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Article

# RivEr/Generation\_LAB. Linking resilience with inclusiveness in the urban built environment of Rome

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**Abstract:** The threat posed by climate change, the progressive erosion of natural resources, the polluting effects related to private motorization, energy waste, excessive consumption of agricultural and natural soils and their progressive waterproofing and reduction in vegetation cover, with the subsequent environmental degradation, have highlighted the need for a sustainable management of natural resources, in terms of an equitable and ethical development, to build inclusive communities able to adapt to the negative effects of emergency phenomena, through new capacities of economic, cultural and social resilience. This contribution presents the results of the activities conducted in the RivEr/Generation\_LAB, a project organized by three CIVIS members (Sapienza University of Rome, Université libre de Bruxelles, Universidad Autonoma de Madrid) as a part of the CIVIS Project "RivEr/Generation\_LAB. Linking resilience with inclusiveness in the urban built environment of Rome, Brussels, and Madrid", financed into the Hub4 Cities, Territories & Mobilities' Call for proposals 2021. The project proposes a methodology of intervention in the Flaminio district, in particular on the 'Olympic Village' and its relationship with the Tiber River, in line with the Sustainable Development Goals, the Millennium Ecosystem Assessment and the New European Bauhaus, to establish new relationships between cities and the natural environment, favouring sustainable and inclusive public spaces.

**Keywords:** Resilience, climate change, vulnerability, water management and urban planning, environmental technological design, nature-based solutions

## 1. Introduction

Urban climate has been widely investigated in the last decades, especially studying phenomena of increase or decrease in air temperature between urban and rural areas, defined respectively as urban heat/cool island effect [1]. Unsustainable urbanization is ongoing, the climate is changing, and European cities are predicted to be exposed, more and more in the next years, to multiple climate hazards [2].

Legambiente [3] highlighted the problems and challenges related to thermal discomfort in Roman urban open spaces. More importantly, the exceptional 2003 summer heat wave, when peak temperatures reached record values, had a strong impact on the population in terms of mortality, with a total of 944 excess deaths observed (+19 %).

A paradigm shift in urban planning and design is consequently necessary in order to effectively face the previously mentioned problems, calling on climate-adaptation strategies, and trying to improve the urban living conditions.

A city comprises thousands of microclimates, which vary as a function of its design, and physical properties. Within this context, it is evident that each area of the city is part of a heterogeneous balance. As such, it should be designed and optimised, being interconnected to the entire city.

Green infrastructure – especially trees and permeable surfaces – has proved to be effective in producing positive effects on the outdoor thermal comfort [4], being able to absorb the solar radiation impinging the city surfaces and mitigating the adverse climatic conditions by radiative cooling.

Among the objectives of this contribution is to underline the importance of re-design the open space and the architecture of any urban area, as an opportunity to mitigate the urban microclimatic conditions, and improve resilience as well as overall quality of life of the urbanites.

The threat posed by climate change and the progressive erosion of natural resources, together with the excessive consumption of natural soils and their progressive water-proofing and reduction in vegetation cover, have also highlighted the need for a sustainable management of, water landscapes as particular ecosystems [5]. In particular, river landscapes, represent a particularly complex condition in terms of biodiversity, ecosystem service productivity and vulnerability because of the impact of the hydrological effects caused by flooding combined with resource erosion, especially in urban contexts. River landscapes, as part of the urban structure, are strictly connected to urban life and are increasingly altered and alterable from a morphological and ecological point of view. Also, for this reason, the European Parliament, in 2007, asked member states to reduce the adverse consequences for human health, the environment, cultural heritage and related economic activities by favouring a long-term planning approach in order to integrate all the cognitive data on hazards, vulnerabilities and hydraulic risks [6]. The strategic objective of ensuring the availability of good quality water to meet the needs of citizens and to support the economy and the environment is pursued through the integration of water management policies with other related ecosystem-based approaches in the field of renewable energy, sustainable transport and urban planning [7, 8].

The restoration of natural and urban ecosystems, according to less aggressive methods of consumption, pollution and fragmentation of the ecological-environmental connections, represents a fundamental activity for ecological regeneration and historical-cultural and socio-economic valorization of urban contexts in order to build inclusive communities able to adapt to the negative effects of emergency phenomena, through new capacities of economic, cultural and social resilience [9]. The identity of cities and communities, historically recognizable in their rivers for the significant heritage and cultural value that they represent, can represent a resource to contrast the increasingly widespread dynamics of degradation and vulnerability by pursuing a new territorial articulation by which ecology restores to the landscape its performative function, making it a new territorial infrastructure to support all new transformation and development activities [10,11].

To this goal, the more recent implementation references to conserve and promote sustainable use of water resources for sustainable development and a comprehensive, ambitious and long-term action to protect natural and urban contexts, reversing the degradation of the ecosystem, are represented by the Sustainable Development Goals of the 2030 Agenda of the United Nations, the New Urban Agenda, the European Green Deal and more specifically by the Water Framework Directive and the Biodiversity Strategy for 2030 [12, 13, 14, 15].

In this framework, the implementation of innovative research and didactic paths, aimed at the protection and restoration of river landscapes, the correct management of water resources and the valorization of urban territories, together with safeguarding-actions, can contribute to the development of a new awareness of the citizens to the ecological, morphological, historical, cultural and social role of riverfronts in producing a new sense of belonging and care. A planning approach that links a responsible, inclusive and sustainable strategy for the construction and networking of new resilient urban spaces through green infrastructures, riverfronts, new green spaces and cycle paths, that represent a resilient response to cities' regeneration,

In particular, this contribution presents the results of the activities conducted in the RivEr/Generation\_LAB, a project organized by three CIVIS members (Sapienza University of Rome, Université libre de Bruxelles, Universidad Autonoma de Madrid) as a part

of the CIVIS Project "RivEr/Generation\_LAB. Linking resilience with inclusiveness in the urban built environment of Rome, Brussels, and Madrid", financed into the Hub4 Cities, Territories & Mobilities' Call for proposals 2021 [16].

CIVIS is a European Civic University co-funded by the Erasmus+ Programme of the European Union and formed by the alliance of 11 leading research higher education institutions across Europe: Aix-Marseille Université, National and Kapodistrian University of Athens, University of Bucharest, Université libre de Bruxelles, Universidad Autónoma de Madrid, Sapienza University of Rome, Stockholm University, Eberhard Karls Universität Tübingen, University of Glasgow, Paris Lodron University of Salzburg and the University of Lausanne. Therefore, CIVIS' main objectives are: to create a truly unique European inter-university campus where students, academics, researchers and staff will move and collaborate as freely as within their institution of origin; to develop a deep level of European integration, involving joint learning path-ways; to promote complementary research facilities and diverse degree pathways.

#### *General goals of the activity*

The project RivEr/Generation\_LAB, by the objectives and values of the CIVIS Programme, acts in sharing, with among different universities, to foster an integrated and holistic approach to achieve a unified by sharing and putting together new different methodologies and backgrounds belonging to the from different universities joining a specific CIVIS agreement. In this case, the integrated approach proposed by the Sapienza University of Roma (SUR), as the hosting University, and the two partners, the Université Libre de Bruxelles (ULB) and the Universidad Autonoma de Madrid (UAM), worked together on a methodology of intervention, in line with the Sustainable Development Goals [8], the Millennium Ecosystem Assessment [17] and the New European Bauhaus [18], to establish new relationships between cities and the natural environment, favouring sustainable and inclusive public spaces.

An approach that aims to build 'bridges of knowledge and action' between the seemingly competing systems of ecology, mobility and economy, which interact and influence each other in our everyday urban and peri-urban environments.

The methodological framework embraces a pedagogical cycle, which allows the CIVIS cooperation values to be tested through an innovative combination of virtual and real mobility.

The virtual element consists of five preparatory webinars in the virtual classroom and collaborative writing. These online elements were complemented by an on-site workshop in Rome, coordinated by the PDTA of Sapienza University of Rome (SUR), with the collaboration of lecturers from ULB and UAM universities, the managerial and organizational support of tutors belonging to the PDTA, and the active participation of the main actors and recipients of this activity, the students from each university participating in the project.

#### *Goals of the RivEr/Generation\_LAB*

In particular, RivEr/Generation\_LAB brings together three river areas in Rome, Brussels and Madrid to address, through cooperation in the field of education, the current challenges of urban sustainability by implementing a problem-solving approach that integrates systems thinking with real-life scenarios and experimental field activities.

The project proposes a comprehensive and inclusive approach to promote diversity in education by bringing together different disciplines and perspectives into a single analytical framework, which explores the commonalities of approaches to the re-generation of urban riverscapes across different dimensions, and critically examines the implications of the interrelation between different sectors and/or domains. The development of original case studies and the critical analysis of urban regeneration policies relate to the existing dynamics at the local level, specific to each of the three river landscapes.

Through the proposed multidisciplinary comparative approach, participants can understand the values of becoming active citizens in local, national and global communities. The comparison of different urban and landscape contexts, starting from the common goal of riverfront regeneration, fosters awareness and understanding of the qualitative aspects

required in such ambitious projects, emphasising the multiple perspectives and values involved in climate-friendly holistic urban transformation processes.

Thus, the project aims to foster civic engagement initiatives. The Riv-Er/Generation\_LAB involves students as part of broader regeneration initiatives, sharing knowledge, skills and motivation necessary for responsible engagement in diverse societies.

In summary, RivEr/Generation\_LAB pursues the following objectives:

- To promote key competencies among students and faculty in the field of sustainable urban development.
- To build capacity among academics, enabling them to successfully implement interdisciplinary and transformative learning contexts.
- To create and share knowledge of teaching and learning, documenting CIVIS cooperation as a replicable educational resource.
- To include different disciplines and/or fields
- To share a comparative approach
- To promote Civic engagement

The short-term results are:

- Efficient dynamic education for the regenerative development of urban rivers
- The development of multidisciplinary and innovative skills for staff and students.
- The opportunity, for students and teachers, to master integrative methods and theories not usually included in their curricula, (inter alia, drawing on knowledge and value systems from other disciplines, systemic thinking, scenario building and visioning, as well as experimenting with integrated social/environmental/economic impact assessment).

The long-term results are:

- The promotion of multidisciplinary expertise through the planned CIVIS cooperation.
- The development of best practices in spatial design and planning, characterized by integrated strategies and nature-based solutions
- The ecological and social reconnection of urban riversides.

## 2. Materials and method

### 2.1 Materials

#### *Description of activities*

The activities related to the Workshop “RivEr/Generation\_LAB. Linking resilience with inclusiveness in the urban built environment of Rome, Brussels, Madrid” were coordinated by the PDTA Department of Sapienza, University of Rome - SUR (Principal Investigator: Carmen Mariano with Maria Beatrice Andreucci and Francesca Rossi), with the collaboration of the Université libre de Bruxelles - ULB (Referent professor: Didier Vancutsem, Master's degree Landscape Architecture and Urban Planning) and the Universidad Autónoma de Madrid - UAM (Referent professors: Maria del Mar Alonso Almeida; Beatriz Narbona Reina and Fernando Borrajo Millan; Maria Escat).

The workshop [19], open to master's degree students from universities in the CIVIS Network, was held from 04 to 09 July 2022 at the PDTA Department, Sapienza University of Rome following a series of preliminary webinars on urban regeneration, organised on the following topics:

-the first webinar, “Urban Planning for RivEr/Generation” (12.04.2022), was coordinated by the Sapienza University of Rome, SUR.

The webinar, introduced by Francesca Rossi (SUR) and with the closing remarks of Maria Beatrice Andreucci (SUR) and Carmen Mariano (SUR), hosted three specific contributions: Historical plans and urban fabric evolution in the Flaminio area by Bruno Monardo, PDTA Department, Sapienza; Rome and the Tiber Designing in flood risk areas, framing the topic first in the Roman context, supporting it with international case studies

that address the phenomena linked to climate change in the urban context with design solutions by Alessandra de Cesaris, PDTA Department, Sapienza) and Water landscapes: Strategies for adapting cities to the effects of climate change and the 3 Macro-strategies for a Resilient urban regeneration: defence, adaptation and relocation, supported by the presentation of case studies, by Marsia Marino, PDTA Department, Sapienza.

- the second webinar, "Mobility. The case of Madrid" (28.04.2022), was coordinated by the Universidad Autónoma de Madrid, UAM.

The webinar, by Beatriz Narbona (UAM), focused on the topic of mobility, providing a practical overview of mobility trends, with a multidisciplinary approach from the social, societal and economic perspectives, always considering the involvement of citizens. The topic of mobility was addressed starting with an overview of smart cities from the sustainable mobility point of view, introducing the topics of Smart Mobility Plans and the MaaS (Mobility as a Service) concept, the integration of various transport services into a single mobility service accessible on demand and with a single payment, and then focusing on the case study of Madrid, in particular by presenting the contents of the project "Madrid 360 Sustainable Mobility: A cleaner air for everyone".

- the third webinar "Urban Economy" (12.05.2022), was coordinated by the Universidad Autónoma de Madrid, UAM.

The webinar, by Maria Escat (UAM), focused on urban economic issues, thus promoting interdisciplinarity, and allowing students to experiment with the main objective and value of the entire initiative, which takes advantage of the specific expertise of the three universities. In this case, the meaning of "Urban Economics" applied to the case study of Madrid was explored, supported by a general presentation of the evolution of the city in accordance with the growth phases of the Manzanares River, citing the 'Madrid Río' project and making economic considerations on the obtained results.

- the fourth webinar "Ecology" (31.05.2022), was coordinated by Université Libre de Bruxelles, ULB.

The lecture explored two core themes of the project: the phenomenon of flooding involving the Veneto Region, with a contribution entitled: Veneto 2100- Living with Water by Marco Ranzato (Roma Tre University) and Ecological Challenges and Nature Based Solutions by Didier Vancutsem (ULB)

- The fifth webinar "Landscape Architecture" (09.06.2022), was coordinated by the Université Libre de Bruxelles, ULB.

The webinar, entitled "Navigating in Brussels waters" was introduced by Didier Vancutsem and followed by two in-depth presentations related to two different approaches to the topic: a first engineering approach, with the contribution entitled "Dialog of rainwater in the public space" by Dimitri Crespín (Vrije Universiteit Brussel), and a second Architectural Landscaping approach, with the contribution entitled "Design private spaces to engage citizens" by Andrea Aragone (ULB).

- The sixth webinar "Environmental Design" (04.07.2022) was coordinated by the PDTA Department of Sapienza University of Rome.

The webinar, by Alessandro Stracqualursi (SUR), focused on the topic of water: risks and opportunities, consistent with the sixth goal "Clean water and sanitation", belonging to the 17 Sustainable Development Goals. The topics of the natural water cycle, urban water cycle, water categories, integrated water cycle management, and water uses about the urban scale of use were then explored. Finally, the theme of water about climate change was addressed, thus the risks arising from scarcity, sea level rise and flooding, providing case studies of adaptation solutions in urban contexts and rural areas.

## 2.2 Method. Workshop Phases

### *Specific goals of the workshop "RivEr/Generation\_LAB"*

- Interdisciplinarity, related to the cooperation values of CIVIS, as evidenced by the topics addressed during the six webinars ranging from Urban Planning for River/Generation, Mobility, Urban Economy, Ecology, Landscape Architecture, and Environmental

Design. The integration, especially of economic disciplines, brought an innovative element from the point of view of sharing knowledge between actors with different backgrounds.

- Defining a model of actions and costs and benefits (toolkit), which recalls the concept of circular economy, a model that implies sharing, borrowing, reusing, repairing, and reconditioning existing places as long as possible. These principles, intended in terms of public space planning, were found in the reuse of public spaces and in the redefinition of the uses of places.
- Providing knowledge of a replicable methodology that enriches the background of each participating student.
- Sharing values and methods. The division into groups was motivated by the desire to make effective the sharing of different methods and backgrounds but above all the sharing of disciplinary knowledge. To this end, the groups were divided heterogeneously, ensuring in each group the presence of students with a background and course of study mainly in the disciplines of economics, spatial planning and architectural technology. This enabled the creation of discussion and knowledge exchange tables, to formulate constructive considerations capable of developing inclusive and integrated group work.



**Figure 1** The Workshop Poster with the Initiative Partners. Source: Authors' elaboration

To make the students' work easier, tutors and teachers have preliminarily prepared information/didactic materials to support the activities.

These materials consist of:

- Town planning documentation relating to the project area | General Regulatory Plan (PRG) [20] (Municipality of Rome, 2008); Rome Strategic Plan 2010-2020 [21] (Municipality of Rome, 2010), Flaminio Foro Italico Urban Project – (PUF) [22] (Municipality of Rome, 2014);
- Cartographic documentation related to the project area | Orthophoto, the DWG file of the project area, PDF files of the project area in scale 1:10.000, 1:5.000, and

1:2.000, the 3D file of the project area, and poster's and presentation's layout for the final presentation;

- In-depth report on the microclimatic analysis preliminarily carried out on the project area;
- Webinars' recordings.

The methodological structure adopted during the workshop aims to acquire a deep knowledge of the urban context, recognizing its structural and morphological components.

Indeed, thanks to a preliminary cognitive analysis of the urban context and a consequent critical evaluation of its components, it is possible to clarify coherent goals, based on which to elaborate a project proposal that fits perfectly with the surrounding area, which provides for a functional mix, which integrates private and public spaces, which contemplates a hierarchical system of mobility and accessibility, and which guarantees the integration of green areas with the settlement system.

What is expressed is reflected by a system and components' approach divided into 3 main phases, carried out from July 4th to July 9th (2022):

- Phase 1 | Analysis and critical evaluation of the territory (04-05/07/2022);
- Phase 2 | Planning (06-07/07/2022);
- Phase 3 | Project (08-09/07/2022).

The workshop started on July 4th (2022) with the presentation of the project area, i.e. the Olympic Village district (Flaminio district, Rome) and the main morphological characteristics of the Flaminio district, providing a historical and urban contextualization.

After the on-site visit to the site, the tutors showed the report of the microclimatic analyses carried out in the Olympic Village district, explaining the results of the following analyses: sun path diagrams and shadow range (using software Ecotect) and the microclimatic parameters such as air temperature, wind speed, wind temperature and relative humidity (using the software ENVI-met) to provide an evaluation framework of the outdoor thermal comfort

Afterwards, the tutors explained the methodology and the design process adopted in the workshop, also showing the students some examples.

The workshop ended on July 9th (2022) with the presentation of the results by each group to professors, tutors, and other students.

This report's "Results" section describes the results in detail.

During all phases ("Analysis and Critical Evaluation", "Planning" and "Project") professors and tutors carried out support and monitoring activities.

In this regard, each day of the workshop was characterized by the following support and monitoring phases:

- Description of day's activities | At the beginning of each day professors and tutors explained the activities scheduled for that day, goals to reach, and the timing of working activities;
- Support and monitoring during activities | During each day, professors and tutors carried out support and monitoring activities for each group aimed at achieving the daily goals defined and discussed with the students at the beginning of each day;
- Work check and Presentation | Each day of the workshop ended with a check of the progress for each group by tutors and professors, also with a moment of collective discussion during which each group publicly presented its progress to the other students, professors, and tutors to encourage comparison, exchange, and brainstorming.

Concerning the methodological structure adopted, a detailed description of the three phases of "Analysis and critical evaluation of the territory", "Planning" and "Project" is given below, explaining the timing and the purposes of each.

#### *Phase 1 | Analysis and critical evaluation of the territory (04-05/07/2022)*

The first phase was characterized by two consequential steps:

1. Objective analysis of the urban context | This step provides for the elaboration of three separate analyses for the "Environmental System", "Settlement Systems",

“Infrastructures, and Public services System”, aimed at bringing out the components of each system that have a structuring role for the urban definition. This type of analysis is very thorough and takes a long time, so the students were provided with supporting urban planning material which already highlighted the main components of each system; in this way, each group was able to study and summarize the material.

2. Critical evaluation of the urban context | In this step a critical evaluation of the systemic components analysed in the previous step of “Objective analysis of the urban context” was carried out. This step is aimed at highlighting the “criticalities”, “potential” and “resources” of each system (“Environmental System”, “Settlement System”, “Infrastructures and Public services System”).

#### *Phase 2 | Planning (06-07/07/2022)*

In the second phase of “Planning”, project strategies and goals were defined, again at a systemic level, which led to the drafting of a “Preliminary Layout Scheme”, on which specific actions and interventions were outlined in line with the strategies and the goals previously defined.

#### *Phase 3 | Project (08-09/07/2022)*

Even the third phase of the “Project”, as the first of “Analysis and critical evaluation of the territory” was divided into two consequential steps:

1. Masterplan | The first step of this phase concerns the representation of the project design proposal for the Preliminary Layout Scheme, i.e., a schematization of site-specific actions related to strategies and goals outlined in the previous “Planning” phase.

2. Toolkit of actions | In the second step, all the design solutions were analysed in detail in a toolkit [20] aimed at clarifying their effects in environmental, social, and economic terms. Moreover, the following characteristics were explained for each action: the scale of intervention, the effect produced in terms of improvement of urban quality, and the actors involved in the implementation.

The third phase ended with the public presentation of the results of the single groups by the students.

### **3. Case study**

The project focuses on the Flaminio district, in particular on the 'Olympic Village' and its relationship with the Tiber River. Rome's riversides are the expression of the millennial relationship between the river and city made up of those elements which testify to the evolution of the urban growth. Among these, the bridges, the buildings, and the mobility network that follows the course of the Tiber) are where the physical, functional and perceptible relationship between the natural component meets the urban.

The Flaminio district is located to the north of Rome, outside the Aurelian walls and remained, until the end of the 19th century, in an 'isolated' dimension, identifying itself as a piece of 'Roman countryside dominated by the consular road Via Flaminia, from which several alleys led to the numerous vineyards and villas of the Roman nobility. Therefore, the modern development of the district goes through the 1909, 1931, 1962 and 2008 Master Plans of Rome, it is strictly connected with the construction of new physical connections between the two banks of the Tiber. In this sense, the development of this area follows the number of bridges built to unify this isolated part of Rome with its surroundings. The Sanjust Plan of 1909 conceived the continuation of the left bank of the Tiber from Ponte Milvio, one of the oldest bridges in Rome, dated 207 b.C.. built in a strategic defence position at the entrance to the city and for this reason the scene of many battles to block invasions from the north. Ponte Milvio, also called Ponte Mollo (Soft Bridge) for its elasticity during the numerous Tiber floods that have plagued the city of Rome from antiquity to the present [21].

The Plan of 1909, therefore, imagined the construction of a new bridge connecting the Flaminio area with the planned Piazza d'Armi district on the other side of the river.

The Plan also envisaged the trident radiating out towards the Via Flaminia, articulated in subdivisions delimited by secondary routes, that nowadays constitute the distinctive footprint of the district. With the Universal Exhibition of 1911, the Ponte Risorgimento was inaugurated, celebrating the 50th anniversary of Rome's proclamation as the Capital of Italy. In 1916, with the proposal to transform the Via Flaminia as a great monumental promenade including the Ponte Milvio and the Via Cassia, the construction of the Stadio Nazionale (later Stadio Torino, today Stadio Flaminio) and the hippodrome (Ippodromo Flaminio at Villa Glori) in the bend of the Tiber, characterized the vocation of the area for sports and recreational activities, confirmed, over the years, by the number of sports clubs and some sports facilities placed on both the banks of the Tiber which still exist.

The Plan of 1931 introduced some changes to the urban design strengthening the trident and providing a double connection between the Flaminio and the opposite bank of the Tiber. Two bridges, Ponte Flaminio and Ponte Duca d'Aosta, intended to link the Flaminio district with the Foro Mussolini, then Foro Italico, conceived by the late 1920s as a large sports and educational complex, a true 'city of sport' whose construction started in 1928 by the Opera Nazionale Balilla just next to Ponte Milvio.

In 1935, Italy proposed Rome as the venue for the 1940 Olympic Games and, after being assigned to Tokyo, proposed for those of 1944, which did not take place due to the start of the Second World War. With the 1960 Olympic Games a watershed in the history of the capital, in terms of urban planning, was signed. New sports facilities, new infrastructures and new parts of the city were rapidly realized, out of a real urban design and outside a common idea of the future of the city [22]. The Olympic Village was realized: a neighbourhood of 1348 apartments, built on the site of the Campo Parioli barracks. The entire area was designated as a public park until a 1950 public plan that allocated it for apartment buildings. The Olympic Village, designed by the architects Adalberto Libera, Luigi Moretti, Vincenzo Monaco, Amedeo Luccichenti and Vittorio Cafiero, is perhaps the most famous modern residential district in Rome and the most rigorous application of the urban planning theories of the modern movement. It was commissioned by INCIS, the National Institute for the Housing of State Employees (National Institute for the Housing of State Employees), which decided to build a district to host Olympic athletes, to be transformed into residences for state employees after the event.

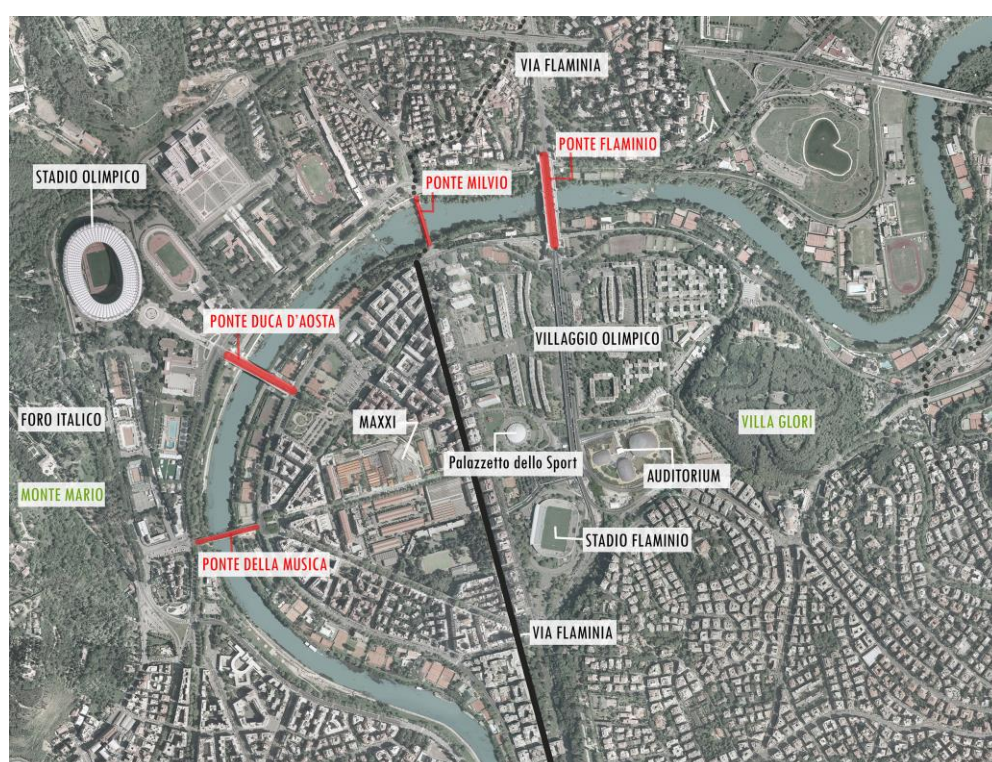
Thirty years after the Olympics, the 1990 World Cup was decisive for the district development, with two structural initiatives that contributed to its transformation: the landscaping of Piazza Mancini, which solved the junction of the axis of Ponte Duca d'Aosta on the undeveloped lots between viale Pinturicchio and the river; the construction of the surface metro between piazza Mancini and Piazzale Flaminio, a protected tram line that develops almost the entire route along via Flaminia, generating architectural barriers (tracks, platforms and protective parapets). The very rare crossings of the line cause difficulties in entering the entire district, especially in the bend of the Tiber up to Piazza Gentile da Fabriano for those coming from the Olympic Village and Parioli.

The same area of the Olympic Village was chosen by Rome's City Council in 1992 after a long debate, to host the new Auditorium of the city. In July 1994, Renzo Piano won the competition, although it was not until 2002 that the halls were inaugurated. A reason for this delay was the discovery, during the preparatory excavations of the site, of the foundations of a villa from the 6th century BC, testifying to the rural vocation of this area in Roman times.

In the autumn of 1997, an agreement for the sale of the former Montello barracks in Via Guido Reni was signed, aimed at the construction of the new Centre for Contemporary Arts (Maxxi) in the Flaminio district. In July 1998, an international competition was announced, and the jury awarded Zaha Hadid's project (February 1999), which was inaugurated in 2011. In the same year, the new Ponte della Musica, was inaugurated as part of the Parco della Musica e delle Arti Project, structured in an east-west direction on the Villa Glori - Monte Mario axis. This new bridge, finally completed the connections between the Flaminio district and the Foro Italico Monumental Sports Complex, responding to the objectives outlined by the Flaminio Urban Project of 2002.

With the General Plan of Rome approved in 2008 the Flaminio district becomes part of the "Historic City", being recognized the historical, architectural and cultural value of a neighbourhood dense with architectural works and rich in natural emergencies. Blue and green infrastructures, and public spaces dedicated to cultural and sporting activities become the new keywords for the regeneration of the Flaminio district's identity.

Three of the five Strategic Planning Zones of the General Plan focused on: the Tiber river, the closure of the railway's ring, the axis Fori-Flaminio-Eur, the Aurelian walls and the Appia Antica Park, cross in the Flaminio Area underlying its strategic role to enhance the traces of the urban morphology, strengthening the great cultural functions of entertainment, exhibition, tourism and leisure and also defining a new sustainable mobility network.



**Figure 2** The Map of the Flaminio District with in evidence the main territorial references. Source: Authors' elaboration

Therefore, the choice of this study area is motivated by four main reasons:

1. Strategic location of the Flaminio district: its proximity to the Tiber river is a fundamental component of the theme of the entire CIVIS project. From an eco-systemic perspective, the Tiber is a primary structural element both at an urban and local level. Its morphological conformation underlines the strategic relation of Rome with the specific nature of the river. Thus, the lessons learnt during the webinars concerning the case studies presented by the universities participating in the project were taken up.
2. Criticality of the environmental, infrastructural and settlement systems that act about the proximity of the river. The river landscape belongs to the historical and environmental relationship with the city and represents a link between natural and cultural components which assume a key role at the identity and landscape level [23].
3. The historical-architectural value of the "Olympic Village" district, and the connections with the urban context in which it is located. Therefore, from this perspective, it is possible to easily identify the river in the urban built area of Rome, as a physical and symbolic stratification process of distinctive landscapes [24].
4. The presence of semi-public and public spaces in the district, not yet completed, are a great potential for urban regeneration actions by defining the river as a hospitable, attractive, and safe place, in which to reconcile landscape and perceptive values

with the contemporary needs of the city and its citizens; by recognizing the river as a common good, an inclusive and sustainable infrastructure; an essential urban component and a place of aggregation, representative of the heterogeneous fluvial and urban identities. In this sense, the river represents a landmark in the territory that fosters morphological, perceptive, and cultural relations between public space and urban activities.



**Figure 3** The Tiber Riverbanks from Ponte Flaminio to Ponte della Musica. Source: Photos by the Authors

#### 4. Results

The workshop activities produced different results for each group that carried out the work independently, supported by professors and tutors through specific contributions and monitoring of daily progress. Below are the results obtained by each working group, dealing with the evaluation framework for the analysis phase and of the integrated project at different scales, using supporting materials, such as drawings, 3D models and references provided by professors and tutors. Then, the definition of the toolkit has been illustrated to show the general master plan with the specific goals and actions elaborated based on the sensitivities of each student involved, highlighting the peculiarities of the project area according to different points of view.

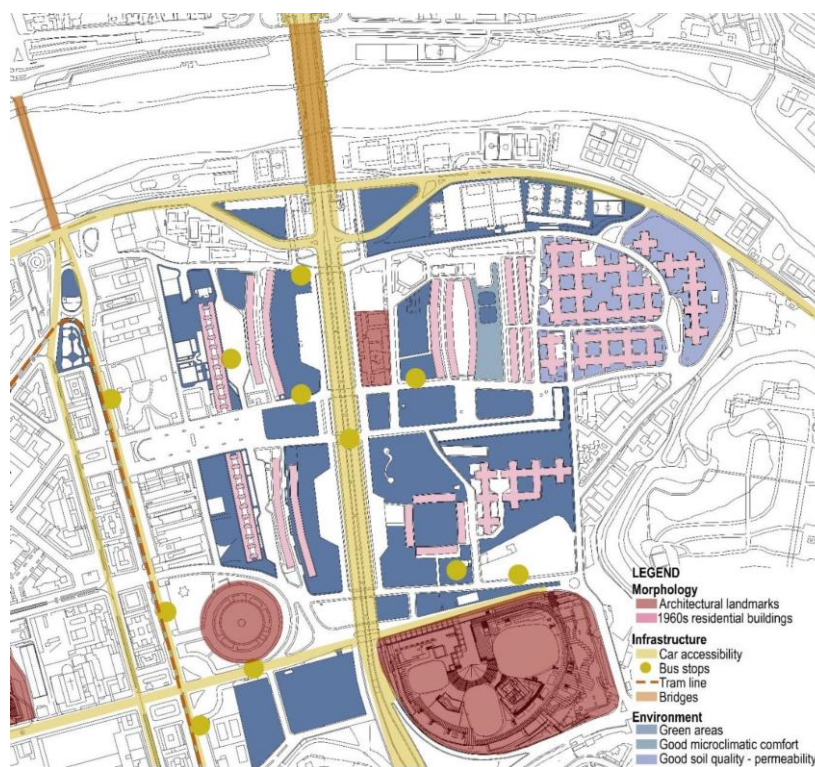
*Working Group 1: Ligia Gherman (SUR), Evelien Van den Bruel (ULB), Mahtab Seyedabadi (SUR)*

#### *Analysis and critical evaluation of the territory*

The working group promoted the reading of urban systems in a joint way to highlight the relationships between resources, criticalities and potential, illustrating the priority areas of intervention, through the analysis.

#### *Resources*

The street hierarchy is a strength for accessibility and mobility within the district, providing both internal distribution and the rest of the city. Building archetypes of the Olympic Village are representative of the Modern Architecture Movement and course, they have valuable elements and blocks, conceived through integrated planning with public open spaces, defining a proper building scale for the human dimension. The other buildings with a sporting and cultural vocation represent landmarks of the city and therefore a great socio-economic resource. Building layout and the presence of large vegetated areas ensure a good level of microclimatic comfort during the year, constituting one of the peculiarities of the district, offering large outdoor public spaces with commercial spots and spaces for events for people living there (Fig. 1).



**Figure 4** Analysis and critical evaluation of the territory – Resources.

#### *Criticalities*

Some critical issues have been determined, such as the inefficiency of public transport and the lack of road maintenance. This compromises the accessibility and safety of the neighbourhood, making it difficult to navigate, with the corresponding social consequences. Rising car traffic in the Flaminio district and mainly in the Olympic Village area leads to poor air quality due to high levels of pollution, weighing on the comfort of open spaces, affected by heat island phenomena in the summer period. The existing vegetation presents a general level of carelessness, caused by the absence of suitable maintenance plans, showing notable criticalities of the ecological system. The large open spaces and squares are not widely used by residents and people who visit the neighbourhood, where only a few commercial activities take place (Fig. 2).



### Planning

The evaluation framework of the project area allowed to provide of specific strategies for each system, as shown below:

Enhancement of the architectural identity of the Olympic Village and the relationship between buildings and open spaces, encouraging relationships between residents and visitors (Morphological System)

Defining a hierarchy for mobility and ensuring accessibility to the Olympic Village (Infrastructural System)

Improving summer comfort conditions (Environmental System)

### Project

#### Masterplan

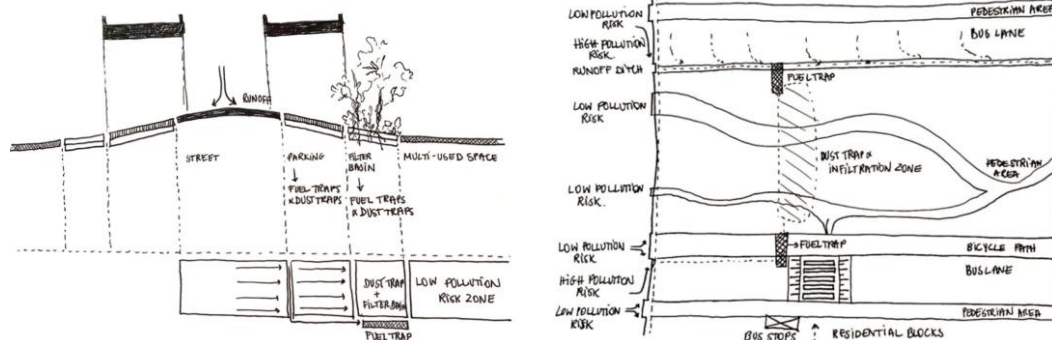
#### Legend

- Infrastructure**
  - Temporary parking with EV charging
  - Parking for disabled
  - Parking under the plots
  - Automobile-only road
  - Temporary car access street
  - Added pedestrian sidewalk ?
  - Improved pedestrian sidewalk
  - Pedestrian and bike access-only street
  - Proposed photocatalytic painting
  - New bike lane
  - Temporary vehicle-access streets
  - Bicycle, scooter and other vehicles rack with electric charging
  - Illuminated crosswalk, sensor-equipped
  - Parking spaces
  - Bus lane
  - Bus stop
  - Vehicle streets, photocatalytic pavement
- Public spaces**
  - Sports areas: skatepark, yoga, plates
  - Smart umbrellas
  - Benches
  - Kiosks
- Green spaces**
  - Existing green areas
  - Green roofs
  - 'Greening the grey areas'
  - Arranged existing green areas
  - Newly-added green surfaces
  - Existing trees
  - New trees
- Safety and orientation**
  - Smart lamppost - 100W LED lamps
  - Intelligent remote-control lighting system cabinet
  - Wide-angle detection radars
  - Vision detection cameras for light regulation
  - Audio services
  - Rain sensors
  - Vehicle (bicycle) counter
  - Energy meters



**Figure 7** Project Masterplan. Specific actions with a particular interest in the central area of the Olympic Village, integrating solutions implementing permeable surfaces such as draining pavements and vegetation, designing new pedestrian paths, and redefining car traffic through a clear hierarchy of distances.

Modelling the soil and unsealing the surfaces have been set as the main strategies of the project, introducing new vegetated spaces. Actions aimed at sustainable rainwater management have been defined, through a circular approach, for the collection, treatment and reuse of water resources, providing low cost of maintenance of open spaces, mitigating the urban heat island effects and reducing the runoff risk affecting the project area (Fig. 5, Fig. 6).



**Figure 8** Section on Viaduct of Corso Francia. Soil modelling for run-off management. **Figure 9** New road design for rainwater management. Functional areas

### Toolkit

The main objectives and strategies were articulated and organized with the related actions indicated for each system in the toolkit. The specific goals and actions of the

Olympic Village have taken into greater detail the central area constituted by the progression of large open spaces designed to connect the neighbourhood and improve its livability (Fig. 7, Fig. 8).

CHALLENGE	GOALS	STRATEGIES	ACTIONS
 Undefined spaces: Safety, communication, economy.	Mixed use according to time. Redefine and strengthen identity of area.	Increase the communication between the two part of neighborhood	Parking lots. Green gardens as Common activities for different ages and genders.
 Uncomfortable spaces: Heat island, poor water management, low impermeability.	Improve water management. Reduce heat island under bridge. Control noise pollution	Increase evapotranspiration.	Ecological Park(ing) site. Veracity of trees and vegetation. Capture, filter and reuse of runoff water for agriculture and selling them on market.
 inaccessible spaces: Safety, mobility.	Redefine parking lots. Arrange accessibility for cars and pedestrians.	Use of different paving types.	Change the asphalt areas into natural terrains that reintroduce biodiversity.

**Figure 10** Toolkit for the vertical axis of the central public spaces in the Olympic Village

CHALLENGE	GOALS	STRATEGIES	ACTIONS
 Undefined spaces: Safety, communication, economy.	Increase identity and social life. Boost of economy.	Connection of residential blocks with central axes. Make axes safe and useful for everybody.	Creation of encounter places for temporary events. Kiosks on the critical connection points with following up activities. Add verity of urban furniture.
 Uncomfortable spaces: Heat island, poor water management, low impermeability.	Reduce heat islands under the bridge and empty areas.	Reduce empty areas. Increase plants diversity.	Reduce asphalt amount. Add canopies and smart umbrella. Rainwater management: Capture, storage, reuse and infiltration.
 inaccessible spaces: Safety, mobility.	Safety for pedestrian.	Highlight crossing roads and prioritize pedestrians. Visibility of crossing roads	Smart lighting. Increasing pavement height. Road marks, traffic boards flashlights

**Figure 11** Toolkit for the horizontal axis of the central public spaces in the Olympic Village

*Working Group 2: Augustina Lezcano (UAM), Irene Maroncelli (SUR), Agahi Najafabadi Parnian (SUR), Khawla Rachadi (SUR)*

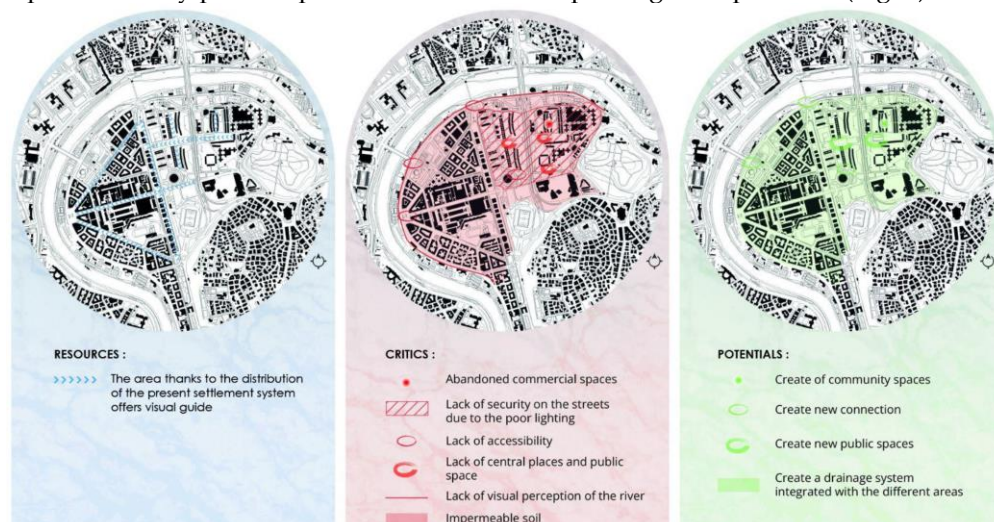
#### *Analysis and critical evaluation of the territory*

The Analysis highlighted the resources, criticalities and potential of each system identified linking the objectives of the project with the analysis, dealing with the environmental, ecological and infrastructural systems.

#### *Environmental System*

Along with the social aspects, the critical issues of accessibility and safety represented the main aspects to deal with in the environmental system. The lack of a relationship

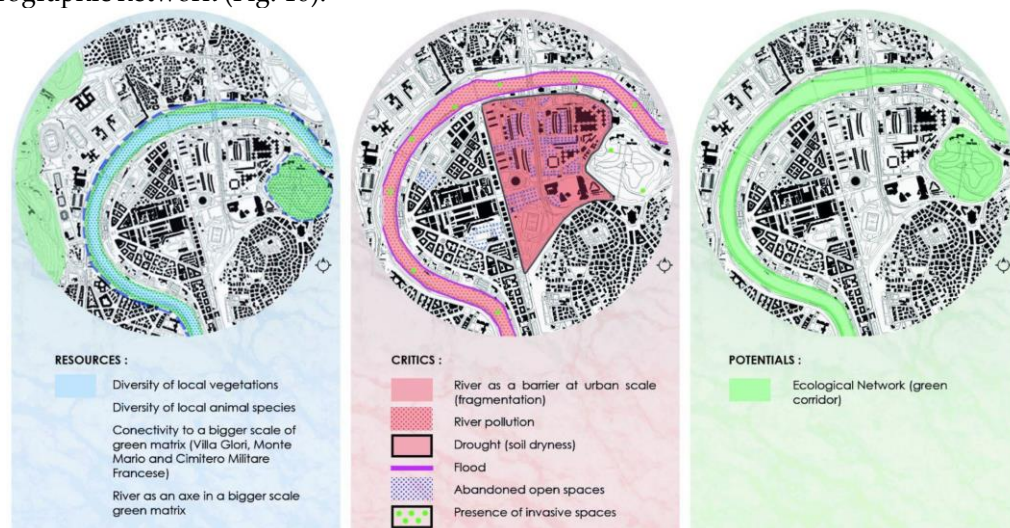
between the neighbourhood and the river was another critical of interest to design the large spaces as a key point to provide connections exploiting their potential (Fig. 9).



**Figure 12** Analysis and critical evaluation of the territory – Environmental System

### *Ecological System*

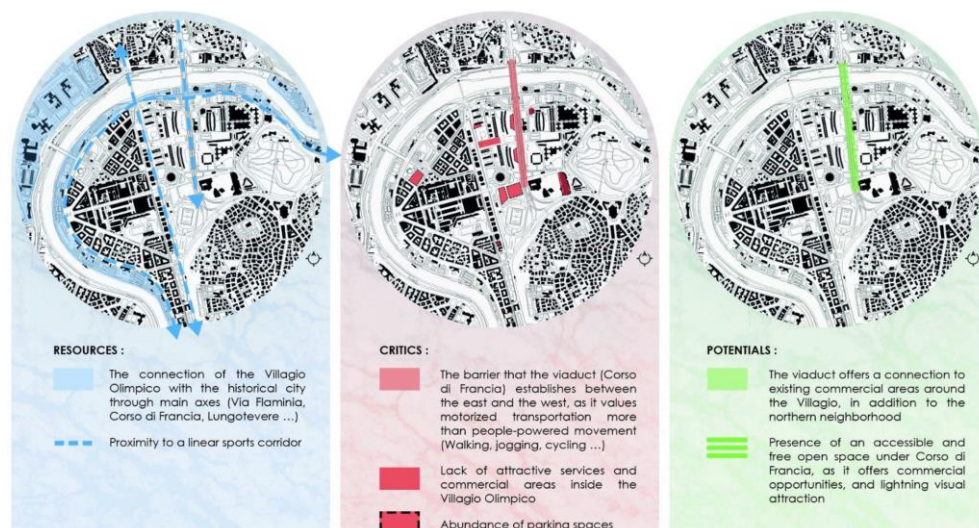
The Tiber river ecological network represents a precious resource within the Flaminio district, providing high levels of biodiversity, guaranteed by the presence of many plant species in the area of the Olympic Village, such as Villa Glori and the Monte Mario Natural Reserve. However, there are several critical issues related to the ecological system represented by the presence of invasive species that threaten ecosystems. Other criticalities are found in the flooding risk due to the soil sealing and the pollution of the soil and the hydrographic network (Fig. 10).



**Figure 13** Analysis and critical evaluation of the territory – Ecological System

### *Infrastructural System*

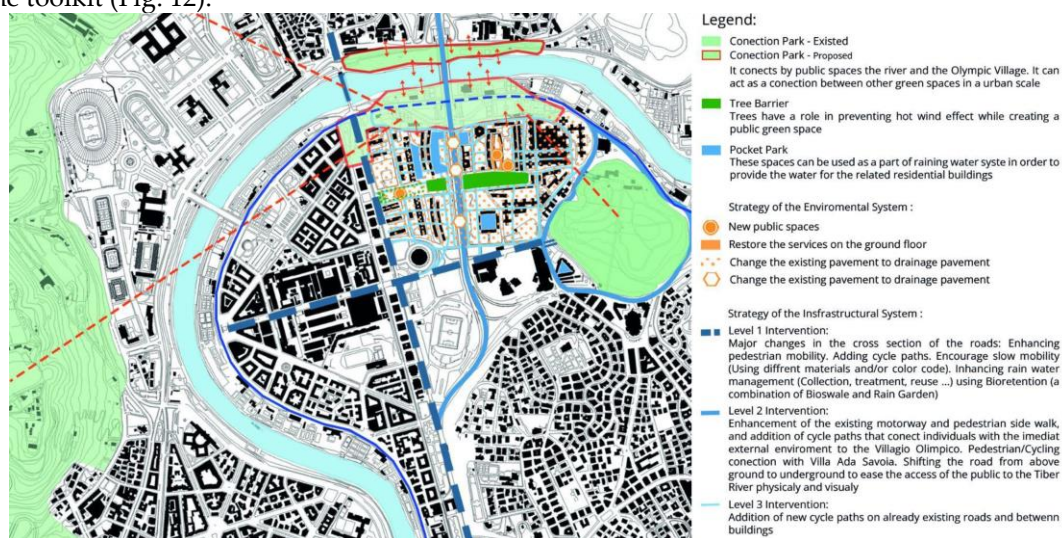
The existing infrastructural system of the Olympic Village provides connections both to the city centre and to the outside, which represent both a resource and a potential. At the same time, the presence of the Viaduct of Corso Francia and the main road axes determine a social criticality, threatening the safety and comfort conditions of the open spaces (Fig. 11).



**Figure 14** Analysis and critical evaluation of the territory – Infrastructural System

### Planning

The analysis of resources, criticalities and potentials led to the identification of strategies for each system, represented in a general scheme anticipating the actions collected in the toolkit (Fig. 12).

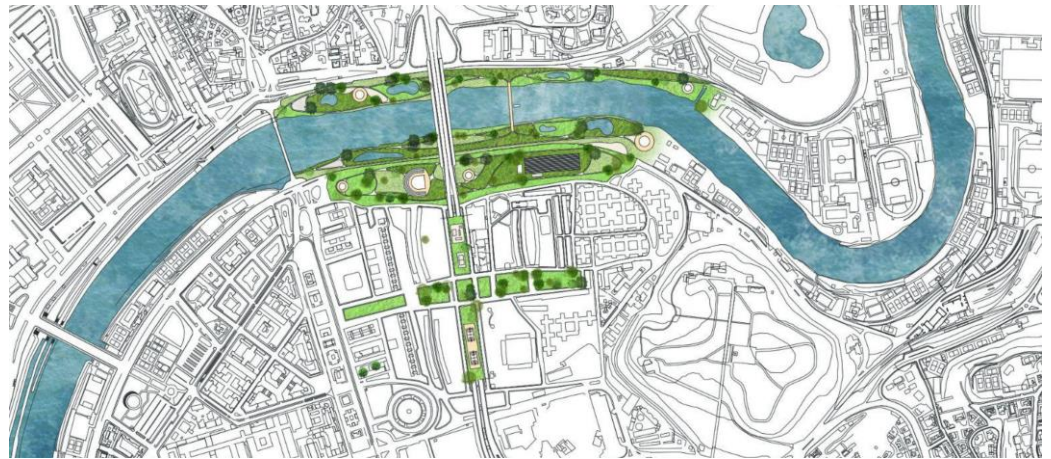


**Figure 15** Project strategies

### Project

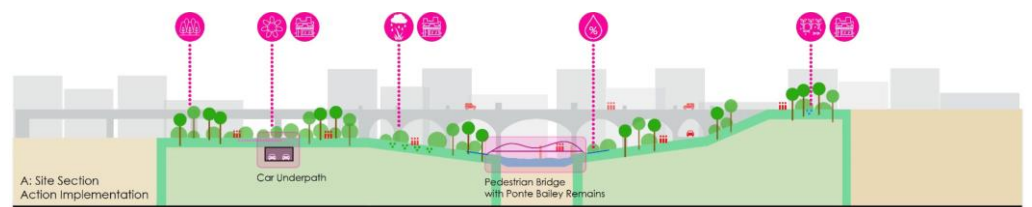
#### Masterplan

In the Masterplan the two new urban parks along the Tiber river banks have been designed to mitigate the flooding risk providing the ecosystem benefits of the vegetation and the relationship between the city and the river, generating opportunities for socio-ecological connections (Fig. 13).



**Figure 16** Project Masterplan

The pictures show the relations between the two urban parks, in which the functions and integrated solutions adopted are designed, where the contribution of ecological-environmental benefits is provided by the presence of vegetation that contributes to increasing the air and soil quality in an inclusive public space (Fig. 14, Fig. 15).



**Figure 17** Section on the twin parks along the Tiber river. Actions



**Figure 18** Section on the twin parks along the Tiber river. Functional areas

#### *Toolkit*

The "Twin Parks" project defined interventions to create new ecological and infra-structural connections, through an inclusive and attractive public space, able to mitigate the risks highlighted in the analysis phase, implementing solutions to promote external comfort, and reducing the urban heat island phenomena (Fig. 16).

CRITICS	SYSTEM	GOALS	ACTIONS	ACTORS	COST	BENEFITS	SCALE
ISOLATION OF THE AREA 	Ecological Environmental Infrastructure	To connect the area in urban scale and create a sense of community 	- Connecting Olympic Village with Farnesina and Tor di Quinto through new public-green spaces through the river, to do that the existing sports facilities will be relocated (Twin Park)  - Connecting Olympic Village with other parts of the city through new commercial activities in the new public-green spaces and other spots in the neighbourhood (Twin Park-Aquaponic System-Agricultural Garden-Tollpan Park) 	Public call Business owner	€ € €	Ecological Economical Social	Urban Local
HEAT ISLAND AND WIND CURRENTS 	Ecological Environmental	- To provide comfortable bioclimatic conditions - To enrich the biodiversity - To reduce the heat of the area - To stop the hot wind - Manage the flood 	- Planting new trees to create a natural barrier and producing shadows  - Enhancing the situation of the pavement - Changing the existed pavements to a permeable one in some parts  - Create wet zones inside the parks 	Consortium Public call	€ € €	Ecological Social	Local
HIGH LEVELS OF ENERGY WASTE 	Ecological Environmental	- To reduce the energy and water demands 	- Creating rain gardens with harvesting system  - Creating Bioswales - Permeable pavement - Integrate Soil cells 	Public Call	€ € €	Ecological Economical	Urban Local

Figure 19 Toolkit

Working Group 3: Luca Annicchiarico (SUR), Carlotta Fabrizio (SUR), Angèle Khoury (ULB)

### Analysis and critical evaluation of the territory

In the first stage, the analysis carried out considered each system coupling resources, criticalities and potential, identifying the environmental system, the mobility and the settlement and services systems in a joint vision of the project area.

#### Environmental System

The natural ecosystems of the area represent the main resource, as well as the large, vegetated surfaces and the open spaces within the district. However, the lack of management of outdoor spaces brings the discontinuity of the vegetation system, but, at the same time, they become potential transformation areas of the Olympic Village.

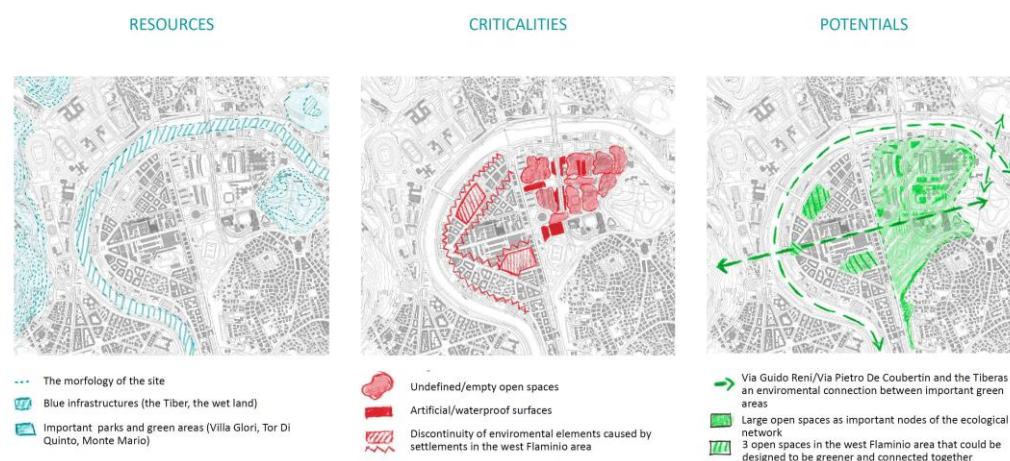
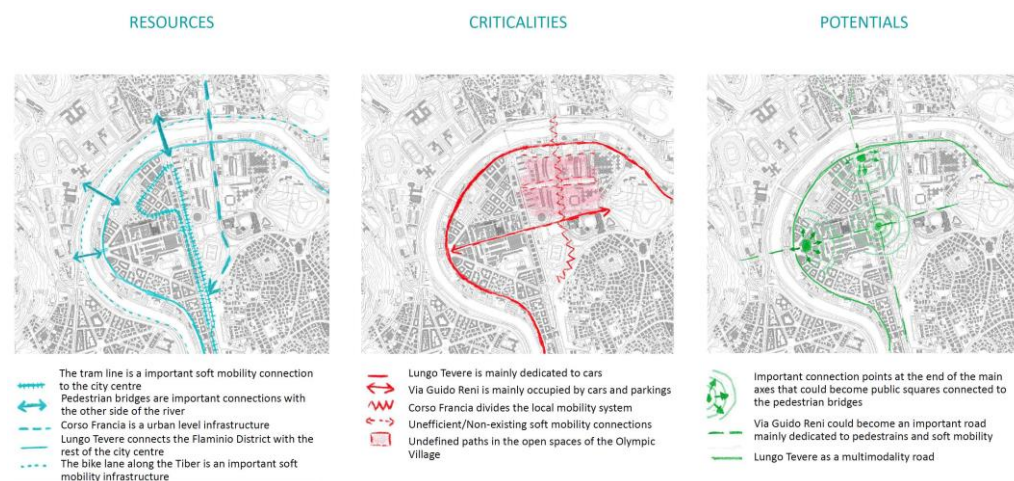


Figure 20 Analysis and critical evaluation of the territory – Environmental System

#### Mobility System

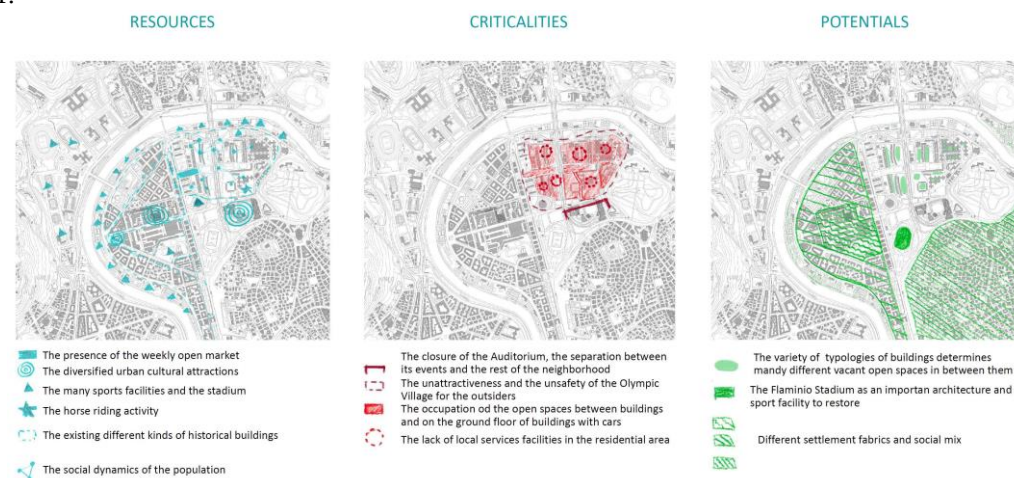
The Flaminio district is served by an infrastructural system able to connect this area with the rest of the city, also provided by public transport and cycle paths, especially the one along the Tiber river. However, the lack of a hierarchy of traffic flows is a critical issue in terms of accessibility to the district and compromises its safety, especially for pedestrian paths



**Figure 21** Analysis and critical evaluation of the territory – Mobility System

### Settlements and Services System

The sporting vocation of the district represents an attractive point, as well as the building's architectural elements, contributing to defining the identity of the Olympic Village. However, an integrated management plan for the sports and cultural facilities is missing, as a real weakness of the Flaminio district, which sees the absence of development opportunities in terms of socio-economic conditions. Therefore, the same areas and disused buildings of the district present themselves as the potential for an urban transformation to increase the quality of the spaces and give back to the district an attractive character.



**Figure 22** Analysis and critical evaluation of the territory – Settlements and Services System

### Planning

While defining the project strategies, the urban systems were reviewed and determined based on the specific objectives of the project, highlighting the actions on an urban scale and the different solutions implemented in the Olympic Village.

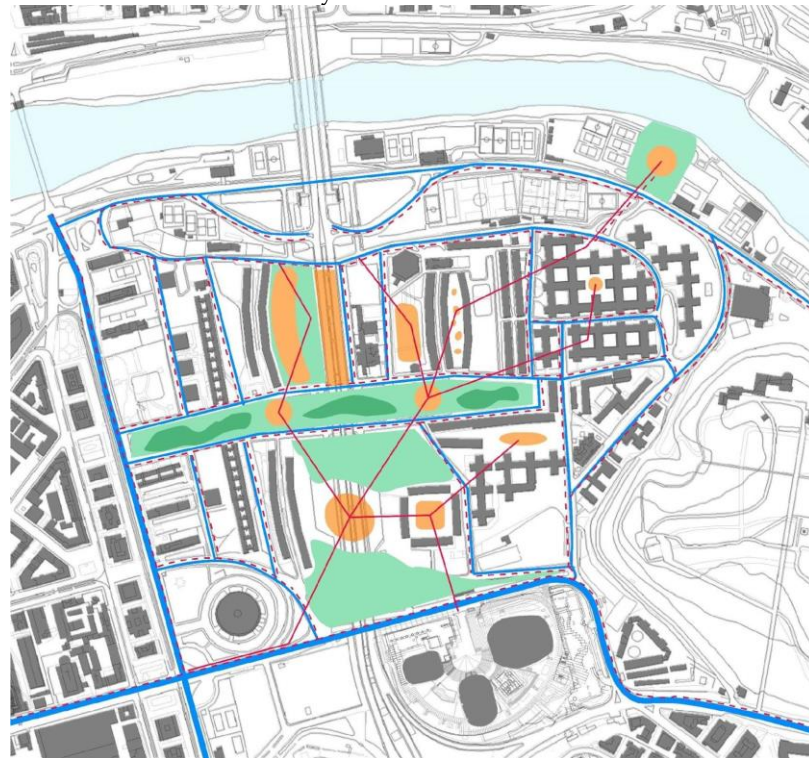


**Figure 23** Project Strategies

### Project

#### Masterplan

The project concept is the “Blooming Village” according to the principles of urban circular economy, to foster the functionalization of public spaces and buildings. To provide a safe and accessible neighbourhood an efficient infrastructural system through the hierarchy of vehicular traffic and cycle-pedestrian paths has been designed, incentivising the modal shift and implementing strategies and solutions aimed at the sustainable management of water resources. Through a bottom-up approach, the involvement of the residents of the Olympic Village is ensured, encouraging virtuous processes for the transformation of the spaces and increasing the attractive power of the neighbourhood. Carrying out collective activities allows for the development of a sense of community, creating new job opportunities and, at the same time, reducing the maintenance costs of public open spaces for a resilient community.



**Figure 24** Project Strategies

### Toolkit

For each strategy represented in the general Masterplan different actions are shown, as indicated in the toolkit, listing the different solutions for each system, illustrating how each action is linked to the specific project goal, as illustrated in the following map.





Figure 28 Toolkit of the Dwellings and Public Space System

## 5. Conclusions

The environmental design regenerative strategies of the Olympic Village of Rome have been considered from a twofold point of view, as follows.

In order to minimise times and costs of construction and reduce its environmental impact, the regenerative scenario levers on natural materials like wood and plants, used both in flexible and modular systems placed in the open space. The buildings' roofs represent another "layer" to be re-designed to mitigate the UHI effect, using reflecting materials (i.e., with high albedo values), green and brown roofs to mitigate the microclimate. New tree-lined rows define the routes and vegetated linear barriers, that mitigate traffic noise and air pollution while improving the thermo-hygrometric conditions through evapotranspiration and shading. New permeable surfaces – on ground (rain gardens and bio-swales) and on the buildings' roof (extensive and intensive green roofs) contribute to the reduction of the UHI effect, in summer. Increased permeable surfaces and a new water square located in the south edge of the complex also allow a significant amount of rain-water to be collected, ensuring a sustainable water management.

On a larger scale, the restoration of the socio-ecological connection with the Tiber River and other relevant green areas, like Villa Glori and Monte Mario is proposed. Focusing on tree planting design and new pedestrian and cycle paths, the design aims at guaranteeing improved connectivity between the residential areas, the Tiber River, and the neighbouring areas, structuring new public and semi-public areas, for the benefit of people and the environment.

The in-depth knowledge of territorial, cultural and environmental heritage and the awareness of risks and vulnerabilities can lead together to the mitigation of the effects of disasters by focusing on adaptive behaviours instead of reactive ones, all this to the end of improving the resilience of local communities [28]. The capability to define and network innovative place-based and nature-based solutions fosters flexible and incremental territorial actions as the fundamental components of urban regeneration strategies, concerning long-standing sustainable development goals as well as concerning pandemic emergencies [29]. Therefore, the innovation of public space is one of the most relevant drivers of the paradigm shift toward resilient, inclusive, and green cities, strengthening ecological connections as well as enhancing social and cultural networks [30, 31].

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19. The workshop “RivEr/Generation\_LAB. Linking resilience with inclusiveness in the urban built environment of Rome, Brussels, Madrid” was coordinated by the PDTA Department of the Sapienza University of Rome. The following Professors participated as supervisors: Carmen Mariano (SUR), Francesca Rossi (SUR), Maria Beatrice Andreucci (SUR), Didier Vancutsem (ULB), Maria del Mar Alonso Almeida (UAM), Maria Escat (UAM). The following participated as Tutors: Marsia Marino (SUR), Marco Delli Paoli (SUR), Maria Racioppi (SUR), and participation of students from each university. Participation in the workshop was open to master's degree students from universities in the CIVIS Network. Seventeen applications were received from students from each university participating in the project and from these, 10 students were selected as RivEr/Generation\_LAB workshop participants. The

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participating students were: Annicchiarico Luca (SUR); Fabrizio Carlotta (SUR); Khoury Angèle (ULB); Lezcano Agustina (UAM); Maroncelli Irene (SUR); Najafabadi Parnian Agahi (SUR); Rachadi Khawla (SUR); Seyedabadi Mahtab (SUR); Van den Bruel Evelien (ULB); Ligia Gherman (SUR).

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