role in shaping land use and development patterns. These water bodies can function as natural boundaries or constraints, significantly influencing the location and density of urban development. Areas situated along these streams may be subject to specific zoning regulations, concerning fragile urbanism and designating them as protected or conservation zones.



graphic 34: The contradictory spatial layout of Cuenca.

anthropogenic influence on streams

As the creation of channels is an anthropogenic activity, it involves disrupting the natural flow of the waterway. The map on the next page points out the historical center of Cuenca, which showcases the disappearance of a notable portion of streams, evident through the integration of channelized waterways. This deliberate urban planning strategy, aligning water channels with the layout of streets, highlights a historical transformation where natural streams have been obscured or redirected beneath the city's surface. This disappearance, while reflecting the evolution of urban infrastructure, underscores the balance between preserving historical water features and accommodating the functional needs of a growing city. The information contained in the graphic is based on the cartography of Cuenca from the years around 1880.

graphic 35: The channelization of water system within historic core of Cuenca.

While mapping channel alterations changes, which result is visible on the previous page, we asked ourselves a question:

"Is a stream an obstacle, as dictates in Rotger and López's (2019) research on La Plata River, or an advantage?"

We started our research by asking questions such as:

Why do they channel streams within the historic center: To control? To prevent overflow? To be able to densify and thus enhance the expansion and urban development of the city?

To switch the focus and not concentrate on suburban and agricultural development?

How does it influence the land use and other impact it has on city development?

However, through tracing the collected cartographies, we noticed orthogonal channelization within the urban historic center. Because of that, we gained insight, that the purpose of channelization was to provide water, within the historic center. Having said that, the development of the city relies not only on its expansion but also on its densification. Those decisions are effective on several levels. Those that we can already delineate now make some topics, discussed, among other things, in the previous section on types of categorizations, more feasible. Mentioned biological categorizations and geomorphology concern the stream's bedding – sedimentation dynamics and its wall's materiality. Contrasting such information with on-site observations and oral stories of flooding - the focus should be on considering whether these measures are living up to their hopes, or whether they are resulting in problematic flooding, as outlined in the subsection called "floods" on page 89.

visibility versus invisibility of the streams

The understanding of streams in Cuenca has evolved, creating a dichotomy between two types: invisible and visible. This division reflects the current physical state of streams in the urban landscape, each type representing a distinct aspect of their existence.

The first type, invisible streams marked on the map on page 88, signifies the potential existence of these water bodies beneath the ground. These streams may not be readily visible on the surface, as they might be channeled through underground conduits or covered by urban infrastructure. The invisibility of these streams does not negate their significance; instead, it underscores the complexity of urban development and the integration of streams into the city's infrastructure. Invisible streams may continue to play a crucial role in Cuenca's hydrological system, influencing water flow, and drainage, and potentially even serving as conduits for sewage systems. Their concealed presence beneath the urban fabric highlights the relationship between natural water features and the built environment. Understanding and acknowledging the existence of these invisible streams is essential for effective urban planning, environmental management, and addressing potential challenges associated with their hidden pathways.

On the other hand, visible streams represent those that remain on the surface, traversing through the cityscape in plain view.

graphic 36: The division of the streams into visible and invisible.

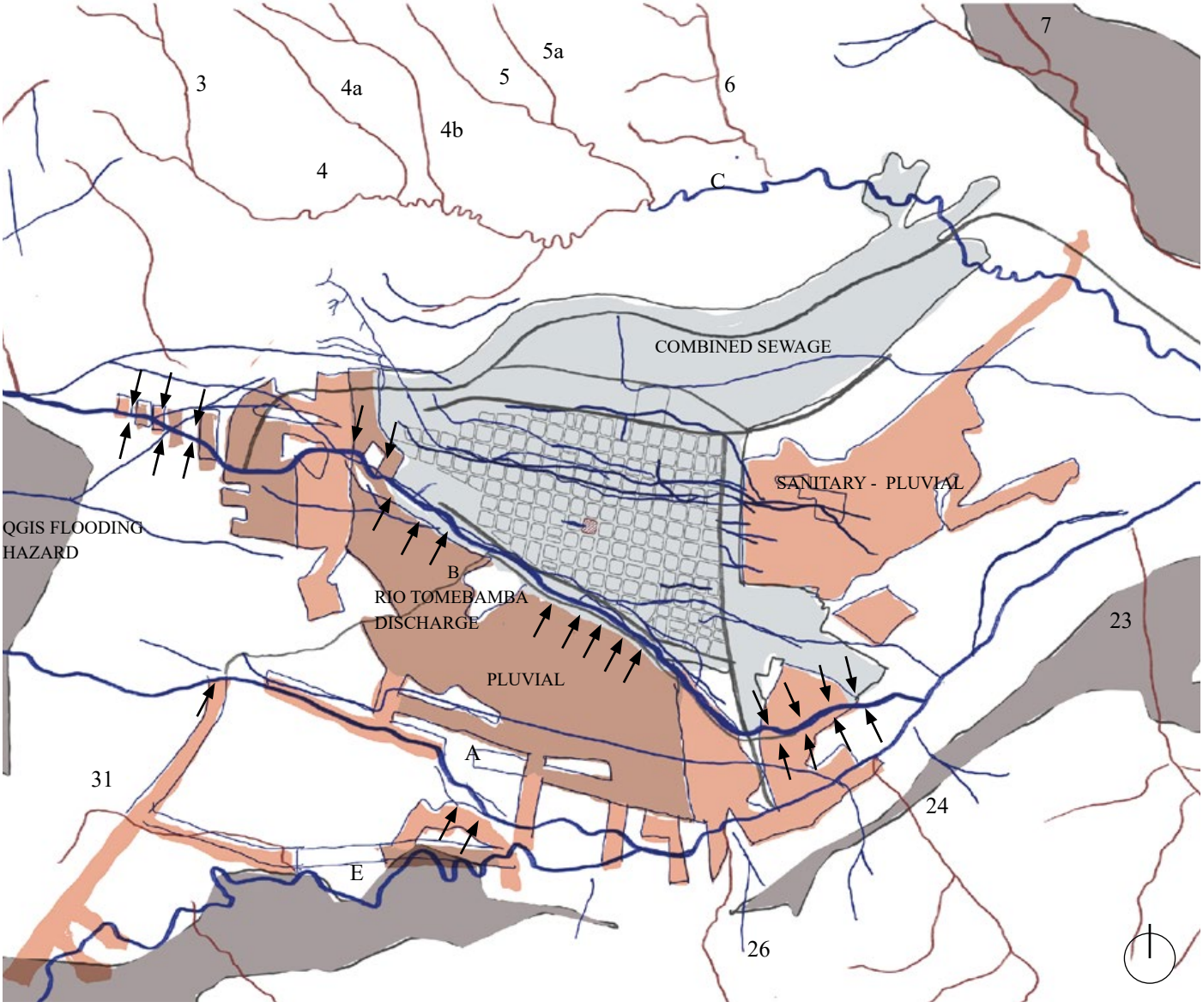
Channel alterations are common in urban areas, addressing specific issues related to flood control or maximizing land use. The map presented on page 91 pertains to El Ejido area, once characterized by salt flats, swamps, and lagoons. It still retains traces of an ancient water channel. Flooding occurs mainly in suburban areas, about which the news[42] and other forms of transferring oral stories inform us. Furthermore, the information compared with depicted flooding zones outlined on the maps found in physical archives had coverage when it came to the use of the land, namely El Ejido and San Joaquin neighborhood with the canal for agricultural purposes continuing parallelly to Tomebamba river.

Overlaying flooding potential zones, presented on page 91, onto our research adds insight into challenges faced by residents in marked areas. Examining flood risk in specific zones, as illustrated, offers a focused perspective on the potential hazards associated with these regions. In this context, the categorization analysis of riparian zones, as discussed in chapter 5, becomes crucial.

42. Floods altered basins of four streams that feed the Tomebamba River (primicias.ec), news accessible via this url: http://elmercurio.com.ec/2023/04/08/lluvias-inundaciones-sectores-cuenca/

The identified flood zones require verification, as our ability to track detailed information is limited to physical archives. Digital records provide a more generic overview and are primarily available for suburban areas with the highest flood risk.
The found cartography implements division for sanitary, sanitary - pluvial and pluvial effects, which showcases points of discharge. Moreover, the dirtiness of polluted water enters the natural flow of the stream, when the main issue is the lack of maintenance, causing water to back up and even disappear locally.
Another example stands for the renovation of Parque de los Eucaliptos with the consequence of covering the water flow that was going through it before.

The future integration of (as the process is not yet finished and must be elaborated in the future) illuvial and alluvial landscapes into our analysis further emphasizes the dynamic nature of the terrain. Movement within these landscapes is connected to the overall understanding of flooding risks and how they intersect with land use. This holistic approach, encompassing flood risk assessment and the analysis of riparian zones, provides an overview of Cuenca's urban landscape dynamics. It not only identifies potential challenges for residents in flood-prone areas but even provides more valuable insights for sustainable urban planning and risk mitigation strategies.

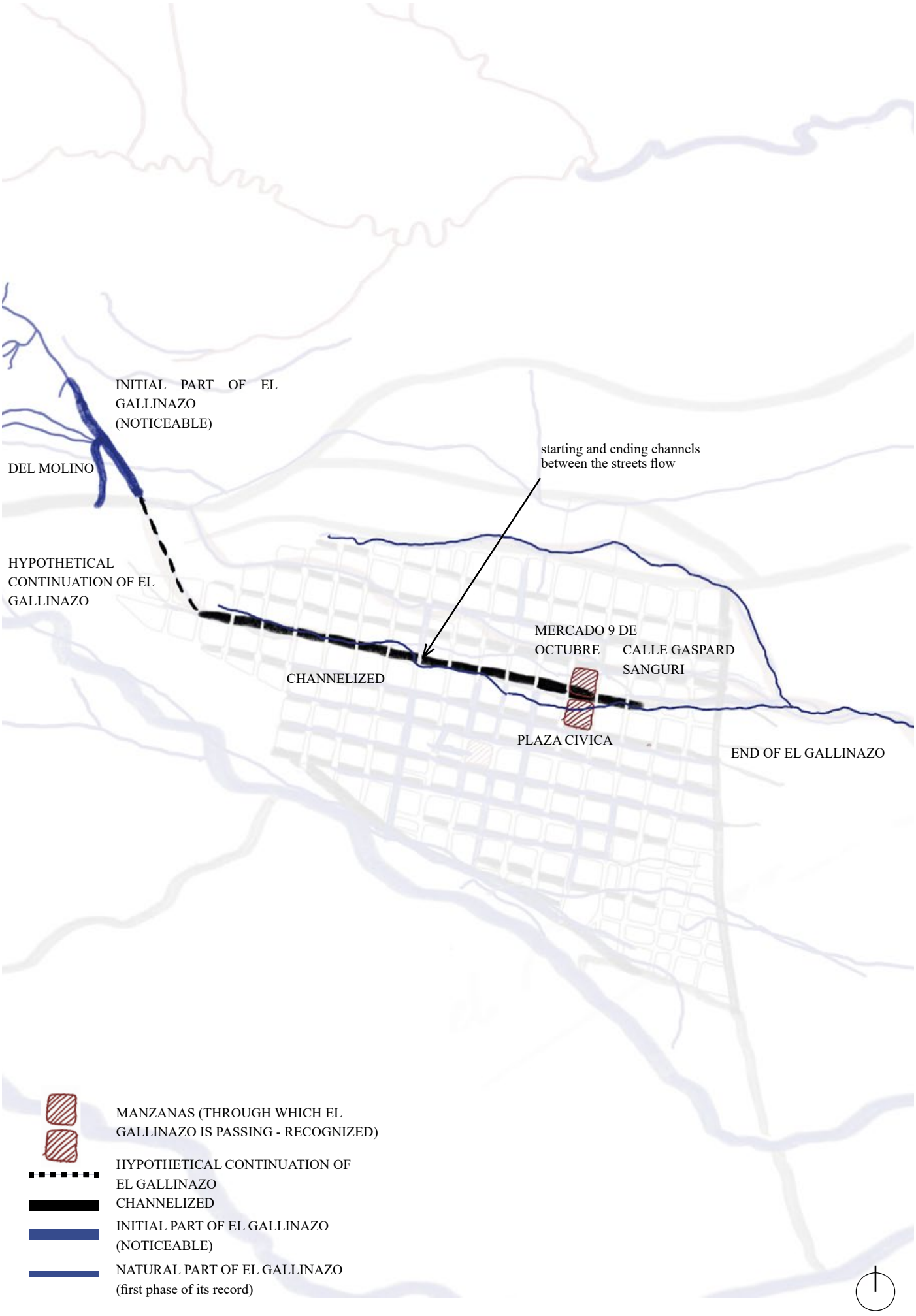


graphic 37: The potential flooding zones.

zoom in on the unsure stream

Despite the historical shifts and modernization efforts that have altered the visibility of streams, some of them remain present in the open constituting water bodies as "a waterbody is any significant accumulation of water on the surface", as if it is presented within the Categorization chapter recalling El Salado. These visible streams serve as a tangible reminder of the city's hydrological heritage and continue to contribute to the aesthetics and ecological diversity of Cuenca.

Recognizing the duality of invisible and visible streams is crucial for an understanding of Cuenca's hydrological landscape and for informing sustainable development practices that balance the needs of urban living with environmental preservation. Another stream we found important to analyze is El Gallinazo, featured already throughout this report, of which routes have been obscured or partially are no longer visible. Thus, on historical records, it is not fully clear if they refer to different streams or the same one. Moreover, the stream is an example of the condensation of all the subsections we have discussed up to this point. We traced the potential flow of El Gallinazo, while understanding that it is a distinct stream, which is one of the natural streams influenced by the orthogonal channelization presented earlier, within this chapter, visible on the next page.



graphic 38: Retrace of El Gallinazo flow.

On the map on page 93, we show the key points we collected as on-site observations, indicating the exact locations:

Del Molino with the natural beginning of the stream left to be open.

Mercado 9 de Octubre, is a significant location registered by the municipality.

As we approached the site, we were able to get a glimpse of the elusive path of the stream through the glass cover. Municipality records validated its presence by securing the remnants of the historic canal within a parking area situated beneath the market.

Furthermore, it covered traces within Plaza Civica, continuing reportedly through Calle Gaspard Sanguri. Despite the fact we couldn't physically witness the stream at this location, we gathered oral stories about its existence. Our assumptions led us to believe that the natural course has succumbed to the urban landscape, hidden beneath the asphalt and structures that now define the street.

7. CONCLUSION

atlas of proposals

This Atlas of Proposals is a summary of the research we did during six weeks at the University of Cuenca, Ecuador. Through the described methodology we researched the streams of Cuenca, via primary and secondary sources (literature review and historical maps), physical observations existing out of interviews with locals, and on-site observations. The information is organized in the collectively prepared system and furthermore processed into the Memory Map and the QGIS Map, which constitute a baseline for the future of the project.

Mapping these streams is a broader need to address urban challenges coming within the mentioned fragile territories. Flooding is already a consequence of the alteration of the natural flow of the streams. Acknowledging the exact location of every stream allows us to prevent and manage present and future environmental challenges. The pluvial flood risks are affected by climate change which emphasizes the importance of recognizing the duality of invisible and visible streams for sustainable and attentive development practices.

The future of the streams is not known yet, but their validation opens the door to possible scenarios. Having said that, the overtake of the research by LlactaLAB group, through the implementation of the focus group, will delve into the recollection of the stream by taking an in-depth process with a qualitative and quantitative approach.

the future of the project

Upon completion of our internship, while working on this publication, we convened with Natasha Eulalia Cabrera, the project lead based in Cuenca. This meeting served to review and discuss the ongoing and future steps of the research group.

Researchers at LlactaLAB are exploring collaboration across disciplines, by sharing expertise to face complex challenges. The research plan is dual, consisting of quantitative and qualitative methods. In their inaugural year of research, they will focus on collecting quantitative data, diligently documenting streams, and creating forms to locate them accurately. They briefed the groups of students on the research, guided them through interpreting the forms, and after the on-site visits conducted sessions with five classes of students to assess the number of kilometers traveled, meticulously verifying the locations. At the time of writing, they have collected 1,064 streams, which are being assigned and reviewed. At the end of this assignment, the error margin will be 5-10%, verified by professionals. After a year of building up all the databases, the next step will be to incorporate them into QGIS. Moreover, each stream is registered with its sonar recording, with the intention of creating a sonar map in the future.

In the second year, taking an in-depth process with a qualitative approach, it will revolve around incorporating a focus group into the case, interviews will be conducted as part of the fieldwork. Furthermore, six junior researchers will participate in the research work. LlactLAB will develop the categorizing of the streams into five distinct groups, subsequently selecting one or two streams per category for an in-depth analysis. This phase involves considering factors such as the urbanization process, administrative impacts, stream relationships, neighboring communities, political decisions, and the determination of the natural or artificial status of each stream. Special attention will be devoted to tracking unknown streams through various tools at their disposal. This meticulous process aims to unravel the complex dynamics of Cuenca's waterways and their interactions with the surrounding environment.

graphic 39: Elle, Sofia, Justyna and Iman at the source of the streams of Cuenca: El Cajas.

The researchers working on the symposium are related to DIEP, the Research Department of the University of Cuenca that generates and disseminates scientific knowledge through studying the interactions and relationships of the population in a social and territorial environment, built from an interdisciplinary point of view, in order to contribute to the construction of a more equitable and sustainable society.

Both the theoretical and practical discourse are combined. Within DIEP, there are four smaller research groups: ACORDES, LlactaLAB - the group we were part of -, and PYDLOS.

graphic 40: II Simposio de Espacio, Población y Sostenibilidad, Group photo of all the participants of the panel conversations of the second day.

graphic 41: II Simposio de Espacio, Población y Sostenibilidad, Group photo of all the participants of the workshop of the first day, led by Natasha Cabrera.

graphic 42: Group photo with Natasha Cabrera and Andrea Sangurima from LlactaLAB.

graphic 43: Group photo with Josè Luis Espinoza.

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graphic 27: Van den Steen, E. (2024). Drawing of the channelized stream.

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interviews

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