EXECUTIVE SUMMARIES

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1.1 Regeneration of urban rivers, parallels between Portugal and Africa – Challenges and practices

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While cities have historically been associated with watercourses - for water supply and waste water discharge - their expansion shows a dissociation from the principles of environmental preservation. The scale of the environmental problems, on the one hand, and the benefits and ecosystem services provided, on the other, are currently being used as arguments for a review of development policies. This underlines that the environmental issues are also political, economic and social issues.

The chapter *Regeneration of urban rivers, parallels between Portugal and Africa – Challenges and practices* provides an exploratory analysis focussed on three different geographical contexts. It addresses cases in Portugal, São Tomé and Príncipe, and Angola to discuss the importance of a sustainable management of river systems, integrating knowledge on river regeneration with urban and social development. The cases were analysed from an integrated conception of water, articulating the construction of identity and society with benefits from the natural ecosystem, giving shape to strategic axes of RUN | Naturalised Urban Rivers. The chapter elaborates on the three cases, addressing the social and urban memory, natural and cultural heritage, and the articulation of watercourses with the urban system, to discuss the enhancement of riverain communities.

Ribeira das Jardas (Sintra, Portugal): The River, outdoors physical activities and the CoviD-19 pandemic

The benefits that nature provides the urban environment with call for integrating nature as a component of land-use planning and public policies. Being multifunctional, public greenspaces offer environmental, economic and social benefits, among which one can find the "space" for the practice of physical outdoors activities. In the case of Ribeira das Jardas (Jardas Stream), the research aimed to create new knowledge about the benefit of watercourses for physical activities - in light of the containment measures during the Covid-19 pandemic. The Ribeira das Jardas, in the city of Sintra, is incorporated in the Dom Domingos Jardo Park - a park opened to the public in 2000, when an "abandoned" space was redesigned along the regenerated stream. The creation of the park enabled a more appropriate use of the land by the population in terms of mobility, passive and active recreation, encouraging the integration of the river in their daily life.

The pandemic exposed the vulnerabilities of the urban environment, highlighting at the same time the links between the built environment, nature and well-being. In the wake of the project entitled *The Importance of the Green Infrastructure and Physical Activity in the Time of Pandemic (verDEsporto)*, processes and methods are discussed to gain knowledge on the role of water resources for active lifestyles. The study explored an interdisciplinary, transversal approach to the nexus greenspaces, physical outdoors activity, restrictions to face Covid-19, and Ribeira das Jardas. The Project gathered quantitative and qualitative data, through a close collaboration between the Faculty of Physical Education and Sport and the Department of Architecture and Urban Planning of Lusófona University. Although the project aimed to shed light on the use of greenspaces during the pandemic, it also suffered of the impact of containment measures, as the fieldwork was also halted because of Covid-19.

The verDEsporto Project, the results of which are still being analysed, also in a collaborative way, has already demonstrated that (re)naturalised spaces are essential for the citizens' well-being. The preliminary analysis also provides insights on how the practice of physical activities and the quality of the space are interconnected, showing that Ribeira das Jardas assumes, in addition to an environmental function, also the role of a central attraction, thus reinforcing identity dimensions in favour of the common good, social representation and more active lifestyles.

Cantagalo, São Tomé, Democratic Rep. of São Tomé and Príncipe: Rivers as tools for equity and sustainable development

The rapid process of urbanization undergone by African societies represents a challenge for territorial management bodies, as is the case of the District of Cantagalo, in São Tome and Principe. The lack of planning tools to guide and limit urban spread worsens the socio-environmental conditions, with direct impacts on local watercourses - **Ribeiras de Afonso**, **Santana** and **Água Izé**. Whereas, on the one hand, the size of the problem underlines the limitations of classic solutions, on the other, these problems are of growing concern also to the local society and government. Both are becoming aware of environmental damage, and call for a more sustainable use of resources and inclusive development.

A reflection on the situation of the three streams in Cantagalo, which suffer from severe pathogenic pollution, is undertaken from the perspective of development in modern societies. However, local development faces challenges of a society extremely dependent on the environment and on rivers not only as a source of raw materials and energy and as a work environment, but also as a waste disposal site. The cases in Cantagalo contribute significantly to the construction of knowledge on the axis linking river - community and the well-being of the population, and to the discussion on building up the concept of environment as a result of social practices.

Gambos, Huíla, Angola: Rivers as schooling factor

The frailty of the educational system and its socio-spatial connotation is in the spotlight in the case of Gambos (Province of Huíla in Angola). The lack of a territorial connection of schools in rural areas limits the extent of knowledge acquisition, thus accentuating inequalities and calling human dignity into question. Gambos faces multiple limitations of a physical nature that condition the settlement of farming and pastoral communities. Seasonal drought patterns overlap agricultural cycles, pushing families to follow water availability. The seasonal movement of livestock and transhumance herding are the culture and identity of Gambos. The daily search for water pushes in particular boys to engage in transhumance, making them embark in long journeys, often as far as 150 km. Hence boys tend to drop out of compulsory education.

Data were analysed using descriptive statistics, which resulted in a social cartography set. Information about the Huíla watershed, climate and biophysical characteristics, and settlements were assembled together, showing singularities in the social composition and the appropriation of the territory. To improve education in Huíla requires suiting it better to the needs of families by measures that facilitate attendance in schools on migratory corridors. Thus, the social cartography entails information that is vital to assess the ideal location of itinerant/mobile schools that could follow the transhumance routes - and to develop strategic thinking both in terms of education and territorial development, thus generating arguments that enhance integrated public policies.

Multi-disciplinarity in approaching urban rivers has proved to be a challenge for land-use planning. This chapter demonstrates the ability to interpret different contents, contexts and emotions in the valorisation of a local identity and dissemination of the benefits of urban rivers. The developed methodology, based on the principles of citizen science, co-creation and placemaking, also connects aspects of (formal and non-formal) education and its reflection on the use and appropriation of territory. A cross-cases analysis enables actors to mobilise knowledge to build more sustainable societies, able to act and react in a timely and efficient way. In addition, a cross-cases analysis can help identify emerging topics in science, and thus lay the foundation for approaches and principles that govern the Cyted RUN network.

The table below shows the approaches that are relevant for each of the cases. This information is crucial in creating local knowledge and in enabling the formulation of more inclusive and resilient development policies.

Approach	**Portugal**	**São Tomé and Príncipe**	**Angola**
Governance	No	Yes	Yes
Territory	Yes	Yes	Yes
Values and Memories	No	Yes	Yes

Proposed Strategies and Projects	Yes	No	No
Research and Dissemination	Yes	No	No
Tools to Understand the Territory	Yes	Yes	Yes
Risks and Disasters	No	Yes	No
Environmental Conflicts	No	Yes	Yes
Blue and Green Infrastructure	Yes	No	No

Albeit distinct, the three cases provide a multiscale, multilevel and multisector view of rivers subjected to anthropic pressures. The cases allow for a more holistic understanding of urban rivers, as well as better knowledge of the territories and societies where they are inserted. Although the "place" of water in human environments has been a societal concern, watercourses in urban development policies and spatial planning practices have often been given too little attention. On the flip side, though, the issue of urban rivers, the features of the natural heritage, demonstrate that the interdisciplinary approach and discussion are also fruitful in the construction of scientific rationality, and that promoting well-being, equity and sustainability in the built environment requires a departure from conventional agendas.

Keywords – Urbanisation, riverside populations, paradigmatic cases, research strand

1.2 Ecotoxicological evaluation of sediments in urban and peri-urban sections of the River Chili in Arequipa (Peru), using aquatic bioindicators

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This case study took place in a region located in southern Peru, specifically in Arequipa, the second most important city in the country, which has several bodies of water within its territory, the Chili being the waterway that flows through the city. This is also its main source of water supply for human consumption and other vital economic activities such as agriculture and mining in the section of the medium and lower basin of the city. This body of water is considered an urban river since it crosses agricultural, urban and industrial areas, this water resources providing support to all the activities characteristic of a city. However, the quality of this river's water is affected by the contamination generated mainly by agricultural as well as illicit industrial and domestic effluents.

The general goal of the present study was to assess the ecotoxic effect of the sediment of the Chili in two urban and peri-urban sections in two non-recipient model organisms. To this end, samples were obtained from the sediment collected in the river, and five dilutions were prepared with dechlorinated water which correspond to a negative control (only dechlorinated water) followed by 12.5, 25, 50 and 100% of total sediments and sediments processed by elutriation, using the two model organisms (bioindicators). As regards invertebrates, neonates of under 24 hours of the water flea *Daphnia magna* were considered, which were evaluated for lethal effects or mortality after 48 hours of exposure to total sediments and in young Guppy fish *Poecilia reticulata* sublethal effects such as hypoactivity after 96 hours of exposure to elutriated sediments, all of which following the protocols corresponding to OCDE 2004 and 2019 respectively. The experimental design of the trial corresponds to a randomized block design (DBCA) with three repetitions per treatment.

The samples of the two sections (urban and peri-urban) directly connected to the Chili are regarded as monitoring points (PM) in the urban sector: at 100 m upstream from the Tingo bridge and in the peri-urban sector located 100 m downstream from the Tiabaya bridge in the Chili subbasin in the city of Arequipa. The samples of sediment were collected with the help of a Van Veen dredger in counterflow in both sectors. They were hermetically stored and transported to the accredited laboratory to determine their respective physical--chemical and total metal parameters. The results of the physical-chemical evaluation of the

sediment collected in both sectors, urban and peri-urban, of the Chili River determined that the level of organic matter was high, in excess of 24 % especially in the peri-urban sector. As regards total metals, copper (56.282 mg/Kg) and arsenic (13.97 mg/Kg) exceeded the amounts established by the guideline on the quality of sediments for the protection of marine life of Canada, CCME (1995). The peri-urban sector downstream from the Tiabaya bridge is the one that records the highest values for both metals. It is important to highlight that the majority of the parameters evaluated are higher in the sediment samples of the peri-urban area by comparison with the urban area, on such metals as iron, aluminium and manganese, among the most outstanding.

The results of the ecotoxicological assessment of the model organisms *Poecilia reticulata* and *Daphnia magna*, with the treatment of 100% elutriation of sediments and total sediments, respectively, present the highest values in percentage of sublethal effects in fish (hypoactivity) and lethal (mortality) in water fleas. The $CE(L)_{50-96}$ of elutriated sediment for *Poecilia reticulata* was the lowest in the peri-urban sector (29.99%), indicating this is a sediment with sublethal harmful effects for fish. However, it was not possible to calculate the $CE(L)_{50-48}$ for *Daphnia magna*, in both monitoring points, and it is understood that the total sediment for this group of invertebrates is not very harmful, since the mortality of neonates evaluated after 48 hours of exposure in the different dilutions does not exceed 50%. The acute toxicological units (UTa) show mixed results, the sediment of the peri-urban sector is considered *toxic*, since it causes sublethal effects for the fish and *slightly toxic* for lethal effects in water fleas. The ecotoxicological status of the total sediment of the sample areas (urban and peri-urban) is *slightly toxic*, as regards the survival of *Daphnia magna* up to 48 hours of exposure.

The action of heavy metals is discussed since they stand out for their toxicity in organisms in the aquatic ecosystems. Their effect is related to a change in the balance of cations such as Ca^{+2}, Mg^{+2}, affecting several cell processes like transport at cell membrane level. They also impact on several mechanisms, decreasing respiration; besides, as in the case of copper, its increase in aquatic ecosystems results in the weakening of lysosomal membranes, releasing hydrolytic enzymes. Hence, these antecedents would explain the sublethal and lethal effects which are presented as results of this work, not only on fish but also on water fleas. Finally, it can be concluded that it is demonstrated that the possible cause of the harmful effect for the aquatic biota around the peri-urban area is due to agrochemical surpluses (heavy metals) of the intensive farming of the area which is concentrated in the peri-urban sector, and which are reflected in the toxicity of the samples of the lower parts (downstream) of the Chili basin. The acute ecotoxicity in the sample areas visible in the test organisms could also be due to the noticeable differences in the composition and effect (especially metals) of the total and elutriated sediments used in this study.

Keywords - *Poecilia reticulata, Daphnia magna*, elutriation,sediments, River Chili, ecotoxicity

1.3 Research and collaborative urban design along the rivers in Cuenca (Ecuador)

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The importance of rivers and streams within the urban ecosystem is evident and crucial, as is the preponderant role of their banks within the public space system. Historically, civilizations have organised around water sources, including rivers and streams, as they are one of the most important natural elements that satisfy the biological needs of humans and animals, and are vital for practices such as agriculture, construction, sanitation, etc. Urban rivers appear as one of the most influential elements in the spatial and social conformation of cities since they serve as articulators of a physical environment. Their margins can be classified as unique and irreplaceable green paths, in which water and land interconnect, achieving spatial characteristics of high value in various areas (Binti et al., 2015). River banks constitute green corridors that allow the conservation of plant and animal biodiversity, the reduction of pollution, and the well-being of the human being (Che et al., 2012). They also provide important ecological, social and landscape benefits which reinforce the notion of the city as a complex system. However, despite the importance of watercourses around the world, the relationship of urban settlements with rivers has deteriorated dramatically. Therefore, it is urgent to reaffirm the role of the water network within the urban mesh (da Costa, 2008), also as a public space capable of strengthening the social and environmental resilience needed to recover from different crises (Maguire & Hagan, 2007). So, design is the tool that allows a connection between landscape planning and its social impact on these environments. In this sense, intervention projects on river banks can be decisive for one of the most significant networks in the natural component of the built context in human settlements.

From this approach, the experience presented in this chapter corresponds to the design process of public space on the banks of four rivers and a stream in Cuenca-Ecuador, which emerges as a second stage in the research process on urban rivers in the Andean region in Latin America. The proposed exercise involved evaluating the sustainability of these rivers and streams through the use of thirteen indicators divided into two main axes: Continuity and Comfort, as well as a synthetic index called the Urban Rivers Sustainability Index (ISRU). With this information, through urban design exercises, both design strategies and the indicators measurement methodology were tested. The results would allow to improve the practice of urban design, turning it into an evidence-based

learning project process, which also contributes to the validation and adjustment of the proposed measurement methodology.

The ultimate goal of this process was to carry out the evaluation before and after a possible urban design intervention on the banks to determine which strategies allow a significant improvement in terms of sustainability. This was implemented in two research-by-design exercises carried out with students and young architects. After the usual design process, the changes that the proposals implied in each of the indicators were verified.

Interesting results were found concerning specific indicators and their importance in the study of urban rivers, noting that above the calculation formula the concepts behind each indicator must be understood. It is also considered that, in pedagogical terms, it is much more interesting and pertinent to promote the manual calculation of the indicators, for a possible later systematisation. On the other hand, some of the proposed indicators did not show significant changes after the design, since they refer to a higher planning sector, that is, they demand an intervention on a different scale. Regarding the design experiences, they constituted a first attempt to apply the proposed evaluation system, not only to measure the current state of rivers, but as an urban-architectural design tool that enables the impacts of certain decisions to be measured. Finally, there is an urgent need to evaluate urban rivers and streams, for which it is essential to have the support of local governments, as actors that not only provide the required information, but also assume this tool as their own. In conclusion, the contributions of this study present a solid theoretical basis for the formulation of future research projects that enable the application and improvement of the proposed methodology.

Keywords - Protection margins, public space, connectivity, research by design

1.4 Living streams: imaginings for a river basin

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Ecology is what unites all living human and non-human beings – we are a great living global social network. However, floods, droughts and pandemics, phenomena aggravated in the Anthropocene, are the consequences of a troubled relationship among those who share the planet, the result of predominantly predatory political regimes and a conflicting occupation of the territory. This chapter aims to present some questions as provocations and approaches regarding the imaginary of rivers in cities using for it the content produced in the context of the Córregos Vivos exhibition, curated by the author, with Louise Ganz (general coordination), Alexandre Campos, Ana Paula Baltazar and Izabela Isidoro. Using the imaginary as a powerful tool and as a metaphorical territorial landscape to rethink the use and the life around rivers, it is our intention to use the experience of the Córregos Vivos Exhibition as a catalyst to water imaginary discussions.

The aim of the Córregos Vivos exhibition, which took place throughout the year 2020, was to discuss urban rivers based on the imaginaries of dwellers, urban planners, movie directors, artists and architects, with the geographical unit of the Cercadinho Hydrographic Basin, in the western region of Belo Horizonte, Minas Gerais, Brazil, as research territory. In this city, whose principle of territorial occupation was conceived from the layout of the roads and the subdivision of the land, and where streams were plugged and violated throughout history, there are few rivers that remain in the open and are experienced as socio-environmental spaces. As a microcosm of this violence, the Cercadinho watershed, located in the western region of the city, has two main streams – Cercadinho and Ponte Queimada – which, even though they still remain in their natural beds in some stretches, are disregarded and mistreated, a contradiction in a city that just wants to make them disappear. A contradiction in a country that only wants to make its Amazonian condition and potential disappear to the detriment of the idea of a country of the future, promoted more than fifty years ago, since the period of the military dictatorship in the 60s with promises of modernity, progress and order. Understanding the Córregos Vivos exhibition as a political-ecological network of multiple scales that shows processes of violence at the same time that it points out poetics of creation, we will discuss the ways in which it was able to produce imaginaries, turning history and exposing the existing social fabric, both in its violence and in its ability to respond to the challenges that arise. Therefore, this chapter is divided into five parts, the first being an introduction to the exhibition while the other four elaborate on these approaches. Firstly, the Córregos Vivos exhibition is presented, with an explanation of the territorial context in which it took place and some main concerns will be addressed, which will also be presented throughout the entire paper - the contradictory development, planning and occupation of the city of Belo Horizonte, the need to think the Exhibition as a nucleation that serves as

laboratory to make experiments in order to rethink Modernity, the relation between nature and culture and other epistemologies. The following four parts were written as essays, using the information produced in the exhibition, such as: the correspondence among authors and collaborators; the pedagogical materials produced in a course offered by the School of Architecture of UFMG; debates in live streaming with experts, artists, architects and dwellers of Cercadinho's hydrographic basin, among others; and commissioned visual works produced by groups chosen by the curators, divided into six themes: Local History, Lived Gardens, Springs and Forests, Territorial Paintings, Living in the Hydrographic Basin, and Economy of the Affections. In the second part, using the correspondence produced in the Exhibition, the contexts that were lived and experienced by the collaborators to problematise the different conceptions and meanings of river, waters and knowledge in different contexts, from Amazonia to Quilombo, are discussed in order to envisage the river in a broader and geopolitical scale. The third part addresses the manners in which history and memory are intertwined and the latter obliterated by colonial practices using the commissioned works regarding the themes of Local History and Lived Gardens. It discusses the power of testimonies and images, including photography as a form of truth. The fourth part concerns the relation between affections, values, economy and incomes. Producing an experiment together with the dwellers and social organisations, using live streaming debates and organising an assembly, all this took place in the lived context of the Hydrographic Basin, and has resulted, potentially, in the creation of a community bank – the Cercadinho Bank. Finally, in the last part, the paintings and sculptures produced in the Exhibition by woman artists and local artists are discussed, considering not only the results, but mainly their relationship with the history of the representation of places that are not so well-known or that are known as exotic in naturalistic painting.

Keywords – imaginaries, narratives, testimony, memories, Belo Horizonte

1.5 A Platform for Urban Greenspace Monitoring - UrbVerde: Methodological challenges and potentialities of a collaborative environment for the Cyted RUN network

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The world population exceeded 7.9 billion individuals in 2021 and is expected to reach 9.7 billion in 2050. At the same time, the global proportion of people living in urban areas is projected to grow from the current 56% to 75% (ONU, 2019). From this context, it is important to define multidisciplinary approaches to the construction of scientific knowledge about urban spaces to provide decision support for public policies focused on new paradigms and strategies associated with improving the quality of urban life. Information and communication technologies play an essential role in achieving this end. However, such technological applications are still scarce, and there is a gap between the data available for annual monitoring and its use in urban environmental planning, since most municipal governments face difficulties in modernising management at the same pace as the global technological advance. In the midst of the emergence of the urban environmental issue, the production of spatial information from new technologies of remote sensing, intelligent digital systems and cloud data processing, provides updated information with low operating costs, high technical rigour and a good level of spatio-temporal detail. In this sense, this article presents, as a first step, the methodological proposal for the construction of metrics and indicators for a customised platform for intra-urban environmental monitoring (Plataforma UrbVerde), with an emphasis on user autonomy to monitor the intra-urban environmental dynamics of the municipalities that make up the State of Sao Paulo, Brazil.

The tooling framework adopted includes open-source software such as QGIS, and research-oriented cloud processing platforms such as Google Earth Engine, as well as public data sources such as Sentinel II and Landsat 8 satellite images, and data from the Brazilian Institute of Geography and Statistics (IBGE). According to Gorelick et al (2017), Google Earth Engine (GEE) is one of the main tools when it comes to large-scale processing using Cloud Computing. Its work environment is based on a programming interface and has an extensive library of remote sensing products, as well as databases on geographic information and statistics de-

veloped by universities, government agencies, the private sector and the third sector. All this apparatus is gathered in a single tool available online without the need to install software.

The databases used to compose the layers of information present in the UrbVerde platform come from different sources. Data on temperature and vegetation come from Landsat 8 and Sentinel II satellite images, between 2016 and 2021. Demographic and socioeconomic data collected by the last demographic census, carried out in 2010 (IBGE, 2010) will also be used. Regarding green intra-urban infrastructures, a vector database is being used, built from information related to squares, parks and green areas extracted from the OpenStreetMaps collaborative platform. The database will contribute to the composition of indicators for three different layers: i) terrestrial surface temperature (TST); ii) vegetation cover and socio-environmental quality; and, iii) access to green infrastructure. In a second moment, the methodological challenges for the appropriation and redefinition of the UrbVerde Platform are presented in order to answer the questions intrinsic to other socio-spatial configurations in the Ibero-American scope, especially those related to institutions that are part of the Cyted RUN network, considering the definition of comparative and relational perspectives, as well as the construction of social participation within this context. The focus on measuring intra-urban inequalities, also considering socio-economic metrics in the distribution of green areas, will allow the government to prioritise areas of greater vulnerability in order to promote urban democracy from the perspective of equality and collective well-being. This will be the first experiment in Latin America of gaining scale in the production and availability of this category of spatial data in an intra-urban context, including tools for analysis in a format that can be monitored and evaluated by both public authorities and civil society. A question that is presented as theoretical, political, social and methodological challenges is to think about the transferability of the UrbVerde platform as a tool that can be adapted to the particularities and singularities of the physical environment and the organisation of the different territories covered by the research of the universities that are part of the Cyted RUN network. Such challenges point to the future possibilities of developing the platform, not only considering the research potential for comparative and relational studies, but also the co-creation and co-development of the platform in the sense of constituting a network that can amplify the potential innovative feature of this tool, providing scalability to the prototype within the scope of the Brazilian case study.

Regarding the theoretical challenges and considering that each country, each territory, has its characteristics and singularities, it is important to discuss how we can, from an idea and problem common to urban rivers, articulate the different disciplinary areas and groups to explore these contexts. How can we adjust and streamline, within the scope of UrbVerde itself, the achievement of our goals? The way in which the territorial units of analysis is defined and the structuring of census data in each country, in each region, also considering variables such as income, race, education, etc. allows for understanding and associating environmental information extracted from remote sensing with socio-territorial inequalities, issues that can be identified from census surveys in different contexts. However, the search for ways

to make it possible to compare and relate the construction of a social indicator based on census data and other variables comes up against the different ways in which territories are organised as well as the different forms and methodologies and different variables produced by the countries. Although the idea is not to create an equivalence, what arises is the need for universal indicators that recognize differences and accommodate differences, considering that they can be used in different countries without disregarding their differences and singularities.

Keywords - Urban environmental monitoring, intelligent digital systems, cloud computing, remote sensing, collaborative networks

1.6 Mediterranean river systems: From ecological quality to knowledge transfer strategies in the Besòs and Tordera river basins (NE Spain)

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During the 1960s and 1970s, Mediterranean fluvial systems were generally affected by intense anthropogenic pressures, mainly due to urban and industrial growth around the middle and lower river courses. These factors led to a decline in their hydromorphological and ecological quality status. The river Besòs, located in the Barcelona Metropolitan Area, constitutes one of the most paradigmatic cases of this process of fluvial systems alteration, being considered during this period as one of the most polluted rivers in Europe.

The implementation of environmental laws and the improvement of wastewater treatment plants (WWTP) have clearly contributed to revert this situation to the point that the ecological quality of these fluvial systems has experienced considerable improvements over the last two decades. However, Mediterranean basins are currently still exposed to several challenges. Due to their characteristics, they are subjected to wide interannual climatic variability, which will be intensified due to the climate change effects, with direct consequences on water resources and associated biological communities.

The case studies addressed here are the Besòs and Tordera Mediterranean river basins (NE Spain), with similar hydrological characteristics and surface (around 1,000 km^2) as well as the heterogeneity in land uses and land covers along the river courses, from headwaters to mouth. In this context, the Observatori RIVUS project, started in 1996, is focused in two main objectives: a) to assess the state of the ecological quality of the Besòs and Tordera basins through the long-term monitoring of hydromorphological, physicochemical and biological indicators (diatoms, macroinvertebrates, fish, birds, mammals, amphibians and aquatic reptiles and riparian vegetation); and b) to implement an environmental education, communication and training program (PROECA) as a transversal element to bring closer and strengthen the link of the "society-river" binomial.

An analysis carried out to determine the trend in the ecological quality during the period 1997-2017 shows a significant improvement in the indicators both at a quantitative and a

qualitative level of all the river courses (upper, middle and lower) of the two basins. Even so, in the middle and lower courses, the biological and hydromorphological quality status did not fall into the correct values required by the Water Framework Directive.

Considering this scenario, the need arises to create a transversal tool that contributes to reconnect society and river systems. And in the current context of global change, environmental education is considered an essential axis to revert the process of disconnection between a community and its immediate territory. Within the Observatori RIVUS project, this transversal tool materializes through the implementation of a knowledge transfer strategy: The Environmental Education, Communication and Training Program (PROECA). In this sense, and under the premise that rivers are an excellent pedagogical resource, the main objective of PROECA is the transfer of the scientific knowledge obtained through the different lines of research of the Observatori RIVUS to different spheres of society through diverse channels according to the target audience. In addition, the project promotes the generation of social interest in river systems, encourages social participation, and fosters the discovery of the natural and cultural heritage linked to rivers. At the same time, the project is also enhanced through knowledge of local traditional acquired in participatory processes and interviews with key actors and local experts, thus allowing this knowledge transfer to be processed through a two-way channel. Since its initiation in 2004, PROECA has carried out numerous environmental education activities among the general public (informal education) and scholars of different educational levels (formal education), in addition to scientific communication, citizen science experiences through the participatory visual census of otter (*Lutra lutra*) another emblematic species of the Mediterranean river systems.

This chapter analyses the main processes of change in the Besòs and Tordera river basins (especially in urban areas), considers the PROECA experience as a clear example of bidirectional knowledge transfer regarding river systems, and provides a reflection of how this affects the urban perception of the river as a common good.

Keywords - Mediterranean fluvial systems, urban rivers, ecological quality status, global change knowledge transfer, environmental Education, citizen science

1.7 Water and the Occupations Park in Belo Horizonte (Brazil)

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This chapter addresses the construction both of the imaginary and of the space of the *Occupation Park*, located on the banks of the stream Ribeirão Arrudas, in the city of Belo Horizonte, Brazil. This stream, still in its natural bed, is part of the hydrographic basin of the Jatobá Stream. The project has been developed by the university extension Programme Natureza Política (Political Nature) of the Architecture School of UFMG, in the illegal, self-built urban occupations of Barreiro. The team's proposal consists of addressing the housing and environmental issues jointly, within the framework of the right to an inclusive city. Thus, the water and the hydrographic basin structure the understanding of the territory, just as the idea of the park as a political tool supports the landscape urban planning project.

Cartography and field research were the methods adopted by the team of researchers. Drawing inspiration from the Interdisciplinary Cartographic Method, the study on the Occupations Valley started with simple questions (what?, what for?, with whom?, with what?, when? and where?). Considering that in field activities there is no place for assumptions based on the "awareness", "empowerment" or even "qualification" of some by the others, the programme's challenge was to build methodological directives that could cope with mapping and bringing to light the ongoing daily practices in the unauthorised self-built territories, which are often invisible. As a way of operationalising this methodology, several devices were used, namely scale models; maps; games; ethnographic interviews; participating observation; photographic survey; cafés; working groups; architectural, urban planning and landscaping projects; technical specifications; participation in forums and committees on urban policy.

In 2008, the social movements involved in the struggle for the right to housing (landless people's movements) occupied some of the land of the Jabotá Industrial District. The occupations are called Eliana Silva and Paulo Freire, coordinated by *Movimento de Luta dos Bairros, Vilas e Favelas – MLB* (Fighting Movement for Neighbourhoods and Slums) and four other occupations, besides some industries, fighting for land with the legal environmental protection area of the stream. The Park project was thus put forward on the basis of the identification of a socio-environmental conflict.

The territory of the park is understood to be the whole area of environmental protection and all the residences without distinction. Thus, the project is being articulated through education, research and university outreach with the development of projects, planting of vegetable farms, planting of trees and bushes, signalling and numbering, political struggle tools, technical specifications, participation in development calls, participation in institutional forums on urban policy. Government bodies have been involved in the proposal. In July 2019, there was a meeting of the stakeholders involved in the project, and four working groups (GT) were created to foster the field activities: GT mobilisation, GT urban planning (drainage and paving), GT agroforestry, GT residue recycling. The new coronavirus pandemic slowed down the ongoing construction process of the Park, but it did not interrupt it completely. The outreach team, for example, organised the "Webinar Political Nature: Splits, approximations and possible representations", with a view to making the discussion on the topic more complex. Associated with the Webinar, a course of the same name was offered, taking on the challenge of expanding the imaginaries on the possibilities of urbanisation of the territory, based on the use of abstract and poetic languages about water, plants and animals.

Throughout the whole construction process of *Parque das Ocupações*, the dialogue between the Political Nature Programme team and the coordination of MLB was constant and continuous. It was developed not only directly with the residents of Paulo Freire and Eliana Silva neighbourhoods, but also with the local authorities and academia. Still, this process is not linear. It was possible to see, for instance, that the solutions created in daily life, are as a matter of course replaced with conventional solutions by the dwellers of occupations. This emphasises the importance of constructing, amplifying and acknowledging non-conventional imaginaries as well as the difficulty of that endeavour. Besides, the relevance of the territory of the Occupations Park for the prevention of flooding in the mouth of the Jatobá Stream also needs to be acknowledged through public investments, both regarding infrastructure and the possibility of accessing public funding resources, via calls. However, residents' solutions lack the necessary formalisation for these funding calls, which eventually results in them being disregarded, increasing the problem that they wish to address. With the new coronavirus pandemic, the journeys to the territory were affected, and other strategies for the construction of the Park project were implemented remotely. Activities in the territory did not cease, and were developed mostly by MLB. There were some initiatives, like cleaning areas where there was rubble, planting in public areas, continuing the community vegetable garden, training residents on agroecology. For the return of the Political Nature team to the territory, the programme includes dynamics with the use of the scale model and games, fostering the debate on the relation between housing and nature, with a view to implementing, together with residents, the urban planning and landscapes directives for the territory. And thus, a Park is being built, following a network approach, with new connections and some splits along the way, by means of material actions and a radical imagination, bringing together the environment agenda and the fight for housing in the territory.

Keywords - Citizen science, political nature, socio-environmental conflicts, existence/ resistance

1.8 Renaturation and its limitations: the case of the Roggero dam in the metropolitan area of Buenos Aires (Argentina)

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The River Reconquista has the second largest basin in the Buenos Aires Metropolitan Area. It concentrates a significant part of the city's socio-environmental problems. Water and soil pollution, lack of sanitation, precarious living conditions are some of the characteristics found in the Reconquista's urbanised floodplain. Although many of the interventions in the lower areas of the basin were carried out informally, others were the object result of planned initiatives. The course of the river was modified by straightening and canalisations schemes. In this context, the aim of this chapter is to focus on these infrastructural objects aimed at controlling floods, and examine the Roggero dam, built in 1972 by the Dirección de Hidráulica, a government body of the Buenos Aires province. The paper approaches the study of the Roggero dam - the only large dam located within the Metropolitan Area of Buenos Aires (AMBA) - from the particular perspective of the renaturation of rivers, in order to examine the legitimacy and pertinence of the removal alternative.

The specificities of the case study are dealt with in the first two sections: the first draws an outline of the historical process of construction of the dam and it shows the relationship between the project by Dirección de Hidráulica and the consequences of a series of floods that affected the lower and more urbanised section of the basin during the 1950s and 1960s. The second section of the chapter examines the urban, infrastructural and environmental transformation brought about by the new dam. In doing so, not only the demographic densification of the lower and middle sections of the basin is considered but also the creation of the reservoir known as Lake San Francisco in the upper reaches of the Reconquista. A third section deals with the criticism levelled at river engineering in order to explain the emergence of renaturation as an alternative. Concepts such as "green and blue infrastructure" and "daylighting" are discussed as part of this theoretical section. Special attention is given to the particular case represented by dams and to the wide range of social and environmental arguments that legitimise projects and policies aimed at their removal, at a time when the construction of this kind of infrastructure has diminished significantly in almost every country. Apart from the damage to the river ecosystems that they cause, dams have been questioned for the traumatic relocation of local communities brought about by the creation of reservoirs. Given the impact and scale of those consequences, dams have been delegitimised for embodying a markedly top-down conception of political power and territorial management. The fourth section evaluates the relevance and pertinence of the arguments on which the renaturation strategy rests for the specific case of the Roggero dam. The adoption of a historical perspective allows us to ponder the role played by local associations in the transformation and management of the River Reconquista, in general, and in the construction of the dam, in particular. In doing so, a more bottom-up process of

construction and management is addressed. As for the environmental impact, the situation has changed during the last two decades. The existence of an important population of birds and, in a broader sense, the comparison of the reservoir to a wetland, with its numerous ecosystem advantages, allow us to understand that conservation has gained consensus as a concern, and that the entire area of the reservoir tends to be conceived today as a natural reserve. Besides, the recreational uses of the reservoir in a series of areas close to the dam have consolidated in the last few years. Although controversial at first, those new uses have been officially recognized and promoted by the local town councils. By addressing the new environmental conditions created by the dam and also the new social uses linked to the existence of the reservoir, the paper acknowledges the importance of the Roggero dam and the San Francisco Lake as landscape pieces strategically located between the Buenos Aires urban sprawl and the rural area of the Pampas.

The consideration of these new conditions allows us to put into question various arguments underpinning dam removal as one of the most radical renaturation strategies implemented in the last two decades. In fact, when it comes to the dam removal option, the consequences appear to be more detrimental than beneficial in the case of the Roggero dam. It can be argued that the flood control currently achieved by the dam could be replaced by a redesign of the riparian areas that could absorb excess water. However, in the case of the Reconquista, whose middle and lower basins are densely occupied, this solution would be unrealistic from a social and economic point of view, not only because of its high costs, but also because it would imply the forced relocation of the local population, an argument that lies precisely at the base of the weak legitimacy of the reservoirs and the dams that generate them.

Keywords - Renaturation, infrastructure, dams, artificial wetlands

2.1 Macro-impacts and Micro-reclamations. Effects from landfills in the vicinity of water resources, and reflections on possible mechanisms for urban and environmental remediation. Case Studies: Cateura, in Asunción, Paraguay and La Chureca in Managua, Nicaragua

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This work develops the comparative analysis of two case studies and illustrates the challenging relationships between landfills, urban areas and adjacent water bodies. The first case analyses the Cateura landfill in Asunción, Paraguay. Cateura has been operating for 35 years and is located in a wetland area. It constitutes a serious urban and environmental problem and a factor of population attraction. This is due to the fact that it is possible to earn a living from the waste economy. The second case focuses on La Chureca Landfill, located in Managua, Nicaragua. La Chureca is situated on the shores of Lake Xolotlán and was, for decades, an open-air landfill that produced highly negative impacts. Through an environmental and urban recovery project, La Chureca has radically improved, mitigating its harmful effects.

A methodological triangulation was developed in this chapter, combining a literature review, interviews with key actors and the production of analytical cartography to understand the evolution of both sites. Evidence was found of (i) the existence of direct and derived negative impacts related to the implementation of landfills, (ii) the role of infrastructure as a factor in inducing territorial changes and (iii) the role of institutional weakness and uncritical decisions in such processes. Regarding the first point, evidence has been found that the main direct impacts consist of contamination by garbage and leached liquids, exposure of the population to the risk of fires and explosions due to methane, deterioration of the quality of surface water and groundwater, deterioration of wetlands and loss of biodiversity, among others. As for the resulting negative derived impacts, the chapter analyses processes of precarious urban expansion in areas of environmental value such as the wetlands of Lake

Xolotlán in Managua and the wetlands of the Paraguay River, in the area known as Bañado Sur, in Asunción. This research has conceptualised and described the "micro-filling expansion process" as a pattern of precarious urban expansion as well as a building technique to occupy the wetlands. In addition, it was found that the synergistic effect of direct and derived environmental impacts is highly negative for ecosystems, water resources and communities. It has been shown that the mitigation of these impacts requires great comprehensive efforts, such as the recovery project of La Chureca. This project faced the challenges of closing the open-air dump, investing in the economic reconversion of the population through its integration into a treatment plant, and the urban improvement through the construction of a new neighbourhood.

Despite the undeniable benefits for the environment and the inhabitants of La Chureca, the closure of the dump was not satisfactory for the majority of the residents. This provides indications that new cycles of urban improvement focused on the diversification of the economy and the creation of jobs are necessary. Further cycles may also strive to increase the mixture of uses in the resettlement neighbourhood and the environmental recovery of wetlands. Cateura, on the other hand, has only established preliminary improvement steps to upgrade from a dumpsite to a controlled landfill. The termination of the landfill concessionaire's contract in 2021 opened up windows of opportunity linked to the relocation of the final disposal site and the deactivation of Cateura. However, no details have been thus far provided about proposals for the environmental recovery of the area, nor for the professional reconversion of the inhabitants of Bañado Sur. Both case studies show the role of urban infrastructure as elements that induce accelerated dynamics of change, such as the development of complex economic and social cycles linked to the implantation of landfills which resulted in processes of urban expansion, wetland degradation and the reconfiguration of the city/water edge.

The research has found evidence that the decision to locate landfills in wetland areas lacked technical soundness. The environmental problems of Cateura are directly linked to the fact that the landfill is located in a wetland area, periodically subject to flooding. An evaluation of the site made in 1993 by JICA suggested the closure of Cateura and its transfer by the year 2000. This transfer has not yet occurred. In relation to the case of La Chureca, the literature review indicates that the dump was enabled as a reception site for the debris derived from the earthquake that devastated Managua in 1972. It quickly became a site for the final disposal of waste of all kinds, without any management. This situation, in turn, resulted in the development of a waste economy, around which some 300 families settled, informally creating a vector of urban expansion. Both cases illustrate the decades of almost total absence of public policies that foster rational solid waste management, which led to the accumulation of negative impacts that affect the urban, environmental and social dimensions of Asunción and Managua.

This study highlights the following conclusions: (i) Wetlands are not empty spaces: wetlands are often considered unimportant due to the fact that these territories are not easily

suitable for urban expansion. The authors present the notion that the inaccurate but pervasive vision of wetlands as empty or irrelevant spaces is one of the underlying causes of the decision to locate landfills in these areas. Such poor conceptualization of the wetlands results in inadequate public policies and the destruction of these valuable ecosystems. (ii) Poor evidence and lack of debate lead to negative impacts; (iii) It is extremely difficult to reverse the damage caused, and (iv) The urgency to deal with the causes - namely the need to pursue comprehensive and rational recycling and waste management policies - and not just the consequences, such as the projects required to address decades of abandonment and negligence in La Chureca and Cateura. Thus, considering the efforts oriented towards building sustainable and resilient cities in the context of climate change, our research points to the fact that it is no longer acceptable to develop poorly planned infrastructures or urban interventions in wetlands, at the risk of producing primary and secondary negative impacts, which are costly and extremely difficult to revert.

Keywords - Dumpsite, urban wetlands, transformations, resilience, impacts

2.2 Ecosystem services of the blue-green infrastructure towards adapting and mitigating the climate change: The case of the urban section of the River Chili, Arequipa, Peru

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Urban rivers are blue-green infrastructures of great importance due to the multiple ecosystem services (ES) they offer, such as regulation, provision, support, and culture. ES strengthen habitat connectivity and reduce the landscape fragmentation caused by the rapid development of cities. The city of Arequipa, Peru, is vulnerable to climate change and faces the following main problems: Inadequate response capacity to intense rainfall events; scarce availability of water resources; pressure on the ecological corridor of the river Chili due to urbanization; contamination of river waters; and the potential urban heat island effect in the historic center due to a deficit of green areas and loss of intra-urban agricultural areas. The urban section of the Chili acts as an axis in the territorial configuration of the city, bordering urban and historic infrastructure and agricultural areas. It has recognized environmental, scenic, cultural, and recreational value. Its watershed provides urban and rural water, allowing the development of energy and agricultural activities; however, there is a gradual loss of the corridor due to environmental phenomena and anthropic alterations that have diminished its ecosystem services. Currently, studies have been carried out on water pollution, as well as physicochemical, hydrobiological, and biodiversity aspects. However, they provide a biased vision of the river's problems and do not allow for the creation of integral solutions for its recovery. The aim is to develop research based on the evaluation of the ecosystem services offered by the Chili in its urban stretch, which will allow a holistic understanding of the river's potential as it flows through the city as a measure for climate change adaptation and mitigation.

First, the urban section of the river Chili was defined based on the application of a criteria of standardized distances around the riverbeds, which also complies with existing legislation on the city. The main ecosystem services provided by the river in its urban section were determined through an evaluation by national and international experts in riparian corridors,

applying two Likert-scale surveys. Secondly, based on an exhaustive bibliographic review, the ecosystem services determined were associated according to their capacity for adaptation or mitigation in the face of climate change in the city of Arequipa. An Analysis of Variance (ANOVA) and Tukey's paired comparison were carried out using Minitab 19 software for the means of the importance ratings of the ecosystem services according to the Likert scale.

The results of the international experts' surveys showed that the most important ecosystem service provided by an urban river is environmental education, which revealed that most of the participating experts have an academic bias. The importance of environmental education lies in the fact that it builds people's adaptive capacity, increasing their level of resilience; and contributes to social learning, being considered fundamental for participatory governance involving multiple stakeholders. On the other hand, the main ecosystem service provided by the urban section of the Chili is the provision of fresh water. This responds to the need for human subsistence, since the watershed supplies water to numerous districts of the city, satisfying the needs of urban uses and economic activities such as agriculture; however, this is one of the ecosystem services that is most negatively impacted and undervalued by the population. Other ecosystem services of high importance are the functional maintenance of ecosystems, regulation of water flows and climate regulation, among others. Most ecosystem services contribute to climate change adaptation; however, two services - air quality regulation and air purification through carbon capture and storage - were identified as mitigation mechanisms. Good ecosystem management allows for emissions reductions and increased carbon sequestration. Regarding cultural ecosystem services, their importance lies in shaping cultural identity and heritage; however, they do not have a direct relationship as mitigation or adaptation strategies.

Given the findings, it is concluded that the preservation of the urban section of the Chili and its ecosystem services contributes to increasing the overall level of resilience of the city of Arequipa, making it a key element in addressing climate change. - Therefore, greater commitment is needed from the authorities in the management of this type of ecosystem and its integration into regional climate change plans. It will be essential to make decisions and formulate solutions based on the recognition of the ecosystem services that the urban section of the river provides to the city, considering the value of this type of blue-green infrastructure as a strategy for adaptation and mitigation of climate change.

Keywords - Ecosystem services, blue-green infrastructure, climate change adaptation and mitigation

2.3 Blue Green Infrastructure and the renaturation of urban streams: a deculverting proposal in the Metropolitan Region of Buenos Aires

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The relatively recent concept of Blue Green Infrastructure (BGI) points to the recognition of the innate capacities of green space and water, and the ecosystems in which they are immersed, to produce environmental benefits that enhance the quality of life of people living in cities. In contrast to the historical and conventional management of stormwater, with an emphasis on grey infrastructure, BGI responds to the need to improve environmental quality in cities as well as to the limitations of traditional solutions by taking advantage of the geomorphic features of natural systems. The English term BGI first appeared in the 2000s, at around the same time that the concept of *Trame Verte et Bleue* emerged in France as an integrated conservation policy focused on the existence of biodiversity corridors along watercourses and through cities. Some BGI components include green corridors, parks, nature reserves, rivers, streams, lakes, lagoons, open green reservoirs, bioretention basins and floodable parks. They range from non-specialized traditional urban features, such as green boulevards and common gardens, to more advanced, but still low-tech-components, such as vegetated depressions engineered to capture and filter stormwater. They can be open to the public or have restricted access, and can be built on public or private land. One of their salient characteristics is that they provide ecosystem services, such as the reduction of the heat island effect as well as temperature regulation in general; improvements in air quality through the use of the phytoremediation capacity of urban vegetation; carbon sequestration; noise reduction; restoration or establishment of biodiversity corridors; and – our main focus here – greater control in the management of stormwater runoff and water quality. In particular, the BGI toolbox applied to stormwater planning and management presents one of the most innovative aspects of this approach. There is a growing consensus regarding the limitations of traditional solutions to solve urban drainage. Conventional hydraulic engineering has historically concentrated its efforts on the volume of stormwater to be displaced, with the aim of moving it as fast and as far as possible from the city, without prioritising its quality or potential to enhance urban life. Grey infrastructure technologies have not only increased contamination in the culverted watercourses, decreased the replenishment of aquifers, and neglected the inherent potential of rivers and streams to provide amenity and environmental

services, but they also exacerbate flooding downstream, due to the acceleration of drainage time and often in the upper basins as a result of obstructions in the culverts. Furthermore, the reduction of natural hydrologic functions has resulted in the increase of the volume of stormwater, which in turn increases the peak, rate of flow, and frequency of flooding.

Contemporary responses to these issues point to a change in paradigm in the design and management of urban drainage. They seek to replicate the natural mechanisms of absorption and retention, with the aim of solving pluvial drainage closer to the site of origin. They often include projects of deculverting and the renaturalization of watercourses to different degrees. Based on an in-depth literature review and a case study in the Metropolitan Region of Buenos Aires (RMBA), we seek to shed light on the understated features of BGI and to identify the benefits and challenges of its implementation in densely populated territories, with high percentages of occupation and land impermeabilization, according to technical, financial, environmental and governance criteria. Our case study focuses on the question: to what extent is the implementation of BGI feasible in the dense urban fabric of the Metropolitan Region of Buenos Aires as a more sustainable way of managing urban stormwater drainage, including the deculverting of water courses? Despite the political-institutional challenges that clearly exist, we argue that in addition to conventional grey infrastructure solutions, it is possible and beneficial to implement BGI, even in contexts of high population density and land occupation. One aspect that is clear from the current COVID-19 crisis is the importance of socio-environmental services in cities and the need to prioritise the main network of natural resources that provides them: the BGI network. The current pandemic has highlighted the need to expand and improve the quality of public green space, increasing the contact with natural environments in our cities, in the form of squares, parks, nature reserves, and blue-green corridors. It is vital not only to increase the amount of public green space per inhabitant in cities, but also to ensure its equitable distribution and, above all, its accessibility. BGI networks expand urban public space, build biodiversity corridors, link distant green and blue spaces, support non-motorized mobility, and provide ecosystem services, such as greater control of stormwater runoff management and the quality of the water. The approach proposed in this chapter for highly urbanised basins aims to begin by exhausting all the instances and opportunities for inclusion of BGI, mainly in terms of increasing the system's retention and absorption capacity.

Our first working hypothesis and initial literature review prompted us to approach this study from a multidisciplinary perspective, addressing the environmental, hydraulic-engineering, planning, financial and political-administrative dimensions in a coordinated way. Thus, we try to contrast a predominant one-dimensional approach with a proposal where the distribution of economic investment aims to find ways to safely include the hydrological cycle in the city instead of attempting to render water invisible in urban life. Taking this path is not an easy task, especially in dense urban environments where it is difficult to replace impermeable surfaces with absorbent floors on a large scale and were current stormwater management favours traditional solutions. It is essential to obtain political support to address changes in

institutional structures in order to guide this type of transformation. There are clear signs and a growing academic consensus on the benefits of moving in this direction.

Keywords - Blue and green infrastructure, sustainable urban drainage systems, nature-based solutions, river regeneration, Metropolitan Region of Buenos Aires

2.4 Technological challenges in the risk management of the River Molino in the city of Popayán (Colombia)

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Colombia is one of the countries with the greatest water wealth on the planet, it has more than 700,000 bodies of water, between rivers, streams, swamps and lagoons, which entails the existence of a great diversity in flora and fauna. In the rivers of the Andina region, there are risk factors that can generate emergencies such as heavy rainfall and landslides, associated with various man-made activities (such as garbage deposit, clogging of drains, burning and felling of forests, among others) that increase the danger of a flood. Colombia constantly faces flooding phenomena that are dependent on the climatic and behavioural conditions of its population. 1.7% of the country's surface is covered by bodies of water, but when floods happen, up to 28% of the territory is covered.

The National Unit for Disaster Risk Management of Colombia has identified the departments with the highest rate of avalanche events, sudden increases and floods, and among these is Cauca, specifically its capital, the city of Popayán, where flood events have been recorded that have generated great impact on the economy and urban development, highlighting the importance of implementing mechanisms for the planning and prevention of flood disasters, based on Early Warning Systems (EWS). To this end, the National Government enacted Law 1523 of 2012, which created the National Disaster Risk Management System, setting important roles for risk management at the national and territorial levels. The aim of this law is to safeguard lives, but it is also a commitment of Colombia at the international level in terms of adapting to climate change. According to the National Unit for Risk and Disaster Management (UNGRD), an early warning system is defined as a "System or set of interrelated capabilities for threat monitoring, forecasting and prediction, disaster risk assessment...". Thus, for the specific case of the city of Popayán, the Mayor's Office with the

risk management office implemented an EWS focused on the control and surveillance of the Molino, which involves a network of water level sensors, rainfall stations, information transmission systems, communication stations and a community network. This EWS has been in operation for several years, and now requires a technological review and update to respond efficiently to the current risk situation that the city is experiencing.

For this research project, a search was carried out on the state of the art of the subject of interest in different databases. Through a scienciometrics-based analysis of the different systems and solutions proposed for risk management at an international level, and specifically for Colombia and the city of Popayán, it was found that, at the international level, China is the country that leads the research on EWS and on the most relevant issues on water quality and remote sensing, followed by such countries as the United States and the United Kingdom. With respect to Colombia, a deployment of early warning systems was found in different regions of the national and municipal territory, where cities such as Medellín, Bogotá and Bucaramanga lead this type of implementation. On the other hand, the Organization of American States (OAS) with the government of Ireland have a manual for the design and implementation of a flood SAT in minor basins, aiming to create a systematic method that brings together the classic aspects of emergency preparedness and response programs to improve community training.

Concerning the city of Popayán, and the River Molino in particular, information was found from the Regional Autonomous Corporation of Cauca (CRC), in conjunction with the Pro-Cuenca Río las Piedras Foundation, that allows for characterising and diagnosing this river system. Additionally, there are studies of Colombian universities focused on water quality issues as well as flood risk and vulnerability in different urban areas. To this end, the mayor's office of the municipality of Popayán and the Risk Management Office implemented an EWS focused on the Molino, consisting of a network of water sheet level sensors and rainfall stations, a management system available to officials and a radio community network system to report on the state of the river. As a result of the initial analysis of this implementation, opportunities for improvement of the EWS were identified around: i) carrying out a technical analysis of the current state of the EWS in order to propose extensions of the sensing network; ii) implementing prediction algorithms based on historical data, which allow the management of alerts to be optimised; iii) improving the communication processes between the lookout network and the risk management office; and iv) conducting training processes on risk management aspects, where, by promoting the integration of the scientific

and technological community, strengthening the capacity for technological development, and fostering the active participation of the business sectors and research groups, it will be possible to develop this type of opportunities in order to contribute to improving the relationship of the community with the River Molino.

Keywords - Risk management, ICT, monitoring, warning, flood, early warning system

2.5 Interactions in the *pedemontan* landscape of Mendoza (Argentina): water, biodiversity and human settlements

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Human settlements in drylands are strongly associated with access to and use of water. Mendoza province, in Argentina, is not an exception: its water sources are the glaciers and the snow. Landscape there is classified as irrigated (oasis) and not irrigated. The irrigated landscape consists of urban and agricultural areas. In contrast, a non-irrigated landscape contains rural areas with scattered human settlements, livestock production, resource extraction, and protected natural areas. Founded in 1561, the city of Mendoza expanded its urban space dissociated from natural ecosystems and built irrigated landscapes, crossed by a network of water canals supplied by the rivers Mendoza and Tunuyán. Currently, the Mendoza Metropolitan Area (MMA) extends between 500 and 1,500 m above sea level and has around 1,200,000 inhabitants.

Mountain ecosystems are crucial to global and regional weather, as they provide the source for most rivers, act at the same time as barriers and corridors for biodiversity and supplying ecosystem services for humans and biological communities. The aim of this chapter is to explore existing scientific output in order to understand and evaluate the renaturalization of water courses in MMA, specifically in the foothill area. The goal is to describe scientific production of the last 50 years to identify major concerns and gaps in existing knowledge. We performed a search for scientific papers related to the foothill area in Mendoza published from 1975 to 2021, and collected 50 papers referring to hydrological, geological, biological, archaeological, urbanistic and historical issues. Then, we proceeded to divide the analysis into three major parts: urban growth, urbanisation (related to alluvial and seismic risk), and biodiversity.

Previous studies recognize three stages in human occupation and land usage in the region. Archaeological records suggest that the first humans inhabited foothills areas near streams 3,000 years ago. Then, with the arrival of the Spanish, a new relationship with the environment and a new territorialization pattern were established. Finally, from the end of nineteenth century to 1960, population growth led to urban expansion over the foothills. This last period witnessed great changes in the environment, including the introduction of countless exotic species as well as urban sprawl. Human population growth toward the foothill produced a loss of alluvial control, the onset of dumpsites, and the rise of shantytowns. Currently, the foothill area is an object of interest and conflict among diverse actors. Natural habitats are being altered by soil removal, natural flora and fauna extraction, spread of exotics species, urban expansion centred on gated communities, natural and deliberate fires, motorcycle and car sports, among other factors. Foothill streams are typical cases of alluvial risk, and Mendoza city had suffered several floodings (the first record dates from 1607). The storm drainage system consists of collectors at the foothill that flow into bigger canals. This system usually is unable to hold summer rains and collapses, causing major flooding. Excessive urbanisation growth in recent years has increased this problem. In addition, the Andes foothill is located at the area of greatest earthquake risk in Argentina. In this context, it is extremely important to know the seismicity of the area in order to design reliable urban growth.

The Mendoza province is located in a desert region called Desierto del Monte. In the foothills, it is possible to recognize diverse vegetation communities along the altitude gradient. Ecosystem degradation has been reported. The causes are manyfold, but we recorded fires, contamination, urbanisation, uncontrolled landfills, and mineral extraction. In addition, urban growth produces habitat fragmentation and loss of ecological connectivity. It is easily observable how the urban area is gradually decoupled from native ecosystems in a gradient from the edges toward the MMA centre. Regarding urban effects on fauna, however, there is a lack of information. Native flora-fauna interactions in desert habitats are important for plant regeneration through seed dispersal and pollination. Small changes can affect multiple plant functions: as soil stabilisers, hydric controllers and erosion preventers.

The findings of this investigation show the toll of the increasing decoupling between natural ecosystems and the urbanisation growth. That process started at the end of the nineteenth century and continues to the present. Bibliographic review shows that there is a significant advance in the production of knowledge about human habitats, biodiversity and water, but gaps have also been identified that are relevant not only for understanding current problems, but also for contextualising the decisions that affect the territory. We found a lack of information regarding present problems related to primordial streams as well as a lack of connection among studies related with human habitat and studies related with environmental and biological issues. There is no information available about native ecosystems conservation. We suggest that it is important to think and design strategies to reduce the gap between native and human-made ecosystems. For this, we understand that it is necessary to rethink the conception of territory and public use of the ecosystem goods and services in order to

integrate bio- and socio-diversity in the urbanisation process. Renaturalization of permanent and temporary water courses could be the starting point to achieve that objective.

Keywords - River Mendoza, permanent or temporary watercourses, biological communities, Mendoza Metropolitan Area

2.6 The wetlands of the Metropolitan Region of Buenos Aires: floods, environmental conflicts and public policies

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Hydrometeorological floods are characterised by being events that have historically affected the inhabitants of the Metropolitan Region of Buenos Aires, emerging as the main disaster risk in the area. This responds to the site conditions of this region: a relatively low area furrowed and delimited by numerous rivers and streams that is home to a significant number of bodies of water and associated floodplains. However, from the late 20th century onwards, the relationship between the city and the extreme events involving water has been reconfigured towards more unequal and adverse expressions in response to the intricate web of causes that explain them.

One of these edges refers to the effects of climate change. In recent times, extreme events of a hydrometeorological nature have become more lasting, frequent, intense and larger in scale. Consequently, the occurrence of disasters is more common, affecting a greater proportion of territories and communities, which translates into increasing losses of livelihoods, property and lives. However, by themselves, the new patterns that climate change acquires are not enough to account for the deep causes that explain this situation, nor to expose the social actors that lead / make them. The orthodox policies deployed during the so-called neoliberal urbanism phase implied the deepening of socioeconomic inequalities. On the one hand, the remaining metropolitan floodplains were valued and incorporated into the real estate submarket of gated communities -after being filled in, terraced, etc.- aimed at the most advantaged groups. On the other hand, the regressive nature of these policies in economic and social matters in times of neoliberalism led to the exacerbation of the process of marginalisation and vulnerability of extensive middle and low-income groups, who were precariously forced to settle on environmentally degraded lands and became subject to recurring floods. In this way, the processes outlined produce increasingly unequal and unfair disaster risk spaces, since amplified dangers are linked together with differential exposures and vulnerabilities for each social group considered.

The environmental issue is another dimension that in recent times the approach to the relationship between the hydrometeorological events that take place in the city has become more complex, particularly after the dissemination of the Ramsar Convention ideology. Some of its precepts - derived from research carried out from the field of the biological

sciences, they managed to socialise globally and find their way into the public agendas of national, provincial, state and municipal governments. This framework helps to understand the gradual passage from the traditional eradication of the urban wetlands of the Metropolitan Region of Buenos Aires towards the social valuation of the environmental services they provide to the city. Mention should be made to regulation-based services that make it possible moderate the adverse consequences of climate change by mitigating global warming since the wetlands function as a sink for carbon dioxide; or else, through adaptation to the negative impacts of extreme hydrometeorological events, by reducing the capacity for damage of floods and storms. At the same time, these environmental services are weighted by their ability to contribute to disaster risk reduction measures in the face of climate change. This situation explains the incorporation of these urban wetlands as a priority axis in the recommendations of international cooperation organisations specialised in the matter, whose proposals articulate the three dimensions of risk and propose to address them in terms of: threats, treatment of extreme weather conditions; vulnerabilities, to improvements in the socio-economic development of societies; and exposures to mitigation and adaptation strategies in their respective territories.

The activism of local communities can be understood as another of the layers that are interwoven in the city's link with the floods, as they raise the need for conservation policies for urban wetlands. This social actor becomes relevant in the face of the social and environmental ravages derived from the modalities in which neoliberal urbanism incorporated the remaining wetlands into the urban fabric, combined with the adverse consequences related to climate change. Faced with this scenario and grouped in environmentalist and grassroots movements, they demand the political conservation authorities through the establishment of protected areas - and green spaces-, understanding them as an effective mechanism that safeguards metropolitan wetlands. These demands go beyond aspects related to biodiversity, claiming other causes that refer to livelihoods and the identity of the groups that interact with these environments. All of this reveals the configuration of contentious areas that usually lead to environmental conflicts rooted in the dispute between distant actors, in socio-economic terms, in the power relations, and in their evaluations regarding the forms of using wetlands.

To sum up, among the multiple simultaneous processes that have been taking place lately on the wetlands of the Metropolitan Region of Buenos Aires, the following can be highlighted: the proliferation and population densification of precarious settlements in urban floodplains; the sale of landscape resources associated with water deployed by the real estate market for the more affluent groups; the application of conservation policies through protected areas; and the resistance of grassroots and environmental organisations. The objective of this chapter is to generate contributions that help unravel the relationships between society, cities and public policies in metropolitan wetlands. The growing prominence of these environments is explained by the development of two key interrelated and simultaneous processes - although they are not unique. The first one refers to the emergence of environmental

conflicts derived from the adverse consequences generated by inappropriate urbanization techniques that affect the magnitude and frequency of floods. Here, other social actors participate in the defence, use and restoration of these ecosystems, which weigh other non-economic forms of valuation. The second refers to the development of public policies aimed at the conservation of wetlands, as well as the use of their services based on mitigation and adaptation measures in the face of climate change from the paradigm of ecological modernization.

Keywords - Wetlands, climate change, neoliberal urbanism, environmental conflicts, conservation policies

2.7 Preliminary analysis of environmental vulnerability and social sustainability in the sub-basin region of the River Bacacheri in Curitiba (Brazil)

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The Brazilian city of Curitiba created from the 1970s an image of an ecological, well-planned and ordered city, establishing it as a model city or a capital of the first world. Over the past five decades, this development model has endured, and has not only shaped urban policies, but also been used by planners and politicians as political propaganda to depict a success story. Along with the image of a model capital, the same decade witnessed a significant increase in urban population and the growth of chaotic land occupation such as hillsides and river banks. The late industrialisation and changes in labour process brought significant changes to the city's natural systems and, consequently, social and environmental problems, which persist until today. Sustainable urban planning, with a view to promoting the well-being of the population, must consider the quality of urban life directly related to socio-environmental and landscape problems. Failures in planning are made visible by an inadequate use of natural resources, in areas of unorganised occupation or irregular constructions, in the high pollution levels of rivers, and the lack of leisure and cultural facilities.

The River Bacacheri is located in the north-west part of the city, draining an area of 30.81 km² and, from source to mouth, crosses 13 neighbourhoods. Its basin has experienced significant land use changes, from a moderately densely occupied area, with some spots of urban voids, to irregular occupations and areas of rapid urban growth and high real estate values, especially close to a lake at its source. Like most of the rivers that cross the city, the Bacacheri was straightened, embanked and partially tubed, and has low water quantity with poor quality. The low environmental quality evidences the need for urgent measures to restore and revitalise it in several parts of the city. However, what can be seen are some specific/isolated actions, which prioritise the most vulnerable areas of the river and its tributaries. These emergency measures are based on traditional reports and analyses, with a technical-financial bias that will likely result in failures. These fragile strategies result of lack of planning and a single objective.

The Project intends to point out that it is necessary to consider the involvement, collaboration and participation of interested parties, both from society in general and from the

communities directly affected by the problems involving the River Bacacheri. Seeking more sustainable alternatives for environmental restoration, the Project will demonstrate that improvements of the most vulnerable parts of the Bacacheri must also consider, in addition to physical intervention, multi-criteria actions based on analysis of social and economic indicators. This study goes in line with Cyted RUN | Naturalised Urban Rivers | as it seeks, through participatory and co-creative processes, to advance scientific knowledge on river regeneration. In order to consolidate the research, this embryonic case study brings a non-exhaustive analysis of the main bibliographic references. These are the main works and studies, selected by at set of classification criteria, already carried out on the topics of environmental vulnerability and social sustainability in a river drainage area. The search considered publications from the last twenty years. The analysis should provide support in identifying assessment criteria for different aspects, with a measurement indicator. Each indicator should show the relevance of the criterion; grouping or ordering these criteria should show best actions and pave the way for the next stages of the work. The analysis resulted in listing four criteria - as listed in the Table 1, considering the three main research lines:

- line 1 is dedicated to the studies of water resource systems considering, in general, the set of elements united by interdependent relationships;

- line 2 includes the water resource policies, and considers the three levels of the Brazilian government, municipalities, states and federal government, as well as the use and management of these resources; and

- line 3 is dedicated to analysing the interventions in river systems. It considers changes in the natural or built environment around a water course or a given river basin.

The analysis is also pondering the inclusion of other lines in further research, as long as they enable the design of action plans for environmental improvement with focus on the social sustainability and quality of life of residents along the Bacacheri drainage area. The preliminary survey makes it possible to guide the local work, and to pursue the goal of creating management and discussions committees for a sustainable development of the Bacacheri basin. These should aim at advancing environmental regeneration and reducing environmental impacts along the drainage area. In addition, it demonstrated the need to develop proposals for the restoration/reestablishment of the riparian forest in order to increase ecological features, reduce natural vulnerability and improve aesthetics along the River Bacacheri and its tributaries, and associated these programmes to encourage health care and environmental education.

Keywords - Bibliographic references, environmental actions, measures to restore and regenerate rivers, social sustainability

3.1 Watercourses and building the heritage space: the case of Ouro Preto (Brazil)

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The colonisation marked by mining exploration was responsible for the consolidation of the urban settlement in Ouro Preto. The role of watercourses was crucial for the construction of the territory, be it for its role in mining, for the decisions taken in the face of urban settlement, or for the construction of historic heritage. Thus, the relationship between water and the territory has always been present, feeding colonisation's model of economic exploitation and boosting the settlements on the slopes along the search for gold in the Minas Gerais region. The presence of water in the urban design was marked by its nature as a common good through fountains – public water, the fundamental elements for economic exploration by mining – water as resource, and the construction of the environmental heritage – water as inheritance. Nowadays, in the contemporary context, we are facing complex situations: sanitation problems, the symbolic and cultural values associated with watercourses, the economic exploitation of the natural and cultural heritage, and the consequences of mining as a constant threat to the heritage territory. In this sense, we propose the analysis of the city's production from the relationship with watercourses, and mapping the space, not only as an object, but based on the understanding of the process of its constitution and its relationship with the territory as well as its symbolic and cultural elements. The relationship with the hydrographic basin in urban design is emphasised as a way of valuing heritage and culture.

Therefore, the present work focuses on building a critical reflection on the occupation of the territory of the city of Ouro Preto and its relationship with the watercourses, which are being re-signified throughout the historical path, and, finally, with the construction of a territory-based heritage. Within this framework, it is worth noting that watercourses are elements of the urban landscape of Ouro Preto, and, consequently, of a territory-based-heritage. We want to point out that the approach of cultural heritage adopted throughout this work is related to a broader vision, in which we consider both the material elements that make up the territory and, especially, the immaterial manifestations. Thus, when analysing the design of the urban landscape of Ouro Preto from its relationship with the watercourses, we will focus on physical and symbolic composition, as well as on the resignifications of these elements in the contemporary context. We seek, therefore, to identify to what extent the watercourses within the urban area still play the role of supporting collective memory and of history, considering the contemporary processes of neoliberal rationality. We also want to identify to what extent urban expansion linked to cultural industry through tourism impacts the relationship of the Ouro Preto's population with watercourses. The urban morphology

of Ouro Preto is fundamentally linked to watercourses, but this relationship has changed over time, mainly as a result of growing population density and the consequences of the transformation of the territory into a commodity by the cultural industry. In a first approach to the research, we noticed some conflicts in the relationship of the watercourses within the urban area, especially in the central part of the city as opposed to the peripheral areas. These conflicts involve the proximity of the constructions to the streams, and the way the daily practices are performed in and around these places. As a result of this, landslides and floods triggered by heavy rainfall in January 2022, provoking conflicts for residents and for the preservation of cultural heritage, intensified the debate about the perverse consequences of the territory occupation model and nature exploitation. In this sense, we emphasise the extreme need to understand heritage beyond the architecture and objects. One should therefore consider the environmental and intangible heritage as keys in the preservation process.

We noticed significant conflicts between the urban sprawl and the way watercourses were systematically erased by a growing construction density, especially in areas far away from the major tourist attractions. The conflicts generated by the process of urban expansion related to watercourses are intensified in periods of rain, as a result of environmental threats to the city, such as landslides, shutdown and reduction of vehicle circulation, power shortage, and even interruption in the water supply. Analysing the issues of the urban landscape without considering the overlap of material elements and symbolic aspects results in a threat to the cultural heritage and the residents' daily life. The activities arising from the recognition of the city as a world heritage site, notably the *turistification* associated with processes of trivialization, tend to create an economic and functional specialisation of the historic centre, along with the morphological segregation of space. These processes have resulted in peripheral occupations in an area of risk, generating more tension in the residents' relationships with watercourses.

Keywords - Heritage, territory, Ouro Preto, city production

3.2 Memories of Rivers and Streams in the Toponymy of the City of Lisbon

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This chapter aims to introduce an ongoing study developed by the LNEC team within the scope of the Cyted RUN network. This study aims to capture geo-landscape imaginaries and memories connected to the hidden heritage (some of it vanished) of watercourses in urban settings – focusing on the city of Lisbon. It contextualises evidences, narratives, images and landmarks, some of which linked to the incidence of floodings, also contributing to a river memory. For several decades, the city of Lisbon was marked by the abundance of water. From its beginning, in which the hill of Saint George's castle gains prominence, Lisbon gradually expanded and grew, never forgetting the presence of water as key element for the settlement and population retention. Thus, the availability and supply of water lies at the root of the urban development in Lisbon, with continued relevance until the present. However, along with underground aquifers, many of the rivers and streams which run at the surface, like in many other cities, were buried or hidden in the process of claiming land for the city's development. These invisible rivers and streams can, nonetheless, be evoked from certain urban landmarks, among which we highlight the street and place signs with urban toponymy. The historical references to the watercourses have been kept in the city's landscape as urban memory, namely through physical references that denote them. From these, toponymic signs stand out, among others, associated elements such as boards, fountains, store names, etc.

The chapter thus proposes to start the collection of the watercourses' traces, by observing beforehand a set of toponymical names which refer to the rivers in the city. To this end, it begins with a brief framework of the city's geological- and river-based memory. The geological and geophysical conditions gave rise to a network of watercourses and a complex hydrographical basin structure, most of them small in size. We must not forget points associated with the existence of underground waters which, albeit excluded in this research, have an impact in the memory of the city. Therefore, the hydrography that is reflected in the Lisbon's urban fabric identifies: a complex drainage network, particularly in the lower areas, close to the river Tagus; an area of dense settlement; an impermeable area; and natural drainage waterways that have been occupied und thus are invisible. Lisbon has seen a progressive settlement from the Tagus towards the inner areas, destroying what was formed naturally. Currently the presence and signs of the river systems can only be perceived in the orography, where the countless valleys become distinctly evident.

The first survey on the names of sites, places and the urban landmarks that in some way refer to watercourses, provide a record of cases in which open bodies of water were hidden throughout the city's evolution, confronting us with their rich presence in Lisbon's toponymy. This was followed by brief search on the website of the Lisbon City Council (CML) regarding the toponymy of the city. Using the term «water», several toponymical references to watercourses and more generically to "water" (or similar element) were detected, many of which vanished and/or were hidden in the meantime. After this, we identified on the map of Lisbon the main toponymical references found in connection with the element "water" or watercourses. This cartographical work aimed merely to visualise the representativity of these references on the city map. From this perspective, we introduced the collection of the river remnants as expressed in urban landmarks, of which we highlight here their presence in the toponymy. The attempt to identify the former localisation of these landmarks in the urban fabric, made also possible to observe a set of toponymical names that refer to watercourses or associated elements. In this sense, names such as "alcântara" (old Portuguese term for bridge), "arroios" (streams), "sete Rios" (seven rivers), "alfama" (from the Arabic 'al-hammâ', meaning hot water fountain) are examples of inherited terms with a history associated, sometimes for centuries, to major segments of the river system, to the evolution of the urban space, the result of the human intervention in it. For this reason, in the chapter, remarks are made on two of these toponymical names, namely, Alcântara and Arroios.

The future goal is to create a database with this information and to use it to design recommendation avenues that support and/or guide initiatives aiming for broader awareness of the city's river landscape, retrieving it to the social and urban imaginary, thus seeking to contribute to the recognition of the importance of rivers and urban streams in our lives.

There are remnants of the relationship between the city, the river and streams, more or less everywhere, and they have very diverse expressions, but sometimes, along the considerable impact in the city's memory, this tends to fade away in time. Actually, we envision the role of memory as a potential resource to foster people's connection with the urban rivers. In other words, considering that memory engages in a constant search for meanings, the present work is one of the studies carried out within the scope of the Cyted RUN network, which, in this case, looks into the role of memory in the reconstruction of urban imaginaries associated with watercourses.

Keywords - Urban memory, geological and river-based memory, Lisbon, toponymic

3.3 The role of memory in the (imaginary) recovery of the urban river landscape

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The chapter carries out a theoretical analysis around the notion of social memory, researches how it connects people and urban rivers. From this perspective, it is relevant to understand the contributions of memory to the recovery of river landscapes in the urban space, in particular those associated with destroyed or hidden watercourses. The existence of an inseparable relationship between people-memory-watercourses is assumed. The starting point comprehends the idea that memory, as an evocation of past experiences, is connected to people's material, natural and mental spaces. Memory can be interpreted as a mediator that connects rivers to the community. Thus, the concealment of rivers can contribute to reduced social involvement and awareness with regard to their recall. Indeed, memories and lived experiences only remain in one's memory for several decades when there is the presence of some physical element that can connect them. In the absence of this information, the memory gradually decreases, falling into oblivion. Memory involves a set of references. But these are dependent on the interests and modes of action of a community, which uses them in the construction of a collective identity. Hence, memory has to be continuously revived, which implies its transmission/articulation, from individual to individual and from generation to generation. As a matter of fact, although they are based on past experiences, these are a driving form of action in the future, allowing for the prediction and change of ways of thinking for the community's evolution.

When it refers to rivers, the memory of past lifestyles associated with watercourses may be explored for the future recovery of river landscapes, bearing in mind that memory needs constant stimuli of connection to the physical space. Memory recovery connected to urban rivers may serve as a means of reconstruction of watercourses hidden by urban development, calling upon the recognition of rivers as historical and natural heritage of high relevance to society. Social memory is complex, neither permanent nor unlimited in time, constituting a set of subjective and, consequently, easily mouldable characteristics and contexts. Thus, the relevance of the specificity of an event that occurred as a way of understanding the impact caused and the respective learning drawn from the events. In turn, the repercussion of memory in communities that are strongly affected by floods and floods, as a source of resilience, must be highlighted. The occurrence of relatively frequent floods contributes to the maintenance of memory in local

inhabitants, which causes the trail of destruction and consequences to remain present, since memory contributes to the construction of a collective identity, given that the phenomenon of flooding arouses unique interest in the population that experiences it. Having the events present results in their voluntary materialization in various forms, recollection being seen as a way of overcoming the disaster that has occurred. It is from this perspective that resilience originates, giving strength and capacity to individuals in a community to reorganize action measures for similar situations in the future. Likewise, consideration is given to memory's ability to create a community that is more cohesive and concerned with the common well-being, as well as focused on providing an immediate and positive response to the future existence of similar episodes. In places where interest in this subject is high, institutions focused on the implementation of action measures are created, playing an indispensable role of influence on the population. However, when there is the occasional flood, the ways of maintaining the collective memory are eventually dissipated, as the passing of information comes to a stop over the generations, and the memory that remains is not sufficiently strong to be preserved. Consequently, it is assumed that memory can be conditioned when events occur in a distant moment in time, and the individuals who witnessed them die in the meantime.

Collective memory allows for storing memories of events and phenomena that have occurred throughout decades, helping individuals to make future decisions and choices. The detailed recollection of all events is not mandatory – it is enough to recall the phenomenon itself. In this case, a greater awareness is created about the strength and importance of water, this being a topic that is continuously present in the life and interests of individuals who often experience natural disasters linked to floods and floods. In order to understand the importance of memory in the call for the reconstruction of urban rivers and their impact on social life – as well as their recognition as historical and natural heritage – eleven projects were collected that seek to fulfil the notion of the memory recovery of urban rivers. In turn, these initiatives constitute a practical application of the theoretical framework devised around social memory and its influence on urban life, through watercourses. Common objectives in relation to the projects analysed are highlighted, namely the production of knowledge, reflection, awareness and appreciation of watercourses present in the urban space. The mentors of these projects thought of different ways of reaching the public, seeking to bring people closer to the place of implementation of the urban rivers with which they live on a daily basis. Among the goals, we highlight the creative field work, from which the direct interaction with people was organized, allowing greater contact with the initiatives to be achieved. In addition, it is vital to stress that the analysed projects had positive results and enhanced the approximation of the relationship between people-memory-watercourses. In sum, memory plays a crucial role in the regeneration of urban rivers, and their presence enabled the creation of memory. The analysis and display of the projects allowed for a better understanding of the search for the preservation of social memory and, simultaneously, the preservation of the importance of urban rivers for life – individually and

collectively. It is, then, concluded that raising awareness to this topic is an issue that concerns the whole society, being a problem that deserves prominence and the interest of a wide range of individuals and that, for this reason, is the focus of this exhibition.

Keywords - Social memory, river landscape, social and urban imaginary

3.4 "Sobre o Rio (Over the River)" and the invisibility of urban streams in Belo Horizonte (Brazil)

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This chapter presents and discusses the art work "Sobre o Rio" (Over the River), a permanent urban intervention authored by me, which consists of the installation of signposts on the streets of Belo Horizonte to indicate the presence of streams and tributaries of the Ribeirão Arrudas, channelled under the city. This work is part of the poetic research "Entre Rios e Ruas" [Between Rivers and Streets] – composed of drawings, photographs, objects, videos, installations and performances – which reflects on the relationships between city, environment and individual, taking as a starting point the relationship that Belo Horizonte has established since its foundation with the rivers and streams present in its territory. My reflection on the theme of streams in Belo Horizonte began in 2006, when I returned to the city after five years of absence, and I came across part of the Ribeirão Arrudas being covered up by an avenue, the so-called Arrudas Boulevard. At this moment, part of a river that is very present in the history of the city and in the memory of its inhabitants has vanished from the city's landscape. Much of my work then began to develop around this theme, giving rise to a broader inquiry, which seeks to make the rivers and streams in Belo Horizonte visible.

The goal of "Sobre o Rio", as well as of the other works that preceded it, was to poetically bring to light the presence of streams made invisible in Belo Horizonte. The aim is, therefore, to foster a cultural change in the relationship that the city establishes with its watercourses, under the assumption that promoting concrete recognition of the existence of streams with local government and the common citizen represents the first step to ensure the preservation of these streams and to incorporate their presence into urban policies. The experience of previous works led to a set of definitions in relation to "Sobre o Rio", so that it could better achieve its objectives. In particular, the idea that the work constituted a direct and permanent intervention in the city was fundamental. On the other hand, the author's choices regarding not "signing" the work, using the existing street beacons, and following the technical specifications of the street signs for the making of the signposts to mark the streams caused "Sobre o Rio" to dilute itself in the city, and eventually be taken as an action by the municipality of Belo Horizonte.

Another important aspect of "Sobre o Rio" is that, as a whole, it represents a monument to the city, as it pays homage to or perpetuates a certain history or memory. Unlike conventional monuments, represented by a statue or work in a specific location, "Sobre o Rio" is a fragmented monument, spatially spread, and, in this sense, more integrated into the city's landscape. Finally, it is worth mentioning that the most fundamental impact of "Sobre o Rio" is in the change of perception of individuals in relation to their surroundings, in relation to

the urban spaces that we/they frequent daily. Urban streams, once brought to light by the identification and signalling process promoted by "Sobre o Rio", become geographical references in the city, and interfere with our spatial notion, our location strategies and our perception of the environment. In sum, some of the elements to be highlighted in this chapter are the public and permanent character of "Sobre o Rio", its status as a monument for the city, and the characteristics of the process of creation, construction and implementation that lead to a blurring of the boundaries between the work of art and an intervention of the city government.

Keywords - Contemporary art, urban intervention, environment, Belo Horizonte

3.5 Gardens and water in the city: cosmopolitical worlds

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Gardens are microcosms of the infinite, a cosmology. The starting point for this study is the historic understanding of gardens as the place for dwellers to socialise, where water has always played a central role. For the research undertaken, the concept of Possible Gardens was established as a space where people engage personally and build a relationship with non-humans.

In this approach, in addition to ecological relations, the interpretation of knowledge, memory and cultural significance, management and traditional uses of flora elements, as well as of the coexistence with animals and water, are ways of understanding the relationships between different beings and between them and their place, shaping what is meant by "Possible Garden". Possible Gardens are multispecies territories present in cities with the potential to recreate it by being or becoming real. The relationship with the body of water has always been essential for the garden since its rise. In a classical conception, the garden is considered to be the representation of a world of cosmology. For the argument developed here, this understanding of gardens as microcosms is paramount. So, what cosmo-perceptions remain in the territory? By revealing elements that might have been made invisible by urban planning, what is the power of these spaces in the production of contemporary cities?

A case study has elaborated the objects of what will be the Possible Gardens found in the territory near Ribeirão Arrudas (the Arrudas Creek), in the São Geraldo neighbourhood of the city of Belo Horizonte. The city's relationship with the water courses has always been conflicted. The memory of the river was gradually erased, only to be associated with urban problems. The neighbourhood lives to this day with the open canal of the river and with springs and streams in their natural beds. Such a spatial situation favours another relationship with the bodies of water. From the river, the methodological path to the gardens was trodden with the understanding that there are other worlds that exist/resist and are built in the memory, in the cracks of hegemonic planning.

To begin with, an exploratory inquiry into the territory was developed involving: informal conversations, photos, exploratory interviews, maps and territorial boundaries. In a second moment, the interviews were carried out, and approximation procedures were defined. In the third moment, ethnographic interviews were applied, supported by participant observation and a photographic survey. The last stage included data analysis and presentation of the results, with a view to understanding the gardens and their contribution to the discussion of the possible worlds, such as those of the watershed. The results and discussions help to understand how water is still perceived in the city in still barely visible worlds, and how gardens contribute to these memories. The vast majority of the use and occupation of the spaces studied with gardens are houses. However, vacant plots with gardens and cultivated as

common ground represent an expressive area with regard to soil permeability. The mapped gardens represent 30.02% of the permeable area, above the minimum permeability rate (20% for most of the area) required by law.

The area around the flat floodplain and the immediate surroundings of Souza Aguiar Street is still quite permeable: 34.44%. Grota's concave surface also has 36.78% permeable area. There is a spring and an area with preserved native vegetation; however, informal occupation has advanced on it. The concave surface of the talweg of the São Geraldo Stream, which is fully channelled, has a much lower permeability rate: 18.63%. The gardens are present in the lots. In three of them there is upwelling of spring water. The watercourse is completely disregarded in the proposals of the Use and Occupation Law, and is made invisible. On convex surfaces, permeability is the lowest found: 15.64% of the studied territory.

The perception of water and the recognition of this agent are present in 69.23% of the 65 interviews. This perception varies depending on the territory. Grota, the talweg of the São Geraldo stream, and then the flat floodplain are the territories where the perception of water is more constant, as well as its relationship with the studied gardens. On the convex surfaces this perception is considerably lower. The positive aspects of the presence of water are related to memories, to the cultural management of water, the existence of a spring, and the contribution of water to plant growth. These aspects are more constant when water is visible. The negative aspects are related to flooding and river pollution. The changes brought on by urbanisation are mentioned with suspicion. In those areas where the body of water is buffered, the negative aspects prevail. Urbanisation works against the water cycle, and the gardens are used to house springs and preserve permeability. The experience of natural rhythms and cycles and their changes are relevant elements for the organisation of gardens and life itself.

In the cultural management of water, ecological techniques are applied, such as the damming and storing of rainwater, facilitating infiltration, the construction of cisterns, the prevention of sliding slopes with plants roots, and the use of spring water for irrigation. The multi-specific relationships that arise at the riverheads highlight some aspects of practices that have truly ecological implications. Water, animals and plants are seen as partners and friends. Even in times of global urbanisation we can discover the gardens as places of memory. The interactions of vegetation, water, source and animals bring to mind the Atlantic rainforest and the *cerrado* (woodland savannah). They create in the imaginary and in the vocabulary an awareness of the woods, the forest, which were erased by the city and urbanisation. The city is a space of fights for the future and for narratives. Gardens, understood as existing/resisting multi-specific territories, territorialise the memories of water. The incentive given to private gardens, and especially to common gardens, in public policies can actually contribute to strengthening the interactions with water bodies in cities, a relevant memory of these worlds that deserves preservation.

Keywords - Memory, water cycle, gardens, cosmopolitics