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AMAZON RIVER NEIGHBORHOODS: VERNACULAR ARCHITECTURE IN FLOOD ZONES OF BELEN, PERÚ

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Summary

Introduction: The Amazonian city of Iquitos is composed of floodable urban communities such as the river neighborhoods of Belen, which relate collective and economic activities to the dynamics of the river and are analyzed through adaptive architecture.

Objective: To analyze the types of adaptive architecture of the river neighborhoods of Belen during the Amazonian fluvial dynamics in the waxing and waning cycle of the Itaya River.

Methodology: Cartographic studies were used to segment the neighborhoods into high, middle and low zones. The scope allowed the categorization of adaptable constructions according to their type and relationship with the river. The ethnographic work includes identification of the social components and collective activities based on observation, interviews, photographs and hand drawings.

Results: The river neighborhoods of Belen show architectural qualities adaptable to river dynamics through three types of systems, fixed systems (30%), pile systems (60%) and (3) floating systems (10%), criteria applied in the construction of houses, bridges, stalls and river transportation vehicles. These are located along the course of eight natural streams or "caños" that redirect rainwater and wastewater into the Itaya River.

Conclusions: The research determines the urban layout of the upper, middle and lower zones by means of eight fluvial "caños", the correlation between adaptive architecture of fixed, pile and floating types with the processes of commercial adaptation, cultural adaptation and constructive adaptation and (3) the positive vision of the settlers in the face of fluvial impacts.

Key words: River neighborhoods; flood zones; adaptive architecture; river canals.

1. Introduction

1.1. Topic Definition

Rivers influence the organization and morphology of towns, allowing the development of their economy and social relations ([Francisco & Alfredo, 2004](#)). The river neighborhood is any urbanized space susceptible to flooding and includes two important components for its conception, the first is related to the urban and its development with the city, and the second is related to the natural riverbed and the impacts they generate on the landscape ([Delahaye, 2009](#)). The study area distinguishes three types of river urban spaces: (1) "The river neighborhood", referring to the neighborhood adjacent to the river, where different economic and leisure activities take place; (2) "Base Village", referring to the direct contact of the historical area of the city with the river; and (3) the "Riverside Neighborhood", focused on neighborhoods close to the river but less affected by flooding ([Delahaye, 2009](#)). This study focuses on Amazonian river settlements, which require architectural elements that allow them to adapt to the flooded physical environment and intangible cultural context for their development. Iquitos is essentially a riverbed, mobile territory or floating city that has incorporated flexible urban and architectural systems that include residential complexes, commercial areas and entertainment venues. These systems can change their physical configurations to adapt to variations in river levels and flooding ([Sharon, 2018 p.65](#)). Consequently, an adaptable architecture is one whose components can be changed in response to an external stimulus; this stimulus may come from the physical environment, from a social, cultural and functional demand, or from the environment itself ([C. Maria, 2015 p.18](#)). The vision of Belén at the neighborhood scale includes community characteristics of its own links ([Veronica, 2013](#)). These perspectives will allow us to understand the architectural characteristics adaptable to the Amazonian environment of the river neighborhoods of Belén-Iquitos, aspects that have helped them to remain over time, in the face of misunderstanding and limited government action to generate progress in the area.

1.2. Research Problem

In Iquitos, more than 90,000 people live in neighborhoods located in flood-prone areas of the city ([INEI, 2018](#)). This shows an urban expansion that goes beyond the limits of the urban area towards the fluvial zones of the Itaya, Nanay and Amazon rivers ([PDU, 2021](#)). These river neighborhoods present heterogeneous realities and must be approached in a specific way in each area, given the climatic, topographic and cultural conditions. Currently, the lower zone of Belén shows slow progress due to the lack of government action in sanitation

issues, which leads to the precarious development of the community by their own means, limiting their coexistence with the river in conditions of risk of contamination.

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In 2014, the Peruvian government enacted a law for the relocation of the community of Belén, Law 30291, a law that declares the relocation of the population of the Lower Zone of Belén as an emergency and of public necessity. This was supposed to improve the area, but due to a lack of information to the population, decisions were made arbitrarily, generating results contrary to those expected. The government did not take local ancestral knowledge into account in its development policies for the community itself, but rather discredited it. (Sharon, 2018 p.65). All of this has slowed progress in the efforts to improve the physical and legal status of the locality. After six years, the law was repealed by Congress. Currently, the community has complete electricity and public lighting services, but the efficiency of the sewage and potable water systems is still pending.

The problem with the relocation and eviction of homes located in the flood zone of Bethlehem is that it uproots the user from his or her habitat and drives him or her to develop in a foreign environment. Belén is that it uproots the user from his habitat and drives him to develop in an alien environment (Victor, 2016). The ancestral knowledge of the river neighborhood of Belén is at risk of extinction due to the implicit irruption of construction techniques alien to reality that are being applied in the face of local incomprehension in collusion with state policies. The community shelter will be condemned to disintegrate in time by the intensity of modern life and the process of urbanization: The neighborhood as the last trench of resistance of proximity relations, identity, memory and belonging (Veronica, 2013). For the community of Belén, the concept of flooding is interpreted erroneously by the government, since the influence of the river does not demonstrate for them greater danger, consequently, it is urgent to develop research on the adaptable architectural qualities according to the dynamics of the river that are taken into account as tools for subsequent proposals on a neighborhood scale from the viewpoint of the "Belenino" residents themselves in order to generate development while respecting the cultural and architectural value.

1.3. Objective and justification of the research

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The objective is to analyze the types of adaptable architecture of the river neighborhoods of Belén during the rising and emptying seasons of the Itaya River, within the Amazonian river dynamics; to publicize its influence on the coexistence of the neighborhood and the river.

Through the approach of theoretical concepts, the analysis of cases and types of adaptive architecture, described from different scales. River cities should be approached from three logical perspectives: the management of cultural heritage, the improvement of ecological quality and the planning of the transition space between the river and urban environments ([Albert & Joan, 2013](#)). This research proposes useful tools that lead to rescuing the Amazonian architectural value of the river neighborhoods of Belén, which are reflected in improvement proposals based on own construction criteria, replicable in similar contexts, and strengthen the identity of the city of Iquitos..

1.4. The river neighborhoods of Belén-Iquitos

Iquitos is exclusively river, this implies connectivity with other cities only through navigation by river or by plane. The Amazon basin allows the rapid flow of people and goods through rivers, which is the main element of urban development, in addition to having a humid tropical climate ([Sharon, 2018 p.65](#)). Before the arrival of the Europeans, the area was dominated by various indigenous peoples, such as the “Iquito” who lived in the upper part of the Nanay River and the “Yameo”, located in the Itaya River sector ([Fernando, 2002 p.22](#)). They were reduced by the Jesuit missionaries until 1767, the year in which they returned to their territories again, although for a short time, until the end of the 19th century, when the rubber phenomenon occurred in the Amazon. The city of Iquitos undergoes transformations at the urban level, although at the end of the period, in addition to the central area there is a significant urban expansion towards flood-prone areas, especially in the mid-20th century. The town of Belén begins to expand progressively and precariously based on its own organization. From 1886 to 1906, a group of workers along with their families, laborers, brickmakers, machinists and freighters, lived in the lower area of Belén. Since 1917, some axes of development have been identified, such as a hospital, market and neighborhoods such as Sacha Jeto and commercial houses, and the port of Belén on the Itaya River also stands out as the main organizing axis, generating the nuclei that will shape to the first housing constructions arranged in rows on Venice Street ([Boris, 2017](#)).

Since the town's official founding in the mid-1970s, no major progress has been made due to government legal restrictions. In 2014, Law 30291 declared the relocation of the population of the Lower Zone of Belén an emergency and public necessity. After six years, this law was repealed by Congress. Currently the community has complete electricity service.

Since 1902, the community of Belén was threatened with eviction by the government in power, as appears in the official Registry of the department of Loreto: The work on the pier in this port must begin, which will include from the “Belén lake” to the newdock being built by the “Booth” company, it is resolved: the port company will notify all the people who have built your house on the indicated tax land so that it can be demolished ([Carlos, 1905 p.89](#)).

State policies in general have always shown a face of incomprehension towards river settlements, despite this the Belén neighborhood continued its urban growth with more emphasis since the Amazon River definitively moved away from the city, causing the Itaya River, its most nearby extends along the eastern part of Iquitos. The residents migrated from rural areas and cities near Iquitos bringing with them ancestral knowledge of adaptation and have used different criteria and materials for the self-construction of homes for their location and development.

The houses are built on stilts, made of wood, with corrugated iron and palm roofs; During the river's flood, they build bridges to organize the river neighborhoods ([Sharon, 2018 p.65](#)). Canoes and boats are the most used means of transportation in the lower part; they become more crowded during the rainy season as they adapt to the rising river, the essential resource for the survival of the residents. Therefore, the risk perception of the urban components of the river neighborhood, the homes on the river and the sense of belonging are different between the residents of Belén and current government policies. ([Silvia, 2019](#)). In order to understand the river neighborhoods of Belén, and the importance of their adaptation to the Itaya River, we must address elements such as culture, history, ancestral knowledge, and the anthropological aspects that help these communities maintain themselves over time, and explain the reason for their self-management ([Nieves, 2006](#)). This connection will produce a unique identity between the inhabitants of Belén and the natural environment of the river with the adaptable architectural and cultural qualities of the community ([Veronica, 2013](#)).

2. Methodology

Research Desing

The research presents a design based on the non-experimental cross-sectional, since the observation and exploration of it will be taken into account without modifying what is studied as a physical object. On the other hand, the descriptive method was considered, emphasizing the observation and study of the architectural adaptation of the neighborhoods and river houses of Belén on the Itaya River. The criterion was the categorization of

neighborhoods and dwellings according to their location, type, organization, variation of activities and urban elements in relation to the natural environment. Thus, the social components of the neighbourhood were also identified, as well as the inherent characteristics of its identity and the delimitation in terms of territory towards the urban and the river ([A. Maria & Jose, 2021](#)).

The ethnographic work includes the recording of information through the observation of the daily activities of the people who live in the river neighborhoods, such as the relationship between neighbors, actions of play, washing clothes, dishes, cleaning the house and the streets, and how they integrate with each other. The experience of "hanging out" in Bethlehem was of utmost importance for the development of the research ([Silvia, 2019](#)). As several studies affirm, the ethnographic qualitative aspect becomes important in the study with the transformation that the delimited sector undergoes, taking into account the socioeconomic context, the immediate context, the climate, and cultural aspects ([Zagal-Carla, 2018](#)). The whole set of relationships obtained are organized in a graphic and descriptive way, for the subsequent analysis of the data of this article based on observation, interviews, photographs and freehand drawings.

2.2. Place of Study

Loreto is one of the Amazonian departments of Peru, it contains a river dynamic of complex functions where changes are perceived in the immediate context that adapts to it as a cyclical metamorphosis. ([Maryory & Victor, 2020](#)). The city of Iquitos is the capital of the Peruvian Amazon and is within the province of Maynas, Loreto ([Boris, 2017](#)). Which is surrounded by three important hydrographic basins, the Amazon River as its main axis and the Nanay and Itaya Rivers, its closest tributaries ([Henry, Ana, & Pilar, 2015](#)). It has four districts, Iquitos, San Juan Bautista, Punchana and Belen. The district of Belen has 68,806 inhabitants. ([INEI, 2007](#)). Distributed in 56 hamlets and 19 neighborhoods in the urban area. The Belén neighborhood is located to the east of the city and borders the Itaya River, which has a length of approximately 132 km. and 545 m wide, the river has a low speed current (between 0.250 to 0.343 m/s) ([Fernando, 2002 p.22](#)). Which fosters the conditions for the habitability of the river neighborhoods of Belén. This is located both on dry land (high areas) and in flood-prone areas (low areas) ([Lucio & Carlos, 2010](#)). The Belén neighborhood is made up of three zones in relation to its location: the upper zone, the middle zone and the lower zone ([Boris, 2017](#)). These aspects suggest the delimitation of the study area and define its adaptable characteristics.

2.3. Universe and sample

14 The research is reduced to the selection of the unit of analysis that covers the community of Belén that is close to the river, this segment allows us to understand the behavior of the different river neighborhoods in the face of the river dynamics of the Itaya River; through the graphic description of common adaptable architectural features. The subset of the study depends on the perceived and analyzed characteristics of the area. For the purpose of this study, the analysis of 2,328 constructions segmented into three zones will be taken into account:

- **High area:** There are 218 lots on fixed land.
 - 80% fulfill housing and commercial functions.
 - They have a very low slope relief (between 3% and 6%),
 - Fixed type construction.
 - It does not present a risk of flooding due to the expansion of the river channel.
- **Middle area:** There are 273 constructions.
 - 20% serve as housing and commerce.
 - Fixed and pile type construction.
 - The soil has a steep slope (between 100 masl and 85 masl).
 - Low flood level
- **Low area:** There are 1,837 constructions
 - Located on the Itaya River.
 - 12% are used for housing and commerce.
 - Fixed, pile and raft type construction.
 - Low soil terraces.
 - High flood level.

2.4. Data collection

The data collection methods related to the analysis of the river districts of Bethlehem were applied through the field study where information was collected through the recorded observation of notes, photographs and/or freehand drawings. A simplified formal overview sheet was also prepared based on criteria of the Ministry of Finance and Economy of Peru for investment projects: "Creation, improvement, expansion or recovery of the early warning service of the locality, district, province, department" ([MEF, 2017](#)). On the other hand, cartographic information was obtained that allowed the precise location of the houses in the river neighborhood, thanks to the cadastral map provided by the District Municipality of

Belén. In addition to the interpretation of satellite images from "Google Earth" and the review of physical publications in the local library CETA, to demonstrate the historical, morphological, urban and water variations of the study area in relation to fluvial dynamics. For the comparative analysis, an identification card of the property was elaborated, where the realities of each zone are contrasted, based on the cards implemented by the Ministry of Cultural Heritage of Ecuador ([INCP, 2012](#)). The observation in the same place of the processes of crescent and emptying, as well as the oral testimony of the inhabitants, allowed us to construct a current description of the place from the perception of the locals themselves.

2.5. Data analysis

- **Field study:** The field study considered the techniques for observing the exterior image of the neighborhood and the interior of the house, its age and its evolution with respect to the development of the community and, in specific cases, the life stories of the families that constitute them and live in the river neighborhood. Through conversations with the inhabitants, freehand notes of the types and forms of construction in each neighborhood according to areas, and in some cases architectural surveys, evidence of the variations of the river and the built environment was recorded.
- **Cartographic information:** Map analysis involves the graphic interpretation of the territory at different scales and times to generate a holistic reconstruction of the context. The aim is to identify urban patterns that lead to an understanding of the characteristics of the river territory concerning the adaptation of the river and the river neighborhoods, the influence of the natural environment and climatic conditions in relation to architectural and cultural behavior. To do so, he contrasted the information between the maps provided by the Municipality of Belen, the CETA library, Google Earth software, and his own description of the place as well as the statements of the inhabitants.
- **Comparative analysis:** Analysis of comparisons between types, contrasted in a way that records the characteristics of similarity and differences between the groups within its classification. Comparative data collection sheets were used, understanding the sample as the essence of the sequence of patterns ([Cristina, 2019](#)).

3. Results

3.1. Identity with the neighborhood

There is a strong sense of belonging of the river dwellers to the place where they live. The experiences they develop in the neighborhood are linked to the habits of cultural adaptation acquired from a very early age. Eighty percent of those interviewed stated that they grew up in the Belén neighborhood, although their closest ancestors came from the interior of the Loreto region. Jesus Manuyama, 66 years old, has lived in the area for nearly 51 years. His house, located on the banks of the Itaya River, is of the floating type, which he built with the help of his wife and children who were born in Belen. Its main economic activity is the river transportation of cargo and passengers in its own "peque peque" boat, which is also self-made. Like Jesús, the other inhabitants also carry out other economic activities such as artisanal fishing, timber extraction and the trade of diverse products; other daily collective actions such as "mingas" or community tasks, sports championships or festivities, contribute to the identity of the river lifestyle and motivate the occupation of the river in a permanent cyclical dynamic, adapting to the Amazonian geographic and cultural context.

3.1.1. Rivers, "Caños" y Neighborhoods

In 1918 the Amazon River ran along the eastern edge of the city of Iquitos ([Andres, 1918](#)). As of 1990, due to the influence of the Amazon river dynamics, it moved definitively away from the city, allowing the Itaya River to extend and currently occupy the alluvial space left by the Amazon River (**Figure 2**). The urban layout of the river neighborhoods of Belen is generally orthogonal blocks, following the route of six "caños" or natural streams that are located according to the relief of each area, at different heights, slopes and distances. They are located at the rear of the houses, facilitating the evacuation of rainwater and sewage, which eventually flows into the Itaya River (**Figure 3**). The drainage system used by the river districts is the same one that has been applied in the city of Iquitos for more than 100 years, although on a smaller scale. Urban "caños" are channeled, paved and converted into sewers as the city grows. In some cases the names of the ravines are used to name later streets and urban areas in the districts, such as the "Sachachorro" neighborhood, which owes its name to the former ravine and currently flows into the Itaya River in the Belén neighborhood; also Soledad Street in the district of Iquitos, taken from the name of the ravine of the same name, Pevas Street, Yavarí, among others. This allows us to remember the previous experiences around the ravines that at the time conditioned the urban layout of Iquitos. Evidence that can be verified by visiting the areas and comparing them with historical

maps of the city (Iquitos map of 1886, 1918). Gullies are natural elements that have been used both for the confluence of rainwater, for the evacuation of sewage, as well as to generate memory in urban areas, maintaining their identity. The case of the study area is no stranger to this system and applies it throughout the urban fabric.

3.1.2. River extensión into the neighborhood

The Itaya River shapes and organizes the community, impacts socioeconomic, collective and cultural activities, and predisposes a particular architectural language within the river system of Belen's neighborhoods. Its route of more than 132 km allows the distribution of products from the interior of the towns of the basin to the Port of Belen; enclosure that, although precariously located, articulates the itinerant trade mainly through the streets: "Itaya", "Number five" and "Venice", in the lower part; "Number six" in the middle part, and culminates in Alfonzo Ugarte Avenue in the upper part up to Jiron Prospero (**Figure 4**). The streets in the lower area are flooded more intensely since February, although the river begins to rise in November. The Itaya River at its highest level extends to a distance of 332 m from the port of Belen, which at first located on the banks of the river, expands into the interior of the streets forming small spontaneous ports (**Figure 4**). The flooding also spreads domestic and commercial waste materials (0.87 kg/person daily) towards the banks and then in the direction of the Amazon River. Small boats of "Shalupas" are in charge of collecting garbage, although the service is not fully supplied. The constant fluvial dynamics of the neighborhood shapes the built environment and conditions the possibilities of adaptation through architectural qualities that articulate the concepts of river and city.

3.2. Adaptive river architecture

The neighborhoods of Belen contain peculiar architectural characteristics that stand out among them for their capacity to adapt to climatic conditions, to weather variations, changes in functions and spatial activities according to schedules and seasons; and also to the versatility of the materials used for their construction. Unlike the settlements located on other flood-prone areas of the city of Iquitos, on the Nanay and Amazon rivers, which tend to intervene the land by filling and containing bodies of water, the buildings in Belén favor the passage of water underneath as they are elevated off the ground, adapting to the river's rising waters. Therefore, the inhabitants interviewed for this study do not consider the river as a threat, but rather plan their arrival in order to take maximum advantage of the resources of each rainy season, which occurs gradually from November to May of each year. No other

community in the city of Iquitos located on the banks of the rivers, maintain a resilient adaptation to water resources as the river neighborhoods of Belen.

3.2.1. Belén river neighborhoods

Although the river constructions maintain characteristic features in common, they also contain certain differences among them, which make them unique in their own level of adaptation to the river. The topographic variable is directly involved in the delimitation of the identified zones; the variation in the heights of the river terraces influences the choice of the types of materials, construction systems and collective activities carried out in each sector. The urban grid is more orthogonal in the upper and middle parts, and the lots are relatively homogeneous in size (between 90 m and 120 m²). The low areas present heterogeneous dimensions in the urban layout because they are located on the alluvial bed, the areas of occupation vary (between 40 m², 90 m², 400 m² and 1400 m²) in public areas such as churches and schools. The zones that make up the river neighborhoods of Belen are three: (1) the upper zone with a fixed type adaptable architecture, (2) the middle zone with a pile type architecture and (3) the lower zone with a floating and "palafitic" type adaptable architecture. Each of them contains inherent characteristics that are in turn interconnected. **(Figure 5)**. They present constructions of flexible qualities such as dwellings, stalls, pedestrian bridges and riverboats. Within the study of the types of architectural adaptation, we can also distinguish the process of commercial adaptive architecture and cultural adaptive architecture.

3.2.2. High area

The high zone is demarcated from the commercial limit of the city of Iquitos on Prospero Avenue, towards the standard slope limit, at an altitude of 100 meters above sea level. It covers an area of 39,000 m², 9 blocks that include the building of the old Belén market. **(Figure 5)**. The upper zone is characterized by its flexibility in its commercial structure, which occupies about 20 perceived streets from the main market to the port of Belen. The report by [\(Pilar & Kember, 2009\)](#) shows a variety of products, "390 are sold on market tables and sidewalks, of which 231 (59%) are of vegetable origin, 157 (40%) of animal origin and 2 (1%) of mineral origin". The ephemeral constructions such as wooden tables with plastic covers represent the ambulatory commerce with more than 5,000 stands. [\(PNUD, 2020\)](#). These constructions occupy

both sides of the roads and sidewalks, reducing traffic flow (**Figura 6**). Although they do not usually remain in place, they are transportable and can be disassembled according to the time of day. They are assembled in the morning due to the intensity of commerce and disassembled in the afternoon (between 5:00-15:00 h) where commerce decreases considerably as does vehicular traffic of "mototaxis"; although it does not disappear despite the closing of the stores, but new products are sold near the sidewalks and corners, usually by women, selling typical foods, fruits and regional refreshments. Almost at the same time, when the stores close, neighbors gather in groups to recreate on the sidewalks, also witnessing the games of their young children who use the street as an improvised sports field in the absence of vehicular and commercial traffic. The upper area is characterized by the change from commercial activities to moments of public recreation on the sidewalks and streets that undergo changes of use from timetables, through the adaptation of ephemeral, transportable and disassembled constructions.

The upper zone presents three sub-types of adaptation, (1) commercial: formal and ambulatory, (2) constructive: historical and current, and (3) cultural: collective and recreational activities. At the architectural level, the upper neighborhood is of a fixed type, and contains homogeneous features with buildings of three, six and nine meters in height, 100% calamine roofs varying from 30% - 40% slope. Horizontal concrete ornaments are placed on the facades of the houses to allow hot air to escape. This typology was largely imposed by the Banco de Materiales in 1990, during the mandate of President Fujimori, where houses were built on a single level, occupying almost the entire lot, with a single large calamine covering, without ventilation ducts due to the rains. This criterion added to the paving of roads and reduction of green areas has generated an increase in the average annual temperature by 0.8 degrees Celsius in less than 40 years. Six large houses with neoclassical stylistic features of the rubber era were also identified, located on the commercial corners; they extend to six meters in height, despite being only one level. The entire upper zone is changing in terms of commercial, cultural and architectural activities. This zone is not disconnected from the subsequent zones, since the neighborhood welcomes people and activities from the city and from the middle and lower zones of Belen.

3.2.3. Middle area

The middle zone extends from the high edge of the commercial slope towards the historic flood boundary demarcated by the Belén small square. With an area of 41,153 m², it contains slopes of 16 m and slopes of 9% towards the Itaya River (**Figure 5**). The properties are of fixed, above ground type and their flood level is of medium-high range. (**Figura 6**) The middle zone is characterized by neighborhoods that adapt to the slope in two ways: (1) Pedestrian neighborhoods, on the one hand, on streets N°1, N°2, N°3, N°4 and N°5; with minimal commerce and passive and spontaneous recreational activity. The neighbors place organic products for sale on wooden "benches" outside their homes, or hold family gatherings on the sidewalks. Access is via steps through the upper central part, and has urban vegetation and 1.20 m wide sidewalks and ramps on both sides of the street; (2) the vehicular neighborhoods facilitate connectivity for transporting people and commercial products from the lower area to the upper area, using motorized vehicles (motorcycles, "motokar", trucks, tricycles and wheelbarrows). The street trade stalls are located on 6th Street, where the commercial population is more intense in times of flooding. The middle, sloping area functions as a connector between the river and the city, where collective and commercial activities vary according to the design of the road.

The architectural patterns of the middle neighborhoods stand out for their solid constructions that allow the transition between the river and the city. Sixty-two percent of the houses have only one level, 35% have two levels, 3.1% have three levels, and 2.1% have one level with an interior loft. There are three uninhabited lots, for a total of 285 lots. The Plazuela de Belén is the architectural landmark that delimits the maximum/average flood level. It is a 500 m² platform, elevated 2.5 m above the ground, which houses the merchants, in addition to functioning as a seasonal port during the high flood season (in this area, from February to May). The central roundabout of the square evokes neoclassical European styles, although it was donated by the Chinese colony in 1908, it was dismantled from the main square of Iquitos and finally placed in the square. The two-level constructions have open balconies, with parapets and concrete balustrade that protrudes 1 m from the façade as well as the roof. The middle neighborhoods connect the lower and upper areas of Bethlehem upwards. By making the route from the river, it facilitates commercial, pedestrian and vehicular fluidity towards the city; Even in the rainy season, its areas are occupied by itinerant vendors, who are pushed to the upper reaches by the rising river.

3.2.4. Lower area

The lower zone encompasses the largest area of land studied, with 1,837 lots within an area of 50 ha. The territory delimited for this study ranges from the eastern meander of the Itaya River, the lower edge of the middle zone, and the natural course of the Itaya River at its lowest level (**Figure 7**). It is made up of 12 independently organized sectors, with their own steering committee. All of them are headed by a general commission chaired by the Lieutenant Governor of "Pueblo Libre. Low-lying river districts have the three types of adaptive architecture, the piling type 60%, the raft type 20%, and the fixed type 20%. Connecting streets and avenues undergo a gradual transformation during flood seasons. Streets that are 40% paved are submerged from January to May; This year the water covered an area of approximately 423,000 m² at a distance of 350 m from the port of Belén, counted from the square, and 2 m above ground level in the lowest part and at 0.5 m high in the highest part, at the base of the Belén square (**Figure 8**). The same flexible streets accommodate the changes of uses, which go from vehicular, pedestrian commercial land, to vehicular, pedestrian and commercial river. The roads that were occupied by fixed and itinerant commerce, are replaced in the flood season by river transport, such as boats, canoes and wooden "peque peques" (1.60 m x 10 m x 0.4 m) with capacity for 10 people who circulate the flooded avenues. All this makes up an architectural language of its own at the urban level adaptable to climatic factors, with approaches to practical solutions in accordance with the river reality.

The inhabitants interviewed in the lower zone do not consider it dangerous to live in the face of the fluvial dynamics, but rather that both the cycle of rising and emptying the river attracts its own benefits, this climatic fluctuation is expected every year to reactivate activities such as artisanal fishing, river transport, and collective actions such as "mingas", festivities, anniversaries, sports games, etc. or everyday conversations. There are traditional construction criteria that can be adapted to the dynamics of the river and integrate collective and individual activities. In terms of construction, the houses are built using a piling system (**Figure 10**). They can be made of wood or reinforced concrete. The "Horcones" or piles of 4.5' in length and 6" in diameter, are embedded at a depth of one meter. The most commonly used wood species such as "remo caspi" (*Aspidosperma excelsum*), "palo sangre" (*Swartzia cuspidata*), "quinilla" (*Manilkara bidentata*), lupuna (*Ceiba pentandra*) and huacapú", stand out for their high resistance to humidity and durability (between 15 and 20 years) outdoors. In terms of

adaptation, 90% of those interviewed in the area said they built their homes themselves; those located on Itaya Street from the Belén port, place temporary stairs on the facades during the flooding of the river, being able to access the house through the balcony of the second level, which is used as a social enclosure, and clotheslines (**Figure 8**). In the areas near the river there are floating neighborhoods; Built entirely of wood, with the exception of the calamine roof. They float with the help of 30 "topa" wooden logs, which constitute the base, on this, a fabric of slats separated at each meter is tied or nailed, above it is placed the platform of planks 25 cm wide. The area of the dwellings ranges from 20 m² to 100 m². The boards for the side covers are arranged horizontally or vertically, although there are houses with walls covered with calamine. Houses with leaf roofs are dying out quickly, and corrugated iron roofs occupy 90%. The river neighborhoods of the lower area comprise types of construction systems that are raised from the ground using systems of piles and floating wooden bases that incorporate pedestrian and vehicular transition elements, as well as mobile homes on the water. The cultural context undergoes a cyclical metamorphosis, which time allows to be shaped through climatic fluctuations (**Figure 7**).

3.3. Relationship and differences between adaptation systems

Each of the riverine study zones presents relationships and variations between systems, identified according to their characteristics of commercial adaptive architecture, cultural adaptive architecture and constructive adaptive architecture. The three systems comprise variations of spatial function based on the impacts of climatic factors. They affect the location and type of structural approach of the buildings. The three study zones show commercial movement in different intensities. (**Figure 5**). The upper zone has 60% of streets occupied by stores and street commerce, the middle zone with 10% and the lower zone with 30%. The latter is reduced to 15% during the flood season, although the river transport and bridge construction type of commerce is reactivated. The fluvial dynamics affect the three zones directly and indirectly; the lower zone undergoes more radical changes in use during the flood months. The first levels of the buildings, as well as their streets are submerged, modifying the accesses and influencing collective and individual activities in each of them.

3.3.1. Commercial adaptation river architecture

The interaction of community commercial activities is presented in a flexible manner in each zone. The upper zone shows dynamics of use especially in the afternoons (5:00 pm to 17:00 pm) when the intensity of commerce increases and is articulated with cleaning actions. The middle part of the area, located on a slope, maintains a slight reduction in trade. Both zones maintain the same mechanism throughout the year, with the exception of holidays such as carnivals in February, "San Juan" in June, Christmas, New Year's Eve at the end of the year, among others. In the lower zone, **(figure 5)** as the spontaneous sales modules retract from the port, the boats board the space left, following the crescent channel. These canoes and boats are driven by adult men, although women were also seen in boats that sold food to the transporters and minors. The architecture becomes adaptable as the river recovers its natural course, action that induces the itinerant commerce to be located in the high places.

3.3.2. River architecture of cultural adaptation

The river cycle directly impacts daily and organized events. Leisure actions are carried out massively in the afternoon. Each street, although it has been segmented for the study in a general way into three zones, at the same time contains particular situations. Unpaved streets and therefore less passable (existing in the lower area) are more festive than paved ones. During the visit to the place, it was possible to verify the spontaneous blocking of the streets, carried out by the neighbors during the carnival festivities in the month of February. The clay soils were used as outdoor entertainment centers. Less traveled paved streets are used for sports activities such as volleyball and soccer. Paved roads reduce recreational activities due to the intensity of commerce and traffic, although sports games are played in the afternoons when the sales modules are dismantled. The Bethlehem square is also a public place, which welcomes boat and canoe passengers during the rainy season and allows interaction between buyers coming from the city to the port and local river vendors and transporters **(Figure 9)**. Sidewalks and patios on the second floors are widely used as open meeting spaces; they are vital spaces for strengthening family ties and friendships, and the use of balconies has increased to 90%, especially in flood contexts. Hammocks, rocking chairs, ladders and wooden chairs are the supports for rest; when the river reduces its flow in the "bajiales" or low areas, the cultivation spaces reappear again, as well as free areas such as sports fields, both areas are occupied collectively through cleaning tasks or "mingas", to remove the remains of garbage, sticks or excess clay. The architectural cultural aspect

is closely related to family and neighborhood activities around public areas, and the quality of adaptation of the buildings on flood-prone public roads depends on it.

3.3.3. River architecture of constructive adaptation

The architectural analysis shows the differentiation of construction techniques applied according to the high, medium and low zones. Reinforced concrete and confined system predominates in the high and medium zones, the partition walls of the commercial dwellings are built with bricks joined (every 3 m) by columns through a confined system (**Figura 10**). The structural criteria for the roof is similar in the three study areas, although they vary in the quality and type of wood, using round "caibro" and square timber and galvanized calamine roofing of two, three and four panels (30% slope). During the floods, pedestrian and vehicular mobility functions are maintained through the construction of temporary wooden bridges located in the center of the flooded streets, which extend an average of 2.9 km in length (**Figure 8**) The fluvial port and the Belén market are connected by a 400 m long wooden walkway, which is also interconnected with the network of pedestrian bridges to the plazuela. The stilt-type architecture is not limited to bridges but also to habitable constructions. The first blocks of the lower zone are built with concrete and brick piles up to 100 m away from the plazuela and from there the houses stand out with wooden piles that rise every 3 m from the ground. The props are nailed together, and tied with wires or "pretinas" (rope), to support the wood platform (10' x 4.5" x 1" boards). The planks for the side enclosures are vertical, joined side by side, and 1" battens are required to cover the slots. When the position is horizontal, the slabs are placed one on top of the other, being inclined for the evacuation of rainwater. The location of the stairs also varies according to the design of the facades. The balsas houses, are built in times of emptying, wooden trunks of topa, are placed parallel to the ground and will serve as support. To them are embedded 3/8" iron bars, which will serve as fasteners for the floor joists of the decking. Once the platform is made, 3" slats are placed in order to support the lateral enclosures and the roof. The houses and stilt and floating bridges have the capacity to adapt to the variations of the surfaces both in times of emptying and rising of the Itaya River.

4. Discussion of results

4.1. Study message

The river neighborhoods of Belén (lower zone) are organized at the urban level through the natural arrangement of eight "caños" or main streams that flow into the Itaya River with its

17 small tributaries and meanders. These bodies of water are immersed in the changes of the rainy season and are activated during the emptying season, being respected by the community to distribute the blocks and lots of the 12 neighborhood sectors and to delimit the general area of occupation. The urban canals articulate the neighborhoods with the fluvial and cultural landscape, although the local urban development plans have been elusive for more than fifty years because they are located in flood zones. In contrast, the ravines of the cities of Valparaíso and Valdivia in Chile, run through the territory towards the sea. These social communities, although they are part of an urban plan, are generally discarded commercially, but they are reoccupied based on the idea of living with nature, generating a new motivation of occupation that attracts a population with different expectations, but with less commitment to the environment, which is why the current urbanization process will lead to the deterioration and progressive disappearance of the ravines and sensitive nature. Consequently, there is an association of contrasting concepts; while the streams are close to the social housing, with less urban development, the better the conservation of water bodies and vegetation; on the other hand, when the real estate is close to the streams, there is more urban development, but less vegetation and natural streams. (Rodrigo, Laura, & Voltaire, 2018). Unlike the ravines of Valdivia, the river canyons and natural areas of the lower zone of Belén are not drastically affected by the urbanization process, since the inhabitants of the neighborhoods, who build stilt houses and floating houses, maintain to a certain extent a style of conservation; they also strengthen the criteria of identity, restricting the occupation of people from outside the community. This attitude of cultural protection can be strengthened through the concept of “occupation motivation” towards nature on the part of visitors, although only on a temporary and responsible level. It is important to consider the areas of the river neighborhoods because they allow us to understand the relationships of the types of systems that interact with the pipes and the river. The results of the research confirm the areas and types of the Bethlehem community described by (Boris, 2017) as the high, medium and low areas; and raft, stilt and fixed types. The difference is that the focus of this study is not limited to the areas, but rather covers a neighborhood scale where the relationship with the river system is evident and the reasons for the interaction of the pipes and rivers are explained through adaptive architecture..

The constructions of the river neighborhoods in the lower area, despite being located on the same river bed, are conceptually not flooded by the river dynamics, but rather are designed to adapt and allow water to pass beneath them; They are elements of high permeability, especially in the support structure, which helps the stability of the building with the

incorporation of elements such as piles and wooden rafts. Although the concept of architectural adaptation suggests in general terms the emphasis on the flexibility of the interior spaces of a building, exerted by the activity of the user and external factors of the context (C. Maria, 2015 p.18); the specific river spaces not only adapt to the interior context but also emphasize the changes of use in public spaces in relation to the collective and individual activities of the users. Those that are developed inside the construction, linked to external collective actions generating the transformation of the natural and built exterior space itself; That is to say, the river architectural adaptation has a focus from the inside to the outside. Changes in river spatial use are governed based on fluctuations in time (rising and emptying) which leads constructions to maintain ephemeral qualities of use and temporal durability. As evidenced in this study, the streets and lower levels of the lower area undergo changes in use, activities, and forms of transportation. The materials used demonstrate situations of change with respect to their degradation over time. The bases, walls, roofs and river vehicles age at different times, showing a changing patina exerted by the climatic conditions of the sun, rain and humidity, so the parts of the houses are replaced according to the pattern of deterioration. The river architecture of the Belén neighborhood contains living elements that change over time, which modify the exterior of the public interaction spaces, evidenced by the ancestral criteria of river adaptation.

2 The lower area of Belén houses a population organized through directives distributed by self-management roles. The community development process was held back mainly by a misconception about the culture of the place. Historically, river neighborhoods have suffered a situation of marginality due to being located in flood-prone areas, which is why today there is a great debate among government agencies regarding the adequate formalization of the community of Belén, according to law 2014, 30291, which declares an emergency and of public necessity the relocation of the population of the Lower Zone of Belén; In 2015, the Ministry of Housing arbitrarily and without public consultation intervened in application of said law, moving families from the sector to the area called “Varillalito” on the Iquitos-Nauta highway. Isolated from their ancestral living environment, collective and economic activities and lifestyles were dramatically affected; In addition to not receiving the promised improvements, they were pressured to return to Bethlehem. Thanks to the pressure exerted by Congress, the eviction law was currently repealed and modified, proposing the voluntary transfer of the residents. The idea of coexistence with the river does not represent the danger that is promoted by the authorities, but is part of the urban imagination. The government did not consider local ancestral knowledge when formulating development policies to benefit the

community itself, rather it discredited it (Silvia, 2019). According to the investigation, residents and authorities maintain contrary positions and visions of the same place, while the government vision is to conceive the place as uninhabitable, dirty and poor; The residents of the neighborhoods emit feelings of identity, development and respect for the natural environment. There is currently a legal vacuum on the form of occupation in flood zones in South America, although in Peru Law No. 28611, the General Law on the Environment, recognizes the importance and protection of wetlands by the state, it does not integrate with the specific need to inhabit the Amazon bed, which behaves differently from the Peruvian coast and highlands. This also requires a comprehensive normative basis that allows a respectful and responsible occupation of the cultural context by those who inhabit it as well as those who visit it.

4.2. Limitations

During the research process, in the stage of delimitation of the territory and the classification by location zones, the cadastral plan of the study area was requested in a timely manner from the District Municipality of Belén, which was in the process of being updated and there were places in the neighborhoods that had not yet been registered. For this reason, it was decided to verify the location of the same river neighborhoods in person, in contrast to the digital territorial maps and reinforced with the oral description of the inhabitants about the organization of the investigated area. In the process of searching for cartographic and documentary information, the great limitation was that of outdated and reliable information on a local and national scale on the subject in question.

4.3. Recommendations

It is recommended that the Municipality of Bethlehem actively coordinate interdisciplinary urban projects with multi-scale impact projects collectively and individually, in order to establish guidelines according to the real situation of the place and reflect the riverine architectural qualities described in the study..

- "The project for the implementation of the adaptive drainage system in homes" is proposed in the urban drainage system by means of river biodigesters adaptable to the rising and emptying of the Itaya River for the filtration of sewage prior to its departure from the house. This would lead to a reduction in the number of water pollutants that reach the Itaya River through the "caños". The studies and financing could be assumed by the central government through the Ministry of Housing, Construction and Sanitation, in relation to the Ministry of the Environment,

channeled by local and community governments as a matter of urgency in the shortest possible time.

- 4 • Implement the "PETARF, Floating Wastewater Treatment Plant" adaptable to the changing flows of the Itaya River, to retain gray and black water from the neighborhoods and treat it properly for its subsequent return to the river, this project will allow greater cleaning in the bodies of water that comes from urban areas, and will be assumed by the Ministry of the Environment being considered a priority for subsequent projects.
- The regeneration of the river-cultural landscape, cleaning of public spaces and the development of floating green areas following the criteria of river adaptation of housing; as well as campaigns to motivate the cleanup with the participation of the entire population of Bethlehem and volunteers from the civil community, school and university students and local and international environmental entities led by the Municipality of Bethlehem. This will allow a better and safer interaction of the population in flood seasons, as well as strengthen the feelings of cultural and environmental identity of the emblematic neighborhood of Belén.
- The architectural intervention of the constructions through procedures that involve the experiential tourism of the community. To this end, the tourist and cultural route called "The Amazonian Venice" is proposed for the reconstruction of the neighborhoods and river houses at risk, applying traditional techniques, materials, and spaces, optimized with current criteria to revalue the culture of the place. This will require the collaboration of students, professionals related to architecture, construction, urban planning and heritage. The Ministry of Culture and Foreign Trade and Tourism, through a national and international competition, would choose proposals that best suit the adaptable architecture of the place over a period of five years, following stages by year.
- Propose the architectural project "Construction of ephemeral dismantlable bridges", with metal structure and wood that are assembled inside the streets during the rainy seasons and dismantled at the end. Assumed with municipal budget and support from the community's workforce, led by specialist professionals who maintain a philosophy of respect for heritage. With the final degree projects of architecture students from universities, the ideas of the government could be contrasted and the attachment to sustainable ideas of development would be promoted.
- Promote a normative basis that allows the responsible occupation of flood-prone soils by traditional communities for the integration between the built and the natural,

respecting and caring for the Amazonian fluvial environment. Debate is promoted in the Congress of the Republic for the pertinent specification of the law for the benefit of the river community and nature. The Ministry of Justice, the regional and national bar associations, in coordination with local urban planners, the College of Architects and professionals identified with the problem within a consultation table establishes the points of this law.

- • Raise awareness among residents and authorities about the cultural value of river neighborhoods, through the incorporation of "The Bethlehem River Festival", with artistic and cultural activities and competitions to produce more solid identities, for this purpose, awareness campaigns are suggested that also involve students from local educational institutions in integration with other districts. To this end, the Ministry of Culture of Peru, the area of culture and sports of the municipality of Belén and the regional government would allocate budget each year for the execution of this project.
- Architectural project of responsible occupation on flood-prone soils, with the implementation "Port of Bethlehem and adaptable ephemeral ports on the Itaya River". With the support of the Ministry of Transport and Communications, Municipality of Belén, sectors of Pueblo Libre lower area of Belén. They establish the design and execution of the port, dock and product access; as well as the implementation of adaptable and demountable floating docks in the streets of the community.
- Comprehensive river urban regeneration project of the city of Iquitos, "Complete mapping of pipe systems for the subsequent separation of sewage and rainwater assumed by the four municipalities of the city and the regional government.

4.4. Conclusions

The research has highlighted the organization of the Amazonian river districts of Belén, based on the segmentation of three studied areas and three types of adaptive architecture that in turn affect the three processes of commercial adaptation, cultural adaptation and constructive adaptation, governed based on the influence of the existing river dynamics.

- The Amazonian architecture of the river districts of Belén has qualities that adapt to the natural water networks using materials and construction systems of traditional knowledge, which are being underestimated and underused to generate proposals for local development. The historical hydrographic variations of the Amazon and Itaya

rivers allow us to understand the process of architectural adaptation and the current location of the river districts of Belén on flood-prone soils, as well as the behavior of the community in relation to the natural pipes to be used as public collectors.

- The houses in the lower area analysed are the ones that best adapt to the river landscape, 60% use pile systems and 20% floating systems. The type of floating dwelling evidences a traditional flotation mechanism through "topa" wooden logs that fluctuate as the flow of the Itaya River increases.
- The vehicular and pedestrian mobility system adapts to the rising and emptying of the river, through the interaction of boats and canoes that replace motorcycles and motorcycle taxis in the flood season, while a network of ephemeral pedestrian bridges of stilt and floating type are arranged in the streets of the neighborhoods to improve circulation.
- There is a specific legal vacuum on the mode of occupation in flood-prone areas that are not threatened by fluvial variation and that can be development opportunities for the communities that inhabit them and maintain traditional knowledge that must be rescued and valued in order to maintain cultural memory.

The urban scale of the research describes the architectural characteristics that show adaptable qualities in relation to the construction systems located on Amazonian flood plains and the landscape relationship between the community and the river. The morphological variations in water show the types of adaptations related to collective, economic and constructive activities during the river cycle. The work contributes to generating alternative visions to the debate on how to live in the Amazon, presents questions about the peripheral settlements that surround river cities and the need to adapt without stopping in the face of social and governmental incomprehension. This research opens up the possibility of deepening new analyses that complement what has been studied. Such as the vital importance of the opinion of the community for the formulation of proposals for the development of the community. It would also be important to analyze the constructive contribution of river neighborhoods in the level of thermal comfort of Amazonian bioclimatic architecture, the style of construction and its adaptation to the city. Water analysis in Amazonian cities could lead to a rethinking of the criteria for the evacuation of wastewater into natural pipes, generating new visions regarding the use and care of rainwater. The study on the formation of the peoples of the Amazon basin from the architectural and urban perspective can add to the search for knowledge about the concept of the fluvial, to direct in parallel to the registration and evolution of the city's ports, to determine the types of river transport vehicles (canoes, boats,

motorboats, etc.) in contrast to the public land transport vehicles related to the Amazon road system, as well as the study of the level of impact of rivers. This paper has questioned the problems and preconceived benefits of the Amazonian river district and the concepts of floodable community. New reflections are proposed on the evolution of the types of architectural systems adaptable to the river environment and their contribution to architecture and respect for the natural environment.

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6. Figures

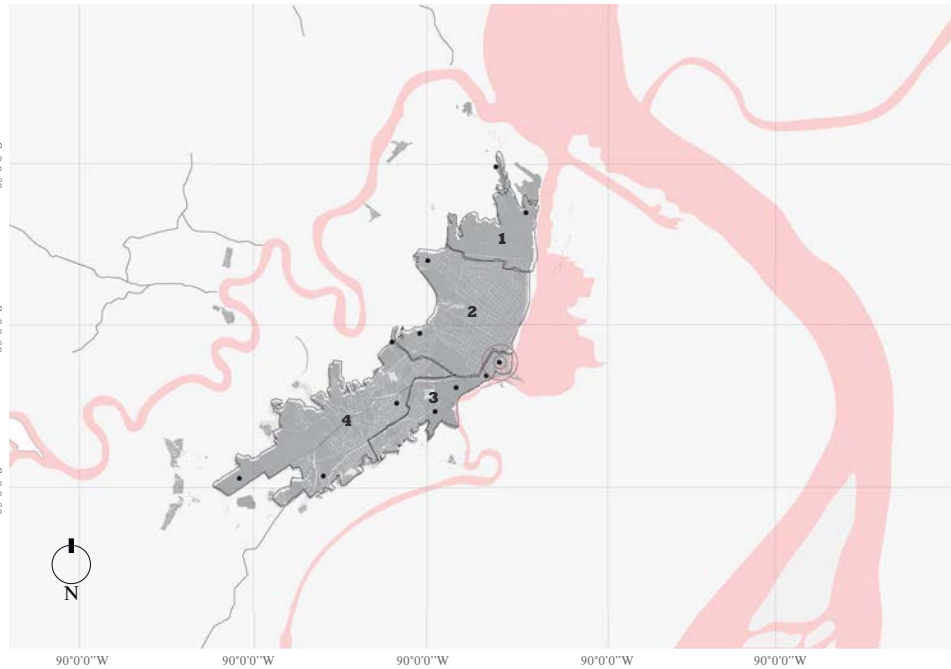
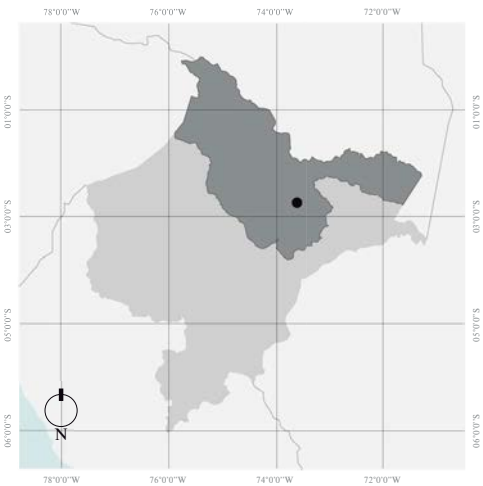
South American Amazon Basin



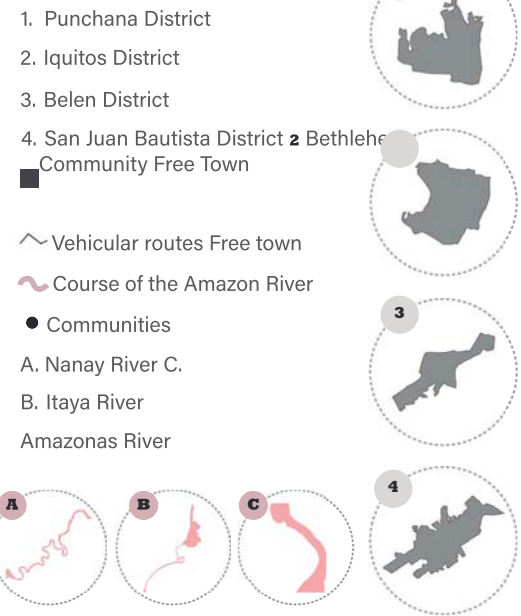
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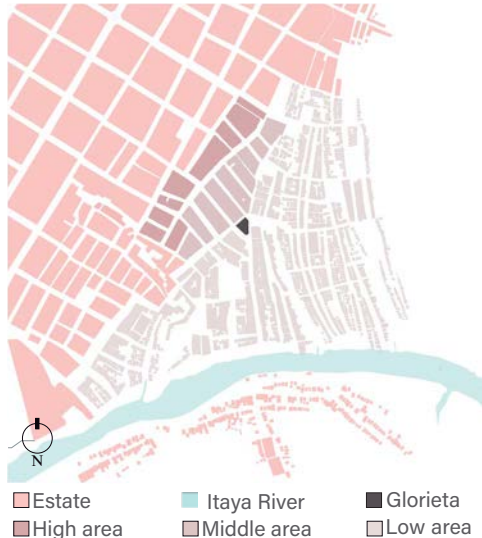
Loreto Department



Legend



Building scheme



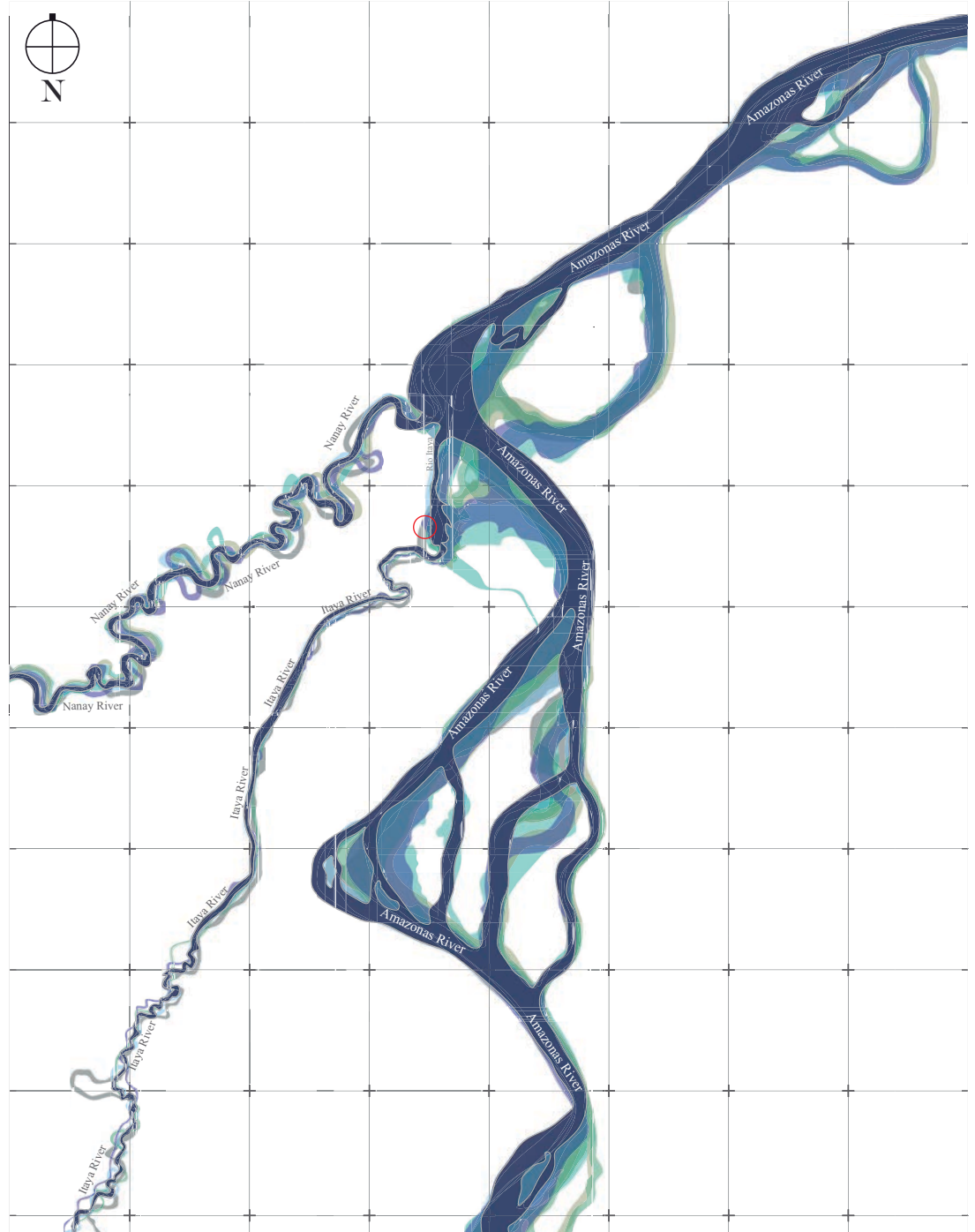
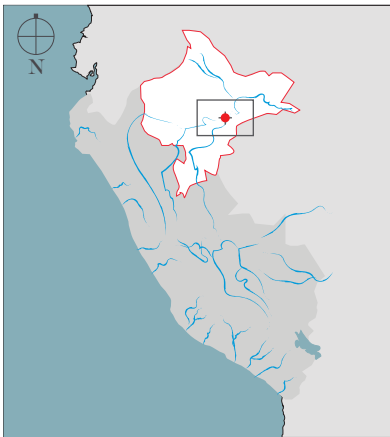
Esquema de cuenca



Esquema de vías



Figure 1. Connection of tributary pipes; Own elaboration with data from the municipality of Iquitos (PDU, 2021)



Legend

- River course by years
 1986 1990 1995 2000 2005 2010 2018 2020
 ● Bethlehem neighborhood □ Vulnerable Areas

Sections

River expansion according to seasons

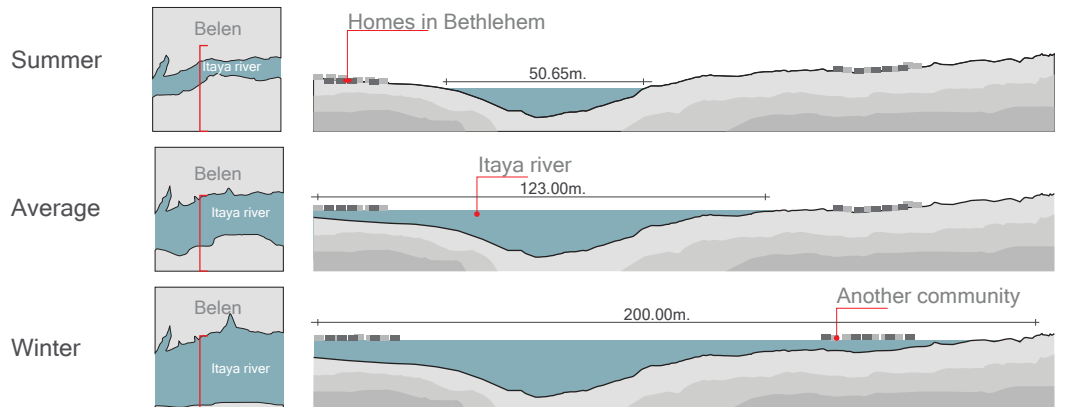


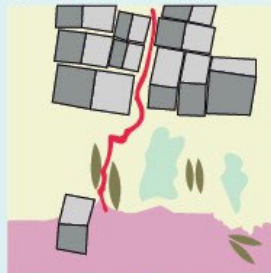
Figure 2. Hydrological Evolution of the Amazon, Nanay and Itaya rivers. Source: Own elaboration with data from the Iquitos library (Joaquín & Nicole, 1994)



Legend

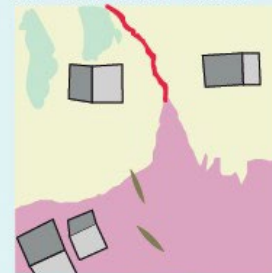
- High Area ■ Middle Area □ Low Area — Course of the pipes
- Itaya River ■ Itaya River in expansion
- Historical landmark Glorieta

C1 - FIRST "CAÑO"



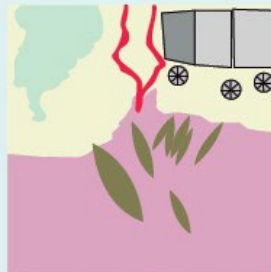
■ Itaya River ■ Canoes

C2 - SECOND "CAÑO"



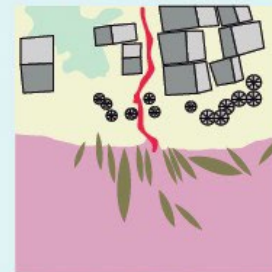
■ Itaya River ■ Canoes

C3 - THIRD "CAÑO"



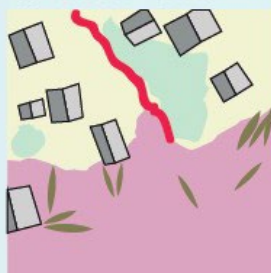
■ Itaya River ■ Canoes

C4 - FOURTH "CAÑO"



■ Itaya River ■ Canoes

C5 - FIFTH "CAÑO"



■ Itaya River ■ Canoes

C6 - SIXTH "CAÑO"



■ Itaya River ■ Canoes

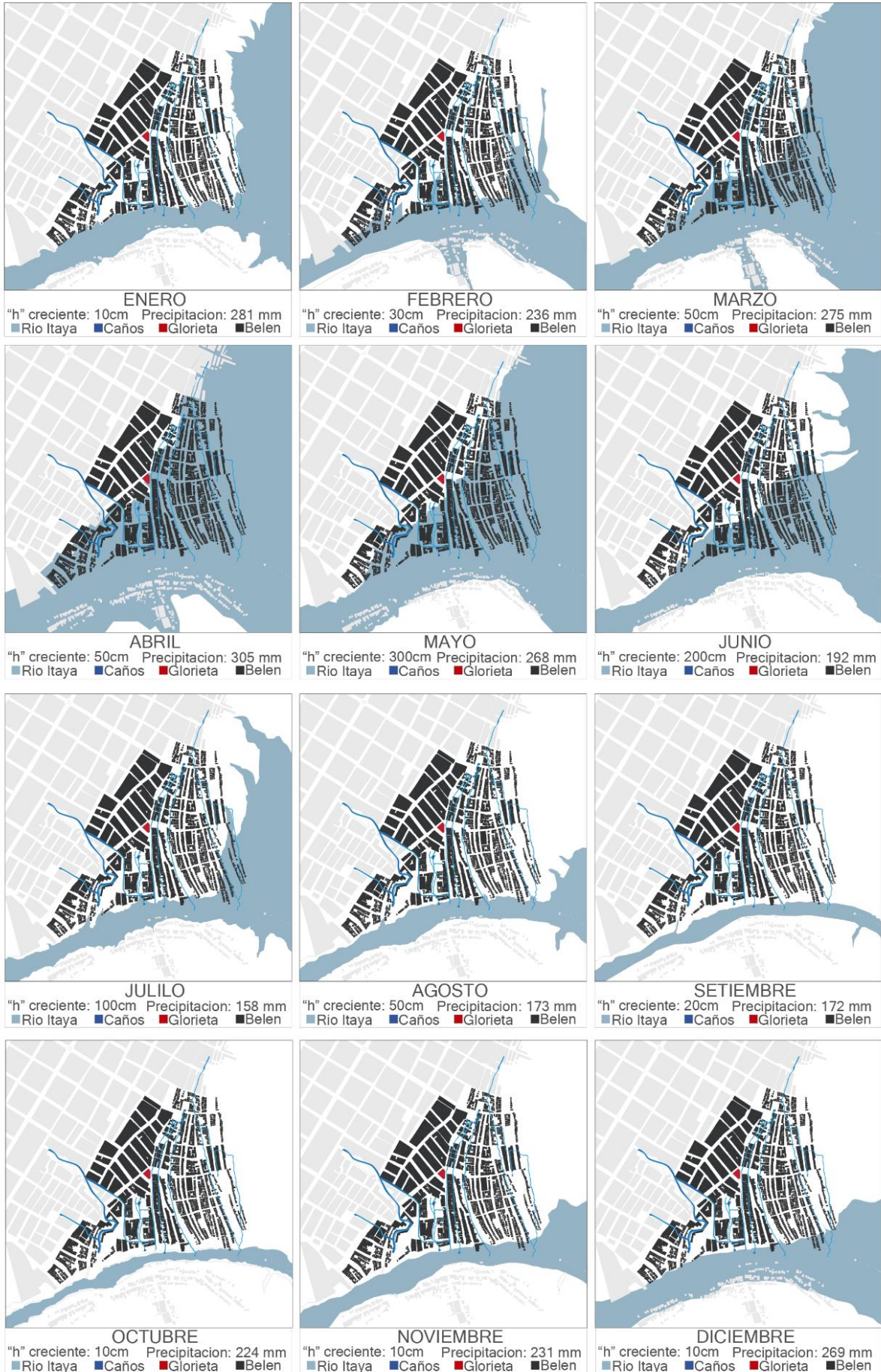
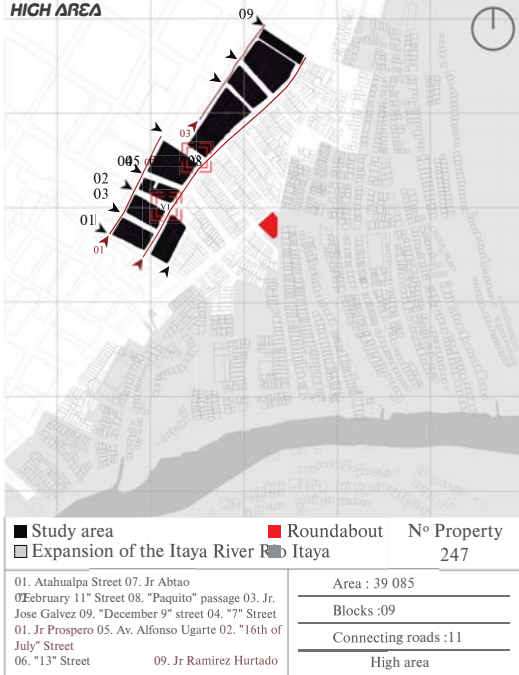


Figure 4. Annual river cycle of the Itaya River, own elaboration based on the (SENAMI, Instituto meteorológico de Iquitos)



HIGH AREA v1
View 01

- Commercial roads from 08:00 to 03:00 are not floodable
- Sale posts

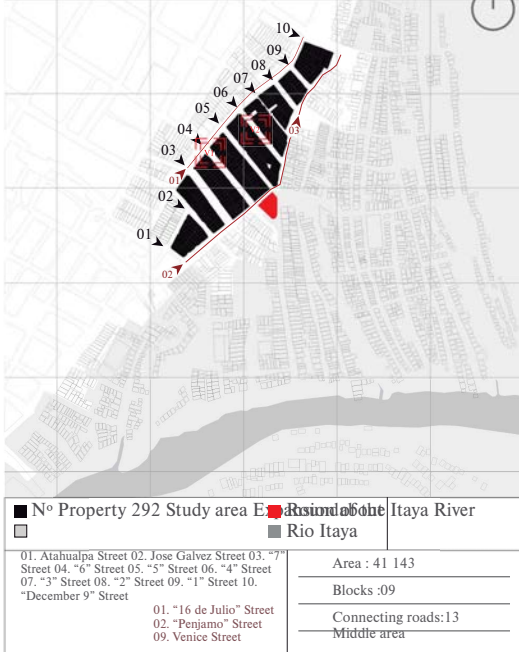


ZONA ALTA
Vista 02

- Commercial roads from 08:00 to 03:00 are not floodable
- Sale posts

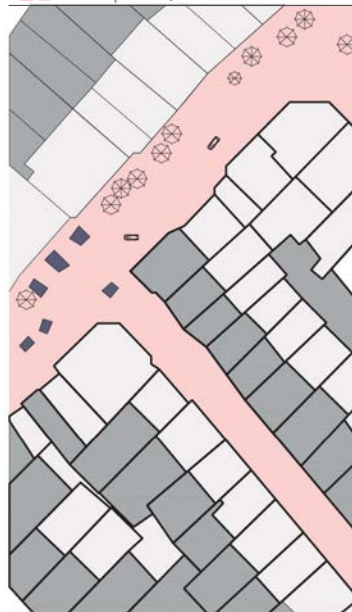


MIDDLE AREA



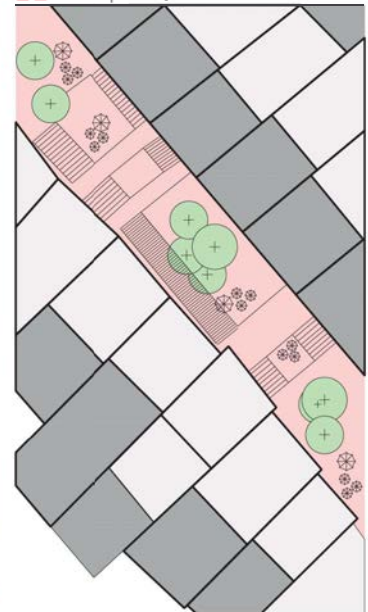
MIDDLE AREA v1
View 01

- Commercial roads from 08:00 to 03:00 in flood transition
- Sale posts

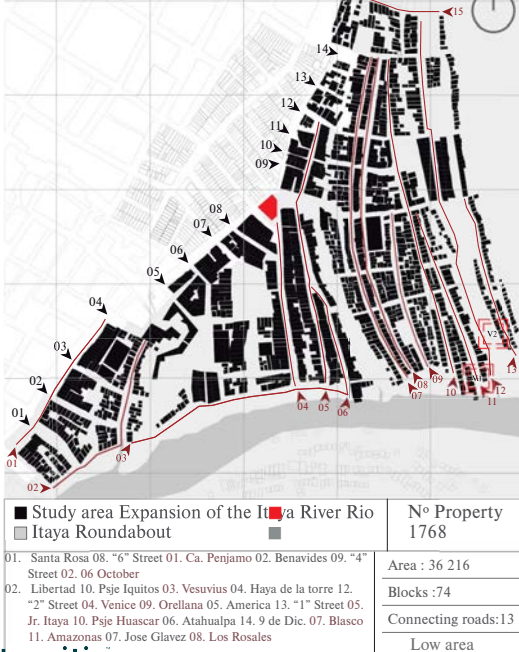


MIDDLE AREA v1
View 01

- Commercial roads from 08:00 to 03:00 in flood transition
- Sale posts

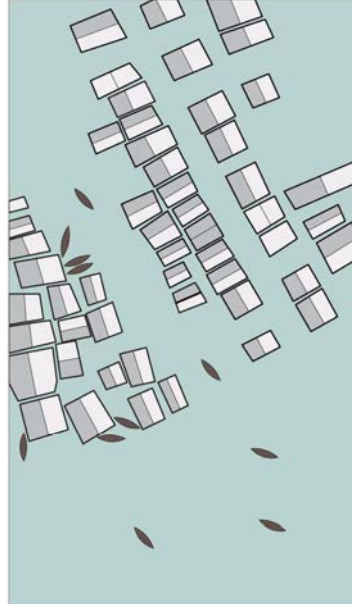


LOW AREA



LOW AREA v1
View 01

- Itaya River in expansion
- River transport
- Households



LOW AREA v1
View 01

- Itaya River in expansion
- River transport
- Households
- Trees

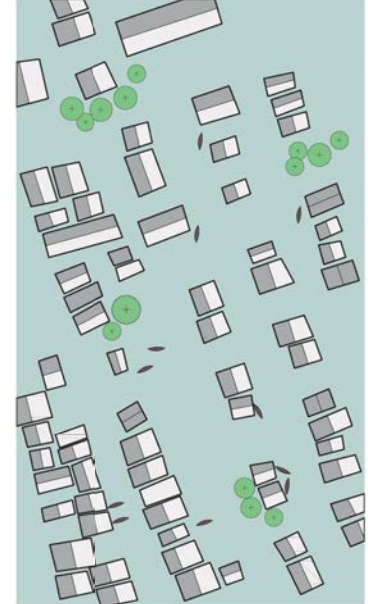


Figure 5. Study areas Source: own elaboration based on interviews and articles



3. LOW ZONE, Floating and pilots type



1 Calle las Flores Sector N° 11, partially flooded, at 40 cm of ground surface. During 15 days in March, the flood covered a distance of 60 m from the initial point shown.



3 Iquitos Street 10-03-2022 4:pm. First level of housing as a hybrid space between private and public.



4 Festive street. The neighborhoods usually gather in the streets on the weekends to



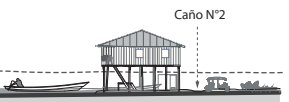
2 Balconies are used more frequently during the rising season, replacing the lower sidewalks as access and social space.



5 Jr. Iquitos 20-03-2021, 12:56 pm. Beginning of adaptation to the growing, motorized vehicles replaced by canoes, elevated social areas, reactivation of the economic aspect.

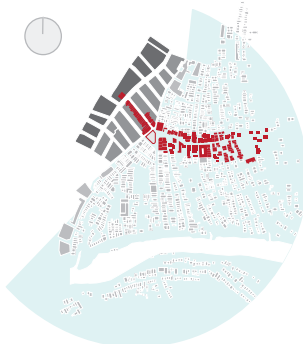


Historic architectural landmark, the Belén traffic circle as an articulator of the lower and middle zone. It delimits the final flood area.



House of José Curowvi, jr. Iquitos N° 100, Average maximum limit of flood: 2.5 mt of height. Housing low zone.

- Commercial Adaptation
- Cultural adaptation
- Cultural adaptation
- Cultural adaptation
- Public use areas
- Flood level
- Flood level



2. MIDDLE ZONE Fixed type and pilots



6 Borde exterior de la plazoleta de Belén (20-03-22)



7 Outer edge of Bethlehem small square (24-05-22)



8 Jr. Iquitos, view of Plazuela Belén (20-03-22), Incorporation of wooden bridges



9 Street N° 5, little informal commerce. Of public use, pedestrian staggered. Sidewalk as a ramp public space for recreation.

(1) ZONA ALTA Fixed type

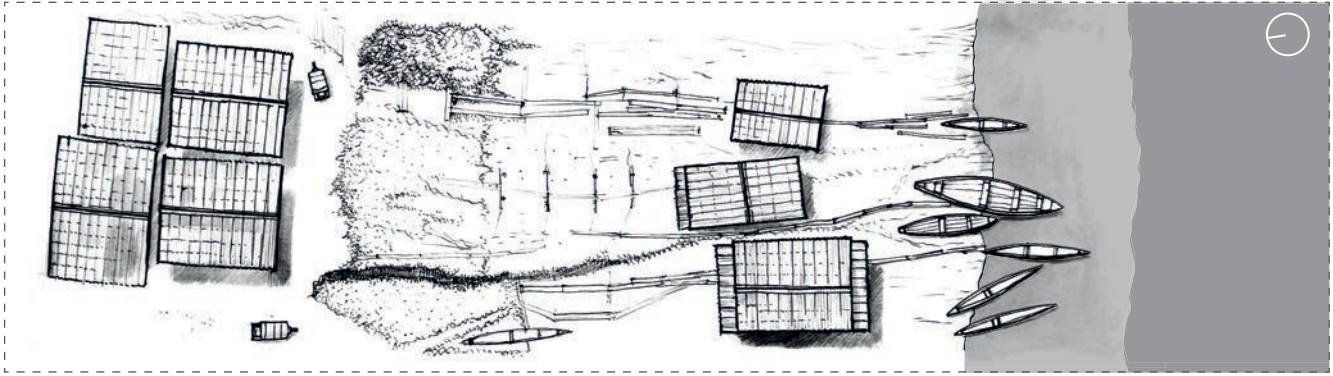


10 Calle 16 de julio



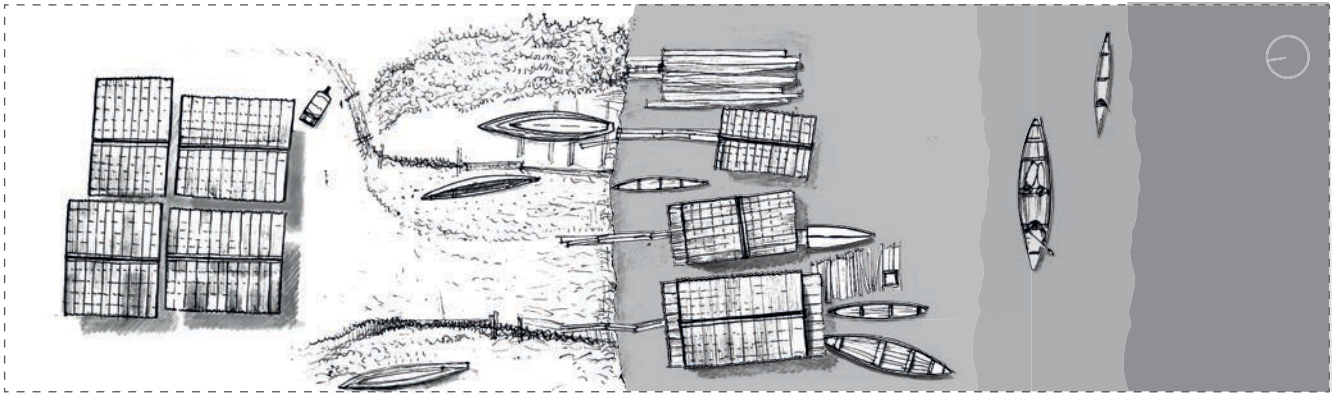
11 View from the upper part of Jr. N° 5 (20-03-22)

RIVER DYNAMICS LOWER ZONE

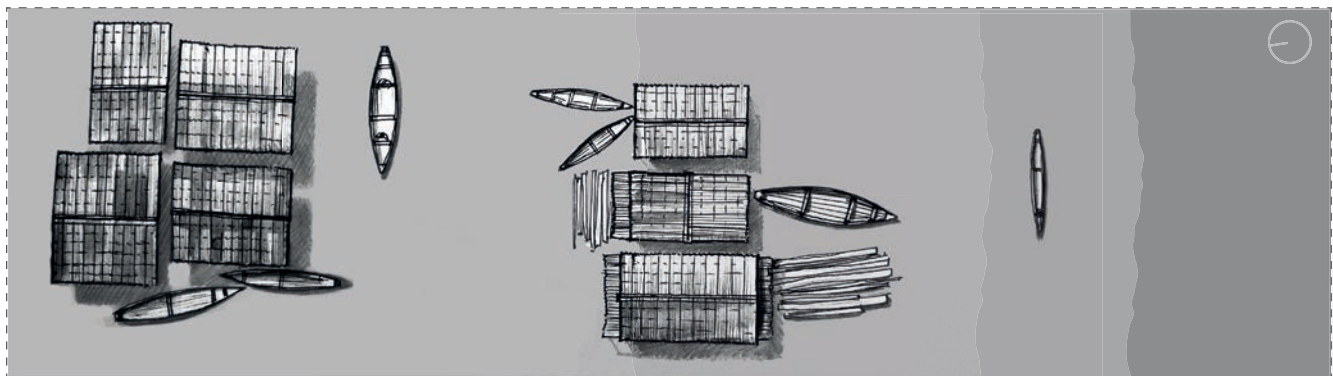


Low flood level, months of June to November (Besuvio Street (Southwest of Belén)
Mixed river neighborhood, housing on stilts on the left, floating dwellings on the right.

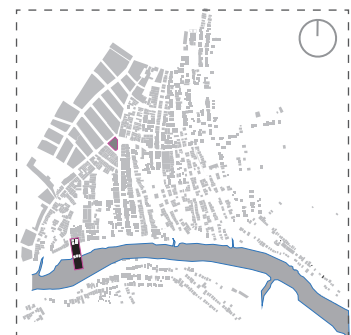
The constructions are adapted to the crescendo. During this transition season, repairs are made to the houses, parts such as calaminas, boards, or logs, are replaced by new parts to extend the durability of the construction system.



Average crescent level, months from November to February.
Floating dwellings are progressively pushed towards the shore, the use of canoes and boats is reactivated; motorcycle cabs are relocated to higher ground.



High crescent level. months of February to June
The constructions are completely enclosed by the river, the stilt structures and rafts allow the water to flow smoothly, without being a barrier to the natural environment.



LOCATION

RIVER CONTRAST OF ACTIVITIES

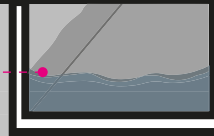
VACIANT
Iquitos Street | Time: 10-02-2022 | Time: 4:00 pm.

GROWING
Iquitos Street
Date: 20-03-2022
Time:10:00 am.

VACANT
Iquitos Street
Date: 10-02-2022
Time: 4:00 pm.



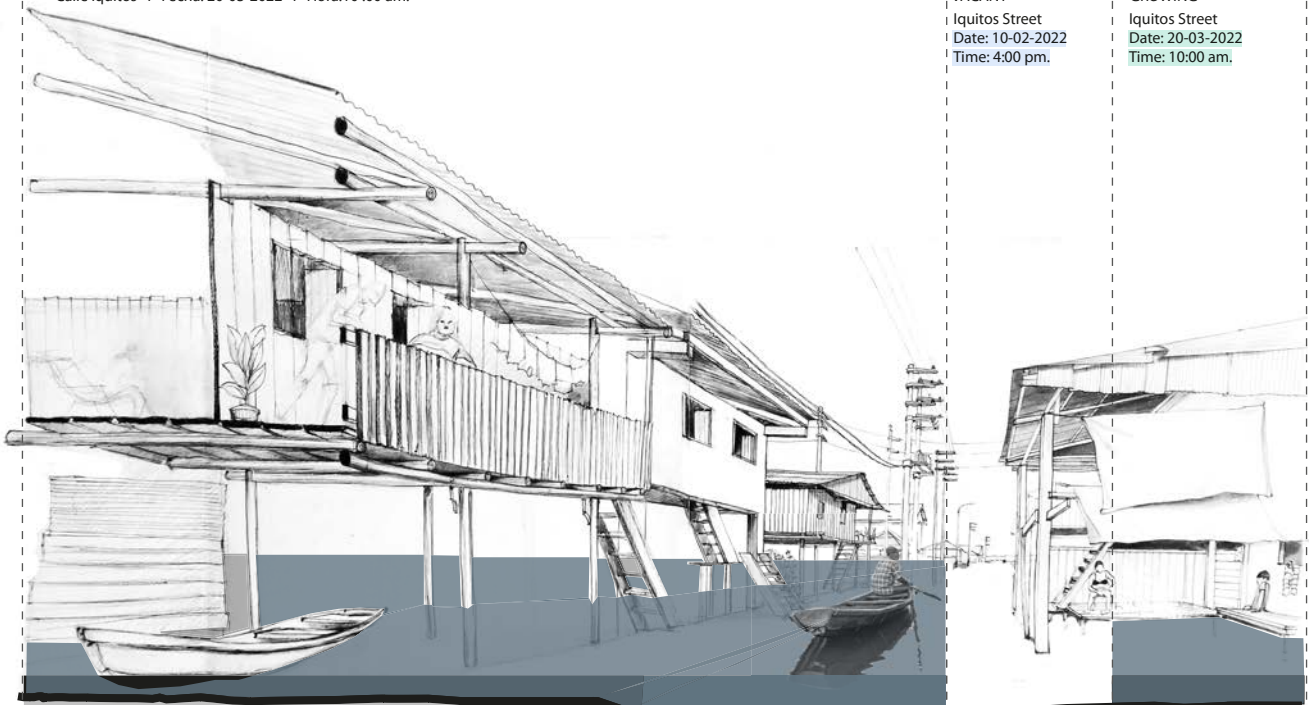
"Caño"-public sewer



Calle Iquitos | Fecha: 20-03-2022 | Hora:10 :00 am.

VACANT
Iquitos Street
Date: 10-02-2022
Time: 4:00 pm.

GROWING
Iquitos Street
Date: 20-03-2022
Time: 10:00 am.



"Caño"-public sewer

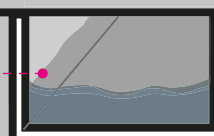
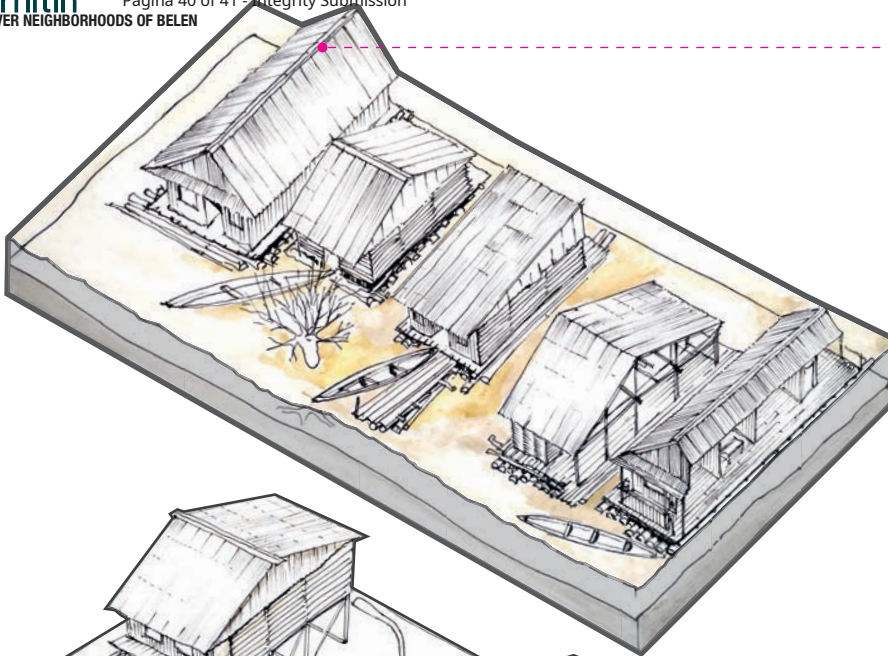


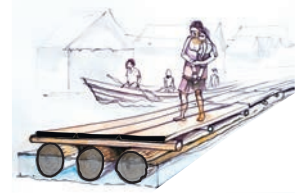
Figure 8. Activities in the lower areas Source: own elaboration based on photographs taken during a visit to the place.



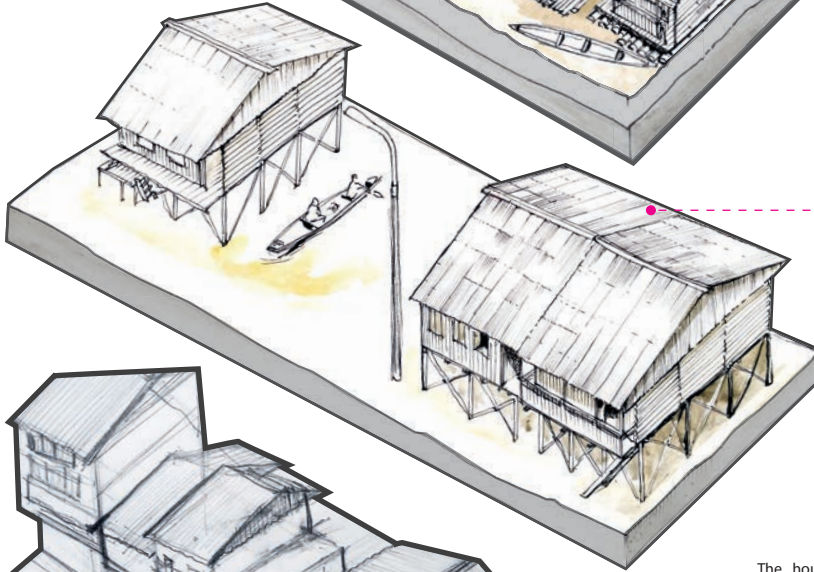
3. LOW ZONE (2)
FLOATING TYPE RIVER NEIGHBOR-

The constructions are adapted to the fluvial dynamics, through the arrangement of wooden logs that form the base.

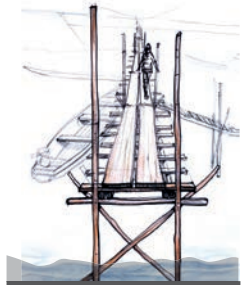
Villagers use floating bridges to connect in short stretches. Flooded streets are navigated by boats and canoes.



The port of Belén is located in this area, which includes Lquitos Street. The sales modules are progressively placed towards the higher parts of the area when the flooding arrives.

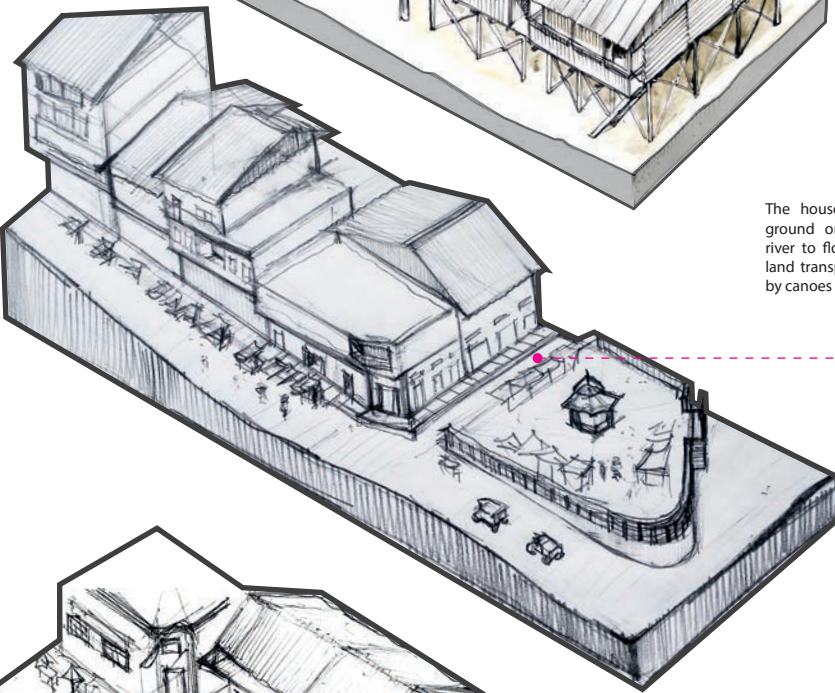


3. LOW ZONE (1)
FLUVIAL NEIGHBORHOOD ON PILES



The house is raised from the ground on piles, allowing the river to flow, and the means of land transportation are replaced by canoes and boats.

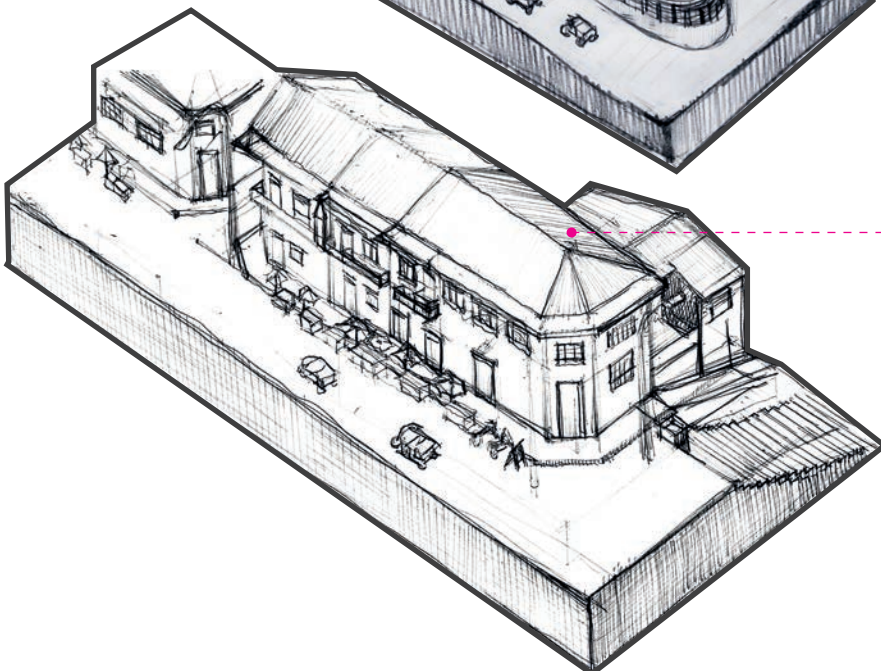
Itinerant river bridges. They are built at the beginning of the flood, and connect the houses with the waterways.



2. MIDDLE ZONE
FLUVIAL NEIGHBORHOOD FIXED RATE

The Plazuela de Belén is the architectural landmark that limits flooding in the area, the water usually extends to this point during the months of April to June.

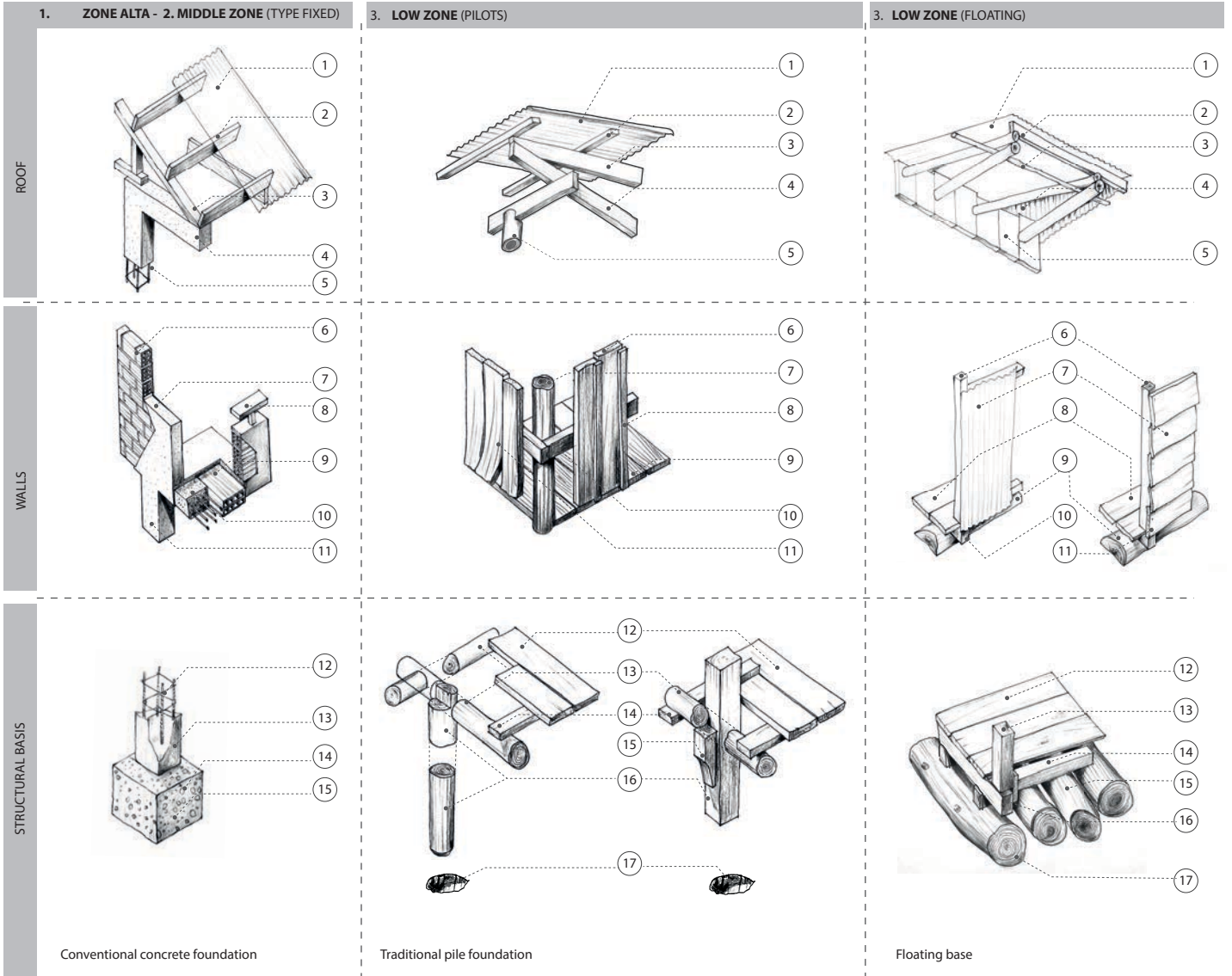
Las calles presentan módulos de comercio itinerante que se desmontan en relación a ciclos de trabajo.



1. UPPER ZONE
RIVER DISTRICTS FIXED RATE

It is characterized by its extensive commercial layout. You can find neoclassical style halls, with balconies and high ceilings.

In the afternoons, when the commercial stores close, the streets reduce the flow of vehicles and recreational activities such as "fulbito" and children's games take place; at the same time, the sale of typical food on street corners is reduced. In the afternoons when the stores close, the streets are reduced and recreational activities such as "fulbito" and children's games take place; at the same time, the sale of typical food on street corners is reduced.



- 1 Galvanized Aluzin calamine
- 2 Wooden beam "catahua" 4" x 2" x 10'.
- 3 Wooden scissors, "Catahua" 4" x 3" x 12'.
- 4 Beam Solera Concrete Armed (25 x 20 cm)
- 5 column detail; 1/2" Iron
- 6 Lateral wall, brick tambourine (12x 10x 23 cm)
- 7 Simple concrete plaster
- 8 Metallic railing, 2 "rectangular tube
- 9 Side wall, brick tambourine (12 x 10 x 23 cm)
- 10 Detail of flat beam, (40 x 20 cm)
- 11 Armed concrete column, (25 x 25cm)
- 12 1/2, stirrups up to every 20 cm
- 13 Detail of reinforced concrete column
- 14 Rubble (bricks, crushed pieces of cement)
- 15 Mixture of fine white sand with cement.

- 1 Galvanized Aluzin calamine
- 2 Wooden "Lizard" joist 3" x 1" x 10'.
- 3 wood beam, "Capirona" 4" x 3" x 12'.
- 4 Capirona wood sill beam 4" x 3" x 12'.
- 5 Wooden prop "Huacapú", 15 cm in diameter
- 6 Side wall, brick tambourine (12 x 10 x 23 cm)
- 7 "Shungo" (central part of the trunk), wooden pile.
- 8 Groove strip, "Cumala" (1/2" x 1")
- 9 Wooden platform "Catahua"; 2" x 6" 10' cm boards
- 10 Enclosure support lath; Cumala 2" x 2" x 10'
- 11 Lateral enclosure, "Cumala" boards 2" x 6" 10' cm
- 12 Wooden platform "Catahua"; 2" x 6" 10' cm boards
- 13 VLupuna" wooden tie beams, 10 cm in diameter
- 14 Joist support for decking, "Huayruro" 2" x 2" x 10'.
- 15 Wooden wedge, for "Lupuna" beam support, 2" x 2".
- 16 Horcones de "Shungo" de madera "Lupuna" circular (7.5 cm (r)
- 17 30 cm diameter hole

- 1 Galvanized Aluzinc Calamine 0.01mm
- 2 Facade tie beam "Lagarto" 3" x 1" x 10'.
- 3 Wooden turnbuckles, "Capirona" 1" x 1" x 10'.
- 4 "Culata" (side cover), Aluzinc calamine 0.25 mm.
- 5 Catahua" wooden planks; 2" x 6" 10' cm boards
- 6 Structural lath, wood "Muena", 30 x 30 cm
- 7 Lateral cover, 0.25 mm calamine and 30 cm planks.
- 8 Catahua" wooden planks; 2" x 6" 10' cm boards
- 9 Topa wood logs, 30-50 cm in diameter
- 10 Wood floor screed 2" x 2" x 10'.
- 11 Nails with head 1" x 16
- 12 Wooden platform "Catahua"; 2" x 6" 10' cm boards
- 13 Lupuna "horcón" sawn timber, 4" x 3" x 12'.
- 14 Joist support for decking, "Huayruro" 2" x 2" x 10'.
- 15 Floating base, wooden log "Topa", 0.3-0.5 m
- 16 wooden beam, for "Lupuna" board support, 2" x 2".
- 17 "Shungo" or heartwood (central part of the wood)



Figure 10. Construction process by area Source: own elaboration based on photographs taken during a visit to the place.