WATERFRONT DIALECTICS

ROME AND ITS REGION FACING CLIMATE CHANGE IMPACTS

Edited by:
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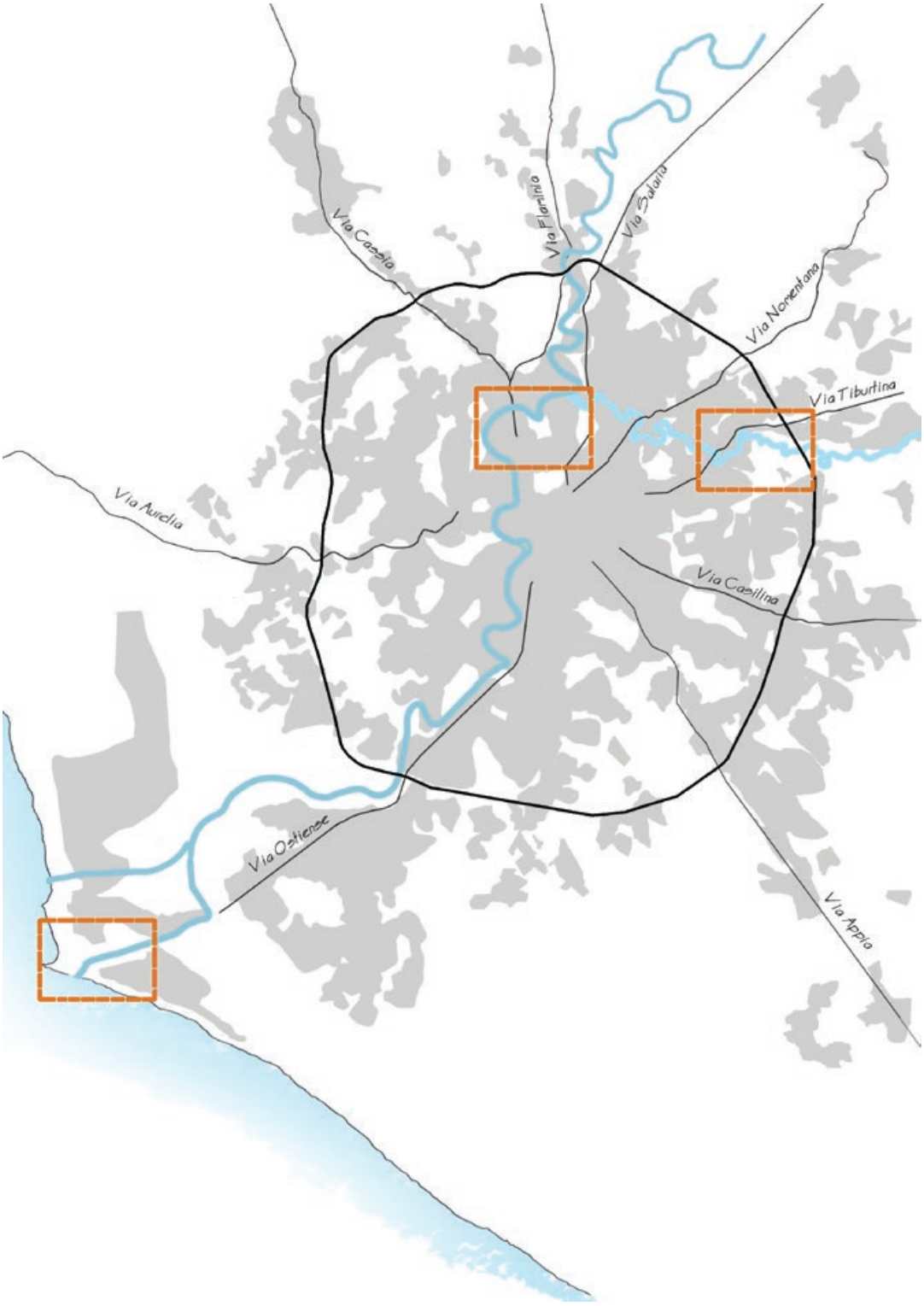
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Introduction

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Vulnerability and Opportunity on Waterfront Facing Climate Changing

Waterfront Cities have been struggling with climate change, but are they more vulnerable than other cities?

In recent years the built environment settled along the shore registered major damages from natural disasters and the effects tend to have a growing impact in the next years. At present urban areas near the water are confronted with greater risks, bringing major losses, high maintenance costs and new threats for their communities, thus raising new challenges.

The SOS Climate Waterfront is a H2020 interdisciplinary project, focused on five European cities: Stockholm, Thessaloniki, Gdansk, Lisbon, and Rome facing climate new patterns. Researchers involved in the project aim to identify specific vulnerabilities and envision possible solutions for each city. The research network intends to identify the coming challenges and explore new opportunities for each city enhancing the capacity to develop solutions of resilience by benefiting from the international and interdisciplinary exposure.

The city of Rome is built over a multitude of layers spread out along large periods of time. The eternal city offers a theoretical framework for the present debate that is meaningful to exchange ideas addressing current and future societal, spatial, and environmental challenges. Though poorly equipped to adapt to climate disasters, such as heatwaves, flooding, and rising sea levels, Rome holds an outstanding repository collection of design solutions that have been tested for centuries and that are relevant today.

At present Europe is committed to decarbonize. The United Nations World Population Prospect stipulates that the quality of water services and living conditions in urban areas will decrease due to climatic extreme manifestations. The European Commission claims that the exposure to natural disasters will affect under-equipped cities and their communities thus innovative climate adaptation and mitigation solutions are needed to improve resilience.

Main vulnerabilities emerge with climate extreme manifestations thus strategies of adaptation to new patterns are being implemented. Decarbonization demands decreasing energy consumption, strategies to prevent urban islands' heat effect and the consequent emission of greenhouse gases. It also demands a greener built environment with stronger presence of vegetation and higher permeability of the soil. Impermeable surfaces in urban waterfronts contribute to flooding and pollution of surface waters.

In 2019 the Oslo Triennale discussed the topic "*Enough. The Architecture of Degrowth*" and the Lisbon 2022 Triennale focused on the topic "*Terra*", both enhancing the importance of reclaiming the balance between humans and the natural environment. The World Congress organised by the International Society of City and Regional Planners in 2020 was dedicated to the "*Post-Oil City: Planning for Urban Green Deals*". At present degrowth, unbuilding and return to nature are becoming increasingly present in the architectural and urban planning discourse.

Authors such as Pedro Gadanho claim that we will be dealing with the great transition imposed by the urgent need to decarbonize. In his 2022 book *Climax Architecture, how architecture must transform in the age of ecological emergency*, Gadanho argues that emergent new design is inevitable and the process of decarbonizing irreversible. Vishaan Chakrabarti in his 2013 book, *A Country of Cities*, argues that environmental degradation, unsustainable consumption, economic stagnation, rising public health costs and decreased social mobility are threatening the quality of urban life. Density and degrowth are key to enlarging open spaces for the natural environment and enhancement of biodiversity within and around the built environment.

Triennale, Biennale, world congress, authors from various countries share the same concern towards climate emergency. The question is how much change is needed and how long do we have to act. There is an agreement on the main challenges, within a common framework, though solutions are not generic, they are site-specific.

Each neighbourhood requires a delicate approach that holds the knowledge of local historic and geographic circumstances. In Rome, understanding the various scales of urban planning, landscape, architecture, and technology immediately related to water management and the result of previous strategies is required to overcome the gap. The urgent need to collect accurate data on new climatic patterns, learn about the new manifestations, and try to anticipate disasters is present among most of the authors in this book. The main question is how to predict? And to what extent preventive actions, of adaptation and mitigation, are needed?

Throughout the last century, the aim to dominate and control the natural environment has guided most of the decisions on urban waterfronts, both culturally and scientifically. In the 21st century there are new parameters to be considered, as new climate patterns challenge the existing infrastructures. Thus, major costs in infrastructure, still being built at present, represent a huge financial effort for the communities and local governmental agencies.

Outdated and unable to deal with new climatic patterns, they raise the urgent need for a new way of thinking, based on a dialogue with nature. This dialogue is dependent on the capacity to listen, observe and engage with contributions. In the first twenty years of the 21st century there are still major infrastructures being implemented that follow methodologies from the 20th century, driven by the aim to control nature instead of dealing with nature. An approach that does not acknowledge either an interdisciplinary dialogue or the capacity to negotiate and accommodate new patterns.

Some communities settled along the waterfront have been implementing solutions based on interdisciplinary discussions for centuries; there are still some heritage buildings and meaningful public spaces that hold clever solutions and a strong cultural presence along the waterfront. They offer a precious contribution to the present debate. In Rome some territories were redesigned to take benefit from the water, the waterways, maritime activities, and the possibility to moor in the city. When it comes to exploring site specific solutions for the 21st century such knowledge is relevant to improve resilience. Resilient thinking can be described as a way of strengthening the urban fabric, boosting urban life and adjusting to new demands. Urban Resilience is the capacity of the systems within a city to mitigate, adapt and grow while taking advantage of crisis or shocks.

The exchange of good practices among the five European cities, brings an added value to the debate. Each being settled on a particular landscape, has been dealing with hydrologic conditions in a unique way. Each holds an elaborated relation with the water, the landfill built over time, offering a handful of urban environments. Together, the five cover a large spectrum of approaches and paradigms. In Rome, layers of history offer theoretical concepts that lead to specific design solutions. However, when it comes to dealing with climatic extreme swings, they face similar challenges as they are unprepared. Singular historic and geographic conditions make Rome's waterfront unique, a result of a narrative of previous generations. Built upon visions to succeed natural forces, cities have domesticated the wild, managed the environment and implemented a unique cultural landscape.

Rome was initially settled over the river *Tiber*, *affluent Aniene* and a few more water streams that attracted humans to settle in the region. Buildings were implemented along a large network of waterways, layers of interventions have shaped the built environment to the present day. Throughout centuries generations of Romans have benefited from these lines of clean water taking advantage of the communities and the access to the Mediterranean Sea.

In the five cities the transformation of the territory brought more buildings, more impermeable areas and consequently higher floods that occasionally devastated the city. The city of Lisbon for instance, suffered an earthquake of 1755, affecting mainly the waterfront neighbourhoods. The deepness of devastation is well documented, built over landfill and sedimented soiled many constructions collapsed and were flooded by the subsequent high tide that reached the areas located along the river. Later in the late 19th century, the industrial port built on the river along the city, took in consideration the precedent catastrophe. New buildings had to be prepared for high tides and storms, this wisdom was included in their design. At the ground level materials covering the walls were water-resistant and designed to accommodate flooding. The knowledge of the natural disaster of the 18th century influenced the design solutions implemented in the 19th century.

In Stockholm the new neighbourhood of Hammarby Sjostad built in the early 21st century introduced permeable public spaces to drain the floods. At the scale of the built environment, most buildings have 3 to 5 floors. The density treasures energy efficiency and the public spaces keep the human scale. Most of the buildings use wooden structures.

Public spaces with vegetation, design to privilege pedestrians, soft modes of transport and the relationship with nature. The porosity of public spaces, which drain heavy rainfall and prevent flooding. All waste produced by the inhabitants is recycled in the creation of combustion.

Involvement of the community in the discussion of the program as it develops. Public participation in the development of the project and the implementation of a bottom-up strategy to influence policy decisions.

Lessons from each city offer a broad understanding of past, present, and future solutions that are specific to particular geographies and sensitive to local communities, their urban environments and the local building materials. Crossing visions offer enlightened design to overcome existing vulnerabilities.

This book, dedicated to Rome, is divided into three parts plus one. Part One, *Rome Coastal System*, presents historical approaches and dynamics in progress covering histories and current transformations along the seaside. Part Two, *Rome and the Tiber*, deals with historical perspectives, strategies and transformation programs linked to the most central areas of the city.

Part Three, *Rome Aniene River*, aims to contribute to the rediscovery of the largest tributary of the Tiber, the Aniene, too

often hidden by aggressive urbanisation within the metropolitan part.

Part Four is entirely dedicated to the expressive drawings that were elaborated during the Spring Rome workshop 2022. They clearly realise how important the empathic relationship with places is in order to fully understand their structure and potential in view of their transformation sensitive to the current conditions of climate change.

The authors listed in this book are developing their own research and come from different disciplines. They offer a sharp perception of the present debate on Rome's different waterfront, along the coastline, but also along the two major rivers, Tiber and Aniene. Articles address the role of local authorities, public and private investors; they cover a large spectrum of possibilities, the cultural identity based on historic, geographic, and societal issues addressing the city, and individuals.

It takes different approaches, environmental, social, technological, economic, cultural, each in its own way and aims to protect the Eternal city from catastrophic climate disasters. Each group presents solutions and future strategies, and some of the design proposals demand a new culture to manage and heal the territory. Decarbonization demands profound shifts in the way cities have been organised. The mobilisation of local communities towards more sustainable behaviours, the protection of biodiversity, and the integration of blue and green systems in the urban environment come across several authors.

Some design, landscape, architecture, and urban design illustrated in this book, leads to the urgent need for urban porosity and the necessity to bring nature back to the urban environment. Such an approach incorporates new perspectives to spatial planning at the scale of the city of Rome, rivers Tiber and Aniene. Emerging strategies integrate parameters to reduce energy consumption and shrink the carbon footprint. The results of the research carried out within SOS Climate Waterfront are made available on open access sources through the website of the program, shared database, and the publication of this book which will be also available online.

The aim is to share the outcomes, solutions and strategies that, in many cases, need the support and the mobilisation of civil society. It is meaningful for the research project to disseminate the results, and influence contemporary culture so that waterfront communities may evolve towards more sustainable behaviours, build responsive networks, and protect their local biodiversity.

Pedro Ressano Garcia, Primary Coordinator of H2020-MSCA-RISE

Do Three Different Waterfront Make Rome a City of Water?

Rome is a very special city. Anyway, I know that every city is special…

But Rome is truly a special place where everything is superlative and lasting.

Centuries of history have so many layers and everything seems to exist even before it begins.

The traces of the past mix with the becoming, sometimes slow and in any case never hasty.

Aspirations for change appear indeterminate and are crushed by a present in which abandonment and lack of care seem to dominate.

But now, the *Eternal City* is called upon to find new declinations, although the permanence of the uses remains a constant in many spaces. The radial network of consular roads still draws the guidelines for urban development and is confirmed as the main road mobility network.

The Aurelian Walls keep their profile almost unchanged; the layout of the ancient Roman aqueducts still stands out in the Roman countryside and sometimes resurfaces even within the denser urban fabric. Contrary to the past, however, today water no longer plays an important role and often its presence is hidden by senseless landfill works. Water is no longer a resource, as it was in ancient Roman times, but more and more often it is proving to be a problem to be tackled with modest emergency solutions.

The main critical issues can be summarised in four broad categories, of which the first three pertain to environmental phenomena, while the fourth refers to spatial relationships with places.

Coastal erosion. The erosion is mainly concentrated near the mouth of the Tiber River between Ostia and Fiumicino, where the mainly sandy coast is subjected to natural and anthropic pressures. Winds and storms, the presence of currents, sea level rise and soil subsidence, solid supply, and flow rate of watercourses to the sea, are natural components that unfold their effects over the long term. Human interventions are responsible for important changes, a part of which dates to the remodelling of Rome, which became the capital of Italy in 1871. Such as, for example, the construction of the river embankments, the so-called “muraglioni”, in the central urban area, about eight kilometres long between Ponte Margherita and Ponte Sublicio, to defend the city from the floods of the Tiber; or the riverbanks of the stretch of the Tiber towards the sea, built in the 1930s to protect the reclaimed land from flooding.

The most consistent and fast transformations, however, took place from the second half of XXth century.

The construction of residential buildings and accommodation facilities along the entire coast, the layout of new infrastructures, the development of tourist ports, have led to heavy "disorganic interferences" which have not respected the delicate balance of marine territories and have accentuated their fragility.

Added to these ones, there are a series of alterations that have modified the course of the Tiber, and therefore, the contribution of sediments, including the repeated withdrawals from the riverbed of huge inert used as construction material, the building of hydroelectric plants and dams upstream for flow regulation.

The floods. The hydrographic structure of Rome is characterised by a dense network of watercourses in which the two major rivers, the Tiber and the Aniene, and 12 short-length tributaries, called "fossi" are distinguished.

Only some of these watercourses are partially visible within environmental corridors, while most of them have undergone profound changes and are incorporated into sewage collectors because of intense and chaotic urban growth. As a result, the landscape suffers for discontinuous alternations of naturalistic stretches and artificial transformations. Green corridors often abandoned are cut by river alterations like fillings and covers, embankment works and captation plants, even illegal ones, which have deteriorated the entire system.

The sealing of the soil, the poor maintenance of the sewage system and the intensification of meteoric events make the city exposed to urban flooding phenomena, especially in the event of particularly intense rainfall, to which are added non-negligible risks deriving from pluvial flooding, or localised flooding caused by the difficult disposal of rainwater.

Water crisis. The effects of climate change, the growing use of water and the increase in water captations, the rise in temperatures combined with prolonged periods of drought, have led in recent years to a critical reduction in the availability of water resources, especially in the summer months.

The flow rates of surface water courses as well as the springs that supply the large aqueducts arriving in Rome, the most populous Italian municipality, are increasingly below the natural levels. Now they are reaching minimum values that do not guarantee the necessary water reserves.

The result is a growing difficulty in the availability of drinking water with important impacts that have repercussions not

only on civic, agricultural, and industrial uses, but also on biodiversity.

Loss of the relationships of perception and collective enjoyment with the sea and rivers. The transformation of the soil from a "natural" to an "artificial" use is a problem of great concern because it affects the fragmentation of the territory, the reduction of biodiversity, the alterations of the hydrogeological cycle and microclimatic modifications.

The coastline, which once represented the opening towards the Mediterranean, is today seriously compromised by kilometres of chaotic urbanisation. The predominantly tourist and residential purpose of the buildings, built above all from the 1960s onwards, completely block direct access to the sea and often also prevent its view.

In an urban context, the Tiber River is enclosed by high "muraglioni" which do not allow direct fruition near the water, but only make possible a broad monumental overview. Furthermore, access to water is practically closed upstream and downstream of the central urban area as the embankments are difficult to access. Industrial buildings and shipbuilding areas, private sports clubs, improper uses such as camps for nomad people and logistics areas, tourist and recreational facilities, alternate with residual open cultivated or uncultivated areas which effectively interrupt the ecological continuity of the river area.

Similarly, the banks of the Aniene are practically "hidden" from view and from pedestrian practicability due to a progressive and illegal privatisation which also negatively affects the quality of the water and the maintenance of the floodplain areas.

In the impossibility of dealing with the vast criticalities due to climate change, which is affecting the entire planet, we have therefore tried to summarize some more immediate problems by identifying three emblematic case studies for the Sustainable Open Solutions Climate Waterfront Workshop in Rome 2022.

The three case studies also correspond to the organization of the volume in three parts and refer to three main problems affecting the coastal area and the two river branches of the Tiber and Aniene.

The first case study is related to the coast, a long strip of sand with dunes, where elements of great environmental quality and large archaeological areas remain. These must live with chaotic urban development, with land consumption often caused by tourism and grey infrastructures, with degradation and lack of care.

Very often the sea is not visible from the hinterland or is difficult to reach. It is hidden by poor quality tourist facilities that have privatized the public use of the coast.

The main goal of the first case study is to re-establish the links between the presences of important archaeological ruins, the surrounding landscape, often disqualified, and the sea.

Green and blue infrastructures could be a good solution to systematize archaeological finds, get closer to the sea and implement landscape and hydrogeological interventions to counteract coastal erosion.

The second case study is in a dense urban space, and it relates to the Tiber River.

The construction of the embankments and the Lungotevere has changed the perception of the river, which has "moved away" from everyday life.

Some urban spaces, even very close to the river, have not been able to assume this presence as a design potential. Often, they even deny its presence…

The main objective of the second case study is to propose an urban project capable of rediscovering and structuring the urban landscape, the role of the river and, at the same time, protecting against floods.

The third case study concerns Aniene River, the hidden tributary of Tiber River. Despite having a very long history in the development of the city and its surroundings (just remember Villa d'Este in Tivoli), its presence goes completely unnoticed.

In the eastern part of the city, Aniene crosses the industrial district and is very compromised from an environmental and landscape point of view.

The main objective of the third case study is to make the Aniene River visible. We need to imagine green paths, open points of view, re-naturalize the smaller hydrographical network, and create a blue network to counteract floods and increasing rains. Climate change strongly interacts with a variety of problems deriving from urbanization, water and air pollution, biodiversity loss and degradation of land and marine ecosystems. Coastal areas as well as river edges are today among the priority places in which to tackle climate change with a design approach to create new landscapes, to reconfigure forms of naturalness, to implement the network of green and blue infrastructures to become more adaptive and resilient. That's what our planet is calling us to do now!

Claudia Mattogno, Sapienza University of Rome

Part 1.
Rome Coastal System


Via Cassia
Via Flaminia
Via Salaria
Via Nomentana
Via Tiburtina
Via Aurelia
Via Casilina
Via Ostiense
Via Appia

Sapienza University of Rome Claudia Mattogno

Rediscovering Layers and Links Between Water Landscapes and Cultural Heritage

The Lazio coast has very peculiar characteristics outlined by ancient evidence of human presence. Finds from the protohistoric era; traces of Roman roads; ancient port structures, transformed later into archaeological and naturalistic areas; defence systems such as watchtowers; salt marshes; wooded areas and scrub Mediterranean maquis; farms and hydraulic reclamation; drainage channels, constitute the historical wealth of the territory. These morphological and environmental characteristics include numerous archaeological and architectural presences in a complex physical context marked by important modern and contemporary anthropic transformations as well as by the effects of recent climate changes.

The different landscapes of the coast, however, still manage to bring out the traces of geography and history, although today they are largely compromised by a consistent, and often uncontrolled, building pressure and tourist use in addition to the construction of important infrastructures, starting from the Fiumicino airport.

These morphological and environmental characteristics include numerous archaeological and architectural relics in a complex physical context, marked by important modern and contemporary anthropic transformations as well as by the effects of recent climatic changes.

Such a varied territory is still able to bring out environmental and cultural potential, but it needs a new strategic vision. The design and awareness-raising practices must be aimed at taking care of the territory so that the equipment and public spaces, the infrastructures and the archaeological-architectural pre-existence are able to dialogue with the environmental peculiarities and generate new forms of collective identity combined with resilient approaches.

However, to challenge climate change it will be necessary to involve local communities and the various stakeholders according to a new synergistic relationship with the administrative powers at all levels: from central government to local administrators. And above all we need an effective and shared strategic vision, immediately followed from concrete actions. Therefore, conscious projects and practices must create a new care of the territory based on sensitive approaches to social needs while preserving the historical, cultural, and environmental legacy.

The first part of the book analyses the Roman coastal system, using the rich and fragile cultural and landscape heritage as a key to understanding it in relation to historical stratifications and in the light of the most recent climate changes. It is proposed

to investigate the development process of the settlements that occurred along the Lazio coast between Civitavecchia in the north and Monte Circeo in the south.

Between the two extremes of this long geographical band, the contributions that follow are concentrated mainly between Ostia Antica and the mouth of the river and are aimed at rediscovering the stratifications and links between the water landscapes of the coast and the cultural heritage, reflecting on the interaction and interdependence of a waterfront territory as a cultural artefact.

The article by Maria Grazia Turco, *The various landscape of the Ositiense coastal and environmental heritage*, introduces this first part and deals with the complex cultural, environmental and landscape heritage of the Ostiense coast, illustrating how the highly valuable morphological conformations that have settled over time are subjected to strong anthropogenic pressures. Its setting is completed by a different approach shared by Sonia Gallico and Barbara Tetti in their article *The coastal territory of Rome. Environment*, *Architecture and Archaeology* which highlights the continuous transformation of the territory along the Tyrrhenian coast.

Annalisa Metta closes the historical topic with an article with a very suggestive title, *Lake Navona and the eels of the Pantheon. Architecture and landscape for floods*, which highlights the fruitful interweaving between architecture of the past and knowledge of the water dynamics, testifying how in ancient Rome buildings and urban artefacts were conceived to accommodate floods and designed to integrate with the needs of the environment.

Giulia Luciani's contribution *A trip along the coast* invites us to travel along the coast, making us discover suggestive images and problems of great environmental emergency, such as those addressed more specifically in the text by Michele Manigrasso entitled *Land consumption and coastal erosion in Italy. A focus on the Lazio Region*. The anthropic transformations and the strong erosion along the Lazio coast are complementary topics to the article *Land consumption along the coast is increasing the local vulnerability: the case of Rome and other six cities* written by Francesca Assennato of ISPRA. Both recognize the vulnerabilities and alterations created by human interventions on this particular coastal territory where valuable landscapes alternate with areas of chaotic urbanization.

The case study of the Roman Riviera concludes the first part by prefiguring a new vision of the Ostia area aimed at reconnecting the links between environmental and historical

values and at the same time attentive to contemporary uses that can allow for an increase in spatial qualities.

It is essential to "free" the shoreline from any incongruous and invasive activity, reusing the areas left free to reconfigure new forms of naturalness capable of ensuring ecological continuity between the different parts that make up the coast, both longitudinal and transversal depth of the territory itself. The protection of the artefacts and landscapes that make up our cultural heritage proves to be strategic as a starting point for a profound environmental redevelopment that knows how to dialogue with the water spaces and the needs required by the ongoing and now unavoidable climate changes.

Figure 1. The Circeo promontory seen from the coast of Sabaudia.

Figure 2. The dunes of Sabaudia.

Sapienza University of Rome Maria Grazia Turco

The 'Various Landscapes' of the Ostiense Coast
Cultural and Environmental Heritage

The essay analyzes the various 'different landscapes' of the Ostiense coastal system intended as strength of the geographical considered area; in this frame, the territory is perceived as a resource, seen as a set of elements settled over time. Ostiense coast is full of ancient, medieval, and modern settlements and testimonies representing an exceptional archive regarding the reconstruction of the main phases characterizing the history, the human and wild environment, over the time (Turco 2016).

Based on archaeological and historical data, as well as on iconographic and photographic documentation, the research aims at reconstructing the various steps describing the settlements' evolution, highlighting the most significant stages; the relation with geomorphological changes, significantly influencing human activities, will be also considered.

These traces have not yet been completely altered by human modification, although the deep recent transformation due to the urban expansion – often uncontrolled – occurred especially during the past century, and the construction of large infrastructures, such as Fiumicino airport.

This landscape is characterized by the presence of ancient vestiges, including: from the protohistoric period finds; ancient urban settlements, such as the archaeological site of Ostia Antica near Rome; paths of Roman origin (via Ostiense, via Appia, via Severiana); harbor facilities; towers, in a defensive system still legible (Cimbolli Spagnesi 1997; Id. 2006, Turco 2020); salt pans and forest; archaeological traces of a punctual built system, such as villas and farmhouses; historic mansions closest to the sea (Torlonia, Sacchetti); archaeological layers, currently included in naturalistic contexts, wooded areas and coastal dunes.

The territory considered comprises valuable landscape and cultural values, some of them already protected by the present regulation (Cambi, Terrenato 1994). For their sustainable use the process of knowledge and reading ability is required in order to reconnect the places and the elements, to base the actions of the present on History, highlighting historical and artistic connections and instances, in some cases, difficulty to read.

The program will achieve a direct impact on local communities, promoting the collaboration with associations of the territory; moreover, the study can include the construction of a free digital archive, to share information about the various architectural, archaeological, and landscape assets, in both the historical context and current.

Figure 1. Pine forest of Castel Fusano, Chigi castle; below the Canale dei Pescatori.

Figure 2. The Ostian coast.

Figure 3. The 'green' in the archaeological area of Ostia Antica.

Among scholars and experts, the consideration of the topic based on the interrelation between Cultural Heritage and territorial and urban issues, urban planning, has been established; this includes social and environmental issues consideration involving a profound rethinking in the planning, design, and management of the various actions.

Actually, 'landscape', 'environment' and 'territory' concepts have been the subject of dialogue and debate for several decades. Since 2000, when the European Landscape Convention was compiled, the field of study has included various areas, so the interdisciplinary approach became a strategic orientation for territorial policies: the Convention recognizes a significant 'aesthetic' interest in sites and landscapes expressing multiple 'values', including cultural, social and economic.

Therefore, the safeguard action is to concern natural environments such as landscapes and contexts characterized by a continuous relationship with the human use, over time.

Regarding the Italian regulation, the Cultural Heritage Code compiled in 2004, further enriched this definition, analysis, evaluation, and enhancement tools, definitively overcoming the 'punctual' approach the former law, 1089/1939; similarly, with special regard to natural and landscape assets, the law 1047/1939 was superseded by the so-called Galasso law, passed in 1985, introducing a systemic vision of the territorial resources.

The Lazio Coast

The state of the art recounts a wide framework of research and insights, nevertheless the studies are often sectorial and limited to individual episodes, therefore the topic requires a careful and well-founded critical review.

In this frame, the Lazio coast area is still scarcely investigated, considering the complexity of the aggregations characterizing the territory, in order to carry on a reading of the transformation 'signs' and of the factors determining the historical stratifications occurred over time, constituting a continuous chain of events, needs, emergencies.

The described frame reveals that the field of study requires to combine specialist research and studies considering various doctrinal, disciplinary and application sectors, conjointly. It's a fact that to consider the whole is needed, as the area includes complex systems, in which each element recalls the others, in an inseparable and continuous relationship, in a dialectical and dynamic system, involving different pre-existences.

Figure 4. The Fiumicino Channel and the Isola Sacra; on the left the Trajan port.

Figure 5. The Roman countryside and the Tiber near the Dragona farmhouse.

Lazio region coast is full of ancient, medieval, and modern settlements and testimonies representing an exceptional archive regarding the reconstruction of the main phases characterizing the history, the human and wild environment, over the time. Actually, this precious whole can be considered as a heritage that belongs both to History and Landscape.

The mentioned goal must include a strategic approach, characterized by coherent and organic interventions, aimed at protecting and enhancing both architecture, and environmental and landscape contexts; this process must be based on a cognitive deepening and on the increasing of cultural, archaeological, architectural tourism, of course sustainable and compatible.

A coastal recovery intended as a cultural and landscape attraction, to be experienced following itineraries and visit routes – improved by an improved accessibility –, realizing the conservation and enhancement of the architectural structures, often left in bad conditions of abandonment or decay.

Therefore, the programme aims at enhancing the cultural and historical value of the coastal system, rich in structures constituting part of the territorial structure, by the recognition of its potential and its values, as well as of the local and regional possibilities of development (Gallico, Turco 2018).

The area, whose heritage – including both human and wild environmental context – is unique, today requires a new attention: the main goal is to give a cultural identity to this territorial context, through study and in-depth actions; the undertaking will be based on guidelines, aimed at achieving the recognition and the maintenance of the places characteristics and the related values, also intangible ones.

The Ostiense Coastal System

The Ostiense coast is rich in ancient, medieval and modern settlements and evidence, and represents an archive of exceptional significance regarding the reconstruction of the main phases, characterizing the history of wild and built environment, during ages.

In accordance with the guide principles of the restoration project – aimed at identifying, preserving and enhancing the "historical pattern" imprinted by human actions and natural events – the research aims at acquiring knowledge to describe and understand places, punctual anthropic systems (ports and towers systems), archaeological-architectural elements and their 'singular'

Figure 6. The landscape and naturalistic oasis of the Port of Trajan.

Figure 7. The archaeological park of Ostia Antica, Domus of Cupid and Psyche, 4th century AD.

constructive story (execution, transformations, decay-instability, restoration).

The research aims at deepening the knowledge regarding the transformation processes, involving the coast of the former Papal State over the centuries, through the reading of historical, iconographic and photographic documentation, identifying its peculiarities and interruptions.

The Ostiense area is particularly rich and complex, made up of archaeological, landscape and naturalistic layers, whose constitution and modification are still today partly legible.

Main role has the Tevere river, and its modifications – advancing or retreating phases of the coast over time – determining the formation of ponds and marshes; this process continued until the end of the nineteenth century, when land reclamation works led to a further phase. More signs characterizing the area are: Roman origin road, Roman harbor systems vestiges, as Port of Claudio and Port of Traiano (Chiavoni, Cerutti Fusco, Esposito, Impiglia 2017), salt pans, remains of the cities of Ostia and Portus, and the rare anthropic systems of the Roman countryside – Campagna – such as villas and farmhouses.

Starting from the Renaissance, cartographers were studying the territory, describing – scarcely at the beginning – the few archaeological fragments emerging in Ostia Antica, not buried by

the ground and still partially visible; these fragments are 'remains' of a past.

The research also investigates the complex relationship established between the ancient city of Ostia and the surrounding area; this relationship has been characterized by both the river and the sea; the context is today modified and difficult to read.

Because of this peculiar position, the area has always been inhabited – even if not continuously –, as evidenced by a sort of 'historicized' road system, prior to the Roman settlement.

The study intends deepen these relationships and links, through the interpretation of the territory and architecture, verifying how the first settlement of the *castrum* was superimposed on a complex environmental context; the goal is to verify if this process took place through a strong operation, breaking the continuity of the pre-existing paths, or by a sequential fusion that keeps use. In this regard, the research aims at understanding if a relationship existed between the pre-existing paths structuring the territory – such as Via Laurentina and Via Salaria (later Ostiense) – and the main road net catheterizing the urban expansion.

The study could also deepen the Ostia-Tiber-sea complex ancient system, starting from a critical reading the historical cartography, illustrating the few archaeological remains still evident, starting from the nineteenth century, calling the attention of scholars and antiquaries who, since the pontificate of Pope Pius VII (1742-1823), were undertaking excavation campaigns, from 1801.

Since the end of the 19th century, starting from the reclamation interventions, the landscape has been deeply modified, and numerous urban centers – mainly summer residences (Ladispoli, Fiumicino, Ostia, Torvaianica) – including communication routes and the construction of the airport intercontinental of Fiumicino, in the fifties-sixties of the last century, structure destined to be further expanded, were created (Antonucci 2012; *Roma. Visioni* 2013).

Shortly, the research goal primarily needs to investigate how the landscape is today; how the ancient landscape was; how the inhabitants perceived their landscape in ancient times; how today inhabitants and visitors perceive their past.

The program also includes historic harbors complexes on the coast, today managed by various Port Authorities (Gabriele 1963; Fonti 2010). Moreover, the historical defensive system, characterized by a compact set of coastal towers, which for

Figure 8. Map of the Ostiense coast before the urban settlement called "Roma Marittima" (1916), Istituto Geografico Militare, Foglio 149 della Carta d'Italia, II N.O./S.O., Fiumicino/Ostia, scala 1:100.000, Florence 1877. Photo: Cartoteca, Dipartimento di Pianificazione Territoriale e Urbanistica, Sapienza Università di Roma.

centuries – from the 9th to the 18th century – constituted the defense against raids from the sea, has a main significance.

These architectures, dismantled during the second half of the nineteenth century, still represent important historical, architectural and constructive events. Actually, along the Lazio coast, from North to South, there are about 30 towers: some still intact, others in a state of ruins.

Today, many structures are included in Natural Reserves – such as Torre Caldara, Area of Community Interest (since 1988), such as the neighbouring area of the solfataras and ditches, Site of Community Interest according to the EEC directive – or defined as "Natural Monuments" – such as Torre Flavia and the "Secche di Torre Flavia".

Furthermore, some areas in Fiumicino Municipality – Isola Sacra, Macchia Grande di Focene and Macchia dello Stagneto, Traiano Lake – and in Municipality X – Castel Porziano presidential estate – "Site of Community interest or SIC'' and "Special protection areas or SPAs". The mentioned areas, due to their biological richness, are included in Natura 2000 Network for protection and conservation of habitats and animal and plant species.

The extremely diversified and complex green heritage is also included in the considered environmental system, consisting of agricultural areas, nature reserves, historic villas, parks and urban green areas (Gallico, Sette, Turco 2017); these elements constitute the main objectives of habitat protection, recovery and defense. Currently, about half of the surface is occupied

by protected greenery, included in the State Natural Reserve of the Roman Coast; the areas of Decima-Malafede and Laurentino-Acqua Acetosa are neighboring. Peculiar significance has Castelfusano pine forest, a large park in Rome since 1932 (1,100 hectares), whose plant dates back to the early eighteenth century, completed at the end of the nineteenth century when the pine forest, created by the Marquis Sacchetti, in the previous century, was extended to the sea in 1870.

Conclusions

After a period of decline of interest by architects to set up extensive and systematic studies on the subject, the study aims at enhancing knowledge and directing the issue of architectural, urban and landscape reality. In essence, to identify all the initiatives that can facilitate the understanding of the coastal territories, with attention to the manners in which the dialectic between various existing elements was conceived and addressed.

Moreover, even in the areas, despite the complexity of the historical stratifications and the damage caused by bad operations – carried out without specific programs and adequate projects – carrying out actions strictly connected to the historical culture of restoration, aimed at improving the state of places, is still greatly possible.

This process can clarify the evolution of intervention methods, attempting to provide new solutions to the problem. For the area identified, the programme will indicate the guidelines aimed at improving the relationship between the natural and built components, aiming at creating a methodology of analysis, planning and intervention useful to support local communities resolutions.

In recent decades, the re-consideration of the environment – no more intended as a set of separate and incongruent parts – and the evolution of information sciences – increasing the managing and the integration of an infinite amount of information of the most various types and origin – provided even more accurate and detailed methods of reconstruction of the territory history.

Regarding this, the program aims at enhancing cultural and historical values of the coastal system, rich in structures constituting the territorial structure, by the recognition of the potentials and values representing a possible development for local and regional territories.

Figure 9. Torre Boacciana, 1956. Photo: Bibliotheca Hertziana-Max-Planch-Institut für Kunstgeschichte, Rom, Photo U.PI. D. 34434.

Figure 10. The Tiber River and the docking point in the Archaeological Park of Ostia Antica.

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The Coastal Territory of Rome
Environment, Architecture, Archaeology

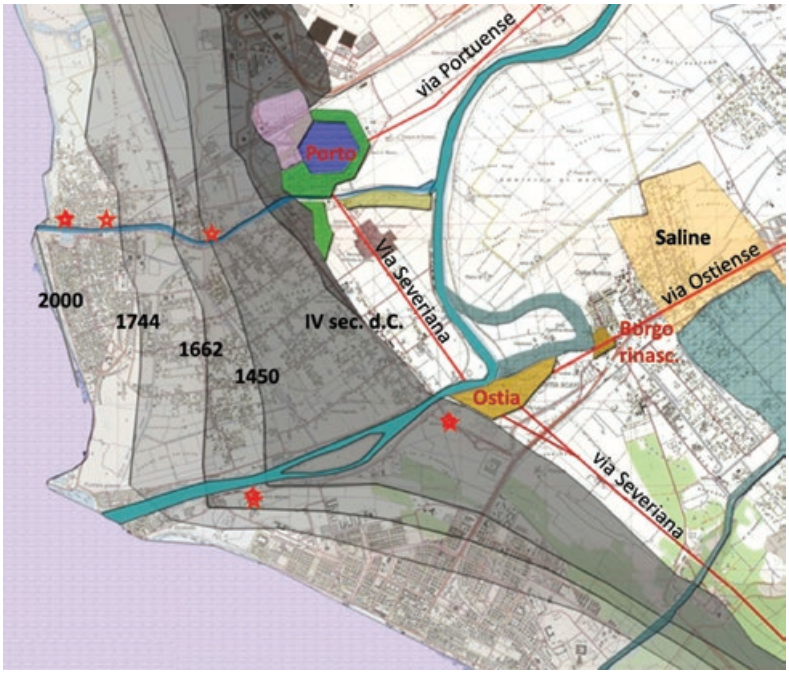
The coastal territory of Rome belonging to the metropolitan area includes two districts: the 10th Municipality of Rome – covering about 150 km² and including over 230,000 inhabitants – and the municipality of Fiumicino – covering about 213.89 km² and including over 80,000 inhabitants –: a large area – more than 360 km² –, considering that it is larger than Florence or Paris, covering about 100 km². The coastal territory of Rome was deeply transformed over time, particularly during recent decades. Changing from a lagoon area, significant in pre-Roman age, including vast salt flats and archaic settlements, was involved in the construction of two harbours, Ostia and Porto, during the Roman era located near the mouth of the Tiber. Moreover, for 1500 years the coastline moved seaward, because of the deposit and compaction of the river debris: the coast advanced to the maximum point of 4 km. Today, an inverse phenomenon, namely the retreat, landward, is observed, especially in the central area today occupied by the district of Ostia. This is due both to the construction of dams along the river, and to the removal by industries using stones to produce lime.

Moreover, as a consequence of climate change, the sea levels are rising, significantly contributing to the endangerment of some bathing establishments. Despite the intense urbanisation that occurred during the XX century, planned and spontaneous, the area still includes large green areas. In this regard, the coastal Park of Rome project prevented further construction. It is worth mentioning that the territory includes also public urban parks – Parco di Castel Fusano –, natural reserves – Capocotta, and Castel Porziano, Presidency of the Italian Republic estate –, local parks, and large cultivated areas – both in the territory of Ostia and in Fiumicino municipality of Fiumicino.

The coastal territory of Rome was alternating phases of development and recession, following the complex history of Rome, periods of splendour and abandonment. Among the archaic settlements, the ancient Ficana emerges. It is a pre-Roman fort located on a hill on the left bank of the Tiber, controlling the access toward Rome; unfortunately, the building is visible only from a distance, and visitors have no access. The territory includes large archaeological areas of a national level.

Ostia was the first port of Rome, built starting from the IV century B.C.; it remained the only port until the I century B.C., enlarged during the Imperial era. From the middle of the I century B.C., the emperor Claudius (41-54) began the construction of a new port on the north coast, enlarged by Trajan (98-117) with

Figure 1. Coastline advance and retreat.



a hexagonal shaped basin. This structure originated the city of Porto, mainly developed during the Constantinian era. As a result, two polarities on the coast – with variations – still existing, were created.

Vestiges, such as temples dedicated to the Roman gods, as the Capitolium – dedicated to Jupiter, Juno and Minerva and approximately twenty Mithraeum in Ostia –, others dedicated to oriental divinities including Isis and Osiris –, a synagogue – possibly the oldest in Europe –, and basilicas and Christian monuments, demonstrate as the Roman society, despite other problems, was open and liberal towards other religions not affecting the cult of the emperor. During the late antiquity, the territory was once more transformed: necropolis and numerous early Christian basilicas were erected on Roman buildings, and the via Severiana, connecting the cities of Ostia and Porto to Terracina, was built.

The mentioned archaeological sites revealed, and will certainly reveal in the future, extraordinary finds, such as the Roman ships found in Isola Sacra.

During the V and VI centuries, significant events regarding the history of Rome and Western Europe, took place on the coast, such as the plundering by the Visigoths headed by Alaric (410), by the Vandals headed by Genseric (455), and the occupation by

the Goths (537). Nevertheless, as Tabula Peutingeriana illustrates, Porto continued to play a major role while Ostia was eclipsed.

In this regard, during early VI century Cassiodorus wrote: "the branches of the Tevere river embrace two beautiful cities shining like two pupils"[1]. Conversely, in mid VI century, Procopius of Caesarea wrote: "on the left, before the other mouth of the Tiber, sits Ostia, a city that in ancient times was worthy of much account over the riverbank, but now has no walls"[2]. During the IX century north of Ostia the fortified area of Gregoriopoli was built, vestiges of the early mediaeval enclosure still exist, as the map by Eufrosino Volpaia clearly illustrates. In the second half of the XV century, on the Tiber bend, the Borgo di Ostia was built as a defensive bulwark of Rome. At that time, Porto was losing its secondary role, comparing to Ostia. This concerns the tower Rotonda of Martino V built in Ostia during the first half of the XV century, shortly after reinforced by a fortress, and the church of S. Aurea, of a single nave. The church, as well as the fortress, has a pentagonal bastion to resist the shots of the new firearms, asked by Giuliano della Rovere, as bishop of Ostia and Porto. Later, Giuliano della Rovere become pope with the name of Julius II (1503-1513) commissioning to Bramante the renewal of the St. Peter Basilica (started 1506), to Michelangelo the decoration of the Sistine Chapel (1508-12), and to Raphael the painting in the papal apartments (1508).

In Ostia, the construction was directed by Baccio Pontelli, whose master was Francesco di Giorgio Martini, a major figure of the architectural scene, especially regarding military fortresses. Inside the Episcope, the frescoes by the Sienese painter Baldassare Peruzzi are conserved, representing war scenes taken from the ancient Trajan's column still standing in the Roman forum. At the same time, towers to defend the coast were built, including S. Michele tower, possibly designed by Michelangelo (1564).

In November 1557, during a stormy night, the course of the Tiber changed. As the ancient maps reveal, the fortification in Ostia lost its defensive value. So, a new phase began, as the late-antique enclosure and the pre-existing tower, – possibly an ancient Roman lighthouse – demonstrates. The remains of Claudius and Trajan basins arose as elements of interest for

1. Magni Aurelii Cassiodorii, *Variarum libri*, libro VII, ep. IX, ed. a cura di A.J. Fridh, Turnholti, Brepols, 1973.
2. Procopio di Cesarea, *La guerra gotica*, libro I, cap. XXVI, a cura di E. Bartolini, Tea, Milano 1970.

Figure 2-3. Fiumicino: Episcope of Porto.

travellers and architects, including major figures of the late-renaissance era, among others Andrea Palladio, Sebastiano Serlio, Étienne Dupérac, more than the ruins of Ostia, buried by the ground.

A relevant phase of the ancient bishopric of Porto began during the XVII century when the monumental complex of the Episcope of Porto was renewed. This phase continued during the XVIII century, when the internal courtyard was renovated by Domenico Gregorini and Pietro Passalacqua – disciples of Borromini – and the magnificent entrance portal was erected (1771). Moreover, during the XVIII, pine forests were planted, still existing. Then, during the XVIII and XIX centuries, a long phase of abandonment affected a large part of the coastal territory of Rome. Ostia village was progressively isolated, about one kilometre away from the riverbed, so Porto increased its role. The territory became largely marshy and unhealthy. Nevertheless, Porto became an important diocese, thanks to its bishop in charge of crowning the Pope; it is worth noting that some popes were bishops of Porto. But other architectures were built on the

Figure 4. Ostia Antica: Fortified castle built by Popes Martin V and Julius II, 15th century.

Figure 5. Ostia Antica: the interior of the Episcope frescoed by Baldassarre Peruzzi, 16th century.

Figure 6. Fiumicino: entrance portal to the bishopric of Porto, 18th century.

Figure 7. Ostia: Saint Michael tower, 16th century.

coast, including Villa Chigi, on a project and with frescoes by Pietro da Cortona.

During the XIX century, Fiumicino became a significant village, where a project by architect Giuseppe Valadier was carried out, including churches and blocks buildings. Conversely, Ostia, completely abandoned, became marshy.

Nevertheless, starting new archaeological excavations, unscrupulous merchants started to take away material to be resold on the antiques market; among them Gavin Hamilton accompanied by Robert Fagan. Regulations aimed at protecting the archaeological remains were promoted by Pope Pius VII (1800-1823) publishing decrees aimed at preventing private initiatives, establishing rules and punishments, and promoting the first systematic excavation campaign in Ostia. The land reclamation works of the entire territory took place at the end of the XIX century, started in 1884 by the Cooperative of Ravenna, as the monument on the walls of Ostia recalls.

During the first decades of the twentieth century, some buildings following the Italian rationalist architecture were built: the best known are the buildings by Adalberto Libera and the bathing structures by Pier Luigi Nervi.

Urbanisation was intense and diffused during the second half of the century. So, during the 70s and 80s decayed districts were recovered, thanks to recovery urban plans, and the expansion of working-class suburbs illegally built were blocked. Thus, in fifty years, the territory of Ostia with the hinterland increased from about 20,000 inhabitants in 1951 to over 220,000 today, and the Municipality of Fiumicino grew from 2,000 inhabitants to about 30,000. Finally in 1996, the Roman Coastal State Nature Reserve was established, a protected natural area promoted by the Ministry of the Environment including a large area disseminated with historical and naturalistic values, between the municipalities of Rome and Fiumicino.

Debated for years is the establishment of the Great Archaeological Park, the largest in the world, possibly joining the Tiber debris Park – including the Pasolini park, now reduced to a few abandoned square metres –, and the LIPU Park (Italian League Bird protection), – currently, a very small area –. In this regard, for the hoped naturalistic and archaeological reserve, the UNESCO protection would be desirable, currently absent throughout the territory. Moreover, the plan for the Nature Reserve of the National Coastline of Rome, established in 1996-160 kilometres of green areas between the municipalities of Rome and Fiumicino –,

Figure 8. Fiumicino: church of S. Crocifisso, 18th century.

Figure 9-10. Ostia: decay at the mouth of the Tiber.

is hoped for protection of the area. Despite the many interventions carried out, some structures have not been re-recovered over time. An example is the Scafa bridge: since the end of the 70s – when the park of Ostia Antica and Porto, and the park at the mouth of the Tiber were debated-, despite many projects submitted, nothing was done, neither the bridge – built in 1950 – was renewed.

Among the most recent projects the new International (Intercontinental) Airport of Fiumicino – even if the fourth planned runway was not built –, the tourist port of Ostia, new districts, and shopping centres – such as Parco Leonardo appear.

The coastal territory of Ostia, apart from the residential districts, added nothing to the former situation; conversely, in Fiumicino the development of some parts of the city took place (waterfront, Villa Guglielmi Park, new municipality building).

The frame shortly described highlights the values of a territory offering significant resources, that can be enhanced by a careful and respectful, and sustainable management that could make it a worthy mouth to the sea of Rome.

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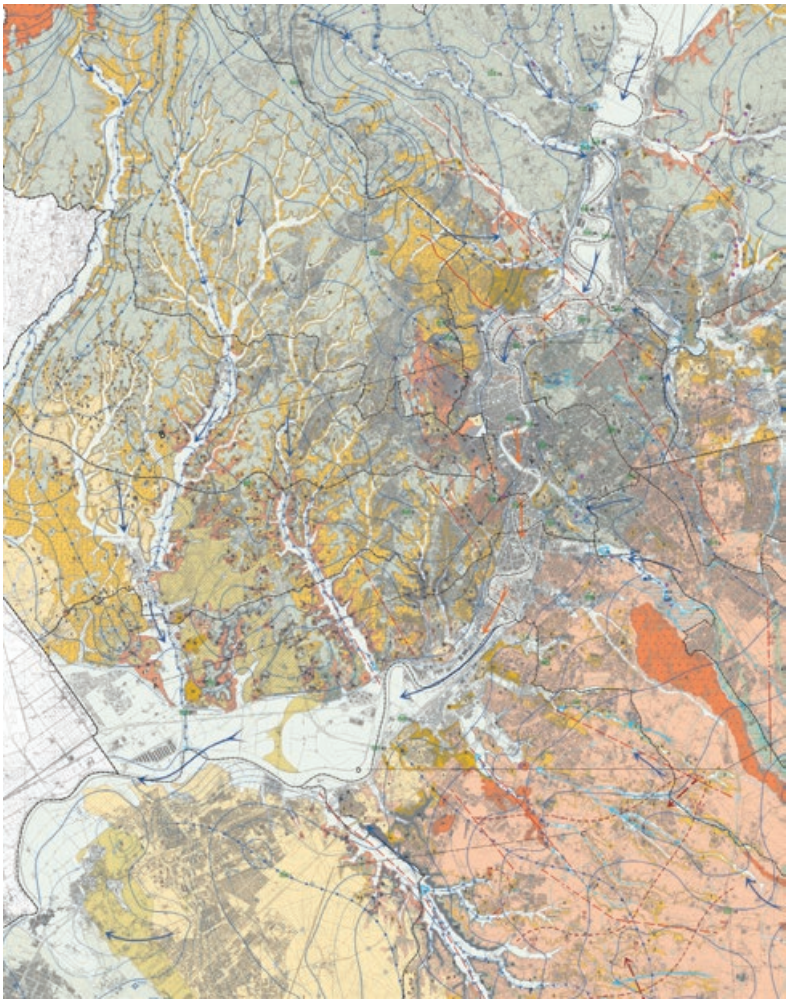
The Navona Lake and the Eels of the Pantheon

Architecture and Landscape for Flooding

Even though climate change is a topical issue, looking at the past could help to address questions and actions for future solutions. This is the case of a story with two main protagonists: Rome and the Tiber, the latter of whom is imaginary. Anyone who has visited Rome would swear that the Tiber is there, but truly it does not exist, simply because no river, wherever, does. All the rivers we can think about are a misunderstanding: this is the brilliant thesis of Dilip da Cunha, who in 2018 published a book with the unsettling title *The Invention of Rivers* (da Cunha 2018). Hovering between the acknowledgement of an evidence and a clear provocative intent, he argues that rivers, understood as perennial watercourses, running between two parallel lines, are an invention of ours, they do not exist. What do exist are the terrains of water (Mathur & da Cunha 2014), unstable situations produced by the varying relationship between the land and the spreading-on water. Rivers, as we typically imagine and draw them, are the category – at first conceptual, then cartographic, and finally geographical and architectural – through which we humans have sought to simplify and stop in a stable and reassuring form the inexhaustible negotiation between land and water. Thus, rivers appeared on maps as a couple of parallel lines sanctioning the absence of any ambiguity – water here, land there, no hesitation – then, we built banks translating that idea into reality. Rivers are water held within an enclosure so that it does not overflow and invade the land. In other words, rivers are the cultural and then spatial construction of a frontier. The threshold between running water and dry land is rather a thickness that refuses to become a line. So, questioning the physical and conceptual stability of the embankments is the only way to prevent the disastrous effects of the floods, which arrive when the water, forcibly tamed, eventually swells and overtakes or breaks down those embankments, with the violence that they themselves have raised up.

So, the Tiber is much more than the watercourse between its two banks: it is a much greater depth, encompassing entire parts of Rome. To understand the real extension of the Tiber, one should consider the hydro-geological map, where the lightest tones represent the valleys, made of silty sediments, accumulated over thousands of years, thanks to the presence of water (Fig. 1). This imprint corresponds to the hydrological network of Rome, and it represents the actual thickness of the Tiber and its tributaries. If we mapped the ensemble of buildings, roads, gardens, monuments, any kind of infrastructure and construction that insist on that area, the result would be a portrait of what can be said the river-city of Rome, a crasis between two worlds – the river and the city – that we usually tend to separate. Finally, we

Figure 1. Hydro-geological map of Rome, 2020.



could say that Rome is not a city on the Tiber but a city in the Tiber (Fig. 2).

It was 1870, Christmas Eve, when the Tiber began to swell after heavy rains. And it did not give way. It swelled again in the following days, until, between December 28th and 29th, about three months after the Porta Pia breach, it overflowed, exceeding 17 meters, as it has not been seen for at least two centuries, an unheard-of event. The impression was great throughout the country. One day later, the king hastened from Turin and convinced himself of the absolute priority of caging the Tiber into embankments, high enough to resist any possible flood and thus safeguard the reputation of the city that was preparing to become the capital of the kingdom (Fig. 3). In no time at all, on January 1st, 1871, a technical commission was set up and, having found financing, the works to trap the Tiber between


PIANTA TOPOGRAFICA
DI
ROMA

walls (called Muraglioni), almost 20 meters high in a constant section 100 meters wide, began in 1875 and went on for more than fifty years, until 1926.

Yet, floods have been part of Rome's history for over 2600 years (Aldrete 2006) – according to the legend, the Tiber in flood dragged Romulus and Remus' basket down to the Velabro, where the she-wolf found them. The Tiber is after all a gentle river, with a modest average flow-rate compared to its main European colleagues, but sometimes it can be turbulent. In ancient times, floods were not considered eliminable: the 'intemperance' of the river had to be lived with and floods were seen as a phenomenon to adapt-to rather than fought-against. For example, the ports were equipped with docks on different levels, to be usable according with different highs of the river, and the riverbed reached 130 meters width, i.e. 30% more than today (Lanciani 1897). One does not need to be a specialist to understand the different hydraulic functioning of the two solutions, where the most ancient created a volume with a flexible capacity and usability, while the Muraglioni made a constant section tunnel. At those times, even the Walls of the city, from Porta del Popolo to the Agrippa Bridge (today Ponte Sisto) and from Porta Portese to Monte Testaccio, worked as embankments in extreme cases.

As a precaution, in the lowest parts there were only public buildings, such as the Forums, which could be easily evacuated, while the houses were on the hills, where the air was healthier and defending against the enemies, water included, was easier. The Circus Maximus was among those buildings, a place for games and chariot races, located exactly where the Murcia stream flows into the Tiber; therefore, it is a river valley transformed into architecture. The ancient Romans knew how to live with water, so they created a monument like a huge basin, as capacious for water, when it arrives, as for social rituals, still today welcoming the events of contemporary Rome. The Circus Maximus is the monumental transcription of a geographical datum, it is geography that becomes architecture. So, it is quite normal that even today, after heavy rains, water collects there. These water-events are even enchanting, because for the time of the rain they completely change the site, the way of seeing and using it, understanding its most intimate and true nature: that of being a river (Fig. 4).

The same happened in other parts of Rome, in Campo Marzio, for example, that is the lowest part of the city. Montecitorio, its highest spot, barely reaches 15 meters above the sea level. For a very long time, it was a permanent marsh that the Romans called 'Palus Caprae' – probably after some religious rituals that included the sacrifice of a

Figure 2. Matteo Polci, *The river-city of Rome*, final degree thesis in landscape architecture, Master in Urban Design, Architecture Department, Roma Tre University, supervisor prof. Annalisa Metta, 2016.

Figure 3. Topographic map of Rome. Originally published in 1866 by the Census General Directorate and updated in 1870 by Giuseppe Partini to show the levels reached by the flood of 1870. © David Rumsey Historical Map Collection, public domain.

goat – so it remained uninhabited (Fig. 5). Its destiny changed in the Augustan age, when Agrippa, the emperor's son-in-law, reclaimed the land, drained the swamp, and turned it into a monumental basin, the Stagnum Agrippae, with an emissary reaching the Tiber (its course roughly corresponds today to Corso Vittorio). In the recovered areas, Agrippa built the Pantheon, the baths with his name – whose *natatio* was the ancient *stagnum*, indeed – and then gardens, the basilica of Neptune, even the first permanent amphitheater of Rome and an immense sundial next to the Ara Pacis. Later, Domitian built his Stadium there, a large open space for athletic competitions. As in the case of the Circus Maximus, the Romans recognized and respected the geography, that of a depression where water collects by gravity, giving the building the form of a spacious empty space. Piazza Navona, symbol of Baroque Rome, was then built there, on the same site. It was the place for events, shows, and rides, as well as for a daily market, then moved to Campo dei Fiori. It was the quintessence of what we mean by public space, as the wonderful Vanvitelli's chronicles testify (Fig. 6) Here, on June 23, 1652, Pope Innocent X, Pamphilij, advised by his sister-in-law Donna Olimpia, inaugurated the 'lake of Piazza Navona'. It was enough to plug the manhole covers and the drains of the fountains, so that the water overflowed and collected into the natural basin of the square, as it had happened since the times of the Palus Caprae. Since then and for about two centuries, on Saturdays and Sundays in summer, the square was transformed into a lake, no more than 50 cm deep. The nobles flocked there in carriages, disguised as gondolas or wooden and papier-mâché vessels, some with sails and rowers. Everyone else would bathe and play. At that time, between the XVII and XVIII centuries, many of the buildings in the square were painted in the *color dell'aire* (the color of the air), a light shade of blue which made the buildings almost dissolve into the atmosphere. Giovanni Paolo Panini depicted it, with the facades of the buildings merging with the sky, and in turn, sky and buildings are reflected on the surface of the lake: it was an enchanting room of sky, light, water, and wonder (Fig. 7).

The lake continued as a popular spectacle, a gathering place, a site for games and courtships, but also a trick to cool off from the summer heat, until the second half of the XIX century. The last known flooding dates to 1865. Then the square was restyled to make it suitable to the new tone of Rome, the capital of Italy, and the paving was redone, assuming its current appearance, with the sidewalks, the lanes for cars, and the central plateau with the fountains. Above all, the topography was modified: from concave, as it had always been, since it was a swamp attended by

Figure 4. The Circus Maximum flooded after a heavy rain, February 2019.

Figure 5. Giovan Battista Brocchi, *Physical map of Rome soil*, 1820. Palus Caprae is well visible in the site of today Campo Marzio district. Source: [https://collections.library.yale.edu/catalog/15824447], public domain.

Figure 6. Gaspar van Wittel, *Piazza Navona, Rome*, 1699. Source: [https://commons.wikimedia.org/wiki/File:Caspar_van_Wittel_-_Piazza_Navona,_Rome_-_Google_Art_Project.jpg], public domain.

goats, it became convex, making any hypothesis of new flooding impracticable. The goal was to remove water as quickly as possible, making it drain and disappear into the sewer system.

A few steps from there, there is another excellent monument, the Pantheon, famous for its immense dome and zenithal light.

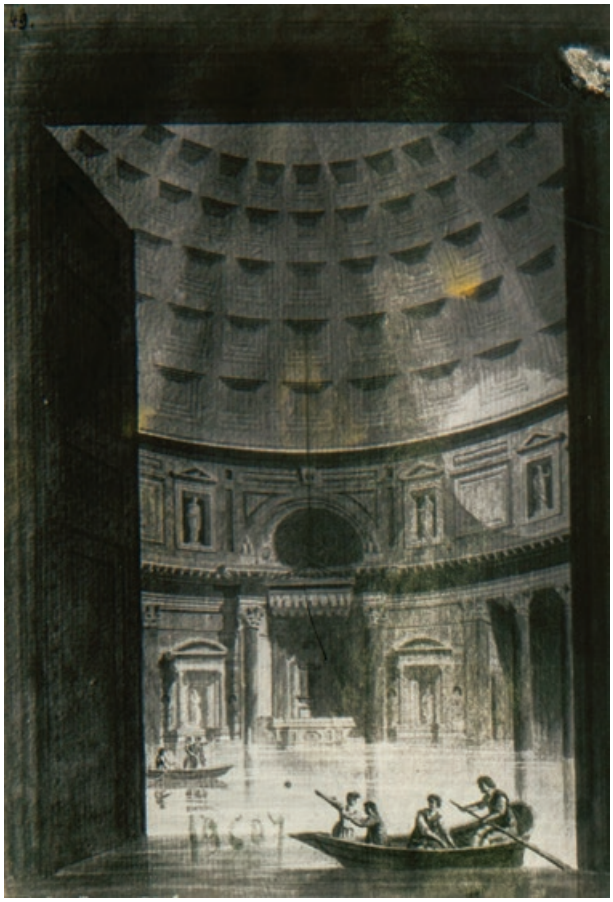
Few pay attention to the floor, where there are 22 small holes, integrated into the marble decorations, which are water-traps, parts of a complex drainage system (Fig. 8). Moreover, the pavement has a double curvature, because it is slightly convex towards the sides, while it is concave in the center. These devices clearly show that this floor was conceived in close dialogue with the water, it was a receptive inside-topography, attentive to the water and its variable choreographies. And since the Pantheon is in the lowest part of the city (12 meter above the sea level), heavy rains inevitably poured down there, so historians agree that, apart from the floods of the river, it is reasonable to think that the Pantheon was under water for a few days at least three times a year. Thus, it is not surprising to have archaeological findings of the drainage system of the building, connected to the urban drains network since the Augustan times. There is also another intriguing clue: an engraving by Giovanni Pannini depicts the Pantheon flooded and navigable with small rowing boats (Fig. 9). Richard Krautheimer argues that it testifies to the degradation reached at the time by the city, which had by then completely abandoned the drainage systems of antiquity (Krautheimer 2000). I do not doubt that he is right. Yet, it is impossible for me to think that the Romans, very skilled plumbers, did not know that they were building nothing less than the temple of all the gods in the most depressed point of the city. And so, I believe that the oculus open to the sky and that generous reservoir for the waters of the river and the rain make this building a meteorological architecture, a landscape-building, capable of breathing with the river and the climate, supporting its intemperance, in a soft and dialoguing way. It is a building where the limits between inside and outside dissolve, where we can imagine the eels swimming on the bottom and the religious celebrations alternating with the breath of the river and the succession of the seasons. Perhaps this capacity of spaces, elements, and sense, so wide to be truly totalizing, could explain the meaning of the wholeness, of *pan* –, that is in the name of this building: Pantheon is where architecture and water can really mingle in the most authentic realization of a city-river.

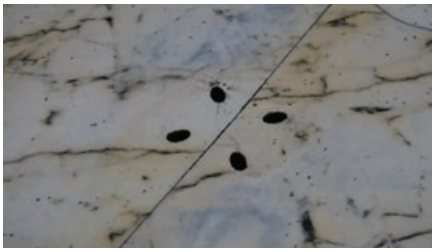
Perhaps, we could look at this story to think our contemporary cities, obsessed as we are by control and predictability, safety, and efficiency, sedated by the analgesic categories with which we have learned to describe the world we like, well-ordered, disciplined, and therefore static, without surprises, because transformation, transition, and change are concepts about which we find ourselves unprepared. We have no choice but to learn from the rivers, which know well that they do not exist.

Figure 7. Giovanni Paolo Panini, *Piazza Navona*, 1756. Source: [https://commons.wikimedia.org/wiki/File:Pannini_GP_Piazza_Navona.JPG], public domain.

Figure 8. Drainage holes in the pavement of the Pantheon, Rome. Source: [https://commons.wikimedia.org/wiki/File:Pantheon_floor_drainage_2.jpg], CC 3.0.

Figure 9. Giovanni Paolo Panini, *The Pantheon flooded by the Tiber*, n.d. Source: © Istituto Nazionale di Archeologia e Storia dell'Arte.





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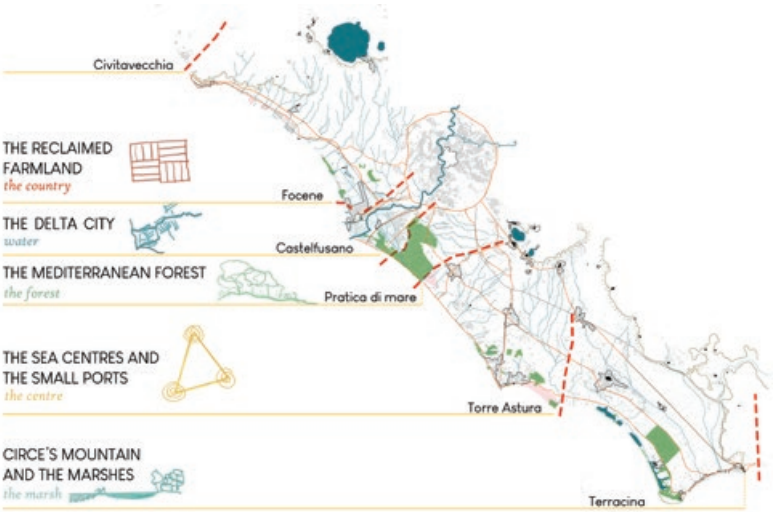
A Trip Along the Lazio Coast

The coast of Lazio Region, considered in the stretch from Terracina in the South to Civitavecchia in the North, can be understood as a composite environment, but at the same time it is marked by unitary characters due to its overall common history. Small and major transformations have left their traces and a rich and diverse system of features. The first layer of traces is the system of archaeological remains, mostly from the Roman imperial period. Another distinctive system of remains is that of the many defence towers, built in the course of the centuries from the ninth until the eighteenth, often on pre-existing structures, to face the Saracen incursions. The most impressive transformation, however, able to deeply change the territory in a very short time, was that of the land reclamation works, begun in the late nineteenth century and completed in the thirties. During the same years, the Fascist regime started a sort of colonisation of the coastal plain and development of a seafront for the capital, founding Ostia Lido and the towns reached by the new roads, Via del Mare and Via Pontina – both names meaning "road of the sea". The land reclamation almost destroyed the previous natural ecosystems and left only some fragments, the value of which was unfortunately recognized too late (Bagnasco 1998). The preservation of these ecosystems is pursued through the maintenance of three main protected areas: the Circeo National Park, the Castelporziano Presidential Estate, and the Litorale Romano State Natural Reserve.

This territory was subject to rapid population growth in the post-war period, especially after the Sixties. Many of the current problems it is facing can be linked to an unregulated urbanisation process, enhanced by several drivers including the settlement of new functions – the airport for instance – the transformation of agriculture, seasonal tourism, and building speculation. This in turn has caused or worsened problems such as coastal erosion, flooding, poor water quality, low accessibility of the seafront, soil sealing.

To elaborate a coherent portrait of this vast coastal area, with the ultimate intention of elaborating a strategy for the regeneration of its most critical parts, a division into sequences has been proposed, based on different elements. First, elements of morphology were taken into consideration: homogeneous areas can be detected looking for example at the flow direction of the hydrographic network. The reliefs, in turn, define the borders of the coastal plain towards the interior and to the North and South, where the promontories reach the sea. Second,

Figure 1. The five sequences. An overview of the division into sequences with an indication of the respective archetypes: the marsh and the forest reminding of nature-ruled places, opposed to the farmland, which symbolises a man-ruled nature; the centre, archetype of the built environment and its hierarchical structure, and water, essential life-giving element.



historical elements, such as the common reclamation history of the two areas known as *Agro Romano* and *Agro Pontino*, or the fact that the whole area was for centuries under the rule of the State of the Church. Connectivity was also important to establish the limits of the area. Finally, perception of the changing or common features when travelling along the coast was recorded and captured through photographic material. Methods for defining an outline of each sequence included surveys, the collection of photographs, an overview of cartographies and planning regulations, and the use of bibliographic material.

Archetypes were also used to portray each sequence in a brief symbolic way, with the aim of providing not only a record of geographical facts, but also an effort to restore a meaning to the territory's perceptive identity. Indeed, the concept of archetype is similar to that of "invariant", indicating elements or features of the territory that time has selected because they were able to better provide a material and symbolic answer to the human needs[1]. An analysis of the morphology and settlement patterns shows a rhythm of sequences where in some cases it is the "otherness" of the place, in the form of the marsh or the forest, that dominates and sets stricter rules to the human

1. As described by A. Marson, archetypes can be defined at two levels, the basic one of the *essential matrices* (the vital elements), and the level of the *functional and symbolic constructs* (constructed and consolidated by the human practices within the environment). Archetypes are analysed as means to re-establish a bond between urbanism and the sacred human relationship with the *cosmos* and nature (Marson 2008).

presence, while in the others it is the stratification of anthropic interventions that gives the sequence its own perceptive identity. An evaluation of the archetypes' state and perceptibility helps to identify the sequence where planning action and design intervention are needed the most. In many sequences it is still possible, despite the alterations, to recognize some functional and symbolic constructs which help to give order and meaning to the human environment. In the fourth sequence, however, a chaotic and unintelligible mosaic of archetypic traces and contemporary *nonplace* (Augé 1992) calls for a descent to a basic level of meaning, that of the "essential matrices", to identify *water* as a representative archetype. Water, once the sacred basis of human settlements, has been normalised and hidden in the contemporary Tiber delta, but if its multiple meanings and perception are recovered, it can be the unifying element from which to restore a sense of place and identity.

Circe's Mountain and the Marshes

The first sequence is a vast plain, dominated by the low peak that was home to the mythological sorceress Circe[2]. The Circeo national park preserves the most important marsh ecosystem in Italy, with its four lakes, where traditional activities are still present in agriculture and livestock farming. When travelling along the coast, one is surrounded by the natural landscape of the lake area, which seems at first sight an almost intact environment, but in fact reached the present arrangement through works of water canalization and cementification of the shores, as part of the same transformation process which turned the once widest marsh, further inland, into an intensively exploited land.

Figure 2. First sequence: the coastal plain**.** After a 2-hour climb on the rocky peak of Circe, the view opens towards the coastal plain, with the lakes, the pinewoods, the cultivated fields.

Figure 3. First sequence: la Bufalara. Livestock farming in "la Bufalara", a place whose name directly recalls traditional buffalo farming. It was one of the main activities also in the Tiber delta and other wet areas northwards in Tuscany.

The Coastal Towns and Small Ports

The Anzio promontory is the major centrality in the second sequence, with the ports and the intertwined towns of Anzio and Nettuno. The two centres feature a strong historically consolidated connection to the Albano volcanic hills and the via Appia towards the interior. The importance of the port today is linked also to the development of Ponza and Ventotene islands as holiday destinations. Leisure and entertainment in various forms are and

Figure 4. Second sequence: Anzio. View from the port towards the town of Nettuno. The two towns are indissolubly tied historically and physically, being only 2 km distant. Ancient Anzio was abandoned during the Barbarian incursions, when its inhabitants founded Nettuno, while modern Anzio developed in the 19th century.

2. According to Homer's Odyssey, Circe was a demigoddess who attracted and seduced the seafarers, trapping them in her island (identified as the rocky peak which is today a promontory) with the help of poisoned drinks. Among her victims were Ulysses' companions.

have always been somehow part of this area's identity, as suggested by the many villas built by the Roman aristocracy from the first up to the eighteenth century. Today, the coast is heavily built-up, and common holiday houses extend with a few interruptions to all the seafront.

The Mediterranean Forest

The third sequence is a unique one, because it preserves part of the ancient Mediterranean forest which once covered the whole coastal plain. Here we can trace back the original natural ecosystem, made of the submerged and the dry sandy beach, the dunes, and the hygrophilous forest, with its species mostly from the oak family. With such a wild and unregulated atmosphere, the beach was since the Seventies the favourite place of freedom for the most disparate people.

The Delta City

The fourth sequence is such a mosaic of landscapes, that the only structuring feature able to somehow unify the area is the all-pervasive water matrix. Tiles in this mosaic range from the impressive archaeological remains of Ostia Antica and Trajan's basin to the towers and fortified villages, from residual wet ecosystems and woods to planted pinewoods and agricultural drained land, from diffused canals to large water treatment plants, from founded centres of the Thirties to extensive urban areas and informal architecture, neglected places and large logistic facilities linked to the ports and the airport. The connection system somehow doubles the ancient road system and seems to mimic and multiply the river's flow from Rome to the sea. In this sequence the plot of traces of the past becomes thicker, it seems to coagulate around the Tiber delta and at the same time to melt into the urban sprawl and abandoned land.

The Reclaimed Farmland

The fifth sequence is dominated by a vast agricultural land, largely designed by the reclamation works in the place of an ancient pond. It is situated between a narrow stripe along the coastline, where natural areas alternate with residential villages and small towns, and a bundle of infrastructures running along the foothills of the first reliefs. Eucalyptus rows are typical of this landscape, chosen to border the canals for their drainage capacity. The asset of the reclaimed area, as it is today, was settled with the construction of Maccarese village, an industrial

Figure 5. Third sequence: the dunes of Castelporziano. The beach is accessible from numbered gates in the fence protecting the reserve. In the Seventies, when the wild character of the area was more prominent, the gates were handmade holes, originating the name "il buco" with which the place was known.

Figure 6. Fourth sequence: Fiumara Grande. The main branch of the Tiber is home to the biggest sailing port in the Mediterranean, although it is considered a ghost port, because it has never been officially authorised.

Figure 7. Fourth sequence: Fiumicino. The second branch of the Tiber is the port-canal of Fiumicino. Increasing port activities have led to ongoing plans for new commercial and touristic seaports.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centre not far from it, and many small farmhouses at regular distance from one another. Cows replaced buffalos, and cereals, forage, vegetables, and vineyards made up for the cultivations. The agri-food vocation is still central to this area's identity, as the presence of prosperous enterprises testifies. Among these, Maccarese SPA, heir of the society that managed the reclaimed farmland at first, is one of the largest in Italy.

A project for the delta sequence will have to consider the coexistence in this unique area of the features and personalities of all the other sequences, albeit in the form of fragments, disjointed and unable to compact into a meaningful narrative. To restore an identity to this sequence, then, an appreciation of the traces of the marsh and wood ecosystems, an enhancement of sustainable agriculture for the care of the open areas, the establishment of an order and a hierarchy for the built environment must be part of a strategy. A new landscape and a new sense of place will emerge when the fragments are mended according to a coherent vision of this chaotic but still fascinating offshoot of Rome towards the sea.

Figure 8. Fourth sequence: Piazza della Rocca in Ostia Borgo. Together with Portus Episcopate, Ostia Borgo is the main one of the fortifications that arose in the Middle Ages to protect the area from the frequent Barbarian incursions. They were part of a system of towers, only partly preserved today, along the coast and the river.

Figure 9. Fifth sequence: Via della Muratella. The canal named "Collettore delle acque alte", bordered by a eucalyptus row, collects water from the natural streams running towards the plain. Drainage canals, mostly with concrete beds, still host an interesting biodiversity of vegetal and animal species.

Figure 10. Fifth sequence: Fregene. The mouth of river Arrone in Fregene is a valuable residual ecosystem. Urbanised segments of coast with their seaside villages alternate with such natural protected areas.

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Legambiente Michele Manigrasso

Land Consumption and Coastal Erosions in Italy

A Focus about the Lazio Region

Costal landscapes

Coastal landscapes represent an environmental resource of extraordinary value for our country in relation to the forms of territorial, economic and tourist development, but also a complex challenge for the intertwining of problems and pressures. In the twenty-first century, the conception of the coastal areas has become more and more crucial as we are facing problems never seen before: the increase in population that continues to move in those areas to live as well as the impacts of climate change – factors that are becoming regularly frequent. As a result, those factors are dramatically increasing the vulnerability of these territories. It appears to be extremely urgent to understand the alterations and the ongoing processes that have occurred to scenarios of such dimension and form in order to update planning tools and territorial governance rules.

Italian Coastal Landscapes Observatory[1] is working to contribute to increase and broaden the attention towards Italian coastal areas and the ongoing transformation processes. Climate change, land use, and new tourism models are some of the issues addressed.

With respect to these subjects, planning will have to provide new operational guidelines for the future of Italian coastal landscapes. The narration and monitoring of ongoing processes are some unavoidable prerequisites to support governance and planning choices, at different territorial scales, and to improve the conditions of protection of our seascape heritage.

This text concerns two important and connected topics analyzed by the Observator: the soil consumption and the phenomenon of coastal erosion along the Italian coasts and in particular along the coasts of the Lazio region, to summarize the main data available, and to reflect on the implications that urbanization has on the coastal morphology and on the relationship between soil and water.

Coast Consumption: the Data of the Phenomenon, in Italy and Along the Coasts of the Lazio Region

Intensified by the climate change, the current environmental crisis is one of the most severe concern for the future of our

1. Italian Coastal Landscapes Observatory (O.P.C.I.) by Legambiente was founded in 2020 by Legambiente and directed by Michele Manigrasso, working with the scientific support of researchers and academics of the main Italian universities and research bodies such as Cresme, Enea, Gnarac, Ingv. For more info visit www.paesaggicostieri.org.

cities and landscapes in regards to the topic of land consumption: a matter of global importance with serious consequences in our country where there is a level of consumption among the highest in Europe (AEA 2015), despite the hydro-geological and seismic fragility, which should (or should have) avoid the building expansion in areas of such high environmental fragility. In recent years, initiatives aimed at reducing the phenomenon are increasing, however the expansion of artificial areas continues often characterized by sprawl and urban diffusion processes with the fragmentation and transformation of natural landscapes of greater value making them profitable and attractive for tourism and agricultural purposes.

Alongside with securing, the limitation of land consumption is a strategic direction for Italy: the recovery of the country's development cannot proceed without protecting the territory from the threat of hydro-geological instability and desertification, protection for agricultural purposes and, above all, without safeguard and enhancement of territorial and cultural resources.

The Italian coastal areas should be indeed at the center of this debate as they are among the most vulnerable landscapes where the settlement pressure has copiously increased in the last decades. The cultural and anthropological transformation that occurred in relations to the coastal areas is not accidental: let's think of the beach as 'empty territory', as described by Alain Corbin in his most famous piece *The invention of the sea* from which fear has passed, in the last century, to an obsessive run towards the coast to obtain the first row with umbrellas, houses and of course seaside establishments.

The twentieth century, in fact, has been the "century of the beach" in our country: a great popular dream in constant organized and articulated forms which changed the profile of coastal cities and built new ones consequently designing them with campsites, tents and caravans in the two months in which millions of people moved from the cities to the sea. There is a broad literature and cinematography on the phenomenon of mass tourism, which has had important implications for the innovation of social customs and changes in the territory; for example the story of the city of Sanremo distorted by the cement in the *Building Speculation* by Italo Calvino. Equally, the economic development of the country changed the coastal landscapes in different ways with the enlargement and creation of new ports and the construction of huge steel poles in some of the country's most beautiful and strategic gulfs (Priolo, Bagnoli, Taranto, Venice). This was

happening whilst the cooling towers of the large thermoelectric power plants became part of the coastal landscape, visible from miles away. They have been building, extending and competing "amorphous urban agglomerations tens of kilometers long"[2] where it seems quite difficult not to get lost and distinguish the town hall as well as the differences between thousands of houses uninhabited for ten months a year which have even occupied the third and fourth rows from the sea. Today, we find these new linear cities along the Adriatic highway from Termoli to Delta del Po, in Sicily, along the entire Tyrrhenian coast, between the suburbs of Rome and Naples, almost seamlessly. The ISTAT data (The National Institute for Data) confirms that those changes occurred; in fact, almost 18 million Italians live in coastal areas today and the population growth continues to be double compared to the rest of the country. Not to mention that on weekends and in summer the population multiplies from 2 to 10 times, depending on the territory.

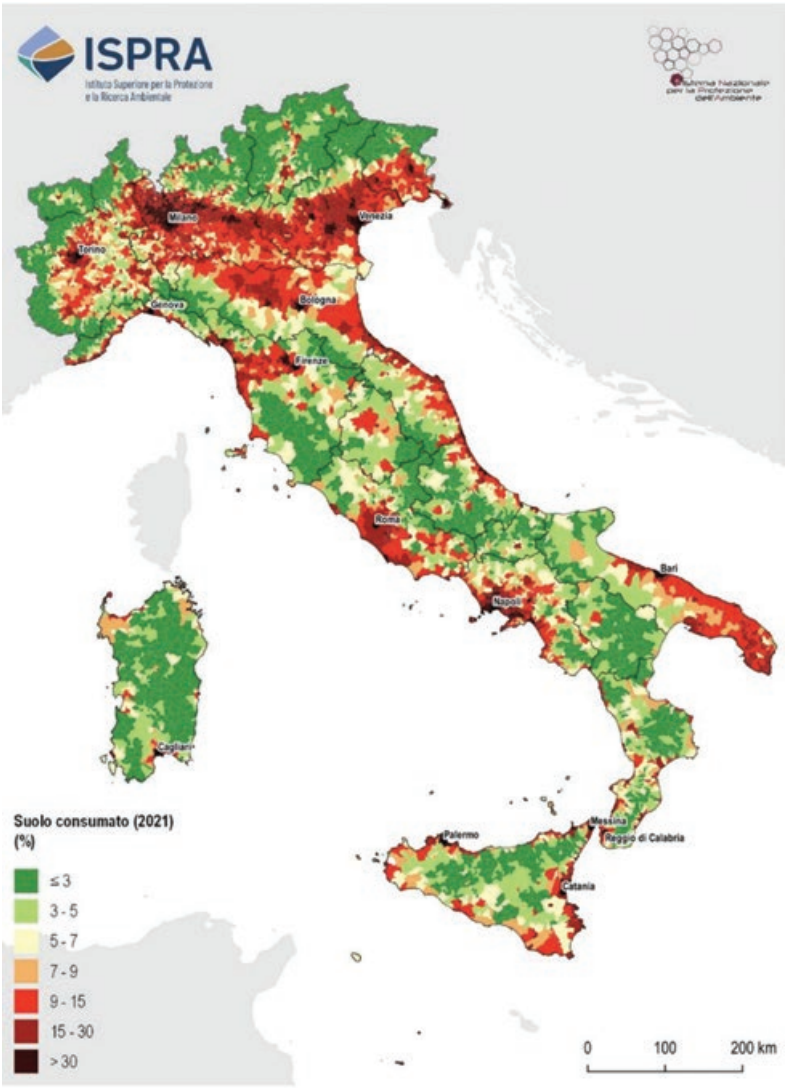
Coastal areas are therefore an important test to demonstrate how a country is able to value history, culture, resources and organize increasingly complex territories for settlement and tourist pressure from an urban point of view. If it is true that "the landscape is the voluntary geography that man shapes (and changes constantly) around him" (Settis 2010), the challenge that is inevitable for Italian coastal landscapes is to examine in depth the transformation phenomenon that have occurred and measure it in order to understand the current conditions of the shortcomings and mistakes committed and consequently pay attention towards a sustainable development that should permeate the perspective of the entire country.

Land consumption in Italy continues to transform the national territory at great speeds. The trend analyzed by Legambiente in 2017[3] about the condition of our coasts in 2012 was confirmed by the latest ISPRA report of 2022. Last year, the new artificial covers affected another 69.1 kmq, i.e. an average of about 19 hectares per day.

The coastline which is long 6477.4 km[4] has been analyzed and divided by Legambiente into belts corresponding to five types of

2. Quote by Antonio Cederna cited in the paper of Walter Tobagi, in Giuseppe Bonura (2011), *Morte di un senatore*, Medusa Edition, Milan.
3. See: Zanchini E., Manigrasso M. (2017), *Vista mare. Le trasformazioni dei paesaggi costieri italiani*, Edizioni Ambiente, Milano.
4. The study covered the peninsula and the two major islands. The remaining 800 smaller islands are absent from the measure.

Figure 1. Land consumed at municipal level (% 2021). Source: ISPRA elaborations on SNPA cartography.



landscapes: industrial and port, more generally infrastructural; high density urban landscapes; low density urban areas (due to the presence of agricultural areas or empty spaces); agricultural and natural ones. A matrix was built to highlight all types of landscape and their corresponding measures (Km) that follow one another along the coasts. Once all the measurements were made the total values for each type were calculated, therefore the corresponding percentages and a summary data was obtained; in other words the data shows the percentage of natural coastal landscape remained unchanged as well as the percentage of the transformed landscape, therefore the percentage of the

protected coastline. This is to underline the lack of protection and highlight the high risk of future transformation of the territory.

The results show that 3,291 km, or 51% of Italian coastal landscapes, have been modified: 719.4 km are occupied by industries, ports and infrastructures, and 918.3 km have been colonized by medium and large city centers. The most alarming figure is the one relating to the coastline characterized by low densities but very often in a continuum homologation: 1653.3 km (25% of the entire coastline) continue to destroy spaces and to settle urban centers away from each other. More seriously, they wipe out agricultural and green areas, in some cases the very last unoccupied places, to which are to be recognised territorial and environmental values, ecological continuity as well as visual permeability between internal territories and coasts are threatened by the advancing cement instead of being protected as they are at risk of extension. Unquestionably, the negative record should be attributed to Calabria, Liguria, Lazio and Abruzzo, where a mere one third of the natural landscapes is saved while the rest is contaminated and occupied by ports, buildings, villas and hotels. In view of this data, it has been possible to re-design the profile of the country through an image which summarizes the transformed coastal sections and those still free.

The Lazio region is one of the territories most affected by land consumption. More than 63% of the coast is transformed. Along the coasts (329 km), from Minturno to Montalto di Castro, 208 km have been transformed for urban and infrastructural uses, i.e. over 63%: 59 km are barriers from the presence of ports, industrial activities and infrastructures; 55 km are very dense urban landscapes, i.e. they are cities, and 94 km of coastline are lower density settlement settings. Only 12 km of coast can still be classified as agricultural landscapes, while 109 km of natural landscapes are still intact (68 restricted results, because they fall within protected areas).

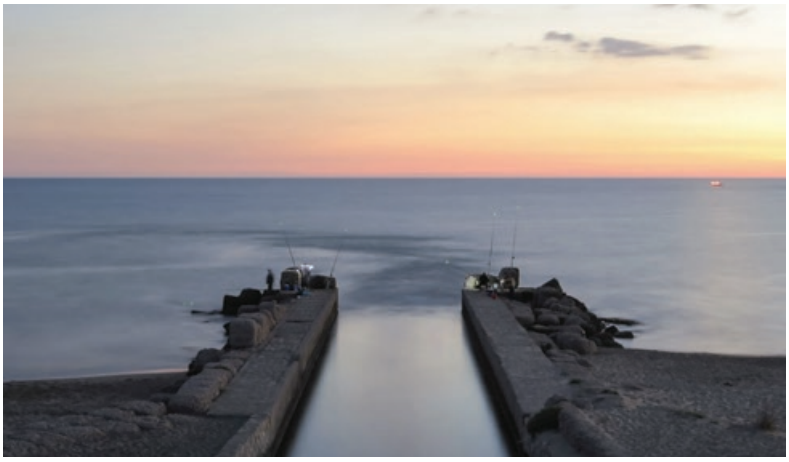
With regard to the morphology of the coastline, 27 km (8%) are rocky, 243 (74%) are beaches, while 59 km (18%) are now irreparably artificialized by the creation of ports, urban settlements and other infrastructure.

In recent decades, some infrastructural works have been carried out: the new port of Ostia and the extensions made in Civitavecchia. And there are new projects proposed for new port infrastructures in Fiumicino, Anzio, Formia, San Felice Circeo, Gaeta.

Figure 2. Lido di Ostia (Roma), 2014. Photo by Marzia Zappone © Legambiente.

Figure 3. Waterfront of Latina, 2014. Photo by Davide Onorati © Legambiente.

Figure 4. Civitavecchia (Roma), 2012. Photo by Francesco Mancini © Legambiente.



Despite the constraints of law 431/1985, since 1985 a further 41,000 meters of coastal landscapes have been irreversibly transformed, an impressive increase in urbanization even in more inland areas is evident by looking at the aerial photos in a closer way. The expansion of some of these centers, behind the coast, has influenced the transformation of the more extensive coastal stretches, also due to the connecting roads to the hinterland, which have become real "urban roads". In particular, in Ardea. And then, the roads that go from Fondi (Salto Covino) to Terracina, from Anzio to Torvaianica have been particularly modified; many transformations have involved Lido di Ostia, the beaches of Fiumicino, Santa Marinella and Civitavecchia, where not only has the landscape been transformed irreversibly in favor of hotels, services, first and second homes, but the beach has been occupied with relevant tourist facilities. In general, the transformation of the coast has taken place at the expense of beaches, dunes and natural green areas, but above all at the expense of agricultural land. In an attempt to stop the building pressure, the system of natural areas that affects the coast has represented a very important safeguard, starting from the Circeo National Park and the state nature reserve of the Roman coast, and then a series of areas of different sizes, from riviera di Ulisse regional park to the Salina di Tarquinia state nature reserve, up to the Tor Caldara regional nature reserve. Today, in Lazio, the protection must be a priority to defend the beauty and quality of extraordinary and still intact landscapes, but which are at risk of overbuilding: the landscapes between Gaeta and Sperlonga, between Terracina and Sabaudia, where even the banks of Lakes have been transformed; and then again, between Astura and Anzio, between Marina di Cerveteri and Santa Severa, between Scaglia and Lido di Tarquinia, and on the border with Tuscany, between Riva dei Tarquini and Montalto di Castro.

Erosion Along the Italian Coast and the Lazio Region: the Need For a New Design Approach

The speeding up of erosion phenomena is one of the most worrying effects of the ongoing climate change. The transformations that are taking place along the Mediterranean coastal areas – and in particular along Italian coasts – are astonishingly evident and often alarming, both for the sea rising level, the ever more frequent tide alternation, wind and rain, and for anthropic interference. Unauthorized development and inadequacy of the techniques and technologies used for

Figure 5. Some photos from the Contest 2020-2021 "Erosions", © O.P.C.I. by Legambiente. See: www.paesaggicostieri.org section "I nostri concorsi".

Figure 6. The erosion caused by a series of rigid structures, © Google Earth.










Google Earth

mitigation have paradoxically helped to increase erosive stress, therefore upsetting landscapes and swiping away their identity and uniqueness.

Considering such an uncertain scenario, the disciplines dealing with territory and sea are invited to deepen and intensify the evaluation and supplementing of their theoretical assumptions as well as of their practice, and to build, along the coastal shores, new chances of discussion, exchange and cooperation.

In the last fifty years, the proliferation of artificial works along the Italian coasts and the growing consumption of land along the coast have occurred in a very intense way: the policy of emergency interventions, increasingly focused solely on safeguarding the economic system that revolves around the territory, prevailed. In other words, this operating practice erroneously underlines that the beauty of places is not one of the pillars on which sustainable tourism development is based (Legambiente 2020).

In the last twenty years, every year, the State and the Regions have spent an average of around 100 million for coastal defense works. At least 80% of these loans concerned rigid works (groynes, barriers). For these reasons, we can say that of the approximately 1,000 linear km of barriers and groynes built around the peninsula up to the year 2000 (and surveyed by APAT), at least another 300 km can be added, so around 1,300 km of rigid infrastructure encloses our beaches. The massive presence of groynes walls the coasts: for example, along the Veneto coasts, we can count more than 120 over a 12 km long stretch (Pellestrina), while in Puglia there are over 200, along 20 km.

The deep artificialization of the coast, or rather the alteration of the natural coastal dynamics, has triggered erosion phenomena. A series of hard works has been created to try to solve this problem: these interventions have solved very little of the local problems (and in any case temporarily); instead, they have shifted the erosion in the direction of flow of the coastal bottom longitudinal current.

Furthermore, for at least thirty years, numerous “soft” interventions have been carried out: that is, interventions for the reconstruction of beaches through beach nourishment, in particular, in the last twenty years through dredging of relict marine sands. The duration and stability of these nourishments deserve in-depth analyses. From an initial ex-post analysis of the nourishment interventions carried out, it seems, in fact, that

Figure 7. Anzio: Dam of the ancient Neronian port, 2020. Photo by Massimo Del Principe © O.P.C.I. by Legambiente.

Figure 8. Anzio: the ancient Neronian port and the unfinished dam, 2020. Photo by Massimo Del Principe © O.P.C.I. by Legambiente.

Figure 9. Anzio: Grotte di Nerone beach, 2020. Photo by Massimo Del Principe © O.P.C.I. by Legambiente.

the alteration of the coastal dynamics accelerates the dispersion of the sediments introduced. Before carrying out the necessary beach nourishment it would therefore be necessary to restore the natural balance of the coastal system.

The Lazio coast is 290 km long overall: 220 km are low sandy coasts. From the official data relating to the De Marchi Commission Study (1970) the phenomena of accentuated erosion were already present in various areas of the coast, especially those with an earlier economic and seaside tourist development: they involved about 20-25 km of coast (10 about % of the sandy coast).

From the data published by the APAT (Ministry of the Environment), around 1990, 77 km of coastline were under erosion, while according to the data from the CNR "Atlante delle Spiagge" (1997) erosion affected around 117 km of coastline (54% of the total low-lying coasts), data also confirmed by the GNRAC (National Research Group on Coastal Areas) in the journal "Studi Costieri" on the state of the Italian coasts (2008). Half of these stretches under erosion had already been "protected" by hard works (groynes, grazing barriers and cliffs), which numbered around 460 around 1997 (APAT data).

By the year 2000, according to ISPRA sources, the Lazio region had lost about 2 million square meters of beach, i.e. a direct economic asset with a total value of about 3 billion euros.

The latest regional data also published in the National Guidelines on Coastal Erosion (TNEC – 2018), refer to the period 2007-2012 and record the presence of 103 km of stretches of coast under erosion (equal to about 44% of the total beaches low sandy), with a loss of beach of about 200,000 square meters / year.

The Lazio region has been one of the regions that has studied the problem of coastal erosion more thoroughly, promoting various European projects since the beginning of the year 2000 and also implementing numerous beach nourishment interventions. In reality, the regional structure responsible for managing the state of the coasts has been dismantled in recent years, with an evident worsening of the situation.

There are numerous coastal realities subject to the phenomenon of erosion, starting from the coast of Rome (Ostia), affected by numerous interventions both of hard works and of repeated nourishments. In particular, close (Ostia Ponente) or spaced out (Ostia Centro) submerged barriers have been built along these 10 km of coastline, semi-submerged groynes

Figure 10. Ostia Lido: Pinetina Bathhouse, 2022. Photo by Luca Tamagnini © O.P.C.I. by Legambiente.

(Ostia Ponente and Ostia Centro), nourishment with sand from terrestrial quarries (Ostia Ponente and Centro), with sand from marine quarries (Ostia Ponente and Levante).

From 1990 to 2015 (the most important period for the amount of interventions) the overall erosion of the Ostia coast went from about 50,000 m^2 to 120,000 m^2. From 2016 to 2018, the situation worsened further: the coast of Ostia is among the primary emergencies of the economy and environmental protection of the Lazio region. The Lazio region, in its 2016 *Report on the critical issues of the Lazio coasts, on the priority criteria and on the possible planning of interventions*, surveyed the state of crisis of the Lazio coast. In addition to the southern area, between San Felice Circeo and Minturno, subject to repeated collapses of the coastline, one of the most critical points for years has also been represented by the stretch of the Fiumicino coast, in the Focene-Fregene area, which during the study period of this Report (2005-2011), records losses of coastal sands for about 100,000 m^3/year, above all due to the rigid structures built.

From 2011 until today – this is also demonstrated by recent reports – the situation has worsened further: in the southern

Fregene area (see the area circled in red in the Figure below) between 2015 and 2018, a loss of half a million m^3 of sands from the coastal system has been recorded, with shoreline retreats greater than 100 meters. Between 2018 and 2019, the worsening of erosion in the section facing the outlet to the sea of the high water collector channel caused the ingression of sea water into the habitat behind it, with very serious damage to the ecosystem: the causes of this disaster they are linked to the presence of groins and cliffs built to the south, which have moved the erosion process towards the north, accentuating it due to the acceleration imparted to the longitudinal current (see Figura 6, with the area in strong erosion crisis circled in red).

The project for the new commercial port of Fiumicino is then grafted onto this dramatic scenario just described. Due to its geometry and size, it will increase the erosion phenomenon on the entire northern coastal strip, always linked to the acceleration of the bed current flowing northwards along the coast. Furthermore, the new structure of the current will inevitably cause the deposition of the sands transported in front of the entrance to the port (meander effect), producing a constant silting and a lower efficiency of the navigability of the port itself.

Concluding Notes

One fact is clear: the coastal system has not been in equilibrium for some time, and it would therefore be essential to intervene on the triggering causes of this erosion, the escalation of which is above all linked to the presence of the rigid structures built and the consequent alteration of the dynamics of the coastal current basically. The phenomenon of sea level rise (whose significant incidences are on a secular scale) and the lower solid input from rivers alone do not justify the degree of erosion recorded, as already represented in the 2006 GNRAC report mentioned above.

The problem, therefore, does not consist so much in the absence of economic resources, as in the lack of a strategy and a relative planning and management of the interventions to be implemented. It is necessary to review the technical and regulatory references (starting from Legislative Decree 228/2011) for the obligation of the ex-ante evaluation of the design choices, through the cost-benefit analysis of the proposed interventions and the obligation of the ex-post evaluation of the interventions carried out, in order to evaluate their real usefulness and functionality. We need a real national strategy

on the Blue Economy with a view to the European Green New Deal, managed and coordinated at an inter-ministerial level, which brings together in a single national direction the multiple and strategic skills relating to the protection of the coasts, the development of sustainable tourism, port, infrastructures and fishing.

It is necessary to seriously reflect on new interventions to simplify and not complicate the natural coastal system, through frequent monitoring of the morphology, to analyze in detail the coastal sand transport, with the aim of keeping the defense structure as natural as possible, represented in primarily from the emerged/submerged beach and its resilient capacity: and avoiding stiffening of the coast that is not consistent with its natural dynamism.

Figure 11. Ostia Lido: Pinetina BathHouse, 2021. Photo by Luca Lamagnini © O.P.C.I. by Legambiente.

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Land Consumption Along Coasts is Increasing Local Vulnerability

The Case of Rome and Other Six Cities

Introduction

Urban densification in the consolidated city as well as sprawling phenomena on fringe and rural areas have become a matter of intense investigation (Bruegmann 2005; Schneider and Woodcock 2008; Strollo et al. 2020) and the need for an accurate analysis in the European context is becoming increasingly urgent for the formulation of efficient territorial policies (Prud'homme and Lee 1999; Smiraglia et al. 2021). Land consumption, considered as the change from non-artificial land cover to artificial land cover, with a distinction having to be made between permanent consumption and non-permanent consumption (Strollo et al. 2020), is a global phenomenon and represents one of the most important factors in landscape change (Lambin and Geist 2006). It is widely diffused in both compact and dispersed patterns (Romano et al. 2017) and is associated with the loss of ecosystem services (Assennato et al. 2022).

With the purpose of ensuring healthy soils for Europe, recently the European Commission has adopted the new EU Soil Strategy for 2030 (EC 2021) and a European law for soil protection is under discussion. One of the main long-term goals of the new EU Soil Strategy is to achieve no net land take by 2050, avoiding the expansion of new artificial surfaces or compensating soil loss with re-naturalization. Also in Italy there is a regulation under discussion, as the National Recovery and Resilience Plan by the Italian Government committed to approving a "national law on land consumption".

Land consumption is one of the main pressures over the sustainability of coastal areas. According to a study of the European Environmental Agency (EEA 2006), in the Mediterranean region population density on coastal areas is on average 10% higher than inland, reaching a peak of 50% in some countries. In the Mediterranean basin the unplanned, or poorly regulated settlement expansion is typical of several coastal urban regions (Falco 2017; Pasquali and Marucci 2021). Furthermore, the change rate of natural coastal areas into artificial surfaces is faster than population increase (Salvati et al. 2013).

In spite of the 300-m strip of coastal land protected by national law in Italy (legislative decree 42/2004), uncontrolled coastal urban development due to the lack of policy and governance integration and coordination led to an unsustainable overexploitation of fragile ecosystems, triggering phenomena such as soil erosion and salinization processes (Salman et al. 2004; Falco 2017; Romano et al. 2017). This is a topic that requires measures to contain land consumption and continuous monitoring of the phenomenon, especially in areas where land consumption trend is increasing, as

reported in previous studies (Riitano et al. 2020). In Italy the national law 132/2016 established the National System for Environmental Protection (SNPA) which is in charge for environmental control and monitoring activities, including land consumption monitoring.

In this contribution we present an assessment of the land consumption in three coastal strips (0-300 m; 300-1,000 m; 1,000-10,000 m from the coastline) in Latium Region in comparison to national and regional[1] level for the year 2020. Furthermore, a comparison was made between Rome and other six coastal municipalities in Italy, selected between those with a high rate of consumption in the first strip, including in the analysis in specific areas prone to natural risks such as hydraulic, landslide, and seismic hazards (ISPRA 2021).

Methods

The analysis of land consumption in the three strips at national level is based on the outcomes of the national land consumption map of Italy updated every year with a spatial resolution of 10 m, and the coastal line produced by ISPRA for the years 2000 and 2020 (https://sinacloud.isprambiente.it/portal/apps/sites/#/coste).

The maps of risk areas are derived from the Report on hydrogeological instability in Italy (Trigila et al. 2021). The Report updates the national maps of the landslide hazard of the Hydrogeological Structure Plans – PAI and of the hydraulic hazard according to the Scenarios of the Legislative Decree 49/2010 (transposition of the Floods Directive 2007/60/CE), realized by ISPRA through the mosaication of the areas detected by the District Basin Authorities. Seismic hazard data are produced by the National Institute of Geophysics and Volcanology (Stucchi et al. 2011).

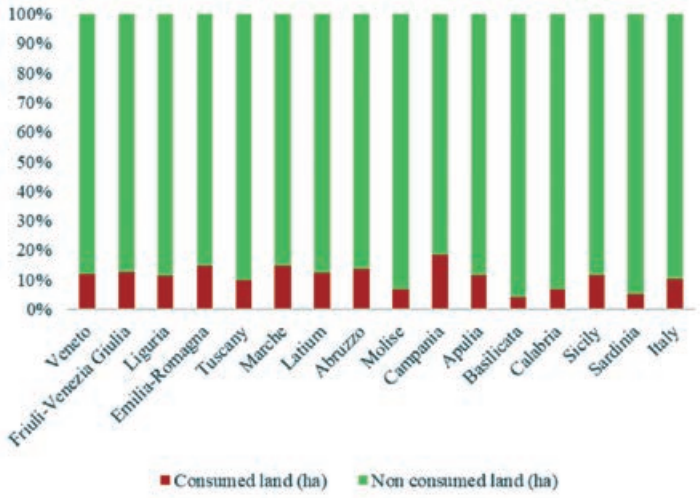
Results

Table 1 shows national consumed land in the three coastal strips for the year 2020 at national level and for the Latium region. Notwithstanding the third coastal strip recorded the highest value of consumed land, the percentages over the strip extension allow us to understand how the first and second coastal strips are the ones most involved in urbanization processes. The results for Latium show a percentage of consumed land higher than the national average in all strips, especially in the first one, with over 30% of consumed land within the first 300 m from the coastline.

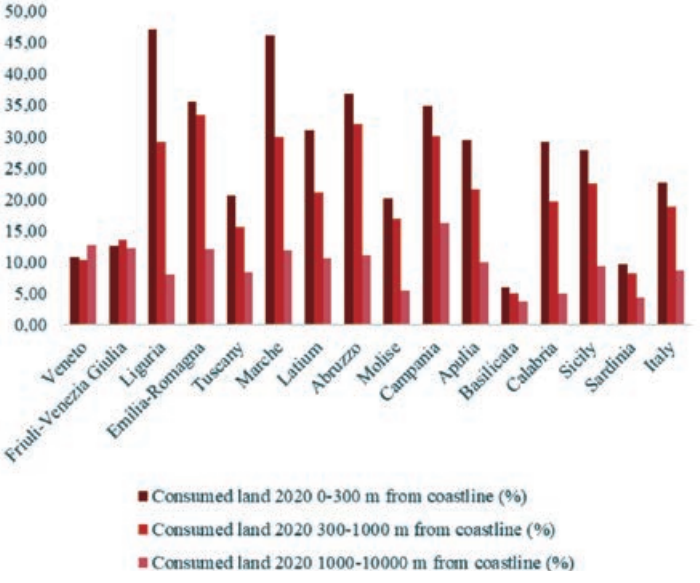
1. [https://groupware.sinanet.isprambiente.it/uso-copertura-e-consumo-di-suolo/library/consumo-di-suolo].

Table 1. Consumed land 2020, in hectares and percentage, in the three coastal strips for the year 2020.

Distance from the coastline	Italy (ha)	Italy (%)	Latium (ha)	Latium(%)
0-300	60.623	22.75	18	30.95
300-1.000	85.490	18.81	38	21.13
1.000-10.000	367.716	8.67	666	11.12



a)



b)

Table 2. Land consumption in Latium coastal municipalities-increase 2019-2020 in ha.

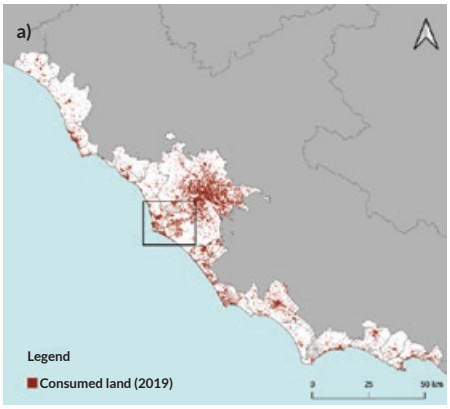
Municipality	Land consumption 2019-2020 (ha)
Sperlonga	0
Santa Marinella	0
Civitavecchia	0
Itri	0,09
San Felice Circeo	0,41
Formia	0,50
Minturno	0,61
Nettuno	1,11
Gaeta	1,17
Sabaudia	1,26
Ladispoli	1,62
Anzio	2,09
Tarquinia	2,37
Fondi	2,53
Terracina	2,59
Montalto di Castro	2,83
Ardea	4,54
Latina	4,56
Cerveteri	5,25
Pomezia	8,59
Fiumicino	22,91
Rome	123,38

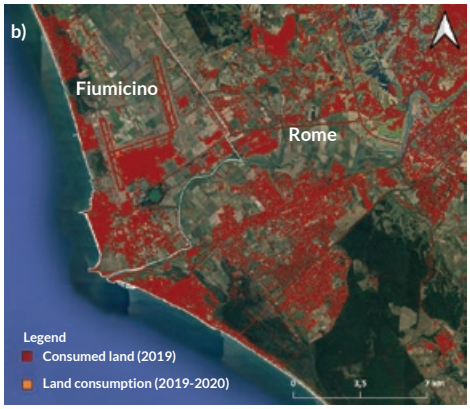
Figure 1. Percentage of consumed land by 2020 in the total area of the three coastal strips, for each region (a), and percentage of consumed land in each coastal strip (b).

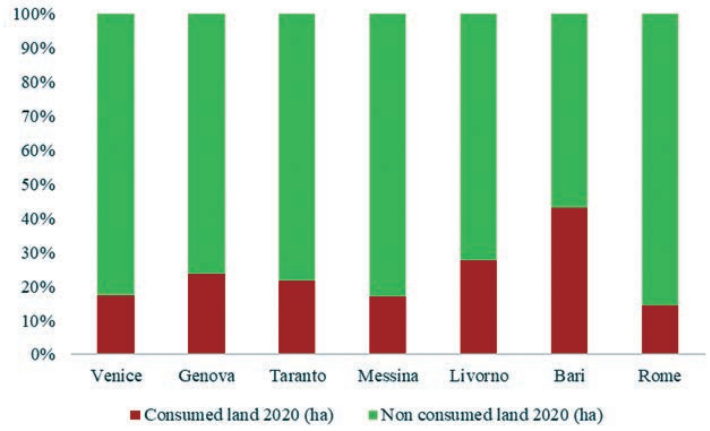
Figure 1 allows the comparison of consumed land in the three coastal strips at regional level for the three coastal strips separately and shows that Liguria and Marche regions are the most affected by consumed land in the first coastal strip from 0 to 300 m (47.02% and 46.07% respectively), followed by Latium with over 30% together with Abruzzo, Emilia-Romagna and Campania regions (between 30% and 36% of consumed land). The second strip from 300 to 1,000 m has Emilia-Romagna, Abruzzo, and Campania at the top (33.46%, 31.97%, and 30% respectively), with Latium at 21.13%. Campania is the region with the highest percentage of consumed land in the third coastal strip from 1,000 to 10,000 m.

A focus on coastal municipalities in Latium region, is provided here through values of consumed land over the entire territory of coastal municipalities rather than on the strips, in order to understand the pressure on coastal areas from the whole territory. In the selected municipalities the majority of land consumption in the last year is associated with Rome (over 120 ha) and Fiumicino (over 20 ha), largely over the other coastal municipalities (Table 2). The map in figure 3 shows consumed land at 2020 and its discontinuous intensity along the cost. The image on the right side

of figure 3 shows the two municipalities of Rome and Fiumicino and the high level of consumed land in the first strip, with the exception of the Pineta di Castel Fusano and the Natural reserve of Castel Porziano along the southern cost of Rome and the WWF Oasi of Macchia Grande in the cost of Fiumicino.







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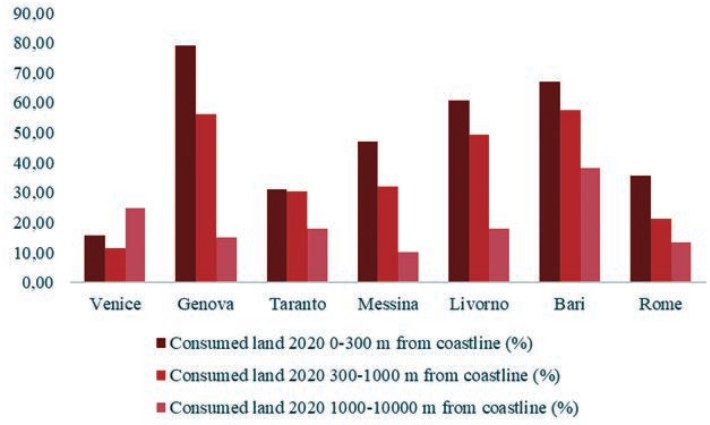


b)

To highlight the specificity of Latium, and Rome in particular, with respect to other main coastal cities, a comparison has been conducted between Rome and other six municipalities used as case studies (Venice, Genova, Taranto, Messina, Livorno, Bari) chosen for the high percentages of consumed land recorded in the first coastal strip (0-300 m).

Figure 4a shows Bari as the municipality most affected by consumed land (43%) followed by Livorno (28%) and Genova (24%), As shown in Figure 4b, these three municipalities have the highest percentages of consumed land in the first (Genova 79%, Bari 67%, and Livorno 60%) and second coastal strips (Bari 57%, Genova 56%, and Livorno 49%). In the other cities the percentage of consumed land in the first and second coastal strip occupies more than ¼ of the territory. In the third coastal strip Bari, Venice, and Livorno are the most affected cities with 38%, 24%, and 18% of their land that have been consumed. Rome has a percentage of consumed land over the entire municipality of 14%, reaching 35% in the first coastal strip and 21% in the second strip.

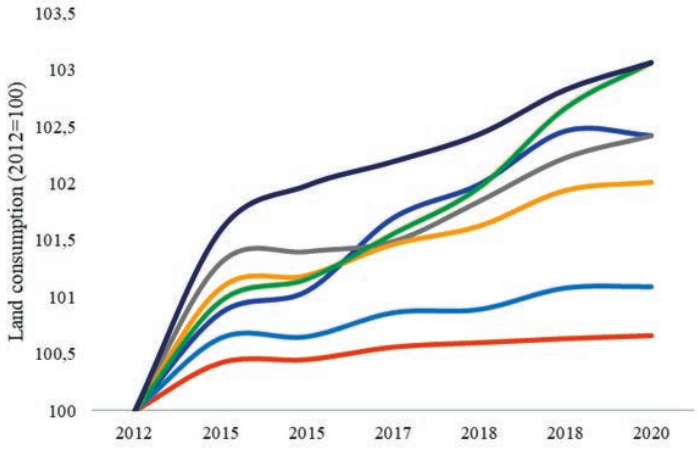
A different picture is provided analyzing the trend of the phenomenon, using the land consumption in the period 2012-2020 over the municipality (yearly increase of consumed land over the period) as an indicator. Figure 5a shows the land consumption trend in the seven municipalities in the period 2012-2020. Rome and Genova municipalities recorded the highest and the lowest trend increase respectively (+3pp and + 0.5pp), whereas Taranto land consumption increased considerably between 2012 and 2015, and then between 2018 and 2019.

Figure 5b shows the relationship between land consumption and population dynamics. The results suggest, especially for Venice, Taranto, and Bari, that there is a growth in artificial surface extent even in the presence of stabilization and in many cases of dwindling inhabitants. In fact, the analysis shows in six municipalities a demographic decrease between 2012 and 2020: Genova and Messina minus 29,460 and 15,235 inhabitants respectively, whereas Venice, Taranto, Livorno, and Bari less than 10,000 inhabitants. On the contrary for the city of Rome the population increased by 131,064 inhabitants between 2012-2020 (ISPRA, 2021). The increasing land consumption per capita demonstrates the unbalance of land consumption as compared to demographic trends.

Figure 6 shows the results of the assessment in the seven municipalities in risk areas. All the municipalities are affected by

Figure 3. Map of consumed land by 2020 in the total area of the Lazio coastal municipalities (a) and a highlighted portion of the map (b) where land consumption 2019-2020 is illustrated in orange. Source: ISPRA/SNPA – Land consumption map and google image.

Figure 4. Percentage of consumed land soil in 2020 for the entire municipality (a), and percentage of land consumed in each coastal strip (b).


Land consumption (2012=100)
103,5
103
102,5
102
101,5
101
100,5
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2015
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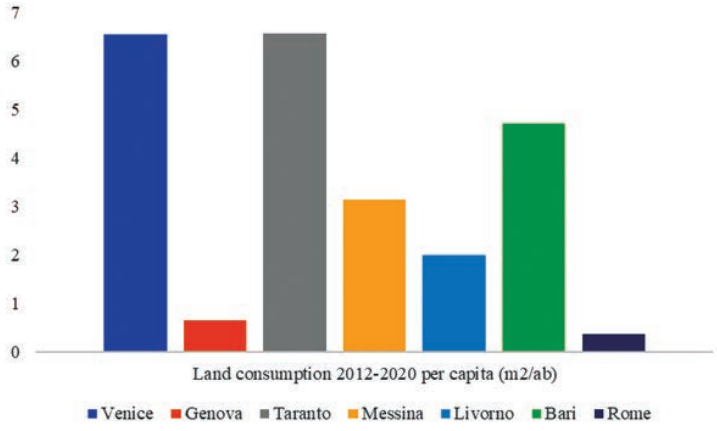
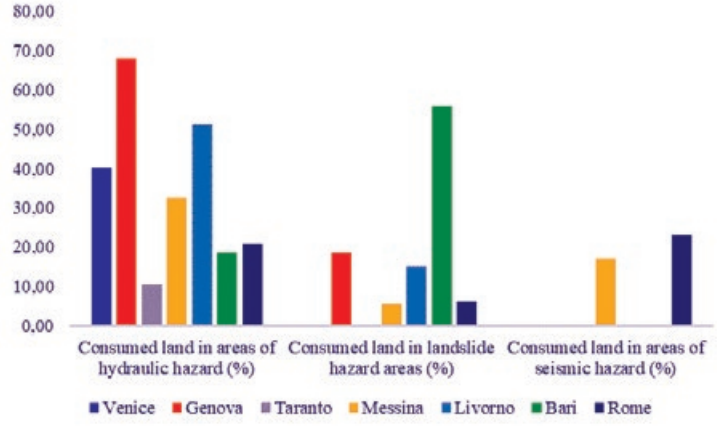
Venice
Genova
Taranto
Messina
Livorno
Bari
Rome

a)


7
6
5
4
3
2
1
0
Land consumption 2012-2020 per capita (m2/ab)
Venice
Genova
Taranto
Messina
Livorno
Bari
Rome

b)


80,00
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
Consumed land in areas of hydraulic hazard (%)
Consumed land in landslide hazard areas (%)
Consumed land in areas of seismic hazard (%)
Venice
Genova
Taranto
Messina
Livorno
Bari
Rome

consumed land in hydraulic hazard areas, the greatest percentage occurring in Genova (67.97%), followed by Livorno (51.13%) and Venice (40%). As for landslide hazard, Bari recorded the highest percentage (55.83%), and lower percentages in Genova (18.48%) and Livorno (14.93%). Eventually, Messina and Rome municipality are the only seismic hazard areas involved (respectively with 17% and 22% of the territory). The municipality of Messina is the most vulnerable since the consumed land is present in all three types of hazards. On the other hand, Genova and Livorno are to be taken into consideration for the high percentages of consumed land in hydraulic hazard areas, and Bari for the high percentage in landslide hazard areas.

Conclusions

This study describes consumed land distribution at national and regional level in Italy, particularly in the Latium region in the year 2020, with a focus on seven municipalities to explore land cover change trends and the relationship between natural risks. The results show that in coastal areas the phenomenon has been and still is even more considerable than the national level, especially in the first coastal strip of 0-300 meters, without substantial differences between regions and selected municipalities. The high values of consumed land within the three coastal strips, with differences dependent also on the geomorphology, confirm the need to stop land consumption, especially in these fragile ecosystems where natural resource exploitation already occurred. Consumed land in areas with hydraulic hazard have been detected in all the municipalities in this study, highlighting the urgency of an integrated consideration of land use, ecosystem conditions and natural risks of coastal areas to avoid the increasing vulnerability of the territory. The municipality of Rome is characterized by high land consumption even in the last year.

Figure 5. Trend of land consumption increase (2012-2020) normalized to 100 (2012=100) for the selected municipalities (a), and relationship between land consumption and population dynamics (b).

Figure 6. Distribution of consumed land in hydrogeological risk areas for the selected municipalities.

In the coastal area of Rome, consumed land is concentrated in the areas of Ostia south and Ostia north, being at the same time the most prone to hydrological risks. The economic growth that invested Italy in the late 50s, combined with the speculative construction that took over leaved Ostia with the structure of a suburban district of Rome–even planned or abusive –and several structural and environmental problems.

In recent years, after the '90, the demographic development, the pressure of commuting to Rome and the increasing of seaside tourism have given way to a process of partial redevelopment of

the coastal territory of Rome, associated with further increase of land consumption in the area, while the hydrological risks remains at state.

The coast of Rome has been partially saved by the Natural State Reserve of the Roman Coast – Pineta di Castelfusano Park and Natural State reserve of Castel Porziano, being a unique combination of habitats that englobes most of the coastal ecosystems typical of the Mediterranean, also included in the Nature 2000 network.

As the analysis demonstrates, together with an increasing land consumption Rome has also a high percentage of artificial land in areas prone to hydrological and seismic risk. In this condition it is necessary to strengthen the contrast to land consumption along the coast and maintain the high level monitoring of changes in order to better support territorial planning and restoration interventions through urban regeneration and de-sealing.

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Projects results

Roman Riviera Rome Open to the Sea

Group Participants
Students: Adam Bieniek, Ligia Nunes, Veronica Chiaccherini
Experts: Paulina Bone, Jakub Szczepański, Katarina Larsen, Iwona Preis

Water has always been at the origin of life and cities, first as a matter of survival, then as a privileged channel of communication. Sometimes primordial, sometimes forgotten, water always found its way.

Ostia, Rome's privileged sea and river port, could be the example that is repeated in many cities that emerged due to the existence of water courses.

Roman coastal morphology was defined throughout history according to its position in relation to the water.

Ostia Antica, once by the river and by the sea, now appears isolated in an apparently random position, having lost its initial relationship with water. New territories were developed according to the water each time and successively in a different position, that was the origin of the patchwork that today characterizes the cartography of the coastal area of Ostia.

Water today appears also as a threat advancing to the shores as a consequence of the rise of the average water level resulting from climate change as well as from the increasing frequency of extreme phenomena.

This region is submitted to the overlapping of several constraints. First, a sum of occupations at different times and scales, which despite having in common a relationship with the evolution of the position of water, present themselves in the territory in an absolutely disconnected way, emphasized by the separation of governance of this territory by several administrative entities with different visions and ambitions, added to a landscape that is already very fragmented and left at the mercy of informal occupations that have worsened the image and the relationship with the waterfront.

From an analysis of the area emerged different realities without a guiding thread that results from the intersection of historical and natural values lost in cartography, ancient Ostia, Trajan's port, gardens, etc.

The synthesis of the area's strength, weakness, opportunity and threats, by themselves, configures the intervention program, which seeks to highlight strengths and opportunities as well as mitigate weaknesses and threats.

The considered strategy is based on the definition of a program that creates a relationship between the fragments of the existing reality that need to be maintained or saved, in a short, long, and medium term, imposing the safeguard of the physical and social integrity of the area.

From the plans foreseen for the area under study, it is assumed a different position of the port, the defense of the coast from

erosion and the highlight of the privileged areas, such as heritage and natural sites, wile dealing with its vulnerabilities.

The area of Ostia reflects the consequence of thinking of a territory in separated and isolated parts without the concern to connect realities and to make it coexist in harmony. These actions taken, mostly in the last century, reflect an area intervened by several times without a previous analyze that could allow these interventions to happen from the existing opportunities that the place offered instead of over an unknown reality and there for creating one conflict after the other until these days we realize that an order must be reestablished.

Besides the analysis results, an additional difficulty arises, the change that unpredictable climate episodes will bring to this area since its located between two water courses, a river, and the sea. Using the existing tools to simulate how this area would be in the next 50 and 100 years, it's easy to realize that without no preventive action and the management of the consequences of climate change this area would become completely submerged in less than a century.

Addressing this reality implies to create a symbiotic relation of all these aspects, as well as environment questions demand the understanding of the complexity of time and how it relates to nature.

An assessment to the area in study exposed different realities along the Ostia region; the most outstanding was the lack of continuity, meaning an obvious non planning that became the main concerns for this proposal.

After the analysis of the territory several opportunities were found that could by itself respond to the existing problems and eventual threats.

After the general approach three sensible areas were considered from which one was selected because of its vulnerability. The decision on where to focus was also taken in considerations to the need to relate social aspects, and a set of values that address the population needs.

Figure 1. The environmental, historical, archaeological and cultural heritage of Ostia.

Figure 2. Masterplan for the enhancement of the main valuable elements of the area.

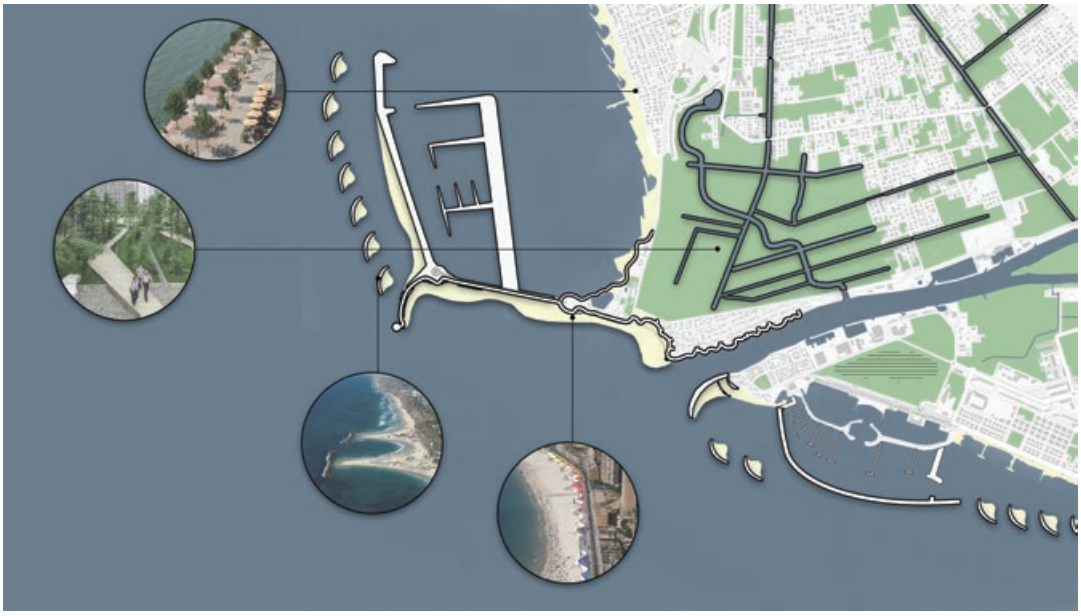

Figure 3. Proposal for a new coastline to protect against coastal erosion and to create new public spaces for inclusive uses.

Figure 4. The new public connection the project provide a new widespread accessibility by bus and train to reach the environmental and cultural spots.

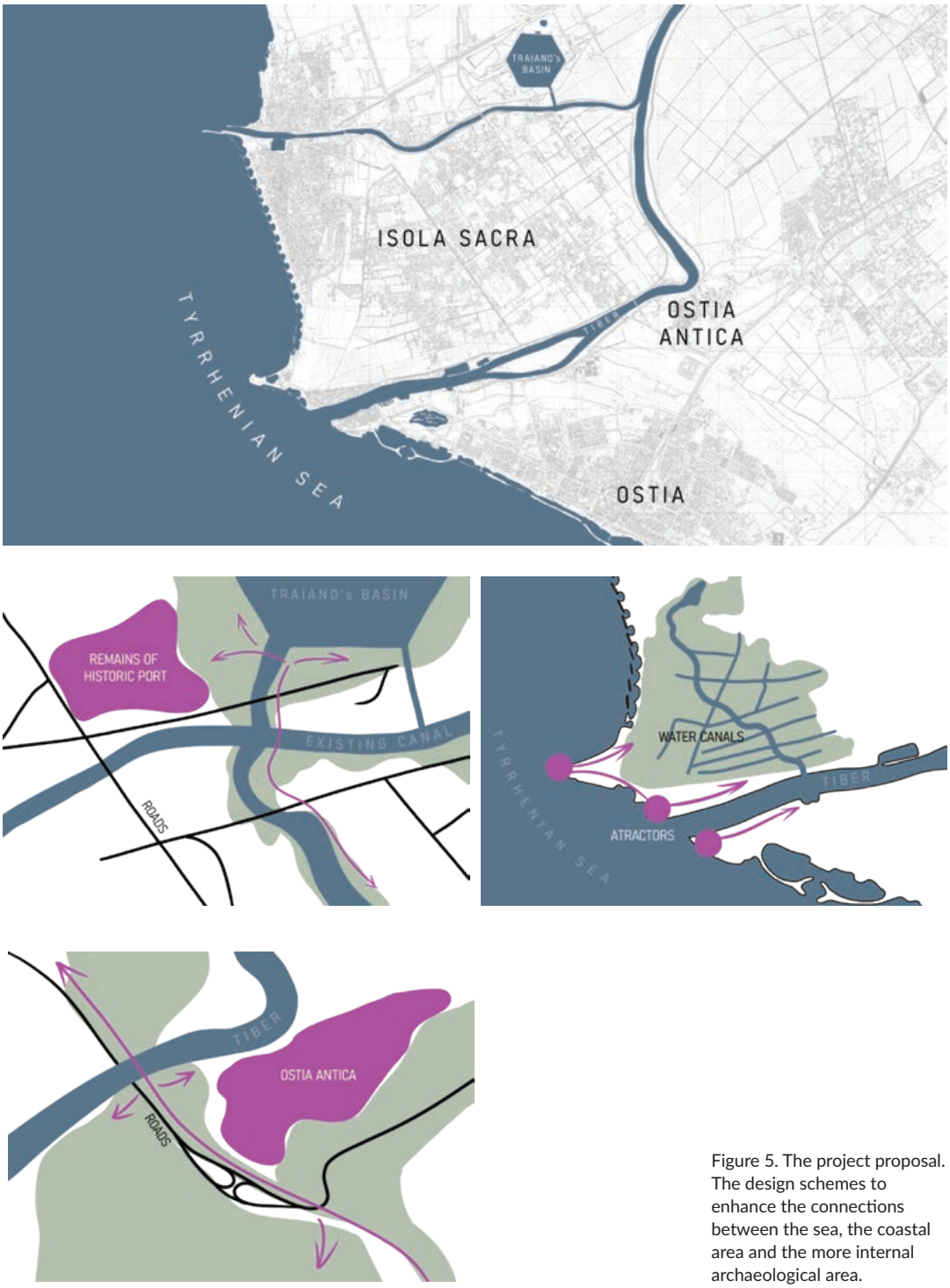

Figure 5. The project proposal. The design schemes to enhance the connections between the sea, the coastal area and the more internal archaeological area.

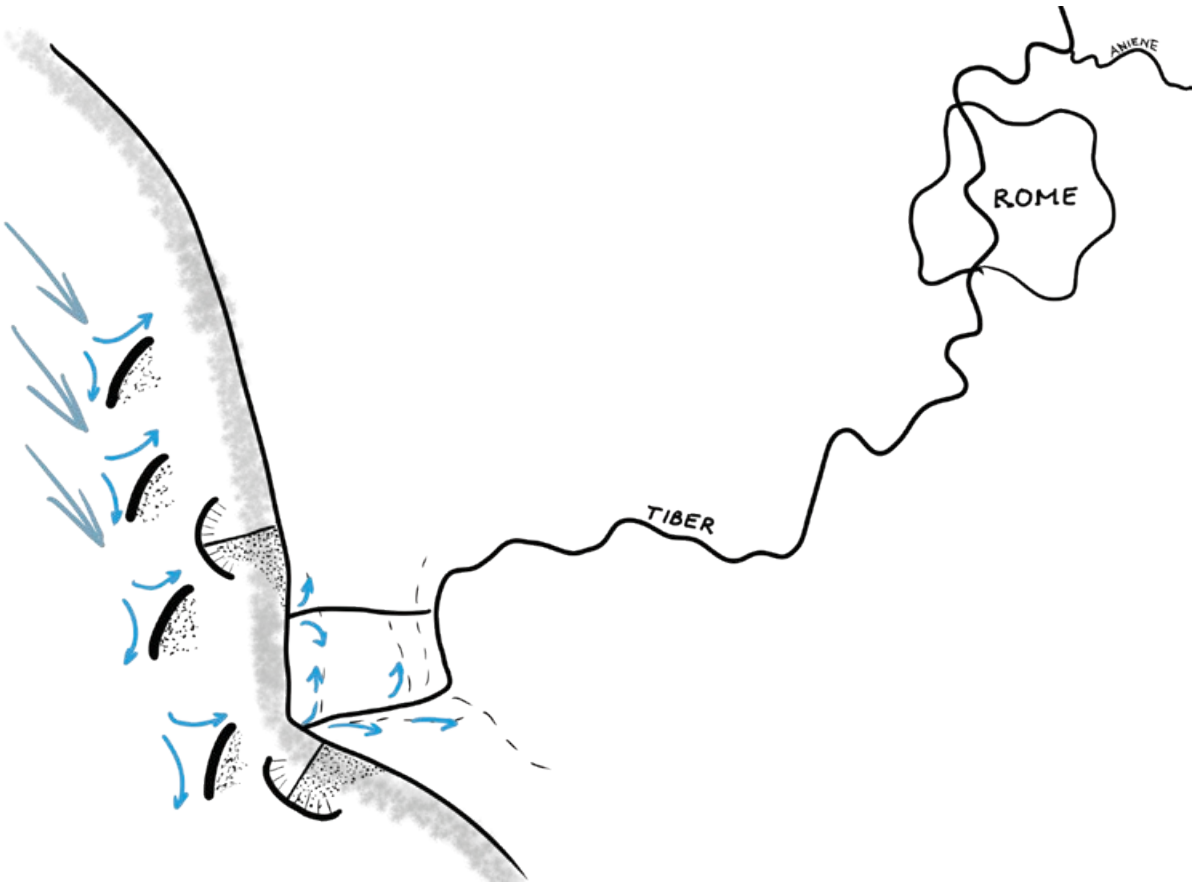

Figure 6. Hypothesis of coastal defense against erosion.

Part 2.
Rome and the Tiber


Via Cassia
Via Flaminia
Via Salaria
Via Nomentana
Via Tiburtina
Via Aurelia
Via Casilina
Via Ostiense
Via Appia

Sapienza University of Rome Bruno Monardo

Interpreting the River through Kaleidoscopic Glances

DOI: 10.36158/97888929566673

The Tiber is the history and memory of Rome. The Tiber is the beginning, the living witness of the incipit and the development of the city, the source from which its myths and identities spring. The Tiber is synonymous with the origins of Rome as water is synonymous with life. The river has always existed, since before the city, it is eternal.

The river which from the beginning of time has carved its meandering path through the alluvial plain of central Italy and especially of Lazio towards the sea, influenced the foundation and development of Rome. After the construction of the "muraglioni" the river runs isolated and disconnected from the life of the city core. And yet, the river is its backbone, its quiet centre which, with the powerful force of the water, at the same time calms and infuses energy. It drags along the fluid collective memory of the city: the river is always present, it is timeless.

Taking into account the complex problems affecting the contemporary waterfronts within the Climate Change phenomena, the glances by the authors of this second part are based on the belief that the dialectics between the civitas in its kaleidoscopic facets and the role of the city's government institutions can become the main tool to bring out questions and debates, the stimulus to open new perspectives on the daily reality of the relationship between the "Urbs" and its river. The most famous myths and the humblest stories that intertwine along the Tiber are the catalyst and the source of inspiration for the authors' visions that intend to reawaken the collective memory of the Rome synergies with the Tiber.

The first group of reflections highlights the historical approach that places in the foreground the deep relationship of the 'Eternal city' with its river. In fact, according to Servius, a Latin author who probably lived during the fifth century B.C., the city of Rome owns its name precisely to the Tiber. The terms '*Rumen*' or '*Rumon*', used by Latins to identify the river, share a similar root to Rome, and more specifically to the verb '*ruo*' which means "to flow".

Maria Margarita Segarra Lagunes recounts the Eternal City's original symbiotic relationship with its river, which has become blurred over time. The legacy of frenetic port activities (from Portus Tiberinus to Testaccio, from the port of Ripa Romea to Ripetta) has been diluted by the decision to build the powerful Tiber embankments in order to permanently cancel flooding phenomena in the city. The significant wounds inflicted on the waterfronts of the historic urban fabric could be mitigated

through strategies that value the seductive advantage point of observing the urban landscape from the water level of the river, recovering and partly regenerating the lost landscape.

The recovery of urban fractures that often divide cities from their water systems and the concept of "affordance" is in the core reflections of Elena Battaglini. Within the intimate entanglement between places and urban communities, the "river affordance" symbolises and draws the relationship with the space morphology, provides the valuable identity and reminds the limits in terms of climatic events.

The historical reconstruction of the data about the major flood events of the Tiber system allows Guido Calenda and Corrado Paolo Mancini to reflect on the concept of modern approaches to the river defence design and works through the possibility to calibrate simulation models in order to reconstruct the peak inundation events in the past and manage the potential future hydraulic risks.

The second package of short essays develops reflections and critical remarks on the kaleidoscopic issues characterising policies, strategies, plans and projects carried on by the dialectics of an extraordinary numerous set of public authorities and other heterogeneous stakeholders in order to regenerate the quality of an amazing and at the same time decadent urban reality in recent times.

The role of the three macro-strategies (defence, adaptation, relocation) that explicate the 'time factor' in the short, medium and long term, respectively, for combating flooding risk phenomena constitutes the interpretative trigger on which Carmen Mariano's reflections are developed within the framework of a research project financed by Sapienza University of Rome and developed with ENEA (Italian Agency for New Technologies, Energy and Sustainable Economic Development). The case study exploration of metropolitan strategic plans in Italian water cities (such as Genoa and Venice) in comparison with virtuous models in northern Europe (Rotterdam, Vejle) highlights how the issue of climate change and flood risk can provide a decisive contribution to planning innovation hinged on urban regeneration.

Irene Poli's contribution develops the issue of blue and green networks as one of the most relevant approaches to pursue the urban resilience idea, both in terms of urban fabric ontology and environmental ecosystem dimension. Rome and its relationship with the Tiber hydrographic basin can represent the trigger of a

paradigm shift drawing inspiration from the experiences of terrific and amazing river park projects conceived and implemented in the last decade along the Manzanares and the northern Seine (Madrid and Paris areas, respectively).

The hydrographic system of Rome and the peculiar role of the Tiber axe represents one of the 'Strategic Planning Zones' in the General Master Plan of the City approved in 2008 and still in force, as Chiara Ravagnan reminds to the reader in her reflections. The strong relationships between the urban historic pattern and its waterflow axe, which have been neglected with the construction of the powerful embankments soon after Rome became Capital of the Italian Kingdom, can be at least partly revitalised through the implementation of the Tiber 'Ambito Strategico' regenerating the river banks as continuous, resilient, flood adapting public space ribbons strengthening "the morphologic and perceptive relationships with the historic architectures and urban axes".

Hydrogeological Structure Plans of river basins are designed to guarantee the best compatibility between the expectations of use and development of the territory and the natural hydro-geomorphological dynamics of the basins, in compliance with environmental protection and the safety of populations, settlements and infrastructures. The hydro-geo hazards of the Tiber basin, especially the urban section from Castel Giubileo to the river mouth (the well-known 'PS5 Plan') are presented and discussed by Fernando Nardi and Antonio Annis.

With the aim of reconnecting Rome to the Tiber, rebuilding and improving the millennial relationship between the city and its river, the Plan also addresses the issue of the floodplains use, seeking the virtuous balance between the protection constraints and the public use intentions. Looking at the wider context of the river corridor, given the particular urban, environmental and historical configuration, the main aim is the valorisation of the integrated system 'Tiber River Park'.

The challenges posed by Climate Change on the urban water systems can be addressed through the River Contracts, useful agreements for the regeneration, management and enhancement of territories characterized by the presence of a complex water system. River Contracts are part of a wider set of tools referring to different categories of water bodies: coasts, lakes, transitional waters, estuaries and groundwater. Luna Kappler's reflections argue about the original path of Roman River Contracts, to be understood as the outcome of an integrated inclusive decision-

making process, which allows to undermine the traditional forms of water management based on top-down hierarchical relationships, and to overcome their strictly technical and sectoral character. On the basis of a voluntary agreement, the River Contracts mobilise the participation of a huge number of players in the river area towards the definition and implementation of a shared strategic framework.

The public space evolution, within the Tiber context, is focused by the critical remarks of Federica Dal Falco, starting from the ecological paradigm shift imposed on contemporary urban settlements by the Climate Change issues and their powerful impacts. The author argues about the porosity of the border concept in the urban realm and, taking inspiration from the general principles ('beautiful', 'sustainable', 'together') conceived by the New European Bauhaus policy, reflects about the potential of the Tiber, as the main axe of the 'Eternal city', to recover the full identity of public space "par excellence" which in the past had privileged and direct relationships with the urban fabric and its edges. Within the Rome General Master Plan in which the Tiber ribbon is identified as a specific 'strategic zone', the regeneration of a complex system of collective 'hot spots' at different scales could be organised around the necklace of historical and more recent bridges, new "inclusive public space that integrates social aspects with knowledge of cultural heritage".

The urbanization process of 'Flaminio' and 'Villaggio Olimpico' neighbourhoods is synthetically reconstructed in the following text by Bruno Monardo. The author's reflections highlight the original vocations of the area as a remarkable space for leisure, arts, culture, infrastructures; since the beginning of the XIX Century the Valadier project of Villa Napoleon has focused the quality of space in the bight of the river for leisure and outdoor activities immersed in a valuable natural-vegetational context punctuated by historic gardens and amenities.

Over time, the growing exaltation of 'Flaminio' as a concentration of extraordinary cultural equipment and services representing identity polarities for the whole city has added to the vocation of leisure. As demonstrated by the recent initiatives for new cultural spaces conveyed by the public administration (Maxxi addition and new Science Museum), the Flaminio embodies the role of a strategic neighbourhood for the regeneration of the hinge fabric between the historic centre and the northern quadrant of the consolidated city, with attempts

to rethink the waterside and, at the same time, explore new relationships with the natural and mineral river ribbons.

Finally, Francesca Rossi's reflections focus on the theme of the urban landscape that the river allows us to discover in its naturalistic and anthropic facets suggested by unusual visual perceptive cones. Moving gently on the various navigable stretches of the Tiber, the landscape offers a palinpsest of crisscross relationships with unexpected and surprising perspective views. The richness of the flora and fauna components of the river area north of Castel Giubileo and south of the Magliana up to the mouth is striking, a naturalness that contrasts with the invasive presence of the "muraglioni" in the denser historical fabric. The perception of historical stratification finds a privileged perceptual condition in the vision "at the water level, walking on the banks or rowing", revealing the fascinations and the most captivating potential for reconquering the identity of the collective space in the relationship between water and urban community.

Roma Tre University María Margarita Segarra Lagunes

Rome and the (Lost) Landscape of the Tiber

In the past 150 years, Rome has forgotten its river and lost the symbiotic relationship that, since its foundation, it had established with it[1]. An ancient nexus that allowed the myth of a *Roma aeterna* to be consolidated. Today, only when the water level threatens to inundate the city do the inhabitants remember the Tiber and look out from the banks and bridges to watch with apprehension what, in the past, was part of the daily dynamics of the city: the periodic floods that marked entire urban and suburban areas, sowing destruction and death. Dramatic narratives describe the damage done to buildings: the Santa Maria Bridge became the Rotto ("Broken") Bridge in 1598, when the frightening flood carried away the two arches that connected it to the left bank. Indeed, every year during the winter, the danger of flooding afflicted the population, which had been accustomed since ancient times to this relationship of give and take, of abuse but also of immense benefits. Because, for many centuries, the Tiber was also the route by which all sorts of goods and merchandise reached the *Urbe*: food, wood, building materials, products imported from countries and regions both near and far.

Trade along the river in fact constituted a fundamental economic resource for the functioning of the city and was therefore a priority in the policies of the Empire and, later, of the Camera Apostolica, the body charged with the administration of papal property. Trading activities took place, even in the Republican era, in the *Portus Tiberinus*, Rome's oldest port of call, housed in the area existing between the Capitoline, Aventine and Palatine hills, alongside Rome's oldest markets: the Forum Boarium and the Forum Holitorium, protected by the gods Portunus, Hercules Victorious, Janus, Hope and Juno Sospita. Later, with the expansion of Rome's power and its trade relations with the provinces of the Empire, from Spain to Asia Minor, passing through Greece and Africa, the port of call was enlarged by covering, with immense structures used as warehouses, the Testaccio plain, as well as with the construction of a functional port, of which, even today, it is possible to appreciate the docks, equipped with large travertine rings, used to moor boats. Evidence of the intense activity that took place there is the Monte dei Cocci (Shard Mount), formed with the accumulation of the fragments of broken amphorae.

Throughout the Middle Ages, the port of Emporium lost its importance and the landing moved to the opposite bank, that

Figure 1. Andrea Locatelli – *View with the Tiber and Castel Sant'Angelo*, in the first half of the 18th century. Source: Roma, Fondazione Sorgente Group.

Figure 2. Hendrik Frans van Lint – *The Tiber in the bend in front of San Giovanni dei Fiorentini and the remains of the Neronian bridge*, in the first half of the 18th century. Source: [https://commons.wikimedia.org/wiki/File:Hendrik_Frans_van_Lint_-_Rome,_A_View_of_San_Giovanni_dei_Fiorentini.jpg], public domain.

1. M. M. Segarra Lagunes (2004). *Il Tevere e Roma. Storia di una simbiosi*, Gangemi, Roma.

of Trastevere, adopting the name Ripa Romea and becoming the welcoming place for pilgrims, who came to Rome to visit the tombs of saints and martyrs. From late antiquity, the Trastevere shore assumed a multiethnic character, thanks to the establishment of *xenodochia* and hospitals to accommodate foreign pilgrims. Later, in modern times and with the construction of the huge St. Michael's complex, beginning in the second half of the 17th century, the port south of Rome was consolidated as the city's most important commercial and productive hub.

To the north, near Porta del Popolo, the landing area for merchandise arriving in Rome from upper Latium, Umbria and Tuscany was arranged as early as the beginning of the seventeenth century, at the instigation of Paul V; but it was from 1703, with the construction of the Ripetta staircase designed by Alessandro Specchi, that the area took on a decisive importance in the characterization of the entire district, as well as a monumental work of urban decorum. Sailors, porters, clerks of the Chamber, duty collectors, inspectors, *pilorciatori*, and *bufalari* were some of the figures in charge of dealing with the problems related to trade and the disposal of products in the city's markets, once taxes had been paid in the Customs offices. But they were also the actors who enlivened the port of call with their frenetic activity, documented by the iconography of the time: suffice it here to mention the engravings of Giovan Battista Piranesi, the paintings of Gaspar van Wittel and the photographs and watercolors of Ettore Roesler Franz that describe, in every detail, an urban reality, now completely disappeared.

Since ancient times, there were also major productive activities on the banks of the river that animated the river landscape, exploiting the benefits of the current: first of all, grain mills, for the establishment of which not only the authorities of the Annona, millers, bakers or flour dealers competed, but also Roman aristocratic families or religious congregations, holders of the concessions granted to them by the Apostolic Chamber, in return for the payment of an annual fee, taxed in pounds of white worked wax, to be paid to the Tribute Chamber on the eve of the feast of the patron saints of Rome, St. Peter and St. Paul. The income from this activity must not have been too meager if the Company of St. Joseph Decollate, concessionaire of a grindstone anchored at Ponte Rotto, derived a sum sufficient to marry two poor spinsters each year. The presence of these floating structures, as necessary as they were perishable, has been documented in iconography at least since the second half of

the 15th century, in the drawings of the *Codex Escurialensis* and in sketches by Giuliano da Sangallo.

But, alongside the grain mills, other mills converged to enliven the river landscape, in the urban stretch, for grinding colors, salt, tobacco and even powder, along with varied fishing posts, equipped with tanks, nets and scales of all sorts and anchored to the remains of old ruined bridges or the ledges formed for the storage of clay materials at the river's edge. Finally, completing this picturesque and evocative universe, soap houses, wash houses, workshops and laboratories for sawing and polishing marble or cutting wood. And, from the middle of the eighteenth century, bathing cabins, established in Ripetta, much to the displeasure of the Clementine College, which considered bathing contrary to morality and, as such, counter-educational for its pupils.

Testifying to the importance of the river for the economy is the copious presence of acts, notices and projects promoted by high ecclesiastical prelates, such as cardinals, bishops and even the pontiffs themselves. The drafting of such documents, as well as the definition of proposals for action to solve technical and maintenance problems, as well as for the management of navigation, was entrusted, from the mid-sixteenth century, to illustrious architects, such as Domenico and Giovanni Fontana, Carlo Maderno –a trusted planner of Paul V, for whom he completed the reparation of the mouth of the Tiber at Fiumicino, witnessed by the fresco preserved in the Vatican Palace –, Domenico Castelli – who worked mainly for Urban VIII but, as "architect of the Tiber", grants licenses for the establishment of mills anchored at the Tiber Island and for the repair of low walls and buttresses damaged by the river's floods–, Carlo Rainaldi – who held that position for several years in the second half of the 17th century, combining it with his activity as designer of prestigious ecclesiastical buildings such as the church of Santa Maria in Campitelli –, Giuseppe Pannini –who in the mid-eighteenth century combined his work on the completion of the Trevi Fountain with the works for the reparation of the river banks in the suburban sections of Rome –, and Giuseppe Valadier – who worked during the French administration –, to mention only the best known.

The prevailing objective of their activity was to prevent, through periodic maintenance, the transit of boats in the river from being obstructed, slowing or even halting the conduct of commercial operations. But their tasks were also affected by

the advances in scientific knowledge, with the introduction of construction techniques aimed at making the repair of the corroded river banks more efficient and more durable, with economic benefits that would bring savings to the coffers of the Apostolic Chamber. Thus, the executive technique of the *passonate*, devised by Carlo Maderno for the repair of the embankments at the mouth of Fiumicino, would be surpassed seven decades later by the introduction of Dutch techniques by the engineer Cornelius Meyer, who, by establishing a professional duel with the most established architects in Rome in the mid-seventeenth century (Carlo Fontana, Carlo Rainaldi, Agostino Martinelli), would win the challenge by bringing to completion one of the works that most plagued the Apostolic Chamber in those years, that is, the repair of the damage caused by the Tiber to the left bank of the river, at the height of the Villa of Pope Julius III and the Via Flaminia. In addition to his publications, which were real manuals of technical solutions for overcoming orographic obstacles, cleaning the riverbed, and repairing the rips, the techniques he devised would remain in use for at least another seventy years until, again, experts who came this time from Ferrara brought to Rome new, more effective and cheaper systems for repairing the river banks.

This complex and articulated universe began to disappear starting in 1870, when in Rome, which had become the capital of United Italy, the decision was made to begin construction of the Tiber embankments, with the aim of permanently eliminating flooding in the city. The destruction of all the fronts of the houses and buildings facing the river, the regularization of its course, inflicting deep wounds in the urban fabric, but above all the elimination of all the productive activities that took place in the riverbed, decreed the definitive and radical separation that today characterizes the Tiber in its urban stretch. But one only has to go down to the water level to realize that, despite everything, the Tiber continues to be a formidable environmental resource.

The recovery of this landscape has become urgent: many European capitals have initiated works to enhance the banks of their waterways – Paris, Porto, Lisbon, London. It is necessary for Rome, too, to find ways to reinvent its relationship with this natural sphere, which was, in fact, the most authentic and historical reason for its existence.

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The River Between Space Symbolisation and Place Affordances

Urban development addresses the way local environmental resources are perceived, symbolised, valued and used by citizenship. Often crossing urban boundaries, rivers protect the place's soul and its genius loci. A river also provides water, food or hydroelectric energy for industrialization; it is a mean of transport, a border or a defensive measure, a vehicle for the disposal of waste and residues of the territorial metabolism. This relationship of vital intimacy between a city and its river frames, forges, shapes and orients the territorialisation processes of its communities. Within this intimate relationship a river has its affordances, in fact: 1) it symbolises the relationship with life and the flows of time; 2) it draws the morphology of its physical space; 3) it provides valuable identity and sociality elements; and finally 4) it recalls the limits, the threshold values of the homeostasis of a place, in terms of climatic events and hydro-geological instability (Battaglini 2020).

To what extent, may scholars observe, describe and frame a river? There are at least two literature strands: Regional Studies are mainly referring to it for its functions, or vocations. Instead, a spatially sensitive sociology, interested in nature/culture relations, interprets rivers for their affordances. These brief notes will mainly deal with the last scientific locus.

In the Regional Studies debate, a natural resource as a river, if not the concept of place itself, conveys a system of ideas or dimensions organised in terms of purpose (policy effectiveness and efficiency). Otherwise, it refers to its "internal" principles – such as those of spatial "vocations" or "functions" –, which do not allow to fully grasping the cognitive (and emotional) background causally active within a specific spatial-temporal context and, above all, its emergent systemic properties.

A river bathes, irrigates, transports, intersects, and marks boundaries; to put it in other words a river conveys a space of relations. From the bowels of the earth from where it gushes forth, a river flows through forests and ploughed fields in a slow or impetuous flow towards a lake, another river, the sea… In some cases it flows inland, or dries up without ever reaching another body of water. It may dry up and disappear; anyhow, a river leaves always signs of change, in its course or in the seasons, of the nature's living through time. Beyond the functions of a river, the vital intimacy that links individuals to water also provides the main frames of meaning to a process of territorialisation, thus binding communities to their elective place and orienting their life paths and development trajectories.

The theoretical frameworks of a spatially sensitive (namely

environmental and territorial sociology) allow us to connote the co-evolutionary relationship (Norgaard 1994) between cities and their rivers, between communities and the environment in which they are living, between the culture and the nature of a place, within the concept of territorialisation (Turco 1988; Raffestin 2012; Battaglini 2014; Dessein et al. 2016). This concept relates to the process through which social actors perceive the specific nature of the place in which they settle and, attributing symbols, meanings and values to their place-based resources, like rivers, reify, structure and organise a locality. Territorialisation is therefore a dynamic process through which a space becomes a place and, subsequently, a territory.

This process closely relates communities to the soil conformation, the morphological structure, its vegetation, and climate and, therefore, drive the use, conservation or adaptation of social actors to the available assets. These resources, before being socially constructed, open up to the eyes and to the senses of observers who perceive and experience, first, their physicality and morphology. Within this perspective, there is a clear reference to the so called Actor–Network Analysis (Goodman and Watts 1997), focusing on the local-level agency of the networks, in which social actors and natural hybrids (Latour 1993, 1994) are mutually and relationally coproduced. Accordingly, the concept of territorialisation allows overcoming the traditional dichotomy between nature and culture. Networks here diverge in terms of dimensions, functions, and power, but all obey the same symmetric principle related to the coevolution of nature and society. For this reason, agency is here intended to be collective and relational (Goodman 1999).

A river in fact establishes a vibrant and dynamic relationship with the inhabitants of a city, with the riparian communities as well as with other social actors, to whom it offers itself, making possible practices of use, conservation or innovative adaptation. In this relational perspective, the literature pertaining to the psychology of the environment, proposes the concept of "affordance" (Gibson 1986), to denote how a river "responds" to its relationship with the city. In this perspective, the term affordances refers to the "latent" opportunities that a river offers and, therefore, to those particular characteristics that could activate appropriate actions and practices, even before the mediation of culture. Affordances therefore suggest the idea of an "invitation" to social actors, which, however, it is only activated within a vibrant relationship (Battaglini 2016). An important fact about this concept is that affordances are

"(…) in a sense objective, real and physical, unlike values and meanings, which are often supposed to be subjective, phenomenal and mental" (Gibson 1986: 127-129).

Affordances arise, therefore, as "means of action": they are latent in the environment and objectively measurable, regardless of an individual's ability to recognise it. They are intertwined with the social capacities to perceive and to attribute values and meanings to the natural configuration that space arises. River's affordances – but also the possibility of local communities to cope with its rhythms, to acknowledge its gifts, to respect its equilibrium, and therefore to share its fate – depend on the social abilities to grasp its essence, its creative voice.

Experiencing one's city through its river, enjoying paths and cycle trucks along its banks, rowing or paddling among its waves, can perhaps contribute to learning the value of the relationship between social actors and places, between nature and culture. Recovering the urban fractures that sometime distance cities from their rivers can perhaps activate in local communities, among their inhabitants, the possibility of breaking out the self-referential and unsustainable narratives and, even at the level of individuals, of empathising with others.

The process of territorialisation – driven by symbols, perceptions and values attribution to a river landscape – derives from the relationship between communities and places: a momentum that unites what "we are" – our perceptual and cognitive frames, short – and long-term intentions – to the "other than oneself'". It is this motion, one of the most important frame that binds communities to their elective place.

If we agree that a river symbolises the relationship with life and the flow of time in a city, it is by its "embodied" experience that it can reveal, or not, to communities their place attachment and place identity (Proshansky 1978; Proshansky, Fabian and Kaminoff 1983; Proshansky and Fabian 1987), according to its tangible signs: harmony or distance.

And on the other hand, as Nietzsche wrote, there is more reason in our bodies than in our best wisdom.

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The Great Floods of the Tiber River in History

Since the ancient Roman times, Rome was plagued by severe floods of the Tiber River, which inundated the town. The years of the floods are reported by ancient historians and other sources, and we know that from the V century B.C. to the fourth A.D. Rome was flooded at least 28 times; that is an average of almost three times per century. Unfortunately, for this period we have no idea of the peak stage[1] of the floodings, since none was recorded. Besides, the elevations of the flooded area were much lower than in more recent times, and also the elevations of the river bed were lower, since the distance of the river mouth from the town was much shorter.

During the early Middle Ages the information became scarcer, and only two flood per century are reported. After XII century the information improves. Starting from the XV century the maximum level of the floods was marked on tablets embedded on house walls. Several levels were reported on two columns the were located in the ancient Ripetta landing. Thus we are fairly sure that we know the series of the peak stages of all the extreme floods. This series show a marked non stationarity, since the number and the severity of floodings was much greater during the XVI and XVII century, at the begining of the so called Little Ice Age. The maximum stage was registered during the 1598 flood.

The first survey of the river bed was made in year 1744 by the engineers A. Chiesa and B. Gambarini. Also the bridges, and the ruins of ancient collapsed bridges were surveyed, and since 1788 systematic stage measurement of the daily flows began at the Ripetta landing.

In December 31 of the year 1870, just three months after Rome was annexed to the Kingdom of Italy, a great flood flooded the town. After the flood, a new survey of the river bed, and the first survey of the ground elevation in the town of Rome were carried out. Also, the peak stages of the flood in the river bed and in the flooded areas of the town were surveyed, and the stage hydrograph of the flood at the Ripetta landing was registered.

In order to prevent further flooding of the town, extensive works were undertaken. Obstacles to the river flow were removed, such as the bridge ruins and the masonry ramps that jutted into the river, connecting water mills to the banks. The most important works were the so called 'muraglioni', high walls supporting the embankments on the river side. These works

1. The 'stage' is the measurement of the water surface elevation above a set zero value. The 'peak stage' is the maximum stage reched by the flood.

were completed at the end of the century. Thus, the actual river bed is broader and smoother than the ancient one, so that the stages are now lower than they would have been previously. A new stage measurment gage was set up near the site of the ancient Ripetta landing, wich was demolished and replaced by a new landing located upstream. The hydrometric measurements continued, but it was not until 1921 that systematic flow measurement began.

In order to evaluate the flood risk, the stage is not a suitable quantity, because it is affected by changes in the river bed, while the discharge[2] is not. The river discharge can be computed using a hydraulic model. Such a model needs calibration, made by comparing the simulated results to a detailed description of the inundation of at least one recorded event. The only well described inundation event is that of 1870, so it was used to calibrate the parameters of the model.

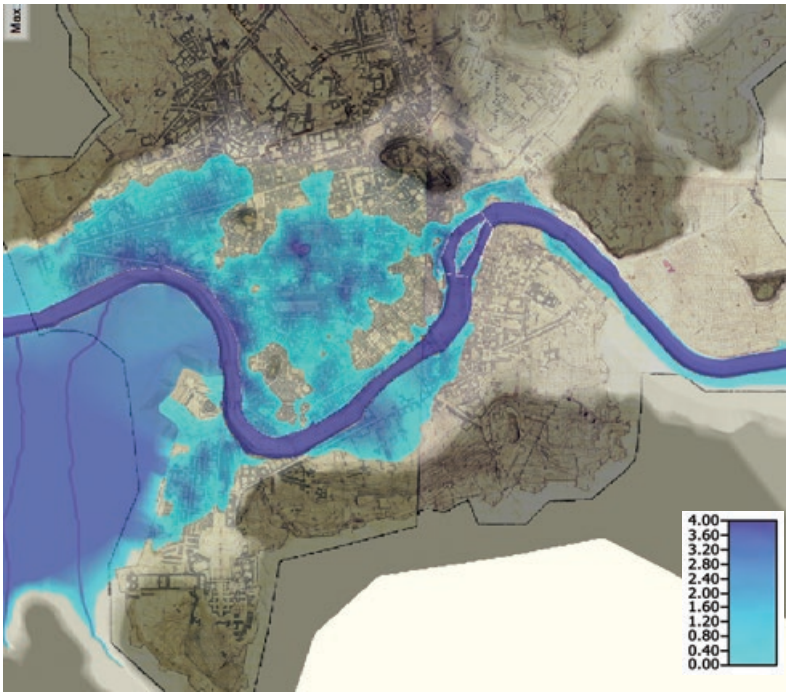
Summing up, in order to evaluate the peak flow of the extreme hystorical floods of the Tiber River at Rome, the following information is now available:

a. a long record of daily stage measurements up to the XVIII century;
b. a survey of the river bed made in 1744 (at the time, only few sections were surveyed in the urban stretch of the river);
c. detailed surveys carried out immediately after the great flood of 1870, including the elevation plan of the town;
d. a survey of the river bed and the flood hydrograph of the 1870 flood;
e. a rich iconography, showing the conditions of the Tiber banks from the XVI century onward;
f. contemporary descriptions of several extreme floodings;
g. a rich series of stage and flow measurements and bed surveys after the great flood of 1870 to the present days.

A two-dimensional hydrodynamic model was used to simulate the flooding of the old town in 1870. Once calibrated, the model allowed to compute the stage-discharge relationship of the ancient riverbed, which for the 1870 flood yelded a peak flow of 2930 m^3s^{-1}. The map of the simulation of the inundation of Rome in 1870 is shown in figure 1.

Comparing the result of the river bed survey of 1870 to that of 1744 showed a substantial bed stability. Since the XV century only three significant river bed modification were recorded:

2. The 'discharge' (or 'flow') of the river is the volume of water flowing in the time unit (usually one second) through a transversal section of the river.



1. the Ostia meander was cut by the 1557 flood;
2. the Palatino Bridge, reactivated about 1500, collapsed during the 1557 flood and rebuilt in 1573÷1575, finally collapsed again during the 1598 flood;
3. the Borgia Tower at the right end of S. Angelo Bridge, was built during 1492÷1503 and removed in 1603.

Thus, by adjusting the hydraulic model to these changes, the stage-discharge relationships of the old river bed were made available from the XV to the XIX century. The peak flows of all the extreme floods of this period are reported in table 1. The maximum registered flood was that of 1598, with 3640 m^3s^{-1}.

Table 1. Peak flow of the extreme floods of the Tiber River at Rome.

year	flow m^3s^{-1}	year	flow m^3s^{-1}	year	flow m^3s^{-1}	year	flow m^3s^{-1}
1422	2930	1557	3170	1647	2670	1870	2930
1476	2990	1589	2550	1660	2900	1900	3110
1495	2820	1598	3640	1686	2530	1915	2900
1514	2570	1606	3260	1805	2670	1937	2800
1530	3460	1637	3040	1846	2620	1965	2710*

**obtained by demodulating the effect of the Corbara reservoir*

In order to assess the flood hazard in Rome, the statistical analysis of the floods was developed using the censored sample of all the extreme floods from the XV century, and the sample of all the maximum annual floods from the end of the XVIII century to the present day. The resluts are reported in table 2 in terms of return periods.

Table 2. Peak flows of given return periods.

return period years	flow m^3s^{-1}	return period years	flow m^3s^{-1}
1000	3850	100	3020
500	3600	50	2770
300	3420	30	2590
200	3270		

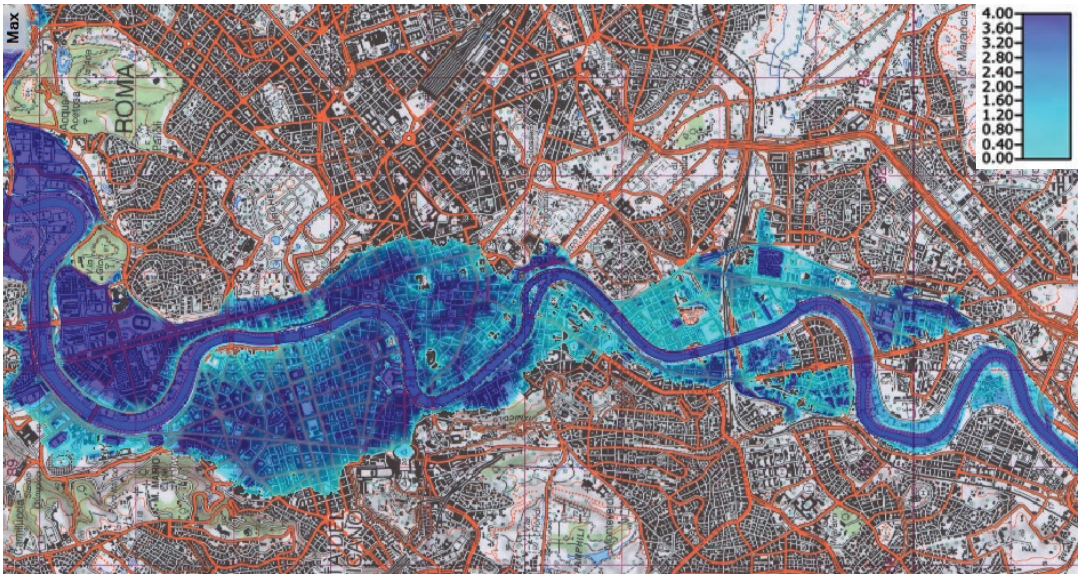


Figure 1. Simulation of the Rome inundation of 1870.

Figure 2. Simulation of the inundation of the 1598 flood in modern Rome.

The map of the simulated inundation of modern Rome with a 500 years return period flood is shown in figure 2[3].

3. This research started twenty years ago at the Department of Civil Engineering of the University of Roma Tre. Team: G. Calenda, C. P. Mancini, S. Lollai, E. Volpi and A. Fiori. The part concerning risk mitigation measures was developed during two series of exercises for the course of Prof. M. M. Segarra Lagunes, Department of Architecture, during the years 2016 and 2017. Among the main publications are: Mancini C. P., S. Lollai, G. Calenda, E. Volpi, A. Fiori (2022). *Guidance in the calibration of two-dimensional models of historical floods in urban areas: a case study*, in «Hydrological Sciences Journal», doi: 10.1080/02626667.2021.2022153. Calenda, G., Mancini, C. P., and Volpi, E. (2009). *Selection of the probabilistic model of extreme floods: the case of the River Tiber in Rome*, in

Using the model of modern Rome it is possible to know the water depth in every point of the inundated area for a flood of given return period.

Once all the openings in the buildings below the water level have been located, it is possible to identify all the assets at risk, and adopt risk mitigation measures, reducing the vulnerability of the territory by adopting permanent measures, as definitive removal of vulnerable objects from flooded areas and installation of permanent watertight fixtures, or, in case of flood alarm, temporary measures as providing for the removal of vulnerable objects, mounting temporary mezzanines and installing transitory barriers.

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The Strategic Approach in Planning Water Cities
National and International Best Practices

Introduction. Sea Level Rise and Climate-Proof Planning

This short contribution has been conceived to highlight the results of the research project run by the Department PDTA, Sapienza University of Rome, together with the Climate Modeling and Impacts Laboratory, ENEA[1] on the issue of the relationship between climate change and urban planning. The objective is to investigate how urban planning may provide responses to the need for planning the coastal urban settings affected by flooding phenomena as a consequence of sea-level rise (SLR) as a linear and permanent phenomenon, and by river floods as a transient event. The phenomenon of SLR associated with other climate events like storm surges, represents one of the next challenges with which the "world risk society" (Beck 2013) will have to grapple, both for the growing impact on cities and territories, and for the empirical evidence of the economic, social, and environmental damage it causes.

The issue relevance is emphasized by numerous international research institutions as the *European Climate Adaptation Strategy* (2021), the *European Green Deal* (2021) and the *Global Goals of the urban agenda 2030* (2015), which express the need to define strategies and plans for territorial adaptation on a national, regional, and local level in order to prevent and manage the risk linked to the climate crisis. So, it is evident the key role of urban planning in reducing the vulnerability of territories, stressing the inadequacy of the approaches and of the sectoral instruments to prevent and mitigate risks, and the need for a transdisciplinary approach.

The global forecasts on SLR at 2100 vary from 53 to 97 cm according to the IPCC and with reference to the RCP (Representative Concentration Patways). A study by ENEA shows that 33 Italian costal areas will be flooded by 2100 (Antonioli et alii 2017).

Methodology and Case Studies

The research analysed the actions by policymakers as response to climate change highlighting a strategic dimension of local agendas for an urban development vision, and a regulatory framework integrating and innovating the planning climate-proofing.

1. Research Programme *Urban regeneration strategies for climate-proof territories. Tools and methods for the assessment of vulnerability and for the identification of resilience tactics in coastal urban areas subject to sea level rise* (Scientific coordinator Prof. Arch. Carmen Mariano), PDTA Department, Sapienza University of Rome with the Climate and Impact Modelling Lab of ENEA, funded by Sapienza University 2020.

Figure 1. Sea levels are expected to rise by 25cm in Vejle's fjord by 2050. Photograph: Municipality of Vejle.

Concerning the former, the definition of short, medium, and long-term horizons with related action strategies are outlined; however, referring to the latter, site-specific actions may be defined placing them within the strategies of ecological urban regeneration.

The research focused on a comparative assessment of strategic plans in national and international settings, as the Strategic Plans of Genoa and Venice metropolitan cities as well as Vejle (Denmark) and Rotterdam (The Netherlands).

These strategies articulate general guidelines for climate-proof urban policies, objectives and actions placed in three design macrostrategies that we have theorized after the analysis: defence, adaptation, and relocation.

The defense strategy identifies, with reference to a short-term horizon, actions for the mitigation and protection from the risk phenomenon, with hydraulic engineering works able to mitigate the territorial impacts.

Adaptation strategies represent a complementary approach to mitigation that implies the population's ability to keep on living their habitat with actions able to minimizing the flood impact. It involves practices of urban regeneration of compromised territories, also by relying on the adoption of nature-based solutions or solutions inspired to the 'Ecosystem-based Approach' (IUCN 2020) that involve a wide range of ecosystem management activities to increase the resilience and reduce the vulnerability of people and the environment to climate change.

The third macrostrategy refers to the need to rethink the coasts with new, flexible urban models for the long-term relocation

strategy for "climate crisis migrants" (Ryan 2015) through 'in town', 'adjacent town' and 'new town' relocation. This strategy refers to contexts where the economic investment of mitigation or adaptation actions does not offer real benefits relating to the area survival.

Looking at the examples of Italian strategic planning, the general guidelines are oriented in implementing urban policies within a short-term temporal horizon (3 years): this circumstance does not meet the need to outline a structured medium and long-term vision, in order to respond to the climate change issues.

These general guidelines have not been followed by any declination on a local scale, except for specific experiments in some cities that set up the guidelines for *Climate adaptation plans*, following the *European and national strategy adaptation* (2020) to climate change.

Instead, in the analysis of international strategic planning case studies, a regulatory and experimental approach emerges, oriented towards site-specific planning actions depending on the orographic and geomorphological characteristics of the territory, articulated in a short, medium, and long-term vision.

The *Vejle's Resilient Strategy* (2019), promoted in the context of the '100 Resilient Cities partnership', demonstrates how small cities can solve big problems and takes into the three macrostrategies (defense, adaptation, relocation). It is distincted into four key strategies for a resilient urban development: 'Co-creating city, Climate resilient city, Socially resilient city, Smart city' and defines the flood risk areas identifying priority settings for intervention with reference to various temporal horizons: 2025, 2050, 2100.

The *Rotterdam Climate Change Adaptation Strategy* (2019) too, focuses on four general strategies for the city's adaptation to the flooding phenomenon and defines the settings at flood risk in 2100, emphasizing the main infrastructures affected by possible inundation. It articulates three strategies for a resilient metamorphosis of the public spaces exposed to risk:

- 'sponge': water plazas, infiltration zones, and green spaces;
- 'protection': dams and coastal protection;
- 'control' of flood events: evacuation routes, water-resistant buildings, and floating structures.

Conclusions and Future Developments

This comparative analysis of the strategic planning experiences underscores the "strategic role of knowledge" (Talia 2020) in

identifying the territorial settings affected by the flood risk phenomenon.

This knowledge allows policymakers and planners to address the areas affected by the risk phenomenon, through the danger level and temporal horizons and to identify the actions aimed at managing the risk within the planning tools.

The aforementioned research project is exploring a method for locating, quantifying and characterizing coastal urban areas at risk, to be consistent to different contexts, and yet informative and useful for the subsequent steps of the urban planning process. Future developments of the research path include the identification of different actions in relation to the urban components at risk, articulated according to the three macro strategies (defense, adaptation and relocation), with the ambition to set up a reference methodological framework for the innovation and implementation of the Local Plan.

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Regenerating Cities with Blue and Green Networks

Inspirational Models and Rome Potential

Blue and Green Networks

The debate on sustainable and resilient cities has fostered the attention of urban planning on the environment and landscape issues, both in terms of defence and preservation of the natural resources, and in terms of urban regeneration strategies.

Pursuing these issues requires to combine two separate disciplinary goals. The first concerns the reconfiguration of public spaces, the strengthening of infrastructure system and the revitalization of urban fabrics. The second one concerns the promotion of biodiversity, the implementation of ecosystem services and the management of natural cycles and risk.

To this end, the most advanced fronts of debate and experimentation identify strategies, either *integrated*, to a physical-morphological reconfiguration, a socio-economic and cultural revitalization and an environmental regeneration; or *multiscalar*, to coordinate design and planning through different levels; or *cooperative and partnership-based*, to combine top-down and bottom-up practices.

Urban planning rethinks therefore disciplinary boundaries toward an ecological perspective that finds a main field of experimentation in *Green and blue Infrastructures* (GI) as the resilient structure of the urban and environmental design of the contemporary city, based on a threefold approach, mitigative, adaptive and place-based.

GI are structural components with a strategic value within the urban planning system, characterised by multi-functionality, multi-scalarity, and connectivity. They direct planning and design project towards a resilient management of fundamental resources, to strengthen the socio-ecological and cultural relationships and to improve the urban operation and efficiency. In particular, in urban areas GI contribute to the strengthening of environmental connectivity, to the risk management and energy efficiency, with effect on the quality and quantity of public spaces, sustainable mobility, and on the costs of the public city, thanks to a recycling and resource saving systems. At the same time, the development of inclusive and adaptive public spaces and activities enables the restoration of place identity through the protection, regeneration and enhancement of common goods, implementing also eco-friendly economies, healthy and inclusive lifestyles, as well as the urban welfare.

In this framework, the relationship between the city and the river appears fundamental. The river, indeed, represents the structural element of the urban layout and at the same time it is

the ecological-environmental connective par excellence. For this reason, the river becomes the foundation of the construction of GI in urban areas.

This relationship, however, during the urban expansion has often been interrupted, due to the mobility, the intubation or the waterproofing of the banks, the progressive physical and morphological separation with the urban fabrics and therefore with the communities.

Many recent urban projects aimed at urban regeneration have placed the river-city relationship at the centre. No place like the river could be a significant context of experimentation of the most innovative policies of environmental regeneration and enhancement of the beauty of the city. For this reason, considering river as a GI is equivalent to consider it as a performing environmental space and a social place, in other words, it could become the strategic armour of the regeneration project of the existing city.

Inspirational Models

The urban project Madrid Rio (2011) concerns 10 km of the river Manzanares and manages over 50 coordinated interventions. The project aimed at the regeneration of public space and the restoration of the natural habitat around the river, achieved by the undergrounding of the M30 motorway. The new linear park, linking 7 existing parks, builds a wide and extensive environmental corridor inside the consolidated city. The river becomes a GI of public spaces, first of all *ecologically sustainable*. The playgrounds and pedestrian areas were made of natural materials, the banks were re-naturalised, with many water squares and water collection basins, and also with urban forests and urban agriculture.

Also, the project is *multifunctional*, as it concerned many green areas with different degrees of naturalness and equipments (forests, green fields, orchards, gardens, open space equipped for sports and leisure) and connected to the theme of water (fountains, water features, beaches, basins, water squares). And *interconnected*, through the overcoming of the gap between the city and the river, historically caused by the mobility, thanks to the connection of the banks through the restoration of historic bridges together with a system of new pedestrian and bicycle connections.

The second practice is located in France, into the *Communauté urbaine Grand Paris Seine et Oise*, in the Seine Valley, an ecological corridor in which there are some experiences of interinstitutional

collaboration focused on the river as a common good, thanks to a large scale vision designed in the *Schéma stratégique pour l'aménagement et le Développement*. At regional scale, the *Schéma régional de cohérence écologique Ile de France* aimed primarily at improving the *trame verte et bleu*, constituting the reference for the local planning.

The Seine City Park project is composed of 5 interventions that integrate the actions of reconfiguration and eco-compatible

re-functionalization of the border spaces between settlement system and river. In particular, the Parc du Peuple de l'herbe (2017), a biodiversity reserve and an educational and leisure area, represents an emblematic project of eco-landscape and recreational park. The project aimed at the enhancement of a former area of excavation subject to flooding, that overlooks 2,8 km of riverbanks. The project provided the implementation of 113 ha of wild nature, 1.7 km of walkways, cycle paths and pedestrian areas, 12.8 km of accessible paths, an Observatory, 800 sqm of houses for insects, 23,000 trees and shrubs, 200,000 aquatic plants, 6 floating rafts for birds' rest.

Rome Potential

Between the city of Rome and its river, historically closely connected, a progressive distance has been consolidated in the last century, especially in the most compact and historic tissues. Not only physical-morphological distance, but also ecological, social and cultural. The Tiber, particularly in the urban area, is also polluted, degraded and dangerous because of the total absence of territorial defence and care.

However, the two inspirational models show us some paths that could be taken to rebuild the invaluable relationship between Rome and the Tiber. Taking these paths requires a paradigm shift that reverses the vision of border spaces between the settlement system and the banks, with a vision to promote ecologically oriented social values. This paradigm shift is already present in the addresses and strategies of the Masterplan (PRG) of the City of Rome, approved in 2008. It is therefore enough to continue in this direction, giving full implementation to urban planning predictions, putting in place bold projects, sustainable and feasible, to govern the necessary changing to transform it into a performing environmental space, a social place and a narrative context that expresses high aesthetic qualities.

Figure 1. *Madrid Rio*, Madrid (source [https://flic.kr/p/KfZisJ]).

Figure 2. *Parc du peuple de l'Herbe*, Carrières-sous-Poissy, Yvelines, France (source [https://flic.kr/p/2nP4QgM]).

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The General Masterplan for Rome and the Key Role of the Tiber Strategic Planning Zone

The Tiber river in the urban development of the Roman urban area

The Roman area is a strongly interrelated system of physical, naturalistic, and historic networks spread between the volcanic slopes of the Monti Sabatini, Colli Albani, Monti Tiburtini and Monti Simbruini. The historic urban morphology finds two structuring components in the waterways of the Tiber and Aniene rivers. This hydrographic system has significantly influenced the origin of the city of Rome as well as the evolution of land-uses and the characteristics of the surrounding plain, including the productive and agricultural development and the leisure activities.

In this context, in recent decades, the "Roman area" has been the subject of numerous studies and research efforts aimed at examining "its open spaces, with their physical, natural, and anthropic features, with their values, their functions and uses" through integrated approaches that move from the awareness that

> ***"the resources and the physical-naturalistic and historic features – considered as two systems and in their reciprocal interrelationship – are to be taken as a primary, priority element, ordering and qualifying in the physical, functional, and formal re-organization of the anthropic territory" (Calzolari 1999).***

Moreover, the Tiber has for centuries been a transport axis that enabled the linkage between Rome and its hinterland. This communication system is connected to the system of the consular roads, which represent as well significant morphogenetic axes in the City, the Province, and the Region. This system development contributed to the configuration of a network of historic places and complexes – ports and bridges (like Ponte Milvio) – affected, in the last century, by the development of the railway network and subsequently by the road network. The Tiber is also a relevant ecological corridor vital for the system of open space that has been strongly affected by urbanisation, infrastructure networks and pollution. The environmental risks and social instances linked to the Tiber have been worsened by these phenomena as well as by climate

changes and pandemic, which highlight the strategic role of the Tiber as an ecological and (soft) mobility corridor as well as a public space full of resources and criticalities.

The Master Plan for Rome 2008 and the Tiber River

After the Unification of Italy in 1861, Rome became the capital and started the development of urban plans. The first 'Piani Regolatori' (1873/83 and 1909) gave birth to a homogeneous and geometrical city, in line with the plans of other European cities, like in the Flaminio Trident. The following plan of 1931 and, in particular, the Plan of 1962-65 guided a relevant expansion of the city along the radial road system, like Via Flaminia and Via Cassia in the northern part of the city, affecting hydrographic networks and greenfields.

The General Masterplan for Rome, approved in 2008, in the framework of an arising awareness of sustainability issues, pay a great attention to the natural and anthropic signs of urban morphology and to the "historic city" that anticipate and foster the attention on the "historic urban landscape" (Unesco 2011). The Masterplan fulfils "a significant methodological step, practicable by a culture capable of combining, the ancient and the modern components, conservation and transformation, history and the project, in a dialectical relationship between past and future" (Comune di Roma 2003).

Within the sustainable perspective, the objectives of defending and enhancing the river system are concretized by the definition of the Municipal Ecological Network (MEN), that articulates the main components of the environmental system in 3 categories: primary component, secondary component and completion component. The PRG recognizes the river as a primary component and a fundamental connection of the natural protected areas and the historic villas. This system is evident in the Flaminio Area, where the River is a fragmented but important connection between Monte Mario, Villa Ada, Villa Glori and Parco di Veio. Furthermore, the project of the MEN points out the importance of semi-natural areas as a secondary component, fundamental to protect and enhance the ecological corridor of the Tiber (such as in Parco di Tor di Quinto). Finally, the completion component relates to a system of local green areas, greenways and tree rows that foster the presence of nature in the urban fabric, like in the Flaminio Trident (Oliva 2001).

From a historical-morphological perspective, the PRG 2008 introduces the Tiber Strategic Planning Zone (Ambito di

Programmazione Strategica Tevere) aimed at contributing to its ecological and hygienic/sanitary recovery, and to repairing the morphological, perceptive, and functional relationships between the city and the river, weakened by the embankments walls of 1875-1910.

In particular, the 'Ambito Strategico', in its urban section, promotes the regeneration of the river basin as a public space at territorial scale, reinforcing the morphological and perceptive relationships with the historic architectures and the urban axes, and restoring the spaces along the river for cultural and social activities in the context of a revitalization and reconfiguration of the embankments.

Furthermore, the Strategic Planning Zone refers to the importance of strengthening the Tiber-Aniene system as a

public bike and pedestrian mobility corridor, limiting the space dedicated to vehicular traffic for the purposes of greater quality, accessibility, and permeability. This is also in a scenario of a relaunch of river navigability, capable of linking the main lines of urban transport.

The Strategic Planning zone also pays particular attention to some distressed areas of the historic city recognized as "Enhancement areas" by the regulations (Comune di Roma, 2008). These components represent areas that have lost identity and morphological values and that require specific and relevant transformations paying attention to the excellence of their historical and/or natural surroundings. In particular, the area of Piazza Mancini, which has been developed through partial interventions and without a unitary design, is currently configured as an area without a precise identity and a definitive structure, due to the presence of different functions located in precarious and provisional structures. The area constitutes a strategic resource of the entire Flaminio for the extension of the potential public space and the proximity to the river and the cultural polarities (Foro Italico, MAXXI, Auditorium).

Closing Remarks

The different planning choices and strategies promoted by the Rome PRG are aimed at managing the complexity of the goals related to the Tiber and to overcome a sectoral approach to the Tiber as natural ecosystem, Historic Urban Landscape, public space and urban axis, mobility network, system of abandoned areas to be regenerated.

In particular, the Strategic Planning Zone intends to strengthen the relationships between historical and naturalistic elements bringing out the role of a sustainable and resilient public space as a connective structure between different urban materials, between natural and artificial, between historic and contemporary, between the urban and the architectural scale (Ricci *et al.*, 2020).

In the light of actual global challenges, such as climate change and pandemic, this integrated approach to urban planning, environmental and landscape issues, as well as mobility planning is an imperative item of innovation in urban planning that is called to enlighten resilient public space through specific strategies, rules and tools.

Figure 1-2. Rome: the old and new along the Tiber in the Flaminio District: 'Ponte Milvio' and 'Ponte della Musica'. Photo: C. Ravagnan.

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Rethinking the Human-Water Interface for the Tiber and the City of Rome

The PS5 Flood Risk Management Plan

The Tiber River Fluvial System in Rome: from the Hydrogeomorphic-Urban Perspective to the Agri-Urban Coastal Domain[1]

The Tiber river hydrogeomorphology resulted from accumulated effects of tectonic uplift of the Central Apennine and drainage, erosion and depositional phenomena of water-sediment fluxes along North-South (N-S) direction. The Tiber valley bottom drains an area of approximately 17,000 km^2 moving surface water flows towards the coastal low land slightly rotating along the NE-SW direction, while leaving the Colli Albani volcanic setting on the S-E side, before reaching the Tyrrhenian sea. The Tiber riparian morphology, including a diverse and extended hillslope range, is still clearly highly distinguishable in the city of Rome landscape, even if the intense urbanization that occurred overtime has fully transformed the land use from natural to agri-urban fabric (Fig. 1).

The high-resolution Digital Terrain Model (DTM) unveils the hydrogeomorphic evolution of the Rome city floodplain that was mainly governed by the shaping effect of past major floods as well as human actions that were implemented over the last centuries to manage and protect the growing urban settlement from nuisance inundation effects within the flood-prone domain. The major human-induced works on the Tiber include the Fiumara meander cutoff, just before the river mouth in Ostia Antica, that followed the 1577 flood event and the city-center levee protection system of the famous "Muraglioni" that were built after the 1870 flood (Frosini 1977) (Fig. 2).

A further major land and water management work is represented by the land reclamation actions executed on the coastal domain that was the subject of different interventions occurring over centuries. But, the actual configuration of the artificial pump-controlled water drainage system of the coastal low land was the result of massive drainage works implemented at the beginning of the 20th century around year 1930, namely the "Bonifica Agro-Romano" (Fig. 3).

The city of Rome is impacted by a significant distributed hydro-geo hazards considering the complexity, density and multiple interacting hydrogeomorphic features and processes developing within the urban domain at large, the metropolitan area of the city of Rome. Subsidence, water-land body pollutants, groundwater depletion, landslides, sinkholes and floods represent a multi-risk hydro-meteo hazard scenario impacting the city. Compound and inter-dependent hydrological dynamics during extreme events

Figure 1. The morphology of the Tiber River valley and its tributaries from the Rome city center to the coastal low lands: the high-resolution digital terrain model (left) and the satellite optical image (right).

Figure 2. The Fiumara meander cutoff (post 1577 flood) and the Rome city center levee protection "Muraglioni" (post 1870 flood).

Figure 3. The land reclamation domain of the "Agro-Romano" in the coastal area of Rome.

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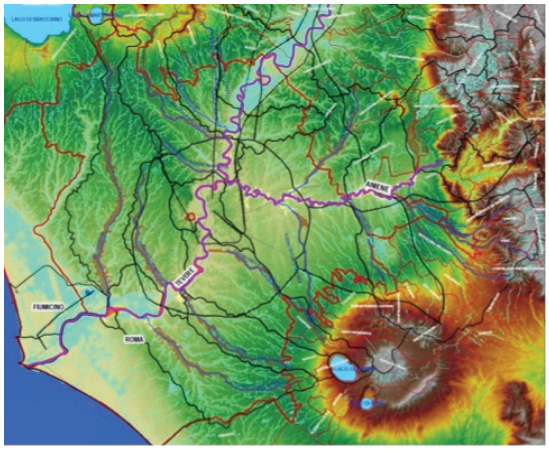
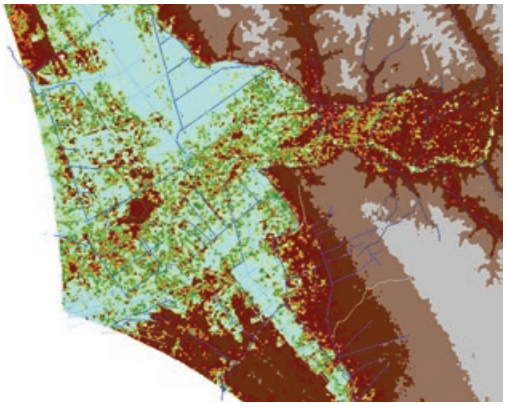




shall be accurately understood, quantified and mapped in order to support integrated territorial management and mitigation of concurring fast growing urban pressures occupying new spaces within the already largely and densely built urban settlement. Investigating the Rome human-water interface, with specific

focus on quantitative integrated metrics of flood risk and urban ecosystem evolving dynamics, represents a core component of any city of Rome resilient and sustainable urban and socio-economic planning actions from large to the parcel scale.

This commentary aims to summarize the research works and studies developed in the last 10+ years for the city of Rome flood risk management program, namely the PS5, sharing the conceptual and solution-oriented framework that was designed and applied to update the flood risk knowledge and mitigation actions for the Tiber floodplain and tributaries from Castel Giubileo dam to the river mouth.

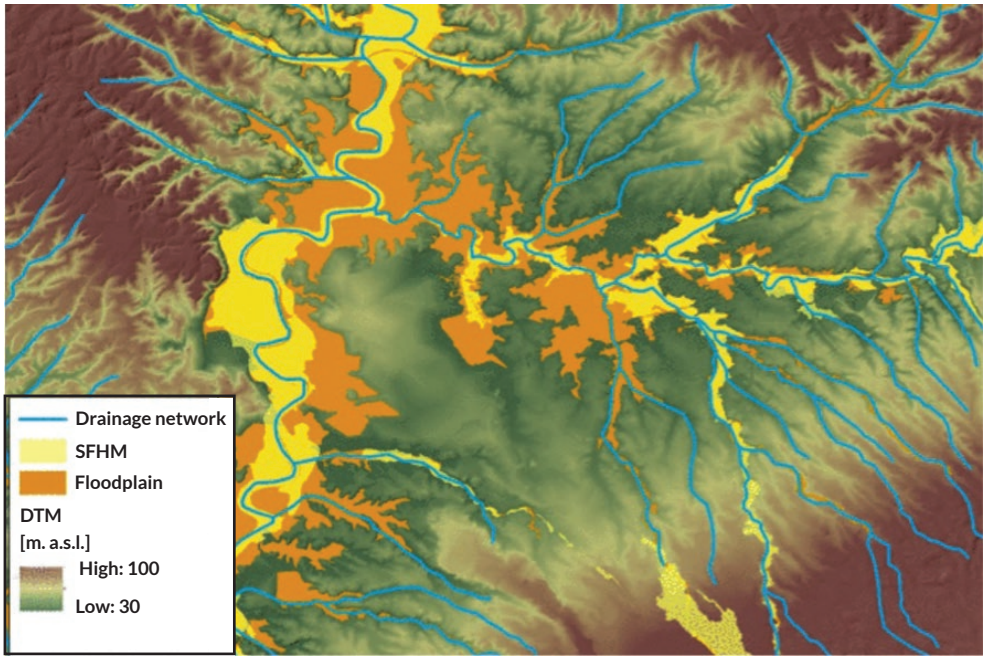
The preliminary section of this commentary, while depicting the heterogeneous and challenging framework of the Rome river-urban domain, shares the need of a flood risk assessment framework that shall implement a hydrologic, hydraulic and geomorphic schematization (i.e. hydrogeomorphic in one word) to accurately define investigation domains to produce inundation hazard metrics at the Metropolitan scale. This hydrogeomorphic schematization allowed to identify the following interacting three flood analytical sub-domains of investigations within the city of Rome limits: the Tiber-Aniene major river system; the 13 small ungauged basins contributing to the Tiber-Aniene rivers; and, the coastal low land of the Tiber river and the artificial drainage channels within the land reclamation area.

Tiber floodplain and the PS5 flood risk map updating program

The city of Rome urban settlement developed over time within the Tiber-Aniene floodplain. Buildings and streets, built within the river proximity, are at lower elevations as respect to the maximum flood levels, especially if considering extreme hydrological scenarios of 200-500 years return time flood events. City of Rome inhabitants are protected by levees and sparse water control systems, but large portions of the city domain may be still impacted by both frequent and rare floods (Fig. 4).

Several major works have been designed and implemented in recent years to mitigate nuisance flood effects, but the city is still impacted by potential disastrous inundation events. Major flood hazards are also distributed along the small river basins, tributaries to the Tiber-Aniene system, that lack of adequate flood water storage and protection systems. Moreover, while flood wave propagation from uplands represents the major driving factor of flood scenarios, local urban rainfall-induced flooding is also a major source of damage and service

Figure 4. The Tiber-Aniene river systems and the floodplains: flood hazard zoning of levee protected (yellow color) and low laying flood-prone zones (orange color).



interruptions, occurring also for frequent hydrological events (i.e. rainfall events of 10-30 years of return time). The coastal area of Rome is also protected by an extended set of water risk management actions including levees, water storage, large pumping systems and artificial drainage channels. Nevertheless, significant flooding still occurs in low laying coastal settings agri-urban domains of Ostia, Fiumicino, Piana del Sole among others (Fig. 5).

The PS5 flood risk modelling and mapping updating program investigates on the multiple source and domains of inundation scenarios within the city of Rome limits and in particular (Nardi et al. 2015):

1. simulating Tiber and Aniene river flood wave propagations using distributed physically-based a 2D flood routing model to identify maximum energy gradient of extreme flood events;
2. simulating flood wave routing using distributed physically-based a 2D hydraulic model along 13 small river basins, contributing to the Tiber-Aniene drainage system, including the Acqua Traversa, Caffarella, Corcolle-Freghizia, Rio Galeria, Magliana, Malafede, Oliviero, Osa, Pratolungo, Tor Sapienza, Vallerano, San Vittorino, Valchetta;
3. rainfall-induced urban flood events impacting the Metropolitan domain both in the city center and in the agri-urban coastal




domain, also supported by geomorphic delineation of water accumulation law laying zones.

A selected set of flood hazard modelling and mapping products of the PS5 project are schematically reported in Figure 6 (Nardi et al. 2015).

PS5 outcomes went beyond the pure aim of updating the flood risk maps, supported by more accurate observations and simulations of topographic-geomorphic, hydrologic and hydraulic dynamics, fostering innovation and extended understanding of new directions for improved knowledge, awareness and security of the city in relation to the flood risk. The PS5 research experience and the significant joint effort and engagement of actors and stakeholders of the resilient and sustainable city planning, involved into flood risk management and mitigation actions, allowed to rethink the problems and potential solutions for the human-water interface for the Tiber and the city of Rome. Summarizing major outcomes and lines of actions of the PS5 (Nardi et al. 2015; Nardi et al. 2019):

– flood risk management requires to integrate the different components of knowledge joining efforts of water-flood

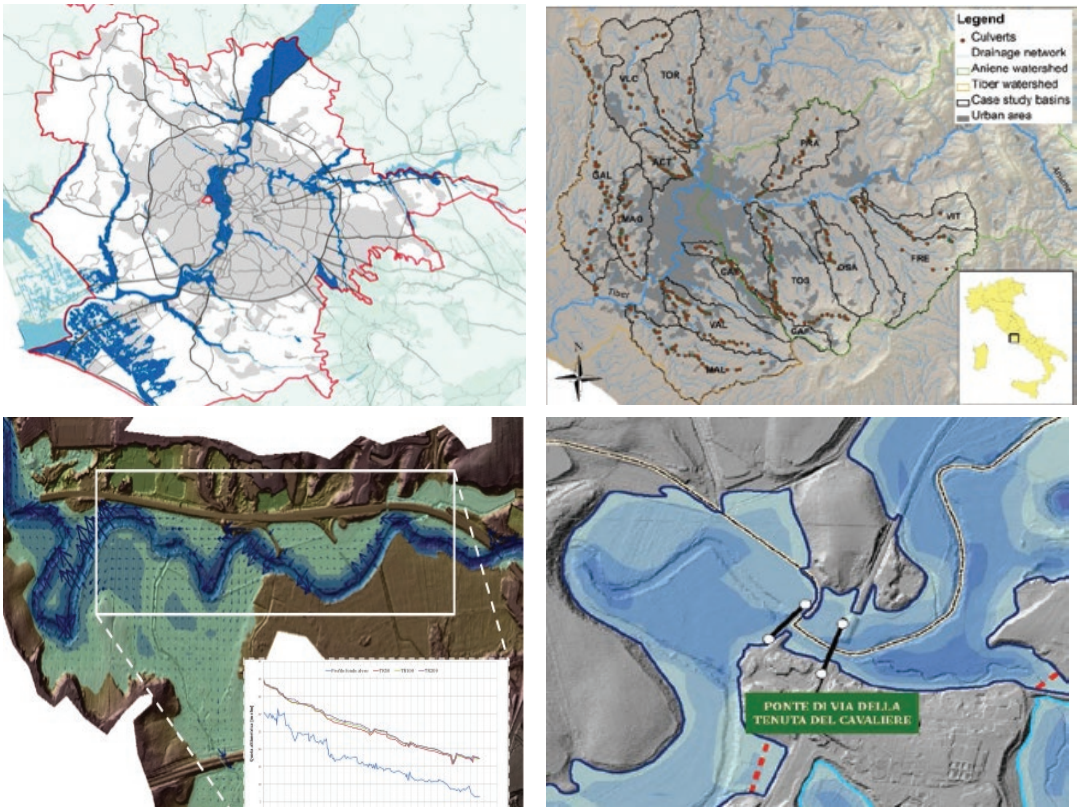
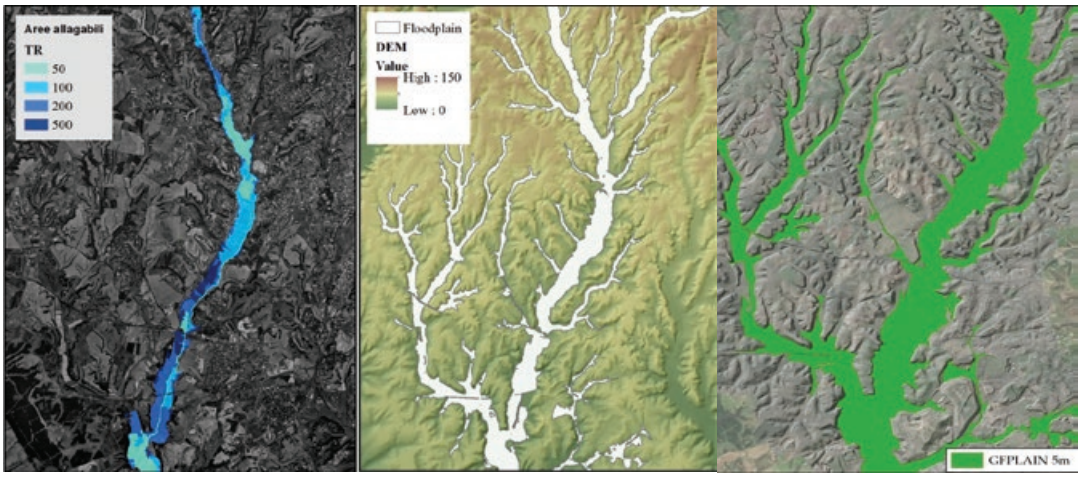


Figure 5. Flood events in Rome: Aniene river in 2008 ponte Nomentano (top left) and Tivoli, Corcolle, Lunghezza, Salone (top right); Tiber river ponte Milvio in 2010 (bottom left); Almone-Caffarella tributary in 2008 (bottom right).

Figure 6. PS5 City of Rome Flood Risk Modelling and Mapping Updating Program with selected products: Updated flood hazard maps (upper left); the 13 small river basins and the impact of river-road intersections (upper right); Aniene river 2D hydraulic modelling and mapping products using high resolution Lidar DTMs (bottom left and right).

engineering and earth science with social sciences and humanities for updated and accurate flood hazard knowledge framework that work consistently at different spatial and temporal scales and foster increased awareness and behavioral change. The geologic and hydrogeomorphic landscape memory of past physical and socio-demographic dynamics related to flood events shall be considered for supporting the co-identification (with stakeholders and citizens) of technical solutions that match the socio-economic, physical and cultural settings;

– human settlements protected by flood protection systems shall be properly identified and managed considering the uncertainties, complexities and inefficiency of urban drainage systems in fluvial valley bottoms. Residual flood hazard is a major source of uncertainty and adequate financial and technical resources shall be dedicated to flood-protected areas. Compound and geomorphic floodplain zoning shall complement or surrogate standard hydrodynamic studies for data scarce flood-prone domains;



- urban-water-flood interacting features and processes in metropolitan domains like the city of Rome required advanced knowledge and tailored mitigations actions with specific focus on river-road intersections, river-sewer coupled systems and rainfall-induced local inundation events that also occur for low return period hydro-meteo events;
- co-identification of waterscapes, space to store and efficiently manage flood waters, employing nature based solutions and valuing ecosystem services along riparian corridors.

Figure 7. The flood hazard map of the Rio Galeria, tributary of the Tiber river in Rome: inundation mapping scenarios for different return times (left) and the GFPLAIN floodplain model (Nardi et al., 2019) for extended flood prone area mapping at 20m calibrated on the Galeria PAI (center) and at 5m resolution matching maximum floodplain extents (right).

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The Tiber River Contract: the Roman Path

The implications of global megatrends will continue to affect European cities and territories in the coming decades (EU Strategic Foresight 2021). Climate change, technological acceleration and digitalization, major economic, geopolitical, and demographic shifts all contribute to ecosystems' vulnerability if not addressed properly. Climate change has significant ramifications for local contexts that are becoming increasingly uncertain, they include droughts, temperature fluctuations, extreme heat, rising and falling water levels, water scarcity, emissions and land-use change, and migration (Manigrasso 2019). As a strategy for guiding cities through such crises, adaptation must anticipate the threat in order to prevent it, whereas resilience, as a characteristic, entails a willingness to restore normalcy with minimal disruption or to maintain the status quo's growth despite the disruption (Taleb 2013). Therefore, how to overcome unpredictable risks when they occur threatening the possibility to anticipate?

Examining local proof, possible solutions are derived from situations with a high degree of urban experimentation that are focused on urban commons, such as the public realm, green spaces, city streets, historical and cultural assets, neighborhood or community services, which are considered common urban goods and services because they contribute to the local community's welfare and the satisfaction of needs related to city living (Hess and Ostrom 2007; Foster, Iaione 2016 and 2019). The experimental nature of these urban responses to environmental and societal challenges has tended to disperse authority and multiply the capacities involved, enlisting many more actors and initiatives and displacing the assumption of centralized control that undergirds modernist planning and government practices (Bulkeley and Castán Broto 2013; Evans et al. 2016; Fuenfschilling et al. 2019; Torrens et al. 2018; von Wirth et al. 2018; Torrens, von Wirth 2021).

Paradigmatic cases can be found in the Roman River Contracts that combine urban and territorial experimentalism, stakeholder engagement, co-design, hydraulic, environmental, and naturalistic engineering towards a systematic institutional and governance change to improve river and riverside management while being mindful of planning restraints.

The two main rivers in the city of Rome, the Tiber and the Aniene, in fact define and sustain urban settlements and landscape, and both material and immaterial cultural heritage. These roles are clear in the minds of its inhabitants, and they have

raised awareness of the need for reconfiguring sociotechnical systems and managing multiple competences conflicts as a step in the political-ecological process of engineering infrastructures (Graham and McFarlane 2015; Gupta 2018; Howe et al. 2015).

River contracts, as strategic and negotiated planning tools with voluntary participation (World Water Forum, L'Aja 2000), have appeared to be the ones that have the potential to respond to these issues by employing a systemic approach and emphasizing a high level of interdependence among stakeholders. According to the European Union's Water Directive (2000/60/CE), the Floods Directive (2007/60/CE), and coherently with the Habitats Directive (42/93/EEC) and the Marine Strategy Framework Directive (2008/56/EC) a river contract is a voluntary agreement between public and private entities that aims to improve the environmental and economic quality of a river system and its associated wetlands, as well as to reduce the risk of flooding. The river contract experience was born in France in the early 1980s and, after spreading in Belgium's Walloon region, was introduced in Italy at the beginning of the 2000s with pilot experiences in Lombardy and, since 2007, in Piedmont. The Italian River Contracts Law, Art. 68 bis of the Environmental Code, recognized that they are becoming increasingly important for pollution prevention and reduction, sustainable water use, environmental protection and aquatic ecosystems, and reducing the risk of floods and droughts.

Each river contract is structured as a negotiated programming agreement defined in relation to current planning and the specific competencies of the various interested parties, leaving room for collaboration, which can include system-wide interventions at various levels on the river with structured activities, that are required to ensure coherence and efficacy in blue infrastructure-based urban regeneration.

With this goal in mind, Agenda Tevere Onlus became the promoter of the Tiber River Contract in June 2017 by aggregating existing experiences and skills firstly with a governance action establishing an association of associations to build a strong relationship with the mission managers of the various relevant institutions, as stated by the Formal Commitment Act of the Tiber River Contract (2022). The goal of this multi-actor and multi-disciplinary collaboration is to create an urban-environmental structured action for the Tiber River and the areas along its banks, which will be accomplished through a broadly shared roman and regional path capable of making the

interventions studied and implemented effectively. The creation of the umbrella organization Agenda Tevere prior to the start of the process was the first governance achievement that pushed for an initial coordinated action among associations working on the Tiber river which did not had the individual power to raise instances and action among institutions.

The Tiber river contract was the first in Italy with a community promoter. Counting on more than fifty associations that are part of Agenda Tevere itself, the contract has been designed as a collaborative strategical planning tool. It allows to define a shared strategy for environmental improvement and enhancement of the Tiber starting from inhabitants and users, and thanks to the interaction between competent authorities, experts and the territory. It is not a tool for urban planning, but rather a shared effort to resolve conflicts and overlaps in accordance with existing planning, aiming to activate a process of re-appropriation led by the community and to rebuild the relationship between the river and the city.

The tool is a commitment pact between administrations that should have to clarify and simplify responsibilities since the management of the Tiber's urban stretch, from the dam of Castel Giubileo to the Mouth, is divided among the state (4 bodies), the region (at least 8 different offices), the municipality (at least 4 departments and 1 superintendency), and a former province, for a total of approximately 18 entities. Thus, about ninety different stakeholders which represents the quintuple helix of urban innovation ecosystem (Foster and Iaione 2016) have joined the process of the Tiber River Contract: public administrations, with the institutional component represented by the City of Rome (Roma Capitale), chairman of the iter-istitutional committee, Metropolitan City of Rome (the former Province which now represents the metropolitan area of the City), Municipality of Fiumicino, District Basin Authority of the Central Apennines, Suprintendency ("Soprintendenza Speciale Archeologica Belle Arti e Paesaggio of Rome"), Port Authority, the Municipalities of the city of Rome with advisory functions; research bodies such as CNR (Consiglio Nazionale delle Ricerche) and INU Lazio (national institute of urban planning) and universities departments at Sapienza and Roma Tre; private sector and public-private agencies such as ACEA, a multiservice Italian company that manages and develops products and services in the hydric, energy, and environmental sectors; professional associations, territorial and voluntary associations mainly under

the umbrella organization Agenda Tevere (55 associations); and community.

The path that led to the signing of the River Contract in 2022 was a complex process of knowledge, analysis, and collaborative planning lead by a Technical Secretariat[1] that began with the selection of the area of direct interest from Castel Giubileo to the Mouth to allow for local enhancement and direct community engagement, as well as broader reflections at the basin level to ensure accurate hydraulic evaluations and biodiversity conservation. Emerging issues have been constantly transferred, discussed, tested and approved within the Inter-institutional committee. The process can be summarized through main pillars corresponding to four main steps: the signature of the Manifesto in 2017; the definition of the Programmatic Document in 2018; the selection and support through the regional public tender towards the Three-Year Action Program that let emerge 21 River Contracts in the Lazio Region between 2019 and 2020 and the signature of the first three-year action program in 2022, with a negotiated programming agreement among all parties.

The manifesto and the programmatic document, which are also peculiar and required outputs of all River Contracts highlighted the objectives for the Tiber grouping them in: hydraulic risk management and water resource management; improvements in water quality; environmental quality; accessibility and use to make Tiber a public space; enhancement of existing projects; knowledge dissemination and active participation[2].

The first three-year action program identifies forty-nine actions with thirty-nine responsible actors that have committed themselves to guarantee funding for the implementation. The Metropolitan City will oversee the continuation of the process with the assistance of Agenda Tevere. According to the negotiated planning agreement, the two actors will be supported in this action by an assembly composed of the legal

1. The Technical Secretariat is composed by a core group of professional and researchers: Paola Cannavò, Laura Clerici, and Paola Verdinelli, president, vice-president and former president of Agenda Tevere, Luna Kappler, Elisa Avellini, and Romina D'Ascanio. The secretariat coordinated the working groups that have analysed the current situation of the Tiber and both the on-field and negotiable activities from the preliminary strategical documents to the Action Plan.
2. The objectives have been operationalized in six strategic axes to identify clearly actions and responsibilities: update and development of the knowledge framework; hydraulic safety; water quality; biodiversity and ecological functionality; integrated fruition; active participation.

representatives of the agreement's signatories and a coordinating co-committee that will identify the technical structure responsible for providing operational guidance.

Agenda Tevere's network capacity and LabGov.City negotiation support have stimulated additional opportunities for river governance. These have led to the recognition of the Participation Foundation with regional law, L.R. Lazio 27/02/2020, n. 1, art. 20. The vehicle would incentivize, stimulate and enable active public and private entities to invest in the quality and enhancement of the river area. It should activities co-financed with regional funds and involving social, civic, cultural, public and sector operators in the enhancement of the river area, including through maintenance, programming, planning, supervision and coordination initiatives. The statute provides that at any time public or private subjects sharing the same aims can join the Foundation. The Foundation guarantees, with its presence in the territories of Rome and of all the municipalities crossed by the Tiber river that express their interest, and stimulates the birth of forms of partnership with universities and research centers, responsible and innovative companies, civil society organizations, including informal ones, to promote sustainability, the fight against climate change implications and circular economy.

Within these unprecedented achievements for the city, the Tiber uniqueness demonstrates that it is difficult to obtain appreciable and non-ephemeral future-proof changes and outcomes without the direct involvement of all actors, avoiding to restore initial imbalances and rigidity. Therefore, as a result, it appears clear that the River Contract must prepare to fulfill two major and related tasks: the definition of innovative governance models to operationalize the proposals and the concretization of some of the hypothesized initiatives as experimental actions such as pilot projects to implement goals through social empowerment and tasking the Tiber with recomposing conflicts, uses, and distances. The key will be in the management and outcomes of the transition of river contract governance from Agenda Tevere, as an entity close to primal and local experiences, to the Metropolitan City, an institutional entity that may have more weight in terms of coordination and responsibility but must be able to maintain dialogue capacity.

As a result, the Tiber will have to face and overcome a new period of disenchantment due to the unrivaled power of the contracting instrument. It is possible that institutions, following

the example of already existing associations in the process, will be able to facilitate contract's implementation by focusing on the people involved, the negotiation, and the responsible confrontation.

The high flexibility, multisectoral approach, and integration of plural actors with clear competences and responsibilities of the Tiber River contract would be lost if the role of system integrator, an intermediary primarily between public institutions and communities, previously played by Agenda Tevere, will not be carried on after this governance shift from community to public.

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The Public Space Around the Tiber Realm

Faced with the Anthropocene, the contemporary culture of design can try to translate environmental awareness into a renewed understanding of the philosophy and politics of public space, making use of interdisciplinary tools and practices[1].

If at the beginning of the 21st century the idea of the city was defined above all by its historical and cultural resources and urban biodiversity was not considered an emergency, in contemporary times urban spaces necessarily contemplate naturalization processes. This vision experiences the complexity of ecological flows and involves new responsibilities and a radical revision of the design approach, also considering how the Covid 19 pandemic has exacerbated metropolitan social and environmental inequalities.

The great changes that began with the birth of Rome as the capital, related to hygiene, public spaces, tree planting, still constitute the vocabulary of the capital's urban management. The need for an ecological renewal of the city involves integrating the stratifications of the past with an ethics and aesthetics of climate change, orienting design research towards a different balance between nature, social dynamics and technological innovation.

The city as a place of coexistence, heterogeneity and relational multiplicity between different forms of life, implies a reflection on the concept of border, as a flexible and porous place. According to this meaning, the border can be continuously transformed and welcome design values based on a holistic approach, an expression of mixes and hybridizations where all the elements have equal dignity[2].

In order to recover and enhance the ethical foundations of the concept of decoration, the small-scale design can experiment with projects for urban spaces and equipment in the name of integration with nature, a fluid society and a more elastic democracy.

The challenge for designers today is also to interpret multiple behavioral variables: those of childhood, of the homeless, of the elderly, of disability. The aesthetics of the ordinary must therefore be measured against the quality of objects, simplification and attention to detail, to educate the gaze and

1. The new geological and cultural era is a consequence of the impact of human activities on the planet. It was defined with the term Anthropocene in 2000 (Crutzen P. J., & Stoermer E. (2000). *The Anthropocene*, in «IGBP Newsletter», 41, 17-18).
2. Among the philosophers and scientists who share this vision, they stand out: Coccia E. (2021). *La vita delle piante. Metafisica della mescolanza*, il Mulino Bologna; Ferriolo M. V. (2019). *Oltre il giardino. Filosofia di paesaggio*, Einaudi, Torino; Mancuso S. (2019). *La Nazione delle piante*, Laterza, Roma-Bari.

civic sense, using a technological mix of durable materials and smart technologies.

This vision, which provides for the multiscalar, interdisciplinary and international comparison between research and projects developed within European universities, is consistent with the New European Bauhaus, the initiative that was launched by Ursula Von der Layen in 2020, aimed at imagining and build a sustainable and inclusive future together.

The three axes on which the New European Bauhaus "Beautiful, Sustainable, Together" is based, indicate respectively: an enrichment inspired by art and culture aimed at responding to needs beyond functionality; a vision in harmony with nature, the environment and our planet; the search for a dialogue between cultures, disciplines, genders and ages.

The border theme is physically and metaphorically linked to the river and can be the subject of an interdisciplinary theoretical reflection that includes philosophical and artistic aspects, medical sciences, psychology, psychiatry and sociology, a set of disciplines that combine to define concepts related to the public space project. Together with the theoretical and research aspects, design experiments for the regeneration of the banks of urban rivers are desirable. In this sense, the case of the Tiber is of great interest[3].

The goal is to promote a European idea of the city and at the same time identify local peculiarities, re-qualifying the public spaces along the riverside. As for the banks of the Tiber, it is a piece of the city rich in memories and centuries-old stories, with a particular microclimate, which can be freed from its state of decay and abandonment even with micro-interventions[4].

3. In consideration of the reflections presented, the Internationalization Unit of the PDTA Department organized in May 2021, the "New European Bauhaus. New Boundaries. Public space toward a sustainable urban environment", together with the Technische Universität Wien. In particular, the Study Day was dedicated to the border areas of urban waterfronts. The comparison was aimed at defining a network of references to improve the quality of the public space project in European waterfronts, promoting synergies between different practices. In addition, an international workshop was held between Technische Universität Wien and Sapienza University of Rome, which was attended by students of architecture, urban planning and design from the respective institutions. The workshop was conceived and coordinated by Prof. Dal Falco of the PDTA Department and by Mladen Jadric (professor of architecture TU Wien), with the participation of Chiara Ravagnan (professor of PDTA Urban Planning), Carmen Rotondi (PhD candidate PDTA), Federica Rizzo (TU Wien teacher).The goal is to promote a European idea of the city and at the same time to identify local peculiarities, regenerating public spaces along the Tiber rivers in Rome and Danube, in Vienna.
4. For further information on the history of the Tiber: Segarra Lagunes M. M. (2004). *Il Tevere e Roma. Storia di una simbiosi*, Gangemi, Roma; Cavriglia S. (2019). *A proposito del Tevere. Storia, bellezza e futuro del fiume che ha fatto grande Roma*, Intra Moenia,

In particular, on the areas between Ponte Milvio and Ponte Flaminio, helping to redevelop the embankments and liminal areas with light stratifications along the lines, by points, and in synergy with the masterplan and dedicated urban projects.

This design approach can integrate various aspects: listening to places also in relation to the behaviour and needs of citizens with systems of tangible and intangible objects; research on materials and details with references to the history of Roman decorative arts; installations in collaboration with nature.

The goal is to reactivate the relationship between the river and the city through small things, making the spaces near the bridges permeable (Ponte Milvio, Ponte della Musica, Ponte Regina Margherita, Ponte Duca D'Aosta) even with floating platforms that accommodate housing units minimal, solaria, hydroponic greenhouses. The interventions are linked by a common approach aimed at an idea of inclusive public space that integrates social aspects with knowledge of cultural heritage, with multimedia narratives incorporated into the systems of objects.

To conclude, if the urban narrative of Rome relates to its being the eternal city where change coexists with the complexity of urban stratifications, it is time to experiment with a new furniture of the world, at the service of an aesthetic and an ethics whose purpose is functionality enriched by culture, biodiversity and social inclusion.

Napoli. In particular, for the Flaminio area: Ostilio Rossi P. (2020). *Nell'ansa del fiume. Frammenti di storia urbana del quartiere Flaminio*, in Ostilio Rossi P. (ed.), *Flaminio Distretto Culturale di Roma. Analisi e strategie di progetto*, Quodlibet, Macerata, pp. 38-101.

Sapienza University of Rome Bruno Monardo

The Flaminio District
Historical Plans and Urban Fabric Evolution

People who do not live or frequently use the Flaminio district could at first sight consider it a hinge between the historic center of Rome and other important neighbourhoods (Prati, Parioli, Pinciano), or an urban fabric simply leaning around the Tiber or that area where nowadays citizens happen to go because of the 'Auditorium Parco della Musica' and the XXI Century Art Museum or a place labelled by sports and great events. However, looking at the history of Flaminio, it is easy to understand how, beyond its century of life as a proper neighbourhood, this part of the capital represents a crossroad of events and characters that make it a place of great charm.

It is impossible to explore the Flaminio without, obviously, highlighting the Via Flaminia. Starting from the 'Campidoglio' this road, that in ancient times connected Rome to Ariminum (Rimini) on the Adriatic coast, followed the route of the current Via del Corso, passed through Piazza del Popolo and continued along the path that we still know today, thus representing a fundamental connection to the north of the Peninsula. Today, the Via Flaminia could appear to be an artery like many other primary radial tracks, sometimes congested and chaotic. Nevertheless, it could be narrated meter by meter, because at every step the ancient consular delivers historical episodes and extraordinary memories (Fabrizi 2020).

A narrative that naturally cannot overlook the river of Rome. Here the Tiber has always been a strong and conditioning presence: there was a time for fishing and trading, for swimming and for games in the water. But there was also the time of floods, because right here the river sometimes overwhelmed the city, so much that 'Porta Flaminia' was called 'Porta Flumentana' (the river gate).

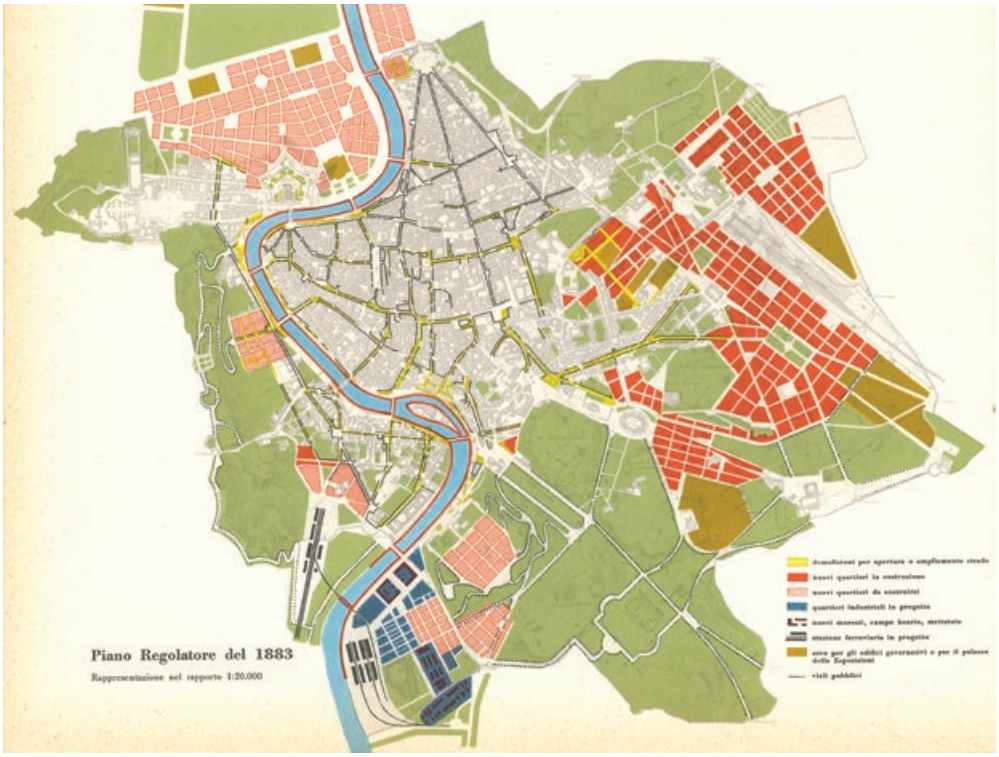
The initial straight segment of the via Flaminia marks the consular axis root that arises from the historical heart of Rome (the Arx, northern height of the Capitol Hill) following the Tiber valley. It immediately establishes a strong relationship with the bend of the Tiber through the 'Ponte Milvio', the extraordinary Roman bridge that has been representing, since the third century B.C., the compulsory passage to connect Rome to the northern territories both towards the Adriatic up to Rimini crossing the Apennines (via Flaminia) and the Tuscany (via Cassia).

Historical maps drawn by the French military authority before Rome became the Capital of the Italian Kingdom, show quite clearly the orographic condition of the area on the east side of the Tiber river, with the Flaminio floodplain between the almost semi-circular river bight and the gentle tuff hills of Villa Glori, the

Figure 1. Map of the Flaminio plain published by the French Military Engineering Corps in 1856 and updated in 1868 (CC 4.0. source: Rossi P. O. 2020, p. 40).

Figure 2. Rome General Master Plan 1883 by Alessandro Viviani (CC 4.0. source Aa.Vv. 1958, p. 117).


Farnesina
Villa Madama
Villa Massimi
Palazzo di P. Giulio
VILLA BORGHESE
Recinto


Piano Regolatore del 1883
Rappresentazione nel rapporto 1:20.000

Parioli neighbourhood and the park of Villa Strohl Fern (part of *Villa Borghese*).

The hills and mostly the river are in this area the principal geographic items defining the neighbourhood morphology and conditioning all the potential urbanisation.

Before 'Rome Capital', the thin urban strip parallel to the river coming out of Porta del Popolo and the northern flooding plain appeared as a non-urbanized land, with vineyards and hidden heritage values (such as the underground signs of the ancient consular "Via Flaminia" or the traces of Roman villas and graves) together with few well-preserved infrastructural and architectural assets (the Milvio bridge or the church of S. Andrea designed in 1553 by the architect Jacopo Barozzi, well known as "il Vignola"). As curiosity, in the Napoleonic age some projects had been proposed to transform all the plain into wonderful leisure spaces and gardens (Villa Napoleon park by Valadier), following the "Italian garden style".

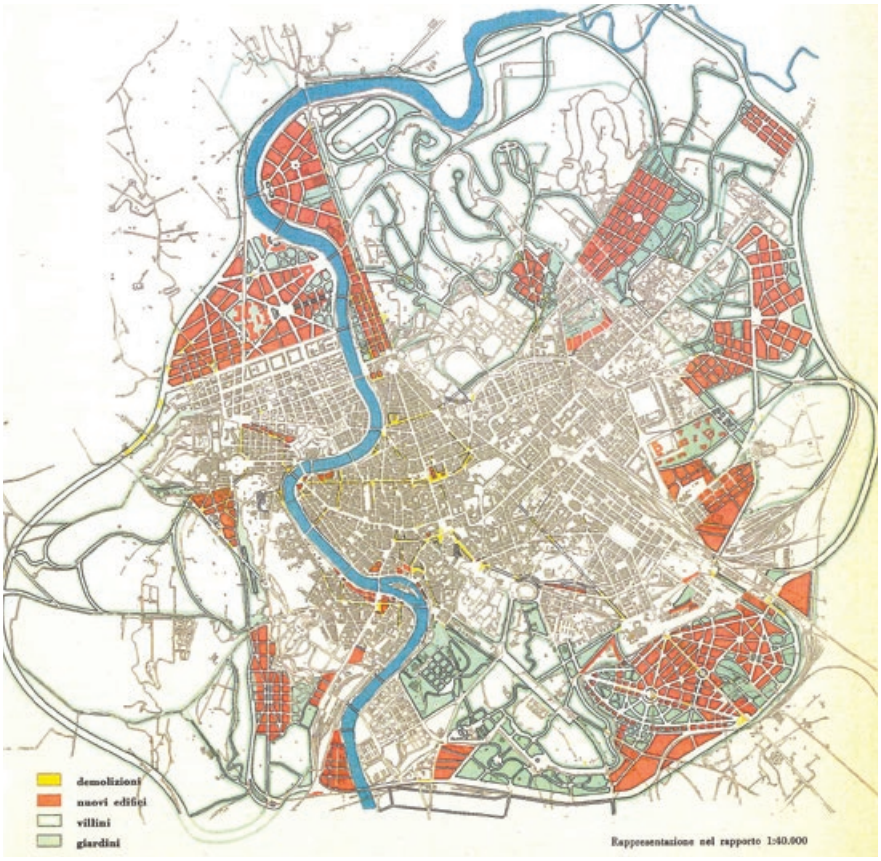
After Rome became Capital of the Italian kingdom, it is interesting to reconstruct the relationship between the official general plans of the city and the real urbanisation process, asking ourselves, as usual for planners, if the city followed its plans or vice-versa. In the proposal of the very first general expansion plan as new Italian Capital (1873 by Viviani), the Flaminio plain was not considered as an urbanising area, differently from the second edition of the same plan in 1883 where a limited reticular urban pattern was conceived around the Flaminia road.

The most important Master plan that changed the destiny and imprinting of the Flaminio plain dates back to 1909, an urban tool invented by the engineer Edmondo Sanjust di Teulada and pursued by the progressist administration of the Mayor Ernesto Nathan. In the context of an expanding Capital with a large development of new high and medium-density neighbourhoods, Sanjust defined a geometric trident layout with dense courtyard blocks conceived to deliver a clear design of the public and private space (Aa.Vv. 1958). The plan had the intuition of explicitly imagining the main 'decumanus' (as integrated and opposed to the historical 'cardo' of the Via Flaminia) and the new bridge that was proposed to connect the eastern part of the plain to the western side of the Tiber. Incredibly, this new connection (the 'Music bridge') would have been implemented just one hundred years later!

The year 1911 was an important step for changings in the urban context: with the celebrations of the 50th anniversary of Italian kingdom the national government promoted a great event: the Universal EXPO 1911 whose areas were located both on the

Figure 3. Rome General Master Plan 1909 by Edmondo Sanjust di Teulada (CC 4.0. source: Aa.Vv. 1958, p. 127).

Figure 4. Excerpt from Rome General Master Plan 1931 of the Commission composed by F. Boncompagni-Ludovisi, A. Brasini, C. Bazzani, M. Piacentini, R. Paribeni, G. Giovannoni, A. Calza Bini, E. Del Bufalo, P. Salatino, A. Munoz, A. Maccari, A. Bianchi, C. Palazzo (CC 4.0. source: Aa.Vv. 1958, p. 143).


demolizioni
nuovi edifici
villini
giardini
Rappresentazione nel rapporto 1:40.000


Legenda

right and left side of the river, connected through the new elegant 'Risorgimento bridge'. The western area was conceived to host the Italian regional pavilions whose location was guided by an imaginative layout; the eastern area, called 'Vigna Cartoni' (today well known as 'Valle Giulia') was planned to host the international fine arts pavilions, which later would have been redeveloped as extraordinary Academia buildings of several countries (Great Britain, Austria, Belgium, The Netherlands, Sweden, Denmark, Rumania…) within the context of the finest historical park in Rome.

In the same year it was completed the new National Stadium (designed by Marcello Piacentini) whose location in the flat plain would have highlighted and enhanced the sport and leisure vocation of the Flaminio district.

Within 1909 and 1937 the urban fabric designed by the Sanjust Plan (and partly the following Rome Masterplan in 1931) was developed with relevant qualitative residential episodes mostly about public affordable or bourgeoise housing, as the so called "Little London" block, 'Flaminio II', or 'Villa Riccio'.

On the contrary, the original imprinting planned by Sanjust for the Flaminio district was partly betrayed by the decision (during the First World War) to settle a huge military area in the heart of the bight, locating barracks and warehouses for the production of weapons, and later of automobiles and precision tools (Vittorini 2004).

The lack of integration of the impenetrable enclosures with the rest of the urban fabric still remains today. This fragmentation began to decrease only quite recently with the construction of the MAXXI (Museum of Modern Art of the 21st century, designed by Zaha Hadid) and with the potential of the public-private partnership project in the southern section of via Guido Reni ('Città della Scienza').

On the right bank of the Tiber, we cannot forget the relationship with the monumental complex of the 'Foro Italico' (originally called 'Foro Mussolini', conceived to celebrate the fascist regime and to support Rome's candidacy for the Olympic Games in 1944. Within a high quality environmental and landscape context, it is an extraordinary concentration of remarkable architectures, mostly urban sport equipment, completed over time by other primary activities and services.

However, the Olympic games were in the destiny of Rome and the Flaminio in particular: they were assigned to the Eternal city for the 17th edition in 1960. The Master plan identified two main areas: the 'Foro Italico' and the Flaminio neighbourhood in the northern part of the city, and the EUR district in the southern part, connected by a western urban ring road.

The most important projects for the event in Flaminio were the amazing sport facilities, the Flaminio stadium and the 'Palazzetto dello sport' signed by an extraordinary personality: Pier Luigi Nervi. It is amazing to recognize the physical configuration of the flat plain between the hills and the river that inspired the urbanization choices of the poetic pieces of architecture, "pure volumes" under the light following the vision codified in the Modern Movement by Le Corbusier.

The Swiss Master, who visited Rome at that time, greatly appreciated in Flaminio the planning and design approach not only of the great sport facilities but also of the Olympic Village settlement. In the scientific literature the Olympic Village plan is considered one of the best residential neighbourhoods of public initiative in Rome following the Modern Movement rationalist principles. At the base of the district there is the desire to respect the natural environment, transforming the open green space into the emerging framework of the urban project.

The recent urbanization process has been characterized by an incremental approach based more on large architectural projects than organic urban transformations.

In the nineties the great complex of the 'Music citadel' by Renzo Piano with the three volumes and the cavea (enriched by the discovery of the archaeologic traces of a Roman villa), the 'Music bridge' as real connection imagined one century before by Edmondo Sanjust, the MAXXI Museum by Zaha Hadid (and its new planned expansion), the recent competition for a new "Museo della Scienza" are all projects able to add values and centrality to a part of the city whose keywords over time are with no doubt culture, arts, sport and leisure (Rossi 2020).

However, some unsolved issues remain, as it was already indicated more than 15 years ago for the Flaminio area by the Tiber 'Strategic Planning Zone' and the specific Urban Project ('Progetto Urbano Flaminio') within the general Master Plan of Rome 2008. These include the cardo-decumanic system to be enhanced, the relationship of the urban fabric with the Tiber to be rethought and some specific parts which, due to unfortunate choices, are still critical areas. Particularly intriguing are the 'Mancini' and the 'Maresciallo Giardino' squares, distopic spaces which could be defined sort of "non-places" following the successful definition by Marc Augé. They represent remarkable potentials for increasing the urbanity of the urban fabric and their relationship with the riverfront.

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Sapienza University of Rome Francesca Rossi

Landscape and Perception Values in the Urban Context of Flaminio

Understanding of landscape and perception values is an essential means to support sustainable land use and spatial planning, because they represent the material and immaterial dimensions of environmental, cultural, social and economic processes, facing constant change.

The landscape provides us with a range of goods and services, represents an important part of our identity, it has a symbolic nature for the equivalence that it has with the context to which it belongs. The diversity of demands, perceptions, and uses of landscapes raise challenging questions about how to best design, plan, and manage resilient landscapes that are resistant to shocks and adaptive to changes in society and environment.

In this sense, we can define green and public space networks (*green and blue infrastructures*, *waterfronts*, *riverfronts*, *new urban public spaces*) as urban and environmental regeneration matrices for a possible socio-economic rebalancing.

From the eco-systemic perspective, the Tiber is a primary structural element at a regional and urban level. Its morphological conformation and its territorial location between the hinterland and the coast underline the strategic relation of the ancient Rome with this specific nature of the river. The identity of the Roman landscape belongs to its historical and environmental relationships, a link between natural and cultural components which assumes a key role at the identity and landscape level (Calzolari 1999). From the landscape perspective we can easily identify the river in the urban built area of Rome, where it flows establishing a physical and symbolic stratification process of distinctive landscapes (Turri 1998).

The reflection of this contribution is aimed at 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; 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, cultural relations between public space and urban activities.

The opportunity to get to know the river in all its perspectives allows to highlight those values, as also critical issues, useful to strengthen the relationship between the river and the city, to improve the fruition and use of the banks, to promote the participation and cultural re-appropriation.

Figure 1. The Tiber at Ponte Flaminio. A privileged perspective on the river landscape.

Observing the Tiber from above, with aerial photos and updated maps, it is possible to understand the role it has had in the organization of the city of Rome, from Castel Giubileo to its natural mouth, between Isola Sacra and Ostia. Castel Giubileo represents the crossroads from which, in ancient times, trade routes between Etruria, Sabina and the south were dominated. From here to its mouth, the Tiber flows for about 60 kilometres in the territory of Rome, with a riverbed, excluding the banks, that is 70 to 120 metres wide. In its flow, the Tiber passes under 38 bridges built between 179 B.C. and 2014 A.C. Between Ponte Milvio and Ponte Marconi it flows between artificial embankments, but with precious stretches, albeit rare, of renatured banks. The central stretch flows imprisoned between high and imposing walls up to 13 metres high but here the Tiber changes its nature. Looking at the Tiber at the level of the city, walking on bridges and sidewalks, the feeling of distance and not-belonging can be even stronger than the unquestionable beauty of the Eternal River.

The walls close the visuals, and the perception of the water that flows in the middle is denied to the eye. The bridges characterize this part of the river landscape because they

represent a privileged point of view at the street level, while the cycle path on the right bank and a few boats give the Tiber a chance to be approached and enjoyed by people.

Finally arriving at the water level, walking on the banks or rowing, it is possible to look at the Tiber by the Tiber itself. It is here that the Tiber weaves a special relationship with nature, history and the culture of the city. The natural vegetation endures, and the riparian flora testifies that the river is the main gateway for animal and plant biodiversity to enter and remain in the city. At least 1300 species of wild plants have been recorded, and at least 600 are in the aquatic habitat, which offers a temperate and humid climate. Although willow and poplar groves that colonised the capital's wetlands have lost their continuity due to cementification and land reclamation, the typical tree species and reed beds resist and represent the ecological vitality of the Tiber, which despite the aggressions and risks aggravated by the climatic emergency of recent decades, continues to guarantee life to original plant and animal varieties or even to those that have been replaced over time but nevertheless represent its richness (D'Angelis 2019).

A limited impact in time and space, without disturbing either the fauna and the flora, is given by the sport activities on the river, which represent a very sustainable way to get to know the river ecosystem. A low-cost offer of river sports, less elitist than the current many private clubs on the riverbanks, would therefore encourage citizens to spend time on the river waterfront also attracting attention on the abandoned dock spaces. A holistic fruition strategy could be conceived, including natural and social aspects with the aim to enhance the natural, landscape and cultural components of the river, its possibility of public and democratic sporting fruition, the safe and clean access to its banks: just a few interventions, if well designed, can transform the Tiber to a new urban centrality (Galassi et al. 2020).

The river as a common landscape, the paradigm of an ecological perception of the city, capable to produce environmental, social and perceptive well-being, through the mitigation of temperatures, control of waters, floods and drainage, the creation of shared urban gardens, pedestrian and cycling spaces, spaces for sports and other outdoor activities, all these items mean the Tiber as a "common good" a shared 'natural and cultural capital' linked to the concept of community and to the responsibility of people.

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Projects results

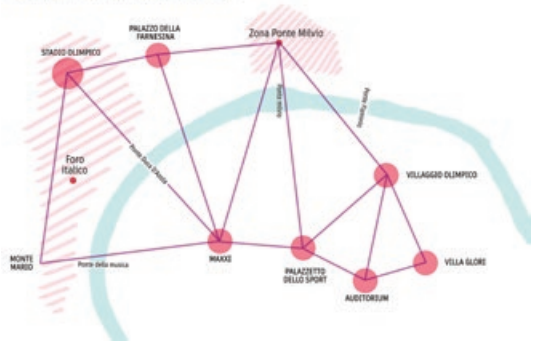
Through water

Group Participants:
– Students: Giuseppe Buffa, Iris Chiarato
– Experts: Hugo Fernandes, Karolina Matej-Łukowicz, Anastasia Tzaka

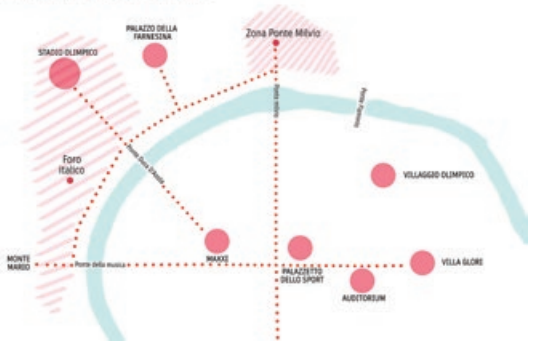
The “Through water” project stems from the desire to conceive a new urban space by exploiting water as the main element, both from an aesthetic and environmental perspective. Starting from the analysis of the Mancini Square and its surroundings, two types of connections were identified: conceptual and physical. The first refers to the mental connections, e.g. places that, although distant, are related by the type of their function. The latter refers to the physical connections, namely the real mobility passages and urban axes. It was noticed how some points of specific importance are very distant and the delineation of connections between them began from there.

Apart from the visual disconnection from the Tiber River, the main problems of the area are pollution resulting from poor quality of urban ventilation, numerous heat islands, and flood risk. For this reason, local environmental conditions were carefully studied. Firstly, the thermal conditions were taken into account. Then a flooding event was simulated and the analysis indicated which parts of the area could be reached by water in different probability scenarios. The studies indicated that the Mancini Square is one of the first areas to be affected. Hence, the design interventions aimed to deliver solutions to tackle these problems. However, the water was defined not only as a source of problems but also as having the potential to bring positive change, becoming the project’s protagonist. A comprehensive system for filtering rainwater and its sustainable re-use was proposed. It consists of rain gardens and swales that convey the rainwater to a water square and floodable playground and, finally, to underground reservoirs.

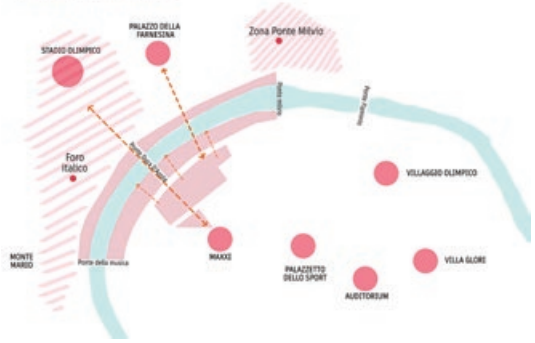
CONCEPTUAL CONNECTIONS



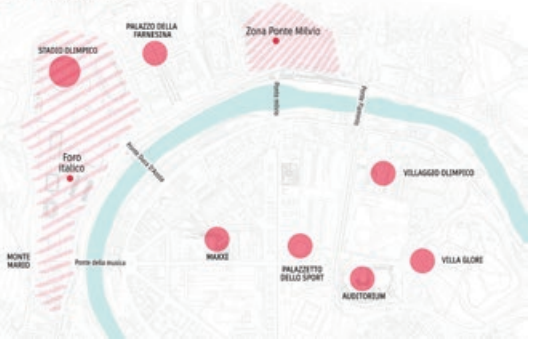
PHYSICAL CONNECTIONS



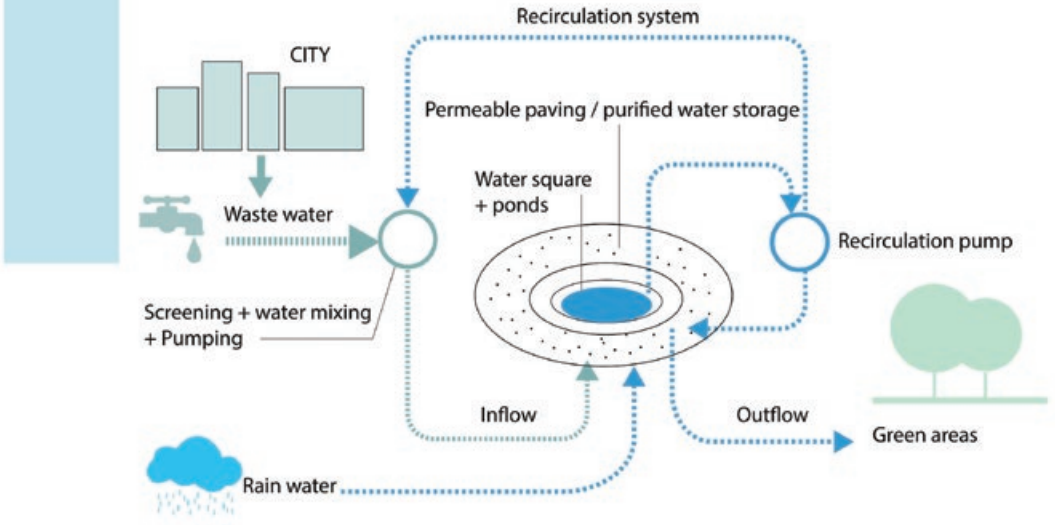
NEW CONNECTIONS



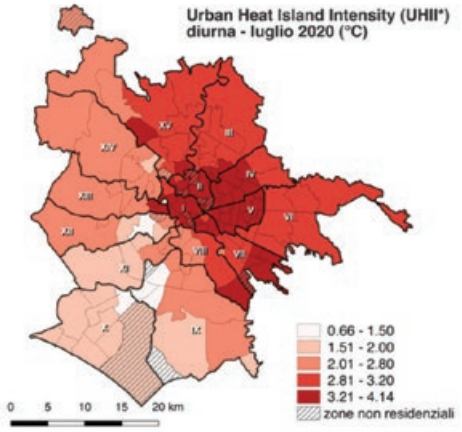
SITE ANALYSIS

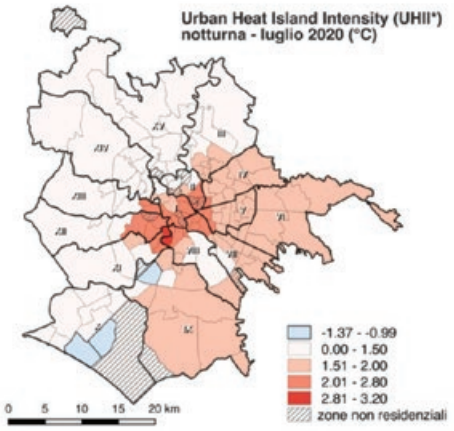


Water circulation diagram

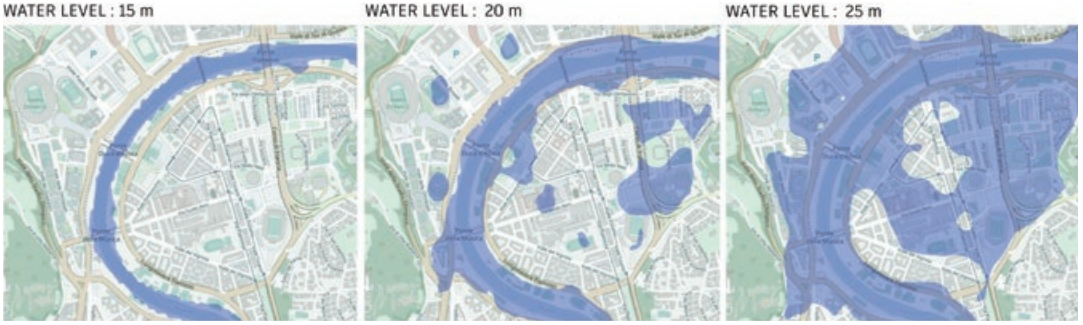


ROME: URBAN HEAT ISLAND





FLOODING SIMULATION MAP



STRATEGIES FOR URBAN HEAT ISLAND


URBAN TREE COVER


POOLS AND PONDS


RAIN GARDEN


NATURAL VENTILATION


GREEN FACADE


SHADING SYSTEMS


GREEN ROOF


FOUNTAINS AND WATER SQUARE


PERMEABLE PAVING


SOLAR PANELS

STRATEGIES FOR RESILIENCE TO FLOODING


URBAN TREE COVER


WETLAND BUFFERS


FLODABLE PLAYGROUND


WET WOODLANDS


URBAN FLOOD STORAGE


POOLS AND PONDS


PERMEABLE PAVING


FOUNTAINS AND WATER SQUARE


RAIN GARDEN


TERRACED WATERFRONT

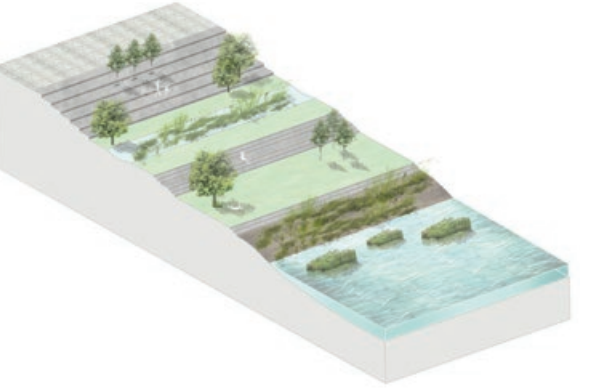
RIVERFRONT SECTION

PERMEABLE PAVING

TERRACED WATERFRONT

POOLS AND PONDS

WETLAND BUFFERS



Projects results

Let it Tiber

Group Participants:
– Students: Chiara Micaela Cassinis, Carolina Calabrese, Syria Lai
– Experts: Justyna Borucka, Szymon Kowalski

The main idea behind the project was to establish the connection between the district and the river, with the focus on the Flaminio area, in particular the Mancini Square. One of the project goals was to redesign the Mancini Square to remove the spatial chaos, propose potential solutions for the Tiber River banks, and acquire new openings for the Tiber River. Furthermore, the issue of establishing a new green connection with the river, the Mancini Square, and the MAXXI Museum designed by Zaha Hadid was also raised and discussed. Lastly, the plans for the modification of the driveways through the reduction of the car lanes and the insertion of tree alleys were also proposed.

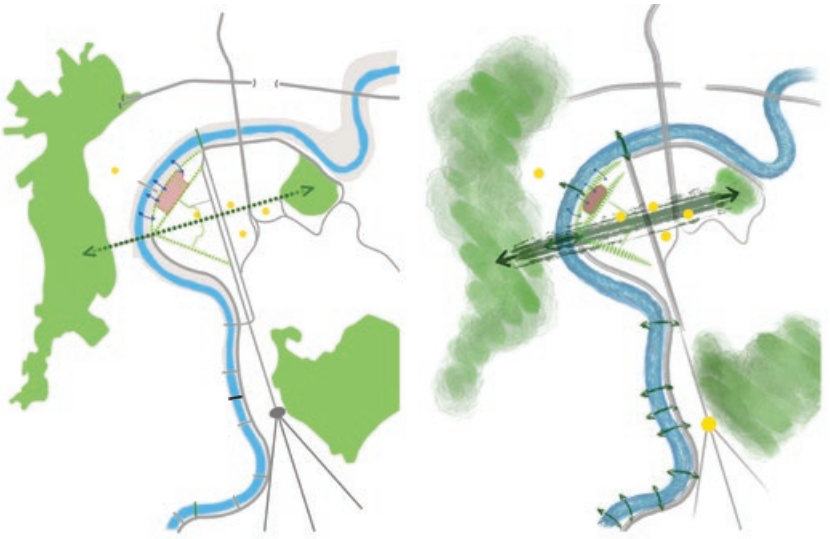
The results of the urban analysis of the area highlighted the pre-existence of highly valuable features, i.e. its outstanding architecture: the Foro Italico, Flaminio Stadium, Palazzetto Dello Sport by Pier Luigi Nervi, Auditorium Parco della Musica by Renzo Piano, and the MAXXI Museum by Zaha Hadid. Moreover, there are bridges from different historical periods in the area, such as Ponte Milvio which retains some ancient elements, Duca d'Aosta bridge, and Ponte della Musica. All these valuable objects are surrounded by the natural reserve of Monte Mario and the Villa Glori Park.

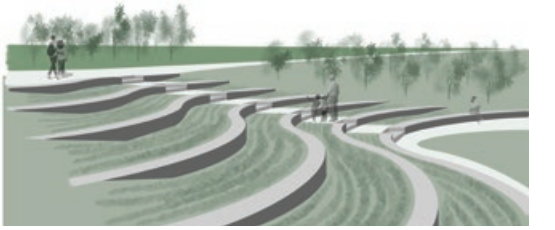
After the analysis of Rome's main development plans and policies with the valorisation of the Mancini Square, the spatial and social problems were recognised. They include the lack of direct connection between the district and its riverbanks, and the fact that the river does not feature in the lives of the local residents. The project outlines design strategies for the problem of intense traffic along the riverbank, which creates a border between the river and the district. A potential solution is to dedicate one of the road lanes along the Tiber to urban public transport and to insert central green bands lined with trees. Besides the reduction of traffic, new connections were designed to introduce new green pedestrian walkways that connect the Mancini square with the Tiber river and the MAXXI museum.

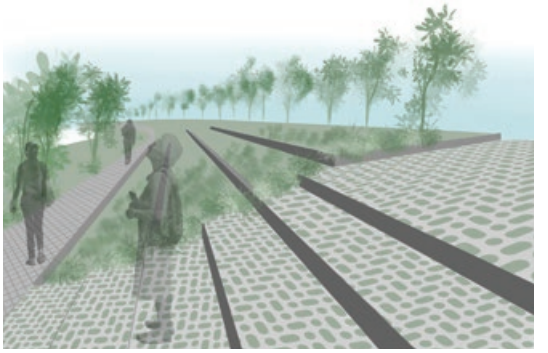
The focus point of the project is the Mancini Square's new design, which involves the spatial division of the square into green bands, each containing different public functions. In addition, some of these bands are designed as rain gardens in order to increase the biologically active surfaces. In the centre of the square, a direct connection with the river was established by designing a new opening that leads directly to the water. Within this axis, a fountain was designed to mark the direct connection between the city and water. Having discovered that the Mancini Square serves as the main transportation hub and analysed this issue, the project's solution was to preserve this function, but in a much more sustainable way, reducing the amount of

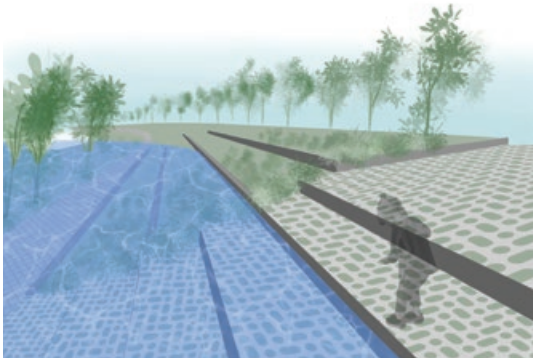
concrete-covered land and transferring the hub into multiple stories vertical bus stations, with public services and a transfer centre for communication with other districts of Rome.

Another goal of the project was to open banks of the Tiber to the public. Multiple stairways and ramps would facilitate pedestrian access to the river and could improve the circulation of people in the area along the river. They could also act as terraces, and in the case of river flooding, could be maintained in a manageable way along with water squares and river flood niches.









Part 3.
Rome Aniene River


Via Cassia
Via Flaminia
Via Salaria
Via Nomentana
Via Tiburtina
Via Aurelia
Via Casilina
Via Ostiense
Via Appia

Sapienza University of Rome Antonio Cappuccitti

The Aniene River and the City of Rome

The Aniene River is the second largest river in Rome. Its course enters the Roman metropolitan area coming from the east, and flows into the course of the River Tiber within the properly urban area.

The river is part of an important green corridor of the ecological and environmental network of the Roman metropolitan area, which determines a precious continuity of the territorial green network in the eastern quadrant of the city.

The relationship between the river, the landscape on a territorial scale and the city highlights very different situations. In various stretches of its course in the Roman area, the Aniene flows within areas of great ecological-environmental value and of particular historical significance. Within the urban area there are river areas also characterized by high environmental and landscape value, but also river stretches characterized by relationships between the river and urban areas that have very different contents and qualities, close to different types of settlement (residential districts, contemporary buildings, historic districts, spontaneous settlements, active and abandoned industrial areas, infrastructural nodes).

The situation of the quality of both the river water and its ecological-environmental environments in different stretches is also diversified.

This multiplicity of characteristics of the different homogeneous river areas of the Aniene river highlights a diversity of potential and problems in the relationship between river and city, but also in perspective the need for an articulated strategy for effective urban regeneration.

In his opening chapter, Antonio Cappuccitti describes the relationship between the Aniene river and the city within the properly urban area, delimited by the GRA motorway ring ("Grande Raccordo Anulare").

The relationship between Aniene and the city can be described by identifying a series of sections that have characteristics of homogeneity from different points of view: ecological – environmental, landscape, urban context. In their internal homogeneity and mutual diversity, these different river landscapes clearly reflect the complexity of the historical evolution of the eastern urban sector of the city.

Seven homogeneous river areas are identified and described, up to the confluence of the Aniene into the Tiber, highlighting their differences and specificities above all from the point of view of urban morphology and ecological-environmental identity.

Furthermore, a possible future guideline of urban and landscape strategy that may be able to favor a regeneration aimed at a new relationship of continuity and complementarity between the river areas and the neighboring parts of the city is briefly indicated.

Elena Paudice instead deals, in her essay, with some important aspects of the relationship between the Aniene river and the landscape on a territorial scale. In particular, the history and current state of the important area of the travertine quarries of Via Tiburtina is briefly illustrated.

The extraction of travertine from the Tiburtine quarries has for centuries been a strongly characterizing activity not only of the physical landscape, but also of the historical culture and human landscape of a significant part of the Roman area; in this activity the river was an essential reference from various points of view.

After a brief analysis of this territorial area from a landscape and historical point of view, a proposal for a regeneration strategy of the landscape of the quarries, consistent with the particular local complexity (environmental, hydrogeological, socio-economic, productive, multiplicity of operators and activity) is outlined.

The essay by Marta Polizzi illustrates the participatory initiatives of local associations in the “Valle dell’Aniene” nature reserve. This valuable system of green areas, located along the Aniene river, was officially declared a reserve with a regional law in 1997, and is under the responsibility of the regional institution “Roma Natura”.

The activity of local associations has been taking place for a long time, and has led to multiple initiatives and actions. Among these, constant attention to the monitoring and qualification of the area, the progressive planting of a large number of trees, educational and fruition initiatives in the greenery, actions aimed at planning the Aniene River Contract.

Even the essay by Tullia Valeria Di Giacomo extensively illustrates the planning and participation initiatives which characterize the system of green areas of the Aniene river. The public planning initiatives that have been aimed over time at the protection, enhancement and regeneration of the river area are indicated, and, therefore, a conspicuous series of initiatives characterized by the activation of the participation of associations and citizens.

The essay by Simona Mannucci and Federica Rosso deals with techniques for the resilience of the built environment

against water and heat. These techniques are particularly topical in the contemporary moment, especially in relation to climate change and the need to increase the resilience of the territory with regard to various types of risks, and could also be applied in various ways to the ecological-environmental and urban regeneration of river areas.

The chapter written by Camilla Di Marcantonio, Agostina Chiavola and Maria Rosaria Boni deals with the topic of the quality of urban rivers with regard to some types of contaminants. This is also an important issue for the environmental qualification of the Aniene river, which for long stretches flows near production areas of various types, including the area of the Tiburtine quarries.

The chapter written by Paulina Bone deals with the problem of forgotten peripheral rivers and streams in big cities, highlighting how water quality and the relationship between river and settlements is crucial for the quality not only of rivers, but in general for the overall quality of the urban environment.

The topic is treated by illustrating the situation of the hydrographic network of the Gdansk area, in Poland, on the basis of some quality indicators and of the respective states in different years, and also by highlighting the specific situation of the Aniene river.

The complexity of the river and urban environment of the Aniene river requires an articulated and targeted urban regeneration strategy, which involves actions of a different type and of an eminently interdisciplinary nature, but also the planning and implementation of new and diversified relationships between the river environment and built urban areas.

Sapienza University of Rome Antonio Cappuccitti

The Relationship between the Aniene River and the City of Rome

Current Status and Regeneration Scenarios

DOI: 10.36158/97888929566674

The Aniene River is the second largest river in Rome. Its course enters the Roman metropolitan area coming from the east, and flows into the course of the River Tiber within the properly urban area.

Obviously the Tiber represents a strong historical symbol for the city of Rome in a proper and primary way, both in the collective image at a global level and in the prevailing collective imagination of citizens. But some evident and important differences between the two rivers highlight the particular and important vocations that the Aniene river, in particular, presents in the perspective of the urban and ecological-environmental regeneration of a large sector of the city, and in the full realization of the future green structure of Rome.

While the Tiber river mainly flows, in its course inside the city, through and alongside consolidated urban parts of great historical importance, the Aniene river flows in parts of the city where areas and districts of more recent formation prevail, which in different cases still require urban consolidation and full qualification or regeneration.

While the Tiber river, in its urban course, mainly flows very close to the consolidated urban fabrics of the city, the Aniene flows within areas that in the main part do not have urban fabrics very close to the river. Therefore, around the river large green areas prevail, of naturalistic interest and in any case not built on, and this shows that the river can constitute an important characterizing element of the metropolitan green structure, as a green and blue infrastructure.

At the same time, the current situation of the Aniene is characterized by a relationship between the river and the city which in some respects still appears incomplete and poorly defined, in the sense that the presence of the river in the city is still waiting to be substantially valued as a relevant and qualifying element of the urban environment, in characterizing the city and in the perception of citizens.

To highlight the characteristics and real potential of the urban roles of the Aniene river in the city, we can analyze the course of the river in its innermost section in the city, starting from the ring road of the Grande Raccordo Anulare up to its confluence with the River Tiber. This section can be divided into a series of homogeneous sections from a morphological and urban point of view, which are distinguished on the basis of the specific characteristics of the areas surrounding the river, the type of settlements and infrastructure, and the current and potential relationship between river and city.

The first section, from the motorway ring road to the Rome East purification plant, is located in the urban sector called “Tor Cervara”, and is characterized by the presence of large green areas

on the sides of the river, while the built-up settlements are several hundred meters away from the river.

From an environmental and naturalistic point of view, this section is characterized by large strips of green river margin mainly in the spontaneous state and of naturalistic interest on both banks, but also by the confluence from the north into the river of the important Pratolungo stream, and by the nearby presence of some historic areas of disused quarries in which equipped green areas and stretches of water have been set up for sport fishing.

Next to the northern section of the river runs the historic Via Tiburtina, along which the most important and extensive production area of the city is located. The Tiburtina industrial area includes equipment for various important productive activities, also of national strategic and high-tech interest, and this has determined the well-known denomination of "Tiburtina Valley", but also a significant share of now disused productive activities, among which in particular the massive and degraded complex of the former "Penicillina" along the Via Tiburtina.

The green corridor in which the river flows also has important continuous green branches towards the Marcigliana nature reserve, in a north-easterly direction.

Continuing further along the course of the river, a substantial change in the river and urban landscape occurs in correspondence with the second section where the vast Rome East purification plant and the large PEEP settlement of "Colli Aniene – Tiburtino Sud" stand on one bank; on the other bank there is the social housing district INA Casa "Ponte Mammolo".

At the important purification plant, on the south bank of the river, the Tor Sapienza ditch flows into the river from the south, ducted and used for technological use in that section, while the PEEP district of "Colli Aniene – Tiburtino Sud", designed with a typically functionalist design in the years 1965-66 as part of the first PEEP plan of Rome, constitutes one of the largest social housing settlements in the city (37,000 total inhabitants envisaged by the original project).

On the north bank of the second section, the "Ponte Mammolo" district (1959-62) has a valuable characteristic design of the Roman popular districts of the time, and can be accessed directly from Via Tiburtina, along which is the underground line B ("Rebibbia" station) and a bus junction corresponding to this.

A subsequent third homogeneous section is characterized by the crossing of the river by the ancient bridge "Ponte Mammolo", on which Via Tiburtina runs, by the presence near the bridge of

one of the major transport interchange nodes of the city (the infrastructural node of Ponte Mammolo, with the underground station B, the urban and regional bus stations, vast exchange car parks), and due to the nearby presence of two districts also created as part of the first PEEP (Tiburtino Nord, Rebibbia).

The Ponte Mammolo infrastructural node constitutes a very important place of accessibility for the entire eastern urban sector, which will in the future be further served by the tramway scheduled along Via Togliatti, which has its own attestation here.

This homogeneous section is also characterized by large green areas located around the river and the interchange node in which the General Master Plan provides for the construction of a future "Centrality of metropolitan rank", with mainly tertiary and service functions, with a view to the vision of a polycentric urban layout planned for the metropolitan area. Furthermore, in the Rebibbia district there is an archaeological area and a thematic museum focused on the particular history of the area.

The fourth section includes the Aniene regional nature reserve, of which the river is a structuring and central element.

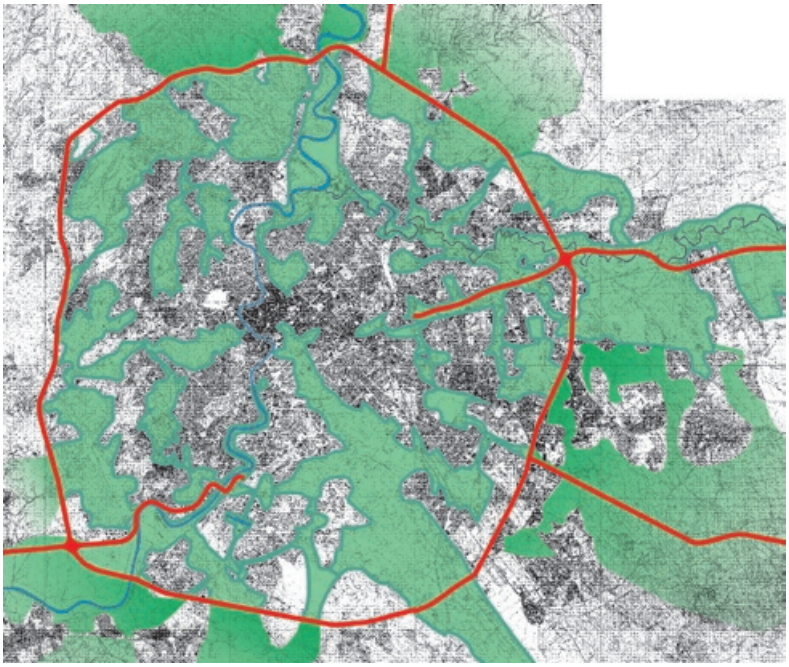
As regards the free and green areas directly contiguous to the river, of particular environmental and naturalistic interest, the Reserve is partly kept in its natural state, and partly equipped with various thematic areas, which favor its active use by the local urban community: areas for sports, areas organized for urban agriculture, areas for walking and recreation, areas used for animal husbandry and grazing, areas with equipped green plantings. The progressive preparation and care of these areas and places has been the result of initiatives that have also actively involved local associations; these initiatives are dealt with specifically in other sections of this book.

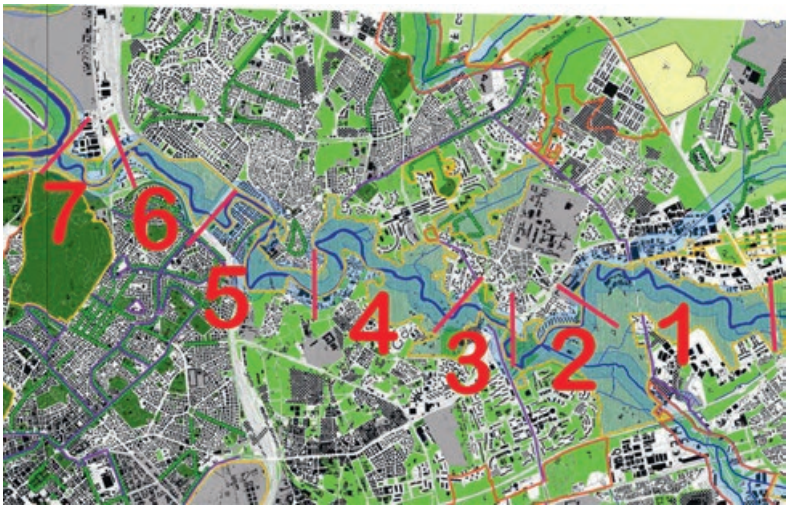
The usable space of the Reserve is made accessible and practicable by some green tracks, among which a main pedestrian and cycle path stands out which is part of the green ring of urban rank called GRAB ("Grande Raccordo Anulare delle Bici"), currently in definition and progressive tooling course. A farmhouse and some little buildings, which have existed for some time in the area and which bear witness to its ancient agricultural history, characterize the area and host service and accommodation functions of the Reserve.

On the edge of the green area of the Reserve, two rather different urban situations can be distinguished. On the north bank of the river, beyond the Reserve and on its edge, stands the large district of Casal de' Pazzi – Nomentano, built – like Colli Aniene – on the basis of a unitary project of functionalist design within the first PEEP of Rome (1965 project, originally planned inhabitants: 21,000).

Figure 1. Synthetic diagram of the green network of the city of Rome. The Tiber River (from north to south) and the Aniene River (in the east quadrant) are highlighted. Urban highways are highlighted in red (elaboration by A. Cappuccitti).

Figure 2. Diagram of the seven homogeneous sections of the green corridor of the Aniene river, illustrated in the chapter (elaboration by Antonio Cappuccitti, based on the graphic document "Ecological network" of the General Master Plan of the Municipality of Rome).





Similarly to other large PEEP districts of the time, the settlement is distinguished by large buildings and an articulated network of green spaces and equipment for public and private services.

On the south bank of the river, on the other hand, the urban landscape is characterized by unequipped green areas in which the massive military building complex of the "Forte di Pietralata", currently in use by the army, and the small rural-urban district of Casale Rocchi, located within a bend in the river where a set of agricultural

lots adjoining the neighborhood, are also located. The settlement of Casale Rocchi was built after the First World War, to house war veterans.

A future cycle-pedestrian bridge, the construction of which has been scheduled by the Lazio Region in 2022, will directly connect the existing green areas on the two different banks of the river, in correspondence with the regional reserve, favoring continuity and a wider and more complete use of the areas greens of the Reserve.

Continuing further, a fifth homogeneous section can be identified at a point where the river flows closer to the existing urban fabrics, squeezed between the neighborhoods of Montesacro – Città Giardino to the east, and Sacco Pastore to the west. In this section the river flows at a significantly lower altitude than in the two neighboring districts.

This stretch has two important bridges over the river: the monumental Ponte Nomentano (built in Roman times but renovated several times over the course of history; now only pedestrian), and the Tazio Bridge, built in 1924 and crossed by Via Nomentana Nuova.

The Montesacro district, originally built in the 1930s on a project by Gustavo Giovannoni and on the basis of the organic urban model of the garden city, has undergone substantial changes over time compared to the initial design idea, especially with regard to the building types, but the system of central public spaces gravitating around Piazza Sempione and a series of blocks of villas with a valuable design and original appearance are still preserved.

The Sacco Pastore district, on the opposite bank of the river, was built in the 1960s with massive residential buildings and substantially devoid of particular architectural quality, in the absence of a central structuring public space, but an equipped cycle-pedestrian itinerary runs along the perimeter of the district, parallel to the river, and public spaces and collective facilities are located along this route.

The sixth homogeneous section of the Aniene river, proceeding towards its confluence with the Tiber, can be identified by taking as extremes the “Ponte delle Valli” bridge upstream, and the bridge crossed by the Via Salaria downstream.

In this section, the Aniene river flows parallel to the two strong urban caesuras made up of two important railway tracks, located respectively north and south of the river. Furthermore, on the north bank, beyond the tracks, there is the extensive green area of “Pratone delle Valli”. Before meeting the Via Salaria bridge, the river flows next to a residential neighborhood known as “Prato della Signora”.

In the seventh and last homogeneous section of the river, leaving behind the Salaria bridge, the Aniene flows next to an area

Figure 3. Equipped green areas in the Aniene Nature Reserve, with the old farmhouse that actually houses the “Casa del Parco”.

Figure 4. Elements of the rural-urban landscape in the Aniene Nature Reserve: thematic areas organized for urban agriculture, dirt cycle and pedestrian paths, building edges of the Casal de’ Pazzi – Nomentano district with office and residential buildings.

Figure 5. The course of the Aniene river near the intermodal transport node of Ponte Mammolo.

of buildings for productive functions located along the north bank, dominated by a shopping centre, and a short distance from this it finally meets its confluence into the Tiber River.

On the southern bank of this last section, on the other hand, runs the important urban highway of Via del Foro Italico, which in this area constitutes a clear break in urban continuity. Beyond the urban highway, the green hill of "Monte Antenne" and the complex of the vast urban public park of Villa Ada.

The meeting point of the Aniene and Tiber rivers, which could potentially have great image and reference importance for Roman citizens, is in fact not visible from the surrounding streets and spaces, and is a place that citizens really do not know, as it appears, not equipped and not open to visitors and squeezed between warehouses and infrastructures.

At the end of this brief examination of the homogeneous sections into which the Aniene river can be divided along its course within the city of Rome, we can draw some conclusions regarding the current state and the potential concerning respectively the environmental continuity and the relationship with the surrounding urban fabrics and districts.

From a strictly environmental point of view, the urban sections of the Aniene river are the structuring and central elements of an extensive and almost continuous system of green areas, even where the river flows closer to surrounding districts. This continuity and environmental quality is highlighted in the provisions of both the current Municipal General Master Plan and the Regional Territorial Landscape Plan as a very important potential with a view to building and strengthening the future urban and metropolitan green network.

Today this structure of green areas is partly enhanced by a regional natural Reserve, a protected area that can be used by citizens and partly already equipped with itineraries and thematic areas, while it is partly made up of areas of high environmental interest and in a natural state.

The strengthening of the environmental value of areas in their natural state, and of their potential to form part of a cohesive and strong metropolitan green corridor, passes through a coordinated series of possible initiatives above all of a naturalistic and landscape nature: maintenance and care of river environments, creation o strengthening of wooded areas, redevelopment of green areas, ensuring functionality and hydrogeological safety.

In perspective, in particular, the major urban vocation of this system of areas is a regeneration that makes even the green areas

Figure 6. The historic Ponte Nomentano and the Aniene river, near the Montesacro – Città Giardino district.

Figure 7. Sacco Pastore district; cycle-pedestrian path and public spaces alongside the river.

currently in their natural state usable and of better landscape quality, in a continuous system of areas of high ecological and naturalistic quality, by means of planning actions of various types and suitably coordinated in a strategic framework. Some institutional initiatives are moving in this direction, which are discussed in other sections of this book.

The morphological and fruitive continuity of this system of areas can certainly be increased and favored also with the completion and expansion of the network of cycle-pedestrian itineraries, which already exists in part of the areas, and by

reconnecting the future route of the GRAB, “Grande Raccordo Anulare delle Bici“.

From the point of view of the relationship with the built-up urban parts existing on the margins, the system of districts gravitating on the Aniene river well reflects a well-known peculiar character of the urban form of Rome and in particular of the periphery: its being articulated in a set of “micro-city within the city”, each of which has its own morphological recognisability, urban identity, problems and vocations[1].

But each of the urban parts and districts on the margin bands of the river, which we have briefly listed, was built in substantial indifference to the river itself, without providing for links and connections or morphological complementarity and visibility with respect to it.

Then the best strategy to promote an optimal relationship and correlation between the city and the river can only be to create over time entrances, paths, special itineraries, central places in the green and belvedere paths, collective equipment, public spaces that can signal and qualify the construction of these relationships, connecting the main and secondary public spaces of the neighborhoods with the thematic and equipped public areas to be set up along the river green areas, and promoting the visibility and importance of the river as the main characterizing and qualifying element of the urban environment.

In a medium-term perspective, the systems of structuring public spaces and central places of the various neighborhoods around the river, already existing or to be strengthened or created through local urban regeneration programs, will be able to be connected in physical continuity with the places and paths to be create along the river green areas and with the public thematic areas existing or feasible in them, in such a way as to achieve the environmental and morphological continuity and the fruition quality that is necessary to build the future green structure of the city.

The Aniene river has the characteristics and potential of a very strong structuring and qualifying element of the environmental system in the eastern quadrant of the city, and the strengthening of this urban role will require a strategy of regeneration programs, regarding both landscape-environmental and urban-planning objectives, which will have to synergistically involve the river green areas and neighboring districts.

1. The research on the Micro-cities of Rome was carried out by CRESME Ricerche in preparation for the Municipal General Master Plan of 2008, and highlighted more than 200 micro-cities in the Municipality of Rome.

Sapienza University of Rome Elena Paudice

White and Blue
Water and Travertine Landscapes Along the Aniene

Cuts in the Landscape

Traveling along the Tiburtina road from Rome to Tivoli near the Bagni di Tivoli hamlet, the landscape is made up of dense buildings, including the imposing access to the thermal establishments of Tivoli, squeezed between anonymous commercial spaces that ruin the ancient baths.

Once past the thermal establishments, proceeding towards the city of Tivoli, the building stops almost abruptly and the edges are defined by the white landscape of the travertine quarries, which hide the silent flow of the Aniene river, parallel to the Tiburtina road.

Travertine quarries tell the story of Lazio architecture, as this material has contributed to the creation of important architectural works and various monuments[1], becoming, over the centuries, one of the representative products of the region, as well as one of the main sources; however uncontrolled extraction has profoundly changed the morphology of the area today characterized by a settlement and functional discontinuity.

The correlation of extraction sites with inhabited centers and valuable naturalistic elements, such as the Acque Albulae basin, as well as the Aniene river, involves various problems, including soil consumption and possible groundwater pollution, with respect to which the municipal and regional policies adopted so far have proved inadequate and ineffective.

It is necessary to plan recovery actions for disused quarries and management policies for active quarries in order to transform the extractive basin into a place in harmony with the surrounding landscape.

White Landscapes: the Travertine Quarries of Tivoli and Guidonia Montecelio

The former quarries represent opportunities to recreate a link between the artificial landscape and the natural landscape, to establish new relationships between an apparently inhospitable place and the adjacent communities, to recreate a now interrupted naturalistic continuity.

Abandoned quarries can become new landscapes, and it is not always advisable to bring them back to their original state since they have now become, for better or for worse, a characterizing element of that territory, as in the case of the abandoned quarries of Tivoli and Guidonia Montecelio.

1. Travertine has been used for the construction of numerous valuable architectural works including: the Temple of Concordia, the Trevi Fountain, the Four Rivers Fountain, the monumental buildings of EUR, the University City and Termini Station.

Figure 1. View of the Barco quarry, the oldest quarry in the extractive basin.

Alongside this “empty” landscape, agricultural areas and settlements have developed over time. The different environmental situations form a complex territorial mosaic, an interweaving of different landscape typologies that tell the difficult context in which the travertine quarries are inserted.

In this context, the only connecting element appears to be the Aniene river which delimits these enormous environmental “caesuras” to the south.

The quarries have developed over the centuries along the banks of the Aniene river and between the outcropping lakes of sulphurous water, belonging to the hydrographic basin of the Acque Albulae. It is precisely the presence of sulphurous water that makes travertine such a precious material that it has been extracted since ancient times, its name in fact derives from the Latin denomination, from the late imperial age, lapis tiburtinus, the stone of Tibur (Tivoli). even if the origins of some extraction sites are in any case older, the first local uses date back to the 3rd century. B.C.

Over the centuries the extraction of travertine has taken place almost incessantly[2] and despite the great use the basin has maintained a limited size but, starting from the eighties of the last

2. In late antiquity, and during the Middle Ages, mining stopped and the quarries slowly turned into a marshy area. The extensive use of travertine resumed in the Renaissance, when Rome returned to being a “white city” and, when the construction of St. Peter’s began, the ancient quarries were reopened.

century, the withdrawal of travertine has increased up to having a single basin of 400 hectares[3]. To date, the basin is made up of a series of partly abandoned contiguous quarries for which there is a considerable fragmentation of the state property regime, in particular there are 17 industries in the area, some of which refer to the ancient valorisation of the Roman Travertine Center. Furthermore, the reference regional law, n. 17 of 2004, appears ambiguous regarding the recovery works, to which is added a discordant management of the two reference Municipalities: the site is administered for 32% by the Municipality of Tivoli and for 68% from the municipality of Guidonia Montecelio.

The two municipalities currently do not follow a shared management line despite both having supported the excavation of travertine for decades without guaranteeing the recovery of the abandoned quarries. The Municipality of Tivoli mainly concentrated on the creation of a thermal park in some disused quarries located along the banks of the Aniene river; while the municipality of Guidonia Montecelio has not advanced recovery projects, focusing exclusively on the continuity of the excavation to protect the extractive industry.

For several years the quarries were seen only as a source of economic and employment development, in fact various industrial activities developed around the basin, even close to the river, involving various problems including:

- the underlying perennially outcropping aquifer;
- the possible pollution of the waters of the Aniene river;
- the settlement discontinuity;
- the development of the extractive industry near urban areas, as well as natural areas;
- the fragmentation of the property regime;
- uneven and ineffective local and regional policies.

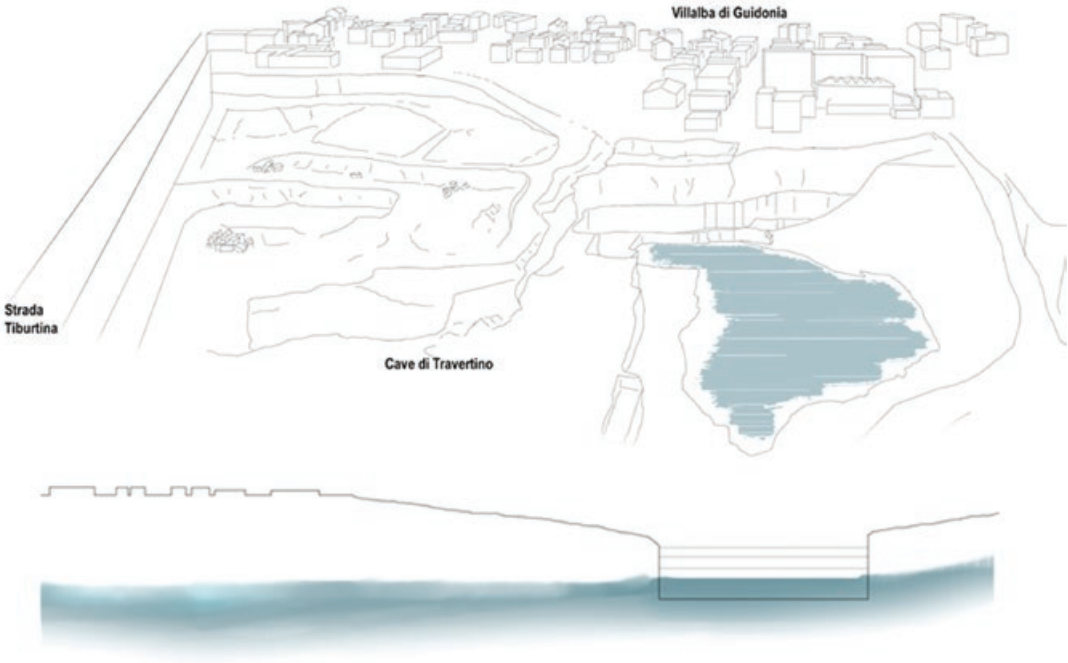
Blue Landscapes: the Aniene River and the Travertine Quarries

The Aniene is the main tributary of the Tiber, formerly called "Teverone", the river originates from the Simbruini mountains, on the border between Lazio and Abruzzo, and extends for 99 km crossing 17 municipalities.

Over the centuries this river has been fed by streams coming above all from the nearby mountains of the Lazio Sub-Apennines, posing a threat to the neighboring inhabitants with its floods.

Figure 2. The scheme depicts the relationship between water – quarries – urban centres.

3. The travertine basin has three times the extension of the Milan quarries and is one tenth of the extraction basin of the Apuan Alps.



In 1305 the first flood of the Aniene river was recorded in the municipality of Tivoli, for which a dam was built in the 15th century[4]. In 1826 Pope Pius VIII commissioned the architect Clemente Folchi to design an alternative solution to better control the floods of the river, the architect conceived the Tunnel of Monte Catillo, consisting of two tunnels dug into the mountain to be able to divert the watercourse. This work gave rise to a new course of the river which, making a jump of over 100 meters, forms today's spectacular Cascata Grande.

In ancient times, the course of the Aniene was also a commercial route, it was in fact a valid alternative to the Via Tiburtina for the transport of travertine, the river was in fact navigable in the section between Ponte Lucano and Rome.

Just along the banks of the Aniene is the oldest quarry in the travertine extraction basin, the Barco quarry, where the homonymous farmhouse stands. In late antiquity the quarry was abandoned; during the Middle Ages it became a marshy area due to the frequent floods of the Aniene itself, but also due to

4. Despite the construction of the dam and other hydraulic engineering works, floods from the river continued to cause damage, and in 1826 a river flood destroyed the dam, which was later repaired.

the presence of numerous sources of the Acque Albulae. From the end of the fifteenth century it was decided to reactivate the quarry, to extract the stone necessary for the construction of Renaissance and Baroque Rome, the bottom was cleaned up, as was the stretch of the Aniene from Ponte Lucano to the Tiber upwards, to make it navigable again.

Once extracted from the quarry, the travertine blocks were slid on poles, along specially created ramps, up to the river bank, where there were large rafts, the transport took place using the river current and / or animal traction along the banks.

In the following centuries, river transport was joined by road transport, on carts pulled by buffaloes or oxen until the end of the 19th century, when the Rome-Tivoli steam tramway was installed (1879) and river transport ceased altogether.

Today this important environmental emergency is hidden by the industrial landscape and welcomes some of the problems deriving from the quarries, since the wastewater from the plants flows into the river, giving the watercourse a white colour.

Near the river, north of the quarries, is the Acque Albulae[5] basin, an emergence of extraordinary landscape and economic importance: the springs are composed of sulphurous mineral waters used since Roman times[6] for their therapeutic properties. Between 1856 and 1863 a commission made up of doctors and archaeologists supported Pope Pius IX's project for the construction of the baths, and the project ended in 1879. However, in the early twenties of the twentieth century, due to the large influx of users, the thermal power plant was expanded.

To date, the thermal establishments of Tivoli represent one of the main polarities of the area despite the adjacent traverine extraction activity affecting the levels of sulphurous water present in the establishments.

Due to the presence of the Acque Albulae springs but above all for those of the Aniene river we can define the territory of the quarries as a landscape characterized by water, a place which without the presence of these important water emergencies would not have become one of the major economic poles. The economy it prevailed over nature and today the Aniene and Acque Albulae are totally imperceptible and inaccessible natural resources.

5. The Latin adjective Albulae, (white) refers to the whitish color of the waters.
6. The exploitation of the sources is maximum in the III century. B.C. and reaches its peak in the second century B.C.

Figure 3. The Aniene river at the margins of the Barco quarry where there is also the ancient Lucano bridge.

Strategies for Valorisation and Recovery of Quarry Landscapes

The extraction of travertine east of Rome has led to a situation of environmental imbalance made up of various problems. In order to understand the consequences of this impact, a scenario visionj[7] has been adopted, which is based on the concept of "what could happen if".

This approach takes note of the presence of active quarries and those being abandoned as well as the possible extension of the excavation over time in order to build possible developments considering the intentions among the various players to try to build the image of a common future.

The production of the scenarios is based on the concept of the territory as a complex system, which also includes the settled society, object of future anthropic actions. This method represents the process of a "conscious construction of a territory", and is based on the process of recognizing the value of the territory and local development (Ferraresi, Rossi Doria 2007).

The introduction of the scenarios is due to the need to try to control the territorial phenomena by prefiguring future arrangements, based on the analysis and knowledge of the state of the places. Sometimes the scenario becomes a revealing tool of little-known phenomena, transforming itself into a means for

7. In economics, the scenario method is a simulation technique, which aims to reproduce the behaviors that arise in certain circumstances, to outline future dynamics. In urban planning this method foresees the possible transformations of the territory "the scenario is a unifying image that interprets the existing in the light of the possible future".

disseminating possible futures, but also of a little-known present (Bisio, Lombardini, Segalerba 2007).

In organizing possible future arrangements, "images" are created which can represent possible escape points from the present, or representations of current trends; o suggested itineraries for the community; o the set of questions and desires of society; or what can be defined as real scenarios, attempts to investigate "what would happen if…" (Secchi 2003).

The application of the aforementioned methodology allows different evolutionary visions of the basin:

- 1st scenario_ Off Limits, in which the continuity of the extraction basin is expected without restoration interventions;
- 2nd scenario_ STOP (Protection of the Territory and Homogeneity of the Landscape) in which the total revegetation of the extraction basin is envisaged.

From the analysis of these two development perspectives, a third scenario was created, RI_CaVa (Regeneration and Enhancement of Quarries), which takes into consideration the continuity of the mining activity and the recovery of abandoned activities, through the creation of a green network that it would allow both to strengthen the connections between the hamlets of Guidonia Villanova and Villaba and to protect and increase the biodiversity of the area with mitigation works.

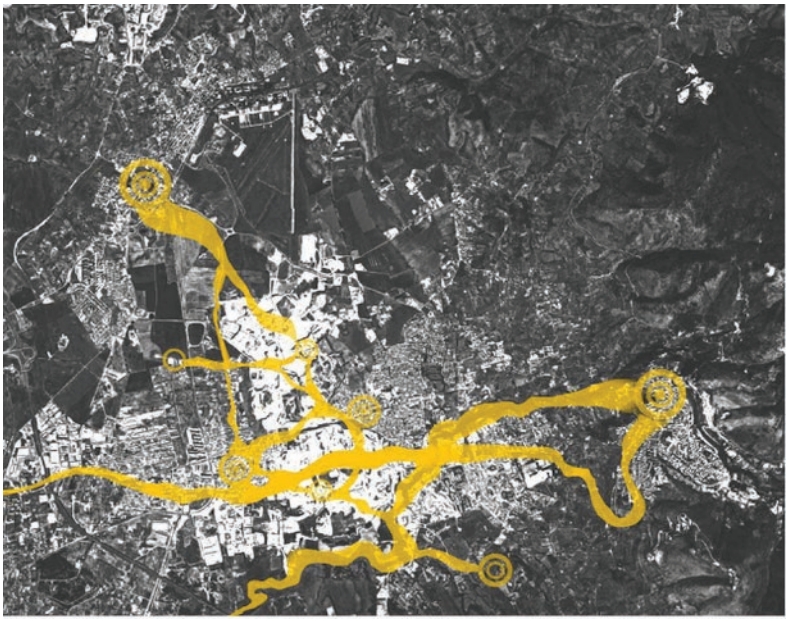
The RI_CaVa project is based on the concept of extractive landscape as an expression of local culture, so that in a recovery plan several interlocutors must necessarily interact, not only those belonging to the public administrations. The fulcrum of the Ri_CaVa project is represented by the creation of a consultation table between Municipalities, the Region, industrialists, research bodies and local associations, to trigger a shared reflection process aimed at developing a recovery plan for the travertine basin.

The Ri_CaVa project proposes both a methodology for the creation of a regeneration plan for abandoned quarries adjacent to active quarries, and a design approach developed for transects in order to implement interventions that respect the context and the historical, cultural and landscape value attributed everywhere.

The subdivision of an area into transects is a methodology used in the natural sciences to survey and census a sample of plant and animal species, to then describe the variations in biodiversity.

Today this methodology finds wide application in urban planning, the first field trials can be referred to Patrick Geddes

Figure 4. Poster of the Ri_CaVa project which has as its objective the environmental and social reconnection of the territory, in which the quarries are the central point.



and his Valley Section[8] which takes into consideration the relationship between nature and the environment.

As in nature, man-made areas can also be divided into transects, to analyze and understand the relationship with the context.

The construction of the transept is based on environmental and social observations at all scales, from local to regional.

The use of the transept therefore constitutes the application of the rules dictated by a large area plan, which in the case of the travertine extraction basin is represented by a scheme of intervention strategies, prepared after the prefiguration of the RI_CaVa project (Regeneration of Quarries and Enhancement).

The transept is used not only as a support for the analysis but also as a design tool, since the landscape of the quarries is a system made up of multiple realities and each intervention can affect the balance of the entire neighboring area.

The margins of the transepts have been identified according

8. In economics, the scenario method is a simulation technique, which aims to reproduce the behaviors that occur The Valley Section (valley section) is transversal and concerns heights and depths, and is a tool that Geddes uses for the analysis of the territory with respect to the context. Geddes in both valley sections represents the mountain from which the river is born which reaches its mouth, located in correspondence with a modern industrial city. No under certain circumstances, to outline future dynamics. In urban planning this method foresees the possible transformations of the territory "the scenario is a unifying image that interprets the existing in the light of the possible future".

to the elements characterizing the territory, dividing them into linear and punctual areas.

In detail, the first transept, or sequence, called Albulae intervenes on a territory in which there are still episodes of agricultural activity, among which the great environmental peculiarity of the Acque Albuale basin stands out to the west.

The second transept, Le Fosse, is influenced by the presence of Bernini's farmhouse, evidence of the use of travertine for large architectural works.

The third transept, Tiburtina, appears to be the most difficult place to intervene on as it is the most urbanized one, and its proximity to via Tiburtina makes it a "door" to the intervention, which is why it must represent the exemplification of the Ri_CaVa project.

The fourth and last transept is bordered to the south by the Aniene river and encloses one of the most representative farmhouses of quarrying activity, the Casale de Barco.

The division of the basin into transects has made it possible to identify the aptitude of each individual area for developing targeted design actions also according to the context, sometimes predominantly anthropic and sometimes predominantly vegetal.

From the analysis of the case study of the travertine quarries of Tivoli and Guidonia Montecelio emerges the need to transform the abandoned quarries, places of possible degradation, into areas of high environmental quality, to give them back to the citizens. It is necessary to take a broad perspective considering abandoned quarries as possible landscapes, as potential bearers of environmental quality.

We welcome landscape changes with a pragmatic vision, which takes into account the socio-economic specificities of the territory and the need for citizenship.

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Spaces and Initiatives Along the River Aniene

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The river Aniene and the surrounding inhabitants

The relationship between the surrounding inhabitants and the Aniene river has always been very rich in interactions since ancient times. It is no coincidence that in the upper Tiber valley, from the springs to the waterfalls of the city of Tivoli, there were several republican and imperial villas that established a dialogue with the watercourse, sometimes even diverting its flow. Moreover, in the middle valley, the interaction with the river has allowed the development of the flourishing paper industry and has allowed Tivoli to produce electricity in alternating current for the first time in the world on an industrial scale (1892). In the lower valley, in addition, the wealth of marble materials and the possibility of moving them along the river allowed imperial Rome to create monumental works of art as well as urban infrastructures (such as the Colosseum or Saint Peter for example).

In the years of intense building construction following the Second World War, then, this link was interrupted towards a mere exploitation of open spaces for building purposes. In the late 60s of the 20th century, finally, a renewed approach to planning made it possible to limit the damage to this fundamental environmental resource. As Annalisa Metta (Progetto per la Val Polcevera) would say, echoing the "time of wetness... [which] aligns us with a design imagination that embraces fluidity, openness and complexity" by Anuradha Mathur and Dilip da Cunha (Mathur, da Cunha 2014) in reality it is the city that lay on the hydrographic basin, of the impluvium.

In what is called the "3rd generation of plans" (Campos Venuti 1987), in fact, the need was found to intervene to minimize the soil consumption of new building interventions in order to better preserve the green open space.

In recent years, then, attention was given with the advent of some specific European directives, see the Water Directive with the Habitat and Flood Directives as well as with various policy initiatives by the European Union such as the one towards the fight against soil consumption, for the promotion of green infrastructure and towards ecological transition by public governance.

An evolution in the sensitivity of citizens has also led to passionate interventions by the population to defend the river corridor.

Also worthy of note in the early 2000s is the change of approach to sector planning instruments. In the years 2001-2003, in fact, at the time of drafting the Piano Stralcio of the

Tiber basin for the metropolitan area of Rome – PS5 and the Project of the Tiber River corridor from Castel Giubileo to the mouth (according to Law 183/1989 on the Defense of soil and river basin plans) in which Professor Vittoria Calzolari also participated, the territory included in the basin area was divided into sub-areas of study. This articulation was meant in order to consider the strategic places, for the concentration of physical, historical, urban, functional as well as the highlighting of the environmental corridors of fundamental importance for the ecological network. In this way, a landscape vision of the watercourse capable of recovering the idea of the river as a resource and not a critical element was underlined.

The Objective

Water is today increasingly central to scientific discussions about global sustainability and urban design, as we seek innovative solutions to the challenges of rising seas, flooding cities, atmospheric pollution, extended drought and aquifer depletion (Mathur 2022). Is it time, then, to focus on best practices to re-articulate the past, to experience the present, and to envision the future rethinking attitudes and interventions in the urban environment facing waterfronts (Mathur, da Cunha 2014).

The Aniene river in its urban path inside the great ring road is undergoing massive rehabilitation from a neglected open space to a precious urban connector and attraction place.

The text intends to illustrate the initiatives involving the Aniene river corridor and to highlight how thanks to the integration of initiatives from below (citizens and associations) and from above (Lazio Region and Rome Municipality) it is possible to enhance a natural resource within the city.

Similarly to how Calzolari wrote in 2007 referring to the Tiber river corridor, in fact,

> ***"the central theme is the reconsideration and recomposition of the relationship – and often conflict – between hydraulic, environmental, landscape and anthropic uses related to water" (Calzolari 2007).***

The purpose of the study is therefore to understand the relationship between the river Aniene and the city of Rome and how a holistic approach can lead to a better urban environment.

The critical issue is to highlight how the river contract tool thus helps in integrating strength, funds in a common vision.

The Context

The Aniene river is the main tributary of the river Tiber in the Lazio Region and together with the Tiber River it is a natural element strongly bonded with the history of the Eternal City. Since 1997 (LR 29 6/10/1997) due to environmental protection the Aniene river, as the Almone River for the Appia Antica Park due to archaeological protection, within the urban territory is embraced by a protected area (650 he) that creates the so-called river corridor.

As an extraordinary potential area, the Aniene's mouth is located in northern Rome and in the final part the river runs through the outskirts of the city entering from east in the urban part of the city and providing a green and blue infrastructure.

The river corridor passes through different administrative units such as the Municipio II, III and IV.

The management of the Protected area (Id EUAP1045) is entrusted to the Regional Authority RomaNatura (Ente Regionale per la Gestione del Sistema delle Aree Naturali Protette nel Comune di Roma Regional Institution for the management of the protected natural areas system in the municipality of Rome) which gave the management concession to the association "Insieme per l'Aniene".

The Statute of the Social Promotion Association Insieme per l'Aniene, which has been dealing with the management of the Reserve since 1999, underlines the commitment to interventions and services aimed at safeguarding and improving the conditions of the environment, as well as protecting, promoting and enhancing the historical-archaeological heritage of the territory within the perimeter of the protected area. Among the activities carried out by the Third Sector Entity there are also those related to education, instruction and training as well as social, cultural, artistic, recreational and tourist activities.

As reported by the European Commission there are many benefits provided by Green Infrastructures that can be articulated in environmental benefits, social benefits, climate change adaptation and mitigation benefits and biodiversity benefits (EU 2013).

As clearly explained by the Guidelines of the Soil4LIFE Project (ISPRA 2021) the sealing of surfaces reduces or cancels the ability of the soil to provide ecosystem services, causing impacts on biodiversity, on the water cycle, on the filtering and purification capacity of the water, on climate regulation and on food production. All these effects are those that increase the risk of the Urban Heat Island phenomenon and of floods and landslides and, therefore, contribute to weakening the resilience of the territories, increasing their fragility in facing the impacts deriving from extreme climatic events.

The Aniene river corridor represents a precious opportunity for improving the quality of the high-density neighborhoods that surround it acting as a blue and green infrastructure.

The Existing Initiatives

The past or ongoing activities for the Aniene River rediscovery were explored through two types of approaches: top-down and bottom-up. The first is focused on the ongoing public strategies while the second part is focused on the local interventions promoted by inhabitants or associations and on the participatory tool of the river contract.

Top-Down Initiatives

Public Initiatives

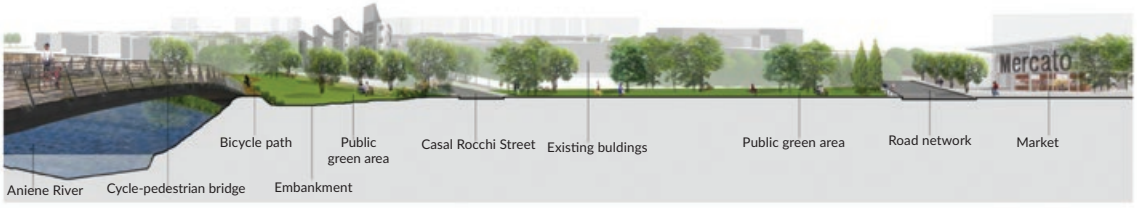
A virtuous initiative undertaken by the Municipality III in Rome which, in the context of the Regional Tender for cleaning and footpaths (Lazio Region – Regional Council Resolution No. 791 of 20/12/2016 Annex A Public notice for the granting of loans for the construction of video surveillance systems, acquisition and management of information, redevelopment of degraded areas, Regional Law of 5 July 2001 No. 15 article 2, paragraph 1, letter b) was the “Aniene Sicuro” (Secure Aniene) Project. In the Project, the III Municipality was able to direct the funding towards a local intervention thus managing at the same time to resolve a security critical issue and to promote the Aniene river.

Two new docks on the river, strongly desired by the inhabitants and associations, were created thanks to this Project. The main objective that was addressed was in fact to make it a living space, frequented and therefore safe. The Capitolina Superintendency was involved in the drafting of this project with the associations Insieme per l’Aniene, A.S.D. Aniene Equestrian Club “Il Ranch”, “National Environmental Guard” and A.S.D. Canoe Kayak Rome-Assex.

On June 22nd 2020 a floating anti-waste barrier was inaugurated on the Aniene river within the Aniene Valley Natural Reserve to improve the quality of water resources. The barriers were anchored by poles to the river bank and allowed plastics and other floating waste to be stopped, conveying them to a storage area close to the river bank. A company has been entrusted with the collection of collected waste, the selection of plastic material, the evaluation of recyclable packaging and the production of objects in recycled plastic.

The territory close to the river corridor is also undergoing a PRINT Plan Programma Integrato (Integrated Program) which aims to increase the availability of public services and basic infrastructure in the Pietralata district. The plan involves the realization of new streets and pedestrian paths as well as the improvement of the existing public space. The construction of a cycle-pedestrian bridge that will cross the Aniene river between Ponte Mammolo and Ponte Nomentano, more precisely between Pietralata district and Casal de' Pazzi district will start in 2023.

Another initiative that concerns the river corridor is the project to complete the Rome railway ring towards the north



thanks to the use of funds from the National Recovery and Resilience Plan (888 million euro). The Project will imply the realization of two new railway bridges crossing the Aniene river to link the two stations of Vigna Clara and Tor di Quinto.

Bottom-Up Initiatives

The Citizens Involvement

The local associations provide many efforts in organizing sensibilization events on environmental issues: examples are reforestation projects, environmental data collection campaigns, Citizen science Projects, learning laboratories to learn the basic techniques for water quality analysis, and artistic installations. Since November 2011, the association Insieme per l'Aniene has undertaken a project of urban vegetable gardens in 4.000 sqm inside the Natural Reserve with 106 lots assigned to citizens. The GRAB Bikes Big Ring Road Project, the cycle path of a total length of 43 km that embraces the Eternal City was also born thanks to the initiative developed by citizens and associations and passes through the reserve.

The Aniene River Contract

The activation of the Aniene River Contract took place in 2018 following the signing of a Document of Intent. The Aniene River Contract, through the implementation of the actions envisaged in the respective Action Programme, contributes at various scales – European, national, regional and local – to the protection of water and nature with the sustainable use of resources, the hydrogeological risks mitigation and adaptation and a tourist-recreational enhancement of the territory. The applied method in the preparation of the Aniene river contract follows the guidelines "Definitions and basic qualitative requirements of the river contracts", drawn up by a multidisciplinary working group coordinated by the Ministry of the Environment and the Protection of the Territory and the Sea (now Ministry of Ecological Transition) and ISPRA in the context of the activities of the National Table of River Contracts (March 12, 2015).

Figure 1. One of the new river docks along the Aniene.

Figure 2. The cycle-pedestrian bridge that will cross the Aniene river according to the PRINT Plan.

The River Contract "RC" has involved, in particular, the activation of a bottom-up participatory process for an exhaustive identification of the problems and for the definition of the actions. The verification of the coherence of the RC with the territorial, social and administrative context in which it is inserted

and with the objectives of the urban planning instruments in force in the area was also guaranteed. This approach makes it possible to achieve concrete and lasting results.

The RC is a participatory process to build a program of actions centered around the river ecosystem: Good status environmental system; Hydrogeological risk control; Local development.

The various activities therefore led to the sharing of a Document of Intent, the implementation of open and inclusive participatory processes and adequate information to the public; development of a Knowledge Framework on the hydrographic basin of the Aniene; development of a strategic document on management objectives for the Aniene river basin; development of an Action Programme; preparation of a formal Commitment Deed. To guarantee effectiveness over time of the interventions a Monitoring Plan was also developed.

The participatory process for the preparation of the Aniene River Contract was divided into three phases: animation phase; preparatory phase; active phase.

The animation phase was preparatory to focus on the opportunity to define the Aniene River Contract consisted of 16 meetings (5 public forums, 3 meetings between members of the Aniene Committee, 8 public meetings). This phase to start off the process towards the Aniene River Contract was divided into 5 events including meetings and site inspections.

The active phase, preparatory instead to defining the Aniene River Contract, was carried out in 19 meetings differentiated between specific territorial assemblies and plenary assemblies.

The various meetings were held in order to guarantee a variation of venue between the upper, middle and lower valley of the watercourse except for the last meetings starting from December 2020 which were held online due to the pandemic emergency from Covid-19.

The participatory process led the 25th February 2022 to the signature of the Action Plan describing the various activities to be accomplished by the year 2026.

About 70 stakeholders involved with the process relate to public entities such as the Regional Authority, Several Municipalities, the Regional Authority RomaNatura and private entities going from the water utility Company, to small business enterprises, several associations and citizens.

In the framework of the RC the different stakeholders committed to accomplish several activities geared to improving the quality of the River Corridor. Some of the main proposed activities are:

- hydrogeological rebalancing of the upper course of the Aniene river;
- integrated hydraulic-environmental redevelopment and fruition enhancement for all stretches of the river and its tributaries with the idea of creating an Aniene Park;
- waste removal and ditch redevelopment;
- creation of inter-municipal cycle-pedestrian paths;
- organization of tourist and sports navigation activities (kayak, canoe, rafting);
- extension of the Valle dell'Aniene Nature Reserve for Municipalities beyond the G.R.A.;
- creation of Embarkation/Disembarkation points on the river;
- urban reforestation;
- environmental monitoring system;
- creation of a cycle/pedestrian connection from Cervelletta to Lunghezza in the IV Municipality.

Final Remarks

The common challenges that many cities in the world are facing in managing water resources and people's quality of life concern a rapidly growing population with evolving lifestyles. Population growth increases the pressure on water resources, with scarcity of water and pollution: risk factors for well-being.

The COVID-19 pandemia has meant that the attendance of citizens towards the reserve has increased tenfold according to the association Insieme per l'Aniene Onlus. This has as a consequence, on the one hand, an improvement in the safety garrison but, on the other, a greater propensity to deterioration phenomena, above all in conjunction with the holidays in which the citizens of Rome love to gather in open spaces for picnics.

These challenges face a changing climate and a difficult economic situation. In these difficult conditions it is necessary to provide solutions towards the creation of more water sensitive cities integrating some virtuous approaches capable of designing multifunctional and flexible urban water systems thus offering a wider range of services and benefits for communities.

European cities are complex and constantly evolving places where the various components must find integration within landscape projects thus offering, together, a series of social, ecological and economic benefits.

Recently, together with the need to guarantee ecosystem services and a healthy natural environment, the involvement of the stakeholders "custodians" of the territory in the decisions

of the institutions has become important. Public participation is one of the best tools to contrast land degradation that has had a pronounced impact on 20 ecosystem functions worldwide (IPCC 2022) and parks and protected areas represent a structural and strategic value in governance processes (Sargolini, 2018) and interact with social systems by weaving relationships and interdependencies with neighbouring territories and communities (Giacomelli and Benetti 2020; Cumming and Allen 2017).

Climate change and human neglect of the territory cause environmental disasters stimulate action towards a change in planning approaches, using negotiated and participatory tools. The fragmentation of knowledge in environmental matters and the consequent multiplicity of sectoral plans highlight the need to apply principles of multidisciplinarity and multilevel governance. River contracts are part of the phase of change trying to recover the sense of collective responsibility of the commons (Di Giovanni 2015).

The difficulties of territorial policies are still represented by the different political times from those of the dynamics of territorial management, by the priority of sectoral, economic and social logics compared to transversal environmental ones and by the lack of awareness of citizens towards territorial democracy.

The River Contract represents a particularly useful tool in the management of a complex system, such as river basins, because, in addition to allowing the participation of the population, it stimulates intra – and inter-institutional collaboration (Di Giovanni 2015) expressing and producing, in fact, the convergence of political expectations and the participation of the communities. Institutional sustainability is indeed a key factor to achieve durable results.

Spaces and initiatives along the river Aniene are so driven for

- preventing natural and man-made risks;
- strengthening the resilience capacity of communities and territories;
- guaranteeing the recovery and defragmentation of ecosystems;
- promoting ecological connections between urban territories and natural territories.

Thanks to the river corridor, therefore, bottom up and top-down approaches shall work together through crucial place-based policies towards a common goal: well-being in a climate change context which is guaranteed by what Michele Manigrasso (2019) calls adaptive urban design.

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Insieme per l'Aniene Onlus Marta Polizzi

The Role of Local Association in Improving the Quality of River Spaces

The Natural Reserve "Valle dell'Aniene" is a perfect example of a bottom-up initiative. The Reserve was institutionalized officially in 1997 with a regional law (RL n. 29), and was put under the responsibility of RomaNatura (regional entity that is responsible for other 15 natural protected areas and 1 marine reserve). But only few know that several years of fights and revendications were actually needed to arrive to that point. The urban plan during the 80's was to build a big elevated road across a significative piece of the riparian area, cutting through the river in five different points and destroying in an irreversible manner the green space that we are lucky enough to see today. If we are able to enjoy the Reserve today, we should thank all the local citizens that didn't agree with this project and that at that time stood up to stop it. The last remains of that project are the cement blocks that are visible walking through several sections of the Reserve. The administrations of that time were (luckily) far-sighted enough to embrace this local movement, stop the road project and work toward the protection law. This is just an example of how citizens can influence policies. Insieme per l'Aniene Onlus was born in 1999 from the union of the three local groups operating at that time, and continued to work for the conservation of the area during the last 23 years, basing most of its efforts on voluntary contributions and initiatives.

Since the very start the association was engaged in promoting the Aniene river contract to stimulate the creation of a network of different local entities along the river, interested at various levels in the management of this important resource. It took more than 20 years from the first public gatherings to the very official signature of the contract: the sensibilization activities started in 2000 and the agreed Action Plan was signed only at the beginning of the current year (25th February 2022). Hence, we are finally in the phase of implementation of the various activities (a total of 94 actions) that each member of the contract committed to accomplish by the year 2026. Among the actions proposed by Insieme per l'Aniene, there is the ambitious project of extending and reinforcing the riparian vegetation belt. The Reserve is continuously involved in projects of reforestation or afforestation thanks to a mechanism of "compensation": industries or agencies need to "compensate" for their gaseous emissions (greenhouse gases) by planting trees (that are known to absorb CO_2 and to mitigate climate). Lately, since this practice is starting to be more frequent, we are trying to direct those contributions and financing to the most degraded and functionally important parts

along the river. In total, there have been planted a total of 3000 trees in 20 years of activity.

Another contribution of the association to the river contract, is the periodic monitoring activity of degraded areas along the urban tract of the Aniene river. We've already mapped the most degraded points in the area and we aim to involve citizens in future activities. Degradation in urban green areas is the most evident sign of anthropogenic impact, and sensible citizens are particularly concerned about this phenomenon. As an association we continuously receive signaling of degraded points, illegal

discharge areas or abusive behaviors, and we've noticed that pro-active citizens are particularly glad to help in this context. This is another point on which the association invested from the very first start: environmental education to increase the consciousness of people living nearby the Reserve. Most of the activities sponsored by the volunteers regard this point: there are a couple of areas dedicated to urban gardens and biological horticulture, a lot of events on education (courses, laboratories, urban hikes) and cleaning initiatives, designed not only for children, teenagers and schools, but for adults too.

Talking about education and rivers, the last project carried out this year was a project sponsored by Lazio Region to teach students how the river contract works. As if they were part of the stakeholders participating in a territorial table (they are, indeed, since they actually are the future citizens of this world we are leaving them) they had to go through all the different phases:

1. getting to know the area, the main problems and the opportunities to improve;
2. brainstorming, sharing ideas and projects on how to solve those problems highlighted and how to emphasize the significative value of the area;
3. implementation phase: putting in practice those ideas and actually preparing materials useful to the proper use of the reserve.

An important project implemented together with A Sud Onlus and financed by Horizon 2020 European grants, was a citizen science project aiming at monitoring the eco-morphological conditions of the Aniene river along the urban tract. We recruited about 60-70 citizens that were educated on some basic river ecology concepts. We prepared a guided questionnaire they could fill from their smartphones through an application (Epicollect5) or from a paper sheet. They had to answer questions on the level of the water, the flow, color and smell of water, the vegetation type and the land use. We collected together with them data on the condition of the Aniene river for three months, from April to June, and we published a report. Citizens were also invited to propose a list of good practices and regulations they thought could be useful at addressing the main problems they found during data collection. We also presented the results to administrations and institutions, to help them address the most critical points. For example, we've noticed that the Aniene river is not affected at all on water flow, the river bank is entirely natural (not rectified) and free to move, and vegetation sits quietly along

the shore. By the way, we have some points were the vegetation is highly impoverished or even degraded: invasive alien species are a major problem, *Myocastor coypus* is a voracious vegetarian eater, feeding on plants and roots, and the two species *Arundo donax* (commonly known as "giant reed") and *Ailanthus altissima* (also called "tree of heaven," for its rapid growth) are strong competitors for the native autochthonous species *Populus*, *Salix*, and *Phragmites*.

That's why we are once again working together with A Sud Onlus on another project, this time entirely targeted on the quality of the water. The project will be carried out for 8 months in total, sampling water from the river on a monthly basis. We have collected on May the first sample of water and checked for some physical and chemical characteristics: turbidity, conductivity, pH, nitrates, phosphates, ammonium and the presence of *Escherichia coli*. The first couple of samplings were also made together with schools visiting the reserve on the scheduled sampling day, but we would like to involve other citizens in the near future.

The association was born on the idea that even a single citizen can make a difference: people are able to fight for what they care for, and that's why the role of the association from the very start was to build a strong emotional relationship between the river, the reserve and the citizens. We don't believe that the best solution is to preclude completely the utilization of the protected areas, but instead, make people feel like home in those places. If people will start to consider protected green areas as a part of their home, rather than something that's just "outside," maybe they will develop more respect toward those places, and claim to keep it healthy and clean. We should importantly, always remember that nature is not entirely free of threats, even when it is protected by law, and each one of us should always act as a sentinel to make sure that our shared places are not degraded or usurped.

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Water – and Heat – Resilient Built Environment

Actions for climate changes

National and international efforts are taking place to face the Grand Challenges that affect our world and society at large. Major areas of intervention are those related to the mitigation of criticalities related to climate changes and design for adaptation, towards an increased resilience in every sector (Barker and Coutts 2016). In greater detail, the United Nations set specific goals to face Grand Challenges. Goal 11 (He et al. 2019) is to "Make cities and human settlements inclusive, safe, resilient and sustainable". The focus of the efforts is thus on cities and urban areas, which are experiencing an enormous growth in population: indeed, today around the 55% of the world population lives in cities, and projections are for over the 65% of total population living in urban areas in 2050. These numbers evidence that cities will be subject to important pressures, while simultaneously facing climate change challenges. Therefore, making cities safer, more resilient and sustainable is a priority for a sustainable future, especially in the aftermath of Covid-19, where cities have suffered from insufficient services and inadequate open public spaces.

In addition, Goal 13 (Oke 1982) reads "Take urgent action to combat climate change and its impacts", which is another focal point of the proposed contribution. Indeed, climate change-related disasters cause billion of people deaths and injuries. Among the climate change related changes, there is the increase in temperatures, which is especially strong in urban areas (Urban Heat Island effect) and exacerbates heatwaves; the sea level rise, up to +122 cm by 2100; the increase in extreme weather events, such as strong rains. Parallel to international efforts, the Italian National recovery and resilience plan (Falasca, Ciancio, Salata, Golasi, Rosso 2019)we investigated the impact of a HW on the UHI in Milan (Italy (PNRR) encompasses measures to boost energy efficiency of the built environment (thus reducing carbon emissions), water networks, green incentives, territorial resilience of urban areas and urban forests.

The proposed contribution illustrates a preliminary approach towards simultaneously mitigating more than one of these climate change related challenges at the same time, in cities, by tapping on co-benefits linked to peculiar solutions. Taking action in this direction is particularly urgent, as global emissions, which are directly linked to climate changes, are projected to increase by 14% within the next decade, while the set target is for them to decrease by 45% within 2030.

Challenges and Strategies Related to Flooding

Climate change is projected to increase both the frequency and the severity of floods, storms, and droughts increasing the vulnerability of urban centres. Moreover, the growing urbanization is affecting the water cycle, exacerbating the effect of the severe environmental phenomena, from the reduced infiltration to thermal discomfort. One of the most known consequences of the increased imperviousness is run-off effect.

Currently, flood protection and adaptation in the built environment are two paramount features that should be implemented to tackle climate-related challenges. The scientific literature underlines the necessity to structure coherent strategies with an integrate, multidisciplinary, cross-scale approach (Barker and Coutts 2016). The following scales are identified:

- national and city scale: Policies and management strategies are formulated. In Europe, for example, the Flood Directive (2007/60/EC) regulates the management and assessment of flood risk;
- neighbourhood scale: the urban environment is associated with a specific flood hazard. The broader strategies conceptualized at the city scale are translated into context specific designs;
- building scale: At the building scale, design measures and technologies are applied at the plot/ building level. Specific actions are defined based on and the characteristics of the flood and local buildings regulations. However, a crucial limitation is the lack of cohesion between the different scales and disciplines involved, often resulting in specific technical solutions to address a single climate issue, while a co-benefit approach for environmental problems has been proven as effective measure (He et al. 2019).

In this study, we assess how the mitigative strategies that can be used at neighbourhood/building scales for run off reduction, can be beneficial for another environmental issue related to climate change: the Urban Heat Island Effect (UHIE). We evaluate different scenarios and provide a quantitative analysis through a case study, a flood-prone urbanized area, the X Municipality of Rome.

The mitigation of the flood risk and runoff control is usually achieved though Sustainable Drainage Systems (SuDs) (Pappalardo et al. 2017) and the reduction of the water in excess is usually achieved through four different processes:

- infiltration: The precipitation or the excess of water infiltrates in the soil, partially used by plants to grow and remitted in

the atmosphere by evapotranspiration, or with a slow process refilling the aquifers naturally. It is necessary to consider the soil characteristics;
- detention/Retention: The excess of water is temporarily stored (e.g., Ponds and basins), then it can infiltrate in the ground where the soil and aquifer conditions are acceptable, or it can be remitted in the drainage system once the peak is passed. Detention basins are usually dry, instead, retention features are wet;
- conveyance: The excess of water is moved through the conveyance systems (e.g., Swales and channels) towards a receiving feature or watercourse;
- water Harvesting: Rainwater is collected and redirected to reservoirs, tanks, pits, or cisterns, usually sanitized and reemployed for domestic use or irrigation.

Under the different processes there are different types of SuDs, the most common in the built environment are:
- rainwater harvesting: It is a system to collect rainwater that would otherwise increment the runoff, primarily for domestic use;
- permeable paving: It consists of a paved area that allows water to infiltrate the ground, typically concrete blocks with gaps filled with gravel separating each block to facilitate water infiltration;
- green roof/wall: Vegetated covers for roofs or walls, used to reduce stormwater-runoff with many side benefits, reduced energy consumption in the building, lessen the Urban Heat Island Effect, increase lifespan of the roof/wall creating a barrier against temperature changes, and ultra-violet light;
- rain garden: It consists of a small depression in the ground, used as an infiltration facility. The plants used in the garden should withstand occasionally increased water levels;
- flood park: Parks used as a storage area, often combined with ther SuDs to promote water infiltration or water conveyance towards a receiving feature;
- basin: they are divided into detention and infiltration basins. The first is usually dry and temporarily stores the excess water to release it at a controlled rate. The latter retains the excess of stormwater and slowly infiltrates it into the ground;
- swales: Small channels used to convey, store, or infiltrate runoff water;
- wetlands: Shallow ponds covered with aquatic vegetation. They provide both flood relief and water treatment;

– floodable areas: Floodable urban areas. They can be playgrounds or squares where water can be temporarily stored to reduce the pressure on the drainage system during a severe event.

Challenges and Strategies Related to Heat

Urban Heat Island effect (UHIE) implies higher temperatures in cities than in surrounding suburbs, up to +10°C (Oke 1982). Extreme heat events, such as heatwaves are further exacerbated by the UHI (Falasca et al. 2019), aggravating the burden on the wellbeing and safety of urban citizens.

UHI is caused by changes in land cover, increased heat storage by the urban structure, higher anthropogenic heat from human activities, lower cooling from evapotranspiration due to reduced green and blue spaces in cities, which limit; dense urban morphology, which modify wind direction and velocity (Santamouris 2015).

Heatwaves and UHI are correlated, and temperatures in cities increase by up to 3.5 °C during heatwaves (example, 2012 in Athens (Founda and Santamouris 2017)). The heatwave occurred in Rome between 1992 and 2004 caused a 28.8% increase of natural deaths of older people (Falasca et al. 2019). Therefore, UHI is a crucial phenomenon to mitigate, by acting on the causes by means of a conscious design of buildings and urban spaces.

Many strategies have been studied to mitigate UHI and heatwaves. In the consolidated city, most often these strategies consist of acting on the materials composing the urban structure, in order to diminish the accumulated heat and increase the evapotranspiration (Rosso et al. 2019).

Towards this purpose, high albedo materials can be employed, which are able to maintain lower temperatures (Falasca et al. 2019; Pisello et al. 2016). They can be employed either on the external envelope of buildings and as urban paving materials.

Another effective solution is to employ greenery and trees, on the building envelope or in the urban space, to increase evaporative cooling and transpiration (Chàfer et al. 2020).

Common Strategies

As it emerges from the strategies against flooding and those against heat, many of them could be employed jointly to mitigate both challenges.

Towards this purpose, cool but also permeable paving could be employed, as well as SUDs consisting in greenery and trees, and

water elements in cities. The Authors of this contribution performed a preliminary study to assess the co-benefits deriving from the joint application of greenery and permeable pavements, on a case study in Ostia (Rosso et al. 2019) due to the increasing soil sealing. Greenery and water implemented in urban outdoor spaces have been promoted as effective strategies to counteract UHIE while Sustainable Urban Drainage Systems (SUDS). Results showed that thermal comfort during summer significantly improves thanks to the strategies, and the runoff risk is reduced by almost the 50% by considering the same strategies. Therefore, these considerations evidence the need to jointly consider all the challenges and all of the possible solutions in a global perspective, which would allow to exploit and design the co-benefits towards a more effective and efficient mitigation and adaptation to climate change.

In Figure 1 the main co-benefit strategies are summarized, as well as their effect risk reduction, both with respect to flooding (runoff) and UHI/heatwave.

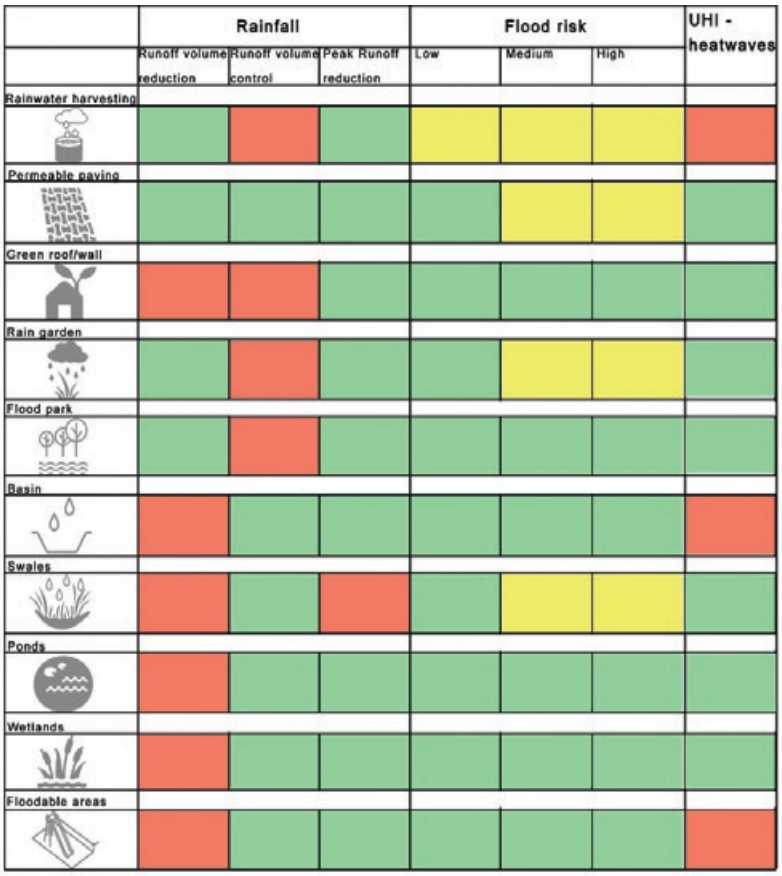

Figure 1. SuDs mitigating strategies for flooding and UHI. Green: appropriate. Red: not appropriate. Yellow: further data to characterize the specific use are needed. The table is an elaboration of the Authors from (Barker and Coutts 2016) (Griffiths 2016).

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Agostina Chiavola
Maria Rosaria Boni

The Quality of Urban Rivers with Respect to the Contaminants of Emerging Concern

The quality of urban rivers is strictly connected with the quality of life in the cities, and both things are strongly interconnected. Indeed, the uses and activities which involve the river are directly and indirectly related to the habits of the citizens. Additionally, a negative perception of the status of the water quality of the river by the population reinforces the "wall" between the city itself and its river.

The European Water Framework Directive (WFD) assesses that the status of surface waters must be based on four groups of quality parameters: the main of them is represented by the ecological status, which is supported by hydro-morphological, morphological and physico-chemical conditions (Directive 2000/60/EC).

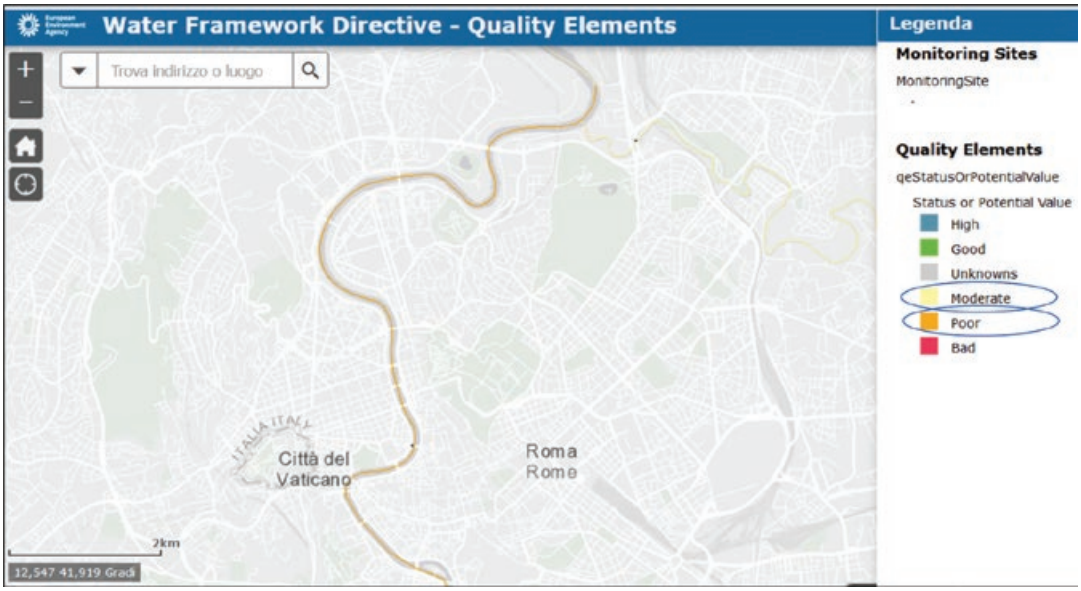
The S.O.S Waterfront workshop focused on the two rivers of the urban area of Rome city, which are Aniene and Tiber, qualitatively classified as moderate and poor, respectively, as highlighted by the interactive map shown in Figure 1, which is freely available among the EU River Basin Management Plans (https://www.eea.europa.eu/data-and-maps/explore-interactive-maps/water-framework-directive-quality-elements).

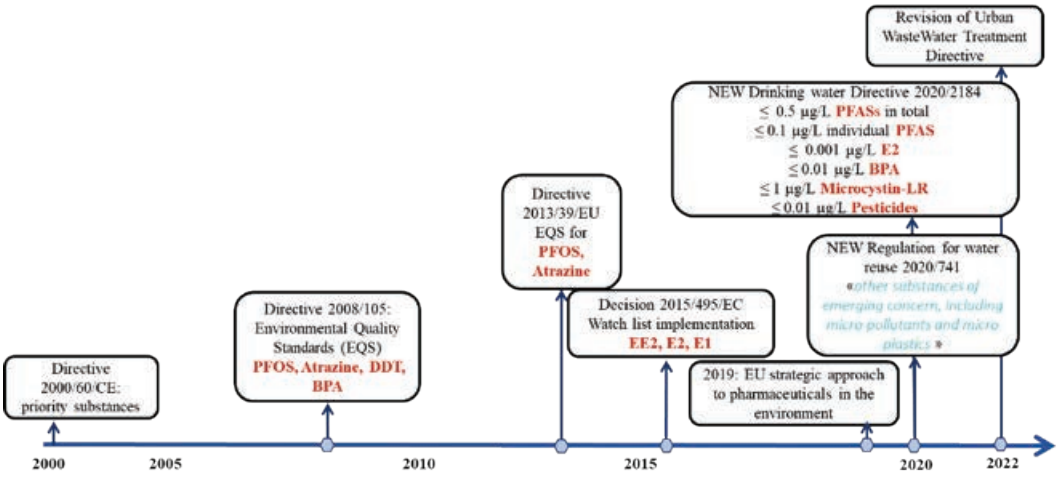
The physico-chemical elements are divided into general parameters (such as oxygen concentration, pH, nutrients concentrations and salinity) and specific pollutants (which include also priority substances). The WFD represents the first mark in the European water policy, which sets up a strategy to identify the high risk substances to be prioritized. A list of 33 priority substances, including hormones and pharmaceuticals, were set to be monitored ("watch list") by the EU member states in the Directive 2008/105/EC, which are also considered as Contaminants of Emerging Concern (CECs). The following Directive 2013/39/EU established the Environmental Quality Standards (EQS) for the priority substances in surface water and biota, with the aim to protect the aquatic compartments and human health.

The watch list was updated in 2015 and then in the Decision 2018/840/EU and Directive 2020/2184/EU. The policy development in this field is continuously ongoing (see Figure 2), with the intent to become more effective particularly with respect to the relatively new class of CECs. Indeed, the new European Regulation on minimum requirements for water reuse entered into force in 2020 (Regulation 2020/741/EU) and the revision ongoing of the Urban Wastewater Treatment Directive (UWWTD) also address specifically these pollutants. The latter document highlights that CECs, which are not included in the scope of the actual UWWTD, must receive more attention since the treatments required by the

Figure 1. Water Framework Directive Quality Elements map of Tiber and Aniene rivers in the urban area of Rome (River Basin Management Plans).

Figure 2. European water policy development.





UWWTD reduce such pollutants in wastewater to some extent but do not target them directly neither achieve a satisfactory level of removal (European Commission, 2019). This assumption is based on extensive scientific activity carried out all around the world (Di Marcantonio et al., 2022; Kumar et al., 2022).

In the framework to obtain a better knowledge CECs, it is of paramount importance to study and assess the sources of contamination of the rivers also going further with respect to the actual policy requirements. This is particularly important in urbanized areas where there are many potential causes of pollution

and the self-purification capacity of the rivers has become limited in many cases. Based on the studies carried out so far, the wastewater treatment plants (WWTPs) have been recognized as one of the main sources of contamination of the aquatic environment. Particularly, they can be responsible of the release of CECs since not specifically designed and operated to remove them (Barchiesi et al., 2021; Di Marcantonio et al., 2020). With the aim to provide a better knowledge on the role played by the WWTPs in the urban river contamination due to CECs, a wide research activity has been carried out since 2017 on full-scale WWTPs for domestic sewage by DICEA of Sapienza University of Rome. The activities focused on a list of pharmaceuticals, illicit drugs and caffeine, since they represent the more diffused CECs in the sewage entering the plants. Firstly, 76 full-scale WWTPs were monitored with the aim to assess the occurrence of the selected compounds in the influent and effluent, considering also any seasonal variation, and the overall removal efficiency (Di Marcantonio et al., 2020). Later on, a detailed study was conducted on the effects of the main treatment stages, i.e. pre-treatment, primary sedimentation, secondary treatment and disinfection. An investigation was also performed on a wastewater plant whose treated effluent is intended for reuse; therefore, after the assessment of the removal achieved through the treatment processes, it was determined the human health risk due to the reuse for non-potable applications of the final effluent containing residual concentrations of CECs (Di Marcantonio et al., 2021). In the last period, the monitoring activity focused mainly on 8 WWTPs distinguished based on the type of the biological process. The aim was to provide a better knowledge on the effect on the removal of CECs of this stage which represents the responsible of the main removal. Traditional water quality parameters were also monitored to find out any possible correlation with the removal of CECs. The environmental risk assessment was carried out considering the residual concentrations measured in the treated effluents of these plants, by following the procedure outlined by the European Medicines Agency (2018). In addition to the standard procedure, an estimation of the dilution effects of the receiving water bodies on the effluent residual concentrations was also performed to make the assessment more site-specific. A preliminary study is also on going about samples collected from the WWTP effluent and upstream and downstream compared to the point of its release into the river.

The results obtained by the studies conducted so far by the research group showed, in agreement with other studies, that residual concentrations of some CECs are still found in the

treated effluent when the layout of the plant is conventional. An improvement of the removal efficiency can be achieved in the presence of tertiary treatments. It was also demonstrated that the presence of these CECs in the effluent does not represent a risk for the aquatic environment. For some contaminants (such as the antibiotic sulfadiazine), the quality of surface water was not affected by the plant effluent discharge since the concentration did not change appreciably between upstream and downstream the point of discharge. For others, it was observed a slight increase downstream. However, it is likely that sources other than the WWTPs are also responsible of the presence of CECs in the river. Further studies are ongoing to better elucidate the sources and relative contribution of CECs to the river and the impact on the quality of water and therefore on ecosystem.

In conclusion, although the numerous studied so far carried out, more scientific research at different levels is still needed, to provide the stakeholders with a comprehensive knowledge about the presence and effects of CECs in the urban river, connecting the engineering aspects (i.e. the plants) with the ecological impacts. The results of the scientific activity must be then implemented into an effective management strategy to ensure protection for the environment and human health. This strategy should be based on two main policy tools: restrictions to the use of dangerous substances (e.g. REACH) and environmental standards to be respected (e.g. EQS).

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The Problem of Forgotten Peripheral Rivers and Streams in Big Cities

Introduction

The following Article presents how watercourses were devastated by human actions and their impact on nature, and how important is to take care of the water condition.

This article includes specific data about the current condition of rivers and streams which is deplorable, but it is not widely known how poor and how dangerous it could be for our environment and health.

For centuries proximity of the water was an incentive for people to settle in a specific area. Nowadays only a few are aware of how many rivers surround settlements, except for the known rivers flowing throughout the country, as indicated on the maps.

However, it is worth realizing that water in the city is more widely available than it may seem, but often we are not able to notice it due to overgrown greenery or surrounding buildings, wasteland, fence, or even a transport line, which is not only cover the water but often contaminate it.

Historically the problem was mentioned several times. Even now it is raised in many publications, but the issue is still growing in some places. Changes are needed, with the participation of the government and specialists. The issue is particularly important in the context of climate change, which we are unable to fight but must adapt to.

Rivers and settlements

Historically, rivers and streams have been places where settlements and housing were starting to grow. They were the beginning of the development of cities and civilization due to the necessity of their presence for life. Freshwater met the basic existential needs of people, and also played a commercial and communication role between other settlement units and smaller towns. Settlements and housing in the vicinity of rivers achieved the fastest and most efficient economic, demographic and social development, despite the threats that the river posed to man. There are hundreds of examples of river course changes, inundations, floods, etc. known in history.

Currently, the river has become a partially forgotten creation, and even a barrier to urban or transport development, and often drastic or destructive solutions are taken to the problem which, according to some individuals, the river is. It is now important to re-open the city to the water and its possibilities, to adapt to and face its opportunities and threats. Water in the city is an extremely important element in the revitalization process and deserves to be devoted more time.

Secondary rivers in cities are not as neat and glorified as main rivers, like the Vistula in Poland or Tiber in Rome, Italy. Near less important watercourses, industries are usually to be found, due to the ease of trade and urban transport, which was of particular importance during the industrial revolution. It was then that factories and large-scale industries were located by the water, not only for transport and trade but also for the use of water to work industries.

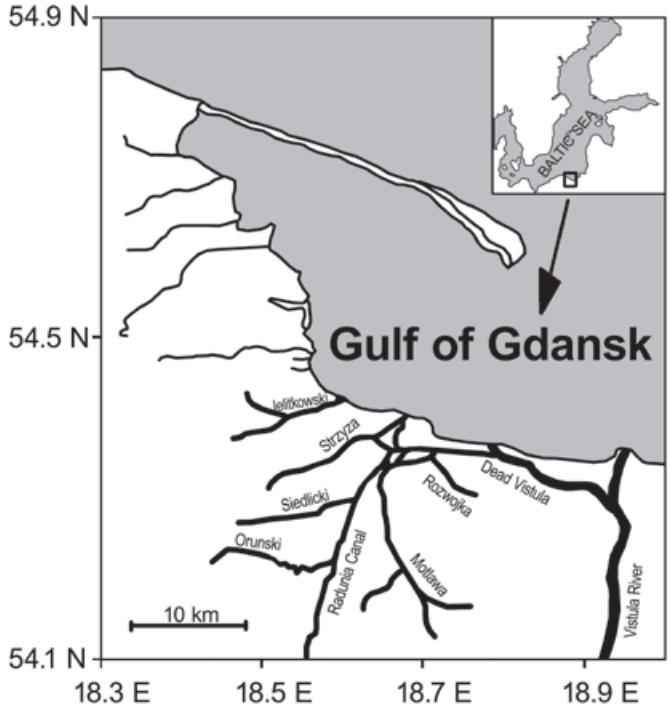
Unfortunately, over time, it turned out that rivers were contaminated due to industry, as well as throwing waste and rubbish into the water, also in the form of sludge, which had an impact on the quality of the water and also affected human life. Many rivers have become contaminated and are not serving people in the same way they could. However, it was not only the contamination of the rivers that led to their omission. Currently, many watercourses are inserted into underground pipes due to their *inconvenient* location concerning the intensive urbanization of cities. Unfortunately, the tendency to canalize rivers in Poland is growing in strength, while in the world these practices are being abandoned.

A canalized river, contrary to the assumptions of investors and city authorities, causes more damage than an open river. Anaerobic bacteria often develop in the sewer due to favorable conditions to accelerate the processes of putrefying residual pollutants, and in the case of heavy rains, the water in the pipe does not withstand the pressure and rushes upwards through the drain grate together with anaerobic bacteria, deadly for living organisms. Open, non-piped watercourses are easier to clean, but also in the case of heavy rains, rivers flood mainly within their river bed, while above-canalized rivers there are often built-up areas, which results in breaking contaminated water onto inhabited areas, underground garages, basements, and even flats.

Gdańsk Streams

The Gdańsk Municipality is located on the southern coast of the Baltic Sea, in the north of Poland. The climate of this place is characterized by four different seasons and the temperatures of water of the Baltic Sea throughout the year range from – 3.4 °C to 21.3 °C (Cieszynska M. et al. 2012).

All streams enter the Gulf of Gdańsk mostly via the Dead Vistula River. One of them is Strzyża – the last left-bank tributary of the Dead Vistula before entering the Baltic Sea. In the past, this watercourse had an important economic role – on the shore, there were grain mills (still in operation in the 1940s), as



well as a silver forge from which the Srebrzysko district took its name. Naturally, the Strzyża stream has a hydromorphology of a submontane character, and the river's course begins in the Tricity Landscape Park (Regionalny Zarząd Gospodarki Wodnej w Gdańsku, Charakterystyka JCWP rzek 2016-2021).

From the end of the 19th century, the stream was subjected to significant interference with the course of the river corridor. This course was regulated and canalized, as well as the mouth of the stream. Currently, Strzyża is partially canalized, among others due to the expansion of communication nodes or new housing estates. Very few people, even residents, know its exact course. In the area of Wajdeloty and Aldony streets in the Wrzeszcz district, the Strzyża stream is well-exposed, organized, and well-kept, creating a beautiful view, often referred to as "Italian", together with greenery and historic buildings. Unfortunately, a bit further, in the area of Słowackiego Street, it is forgotten and neglected. It flows along a busy street without pedestrian routes. Its trough does not look neat and there are no recreational spaces or a sidewalk around it. The Strzyża Stream can be described as unused potential. Such a situation is present in many sections not only of Strzyża but also of many other Gdańsk streams.

Figure 1. Map of streams in Gdansk [1]. Source: Cieszynska M., Wesolowski M., Bartoszewicz M., Michalska M., Nowacki J. 2012.

Despite the canalization, the Strzyża stream absorbs water very well during heavy rains, since it has many natural retention pools that are able to store excess water. It is also a good example showing that a chain of rhythmically located smaller reservoirs is more effective than one large reservoir.

Another example of Gdańsk's forgotten watercourse is the Royal Stream, which is also one of the tributaries of the Strzyża Stream. It is also a watercourse with potential, but instead of perceiving it, people see water as a disadvantage that "hinders" urban development. The stream has been partially canalized, but a large part is still discovered and worth developing. There are also examples of total stream sewage in Gdańsk. Such an example is Siedlicki Stream, today it's practically impossible to save because it runs in the canal under intensively used communication routes.

Based on the 2019/20 research carried out by the Gdańsk Municipality (Gdańsk Municipality, 2019/20), it is possible to determine the current state of watercourses in Gdańsk. For example, for the Strzyża stream and the Siedlicki stream, the assessment of the ecological status is as follows:

Table 1. The results of the assessment of the ecological status of individual watercourses examined in 2019/20. Source: Monitoring of watercourses in 2019/20, Gdańsk Municipality.

Stream name	Assessment of the biological element	Ecological condition (quality class)
Strzyża stream	the biological element indicates a very good condition of the waters	**moderate (III class of water quality)**
Siedlicki Stream	the biological element indicates a very good condition of the waters	**moderate (III class of water quality)**

Table 2. Assessment of the water status of the analyzed watercourses of the Gdańsk in 2019/2020. Source: Monitoring of watercourses in 2019/20, Gdańsk Municipality.

Watercourse	Ecological state	Chemical state	General assessment
Strzyża Stream	moderate	below good	bad water condition
Radunia Canal	good	below good	bad water condition
Dead Vistula River	moderate	below good	bad water condition
Rozwójka Canal	moderate	below good	bad water condition
Motława River	good	below good	bad water condition
Radunia Canal	good	below good	bad water condition
Czarna Łacha Stream	good	below good	bad water condition
Oruński Stream	moderate	below good	bad water condition
Siedlicki Stream	moderate	below good	bad water condition
Rynarzewski Stream	good	below good	bad water condition
Jelitkowski Stream	moderate	below good	bad water condition
Strzelniczka Stream	moderate	below good	bad water condition

Taking into account the summary list of watercourses in Gdańsk, it is noted that the overall assessment of the water quality of the watercourses is bad, which unfortunately translates into the attractiveness of such water among people, apart from unorganized green and recreational areas along the given watercourses.

The level of contamination of the studied watercourses based on the indicators of physicochemical pollution and the indicator for substances particularly harmful to the aquatic environment summarized by Gdańsk Municipality in the paper *Monitoring Watercourses* shows that level has increased since 2016-2017 but is slightly lower than the average for the last 10 years (84.9%) (Gdańsk Municipality, 2019/20).

In the case of the chemical status, the situation has not changed since 2014 – the chemical status of all watercourses (17/17) is classified as below good (Gdańsk Municipality, 2019/20).

Water quality levels:

a. biological indicator of water quality (Table 3.);
b. ecological state after taking into account the physicochemical indicators (Table 4.);
c. the chemical condition of the watercourses (Table 5.).

From the biological condition of Gdańsk watercourses, it can be seen that it is rather stable at a good level, while the ecological condition taking into account physicochemical factors also shows no major changes, but the level itself is moderate. The chemical status is below good.

Aniene River

Aniene is the tributary of the Tiber River in central Italy, and the second river in Rome in terms of length and width with an average flow of 35 m^3/s. It is afflicted by various sources of pollution, such as industry or urban development.

Based on the book *Environmental Earth Sciences* from 2009 it was proved that the presence of serious water pollution in most of the streams in the eastern area of Rome (La Vigna, Ciadamidaro, Mazza and Mancini 2010). The water quality is mainly related to poor quality in the indicated watercourses, which shows that the problem does not only concern the watercourses of Gdańsk, but is a global problem.

In the article from 2022 on Untargeted analysis of contaminants in river water samples: Comparison between two different sorbents for solid-phase extraction followed by

Table 3. 4. 5. Source: Monitoring of watercourses in 2019/20, Gdańsk Municipality.

	A number of watercourses with a specific water quality status									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2019/2020
very good	12	15	16	14	13	12	12	16	14	13
good	1	1	1	3	3	2	5	1	2	2
moderate	1	0	0	0	1	3	0	0	1	2
poor	1	0	0	0	0	0	0	0	0	0
bad	1	0	0	0	0	0	0	0	0	0

	A number of watercourses with a specific water quality status									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2019/2020
very good	0	0	1	2	2	0	0	0	0	0
good	0	0	0	6	8	2	1	1	0	8
moderate	14	16	16	9	7	15	16	16	17	9
poor	1	0	0	0	0	0	0	0	0	0
bad	1	0	0	0	0	0	0	0	0	0

		A number of watercourses with a specific water quality status								
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2019/2020
good	0	15	13	0	2	0	0	0	0	0
below good	16	1	4	17	15	17	17	17	17	17

Table 6. Index of Aniene River functionality with the condition of its streams. Source: La Vigna, Ciadamidaro, Mazza, Mancini 2009.

Stretch	Water sampling sites	Score	Class	Condition
San Basilio	B2, B3	146	III	Sufficient
Cecchina Tor Sapienza	B1	113	III-IV	Poor
Villa Senni		118	III-IV	Poor
Carrefour	S4	77	III-IV	Poor
Giardinetti		137	III	Sufficient
Torrenova	S3	58	IV-V	Poor/bad
Longoni	S2	85	IV	Poor
Tor Cervara	S1	151	III	Sufficient
San Vittorino	C1	240	II	Good

liquid chromatography-high-resolution mass spectrometry determination (Montone, Giannelli Moneta, Aita, Aulenta, Cavaliere, Cerrato, Fazi et al. 2022), a study was created by collecting 5 water samples from watercourses in Rome: 4 samples were of Tiber River and one sample went of Aniene. It has been proven that the most contaminated samples were collected from the Aniene River and the Tiber River downstream of the City

of Rome and South Rome. The second one is likely related to the impact of the City, while the Aniene River contamination is similar due to more industrial than urban activities. The analysis of samples collected in different locations along the Tiber River and the Aniene River highlighted the anthropogenic impact of the City of Rome on its main water flows (Montone, Giannelli Moneta, Aita, Aulenta, Cavaliere, Cerrato, Fazi et al. 2022).

Conclusions

In Italy, in the last decades, national authorities have increased interest in the analysis of environmental samples by showing the importance of affection to human and ecosystem health. It is highlighted how important is continuous analytical surveillance and the implementation of more effective wastewater treatment technologies to reduce active compound discharge into surface water.

It is worth considering why this is so. Water, despite playing a huge role in human life, is often treated as waste storage, which translates into our health and quality of life. Often treated as an intruder on the path of urban development, she is pushed underground into the canal. It is worth drawing the public's attention to the need to interact with water by increasing people's awareness, as well as talking about the consequences of human actions. Few people are aware of the effects of channeling rivers or littering them with sludge.

It is important to pay special attention to the presence of water when designing a small investment or even the entire region. We cannot see water as an obstacle these days – it is part of our life and landscape. People who choose apartments often prefer the proximity of water, yet many developers decide to hide it underground – often generating erosion and disasters. Covering the water with concrete is not a solution, we should not fight the water, but cooperate with it and adapt to its presence.

By treating water for many years as a waste site or an obstacle to urbanization, the current water quality situation is very bad. Designers' approach should change from the ground up, not only increasing attention to new designs but also repairing what has already been destroyed. More attention should be paid to the current state of water, which has been achieved by society over many years, and care should be taken to improve it to make the presence of water unique to people.

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Projects results

Discovering Aniene

Group Participants:
– Students: Ilaria Fiocchi, Livia D'Urso
– Experts: Germaine Sanders, Sara Macedo, Wojciech Litwin

The project focuses on the strategy to redeem the Aniene river to Rome's inhabitants and open the city to the presence of the river. The main idea was to create a unique system of diverse connections: pedestrian paths, cycling paths, kayak paths, and a series of interconnected green areas, aiming to create different loops and bypass one another. The path connects unique elements such as a bamboo forest, an open-air library with reading space, a resting area with a cafeteria, and a shelter for kayaks. Each part of this new system had the task to participate in the creation of a complex ecosystem that would connect with the Rome landscape. The general concept was to reorganise and connect the existing green areas at different scales and create new accesses to the river which is now hidden and unknown. In particular, the design focus is on three areas: Parco delle Valli, Pietralata district, and INA-Casa neighbourhood.

The project proposed new river access for Parco delle Valli through a new channel. It consists of a "water line" and pedestrian and cycling paths, linking the metro station of Conca d'Oro to the river. The "water line" starts from a small "water plaza", a landmark to invite citizens and tourists to discover the Aniene river. Then it takes the water from the river and purifies it under the "water plaza", and lets it flow again in the river. All the system works, on one hand, as a purifier, and on the other one, as a basin to stock the water and reuse it when necessary. At the end of the perspective channel, the "water line" changes into a waterfall, where a sitting area with benches and an overview of the river is designed.

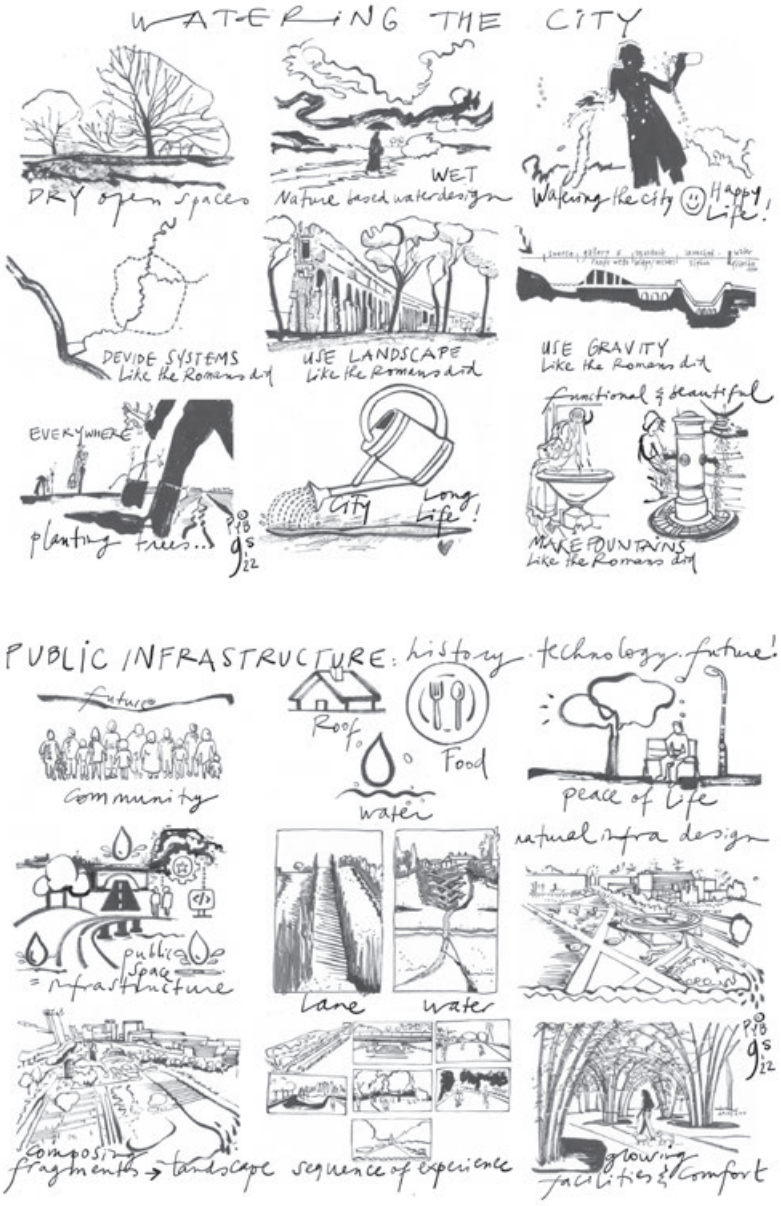
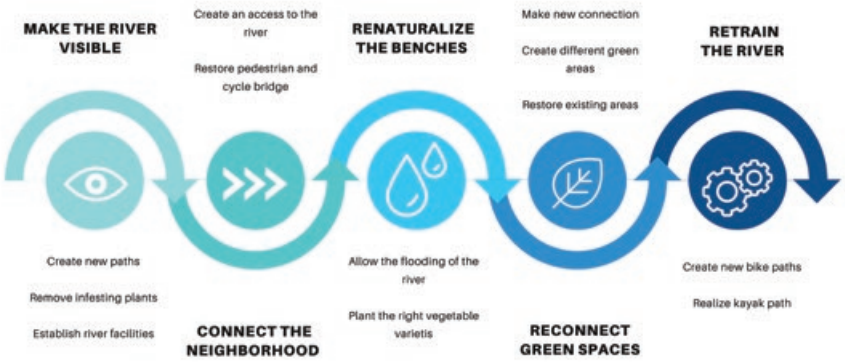


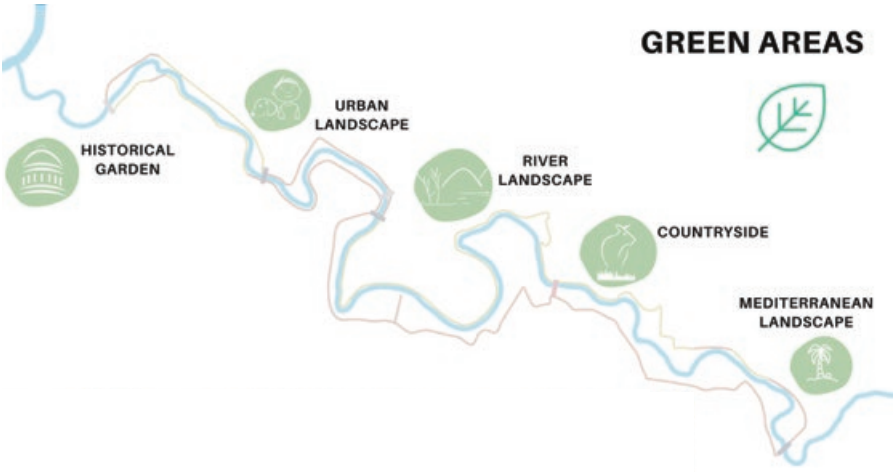
Figure 1-3. Resource the Aniene river; watering the city; public infrastructure: history technology future. Drawings by Germaine Sanders.

PROJECT GOALS



SPECIFIC GOALS

MAKE THE RIVER VISIBLE	CONNECT THE NEIGHBORHOOD	RENATURALIZE THE BENCHES	RECONNECT GREEN SPACE	RETRAIN THE RIVER
Create new paths	Create an access to the river	Allow the flooding of the river	Make new connection	Create new bike paths
Remove infesting plants	Restore pedestrian and cycle bridge	Plant the right vegetable varietis	Create different green areas	Realize kayak path
Establish river facilities			Restore existing areas	



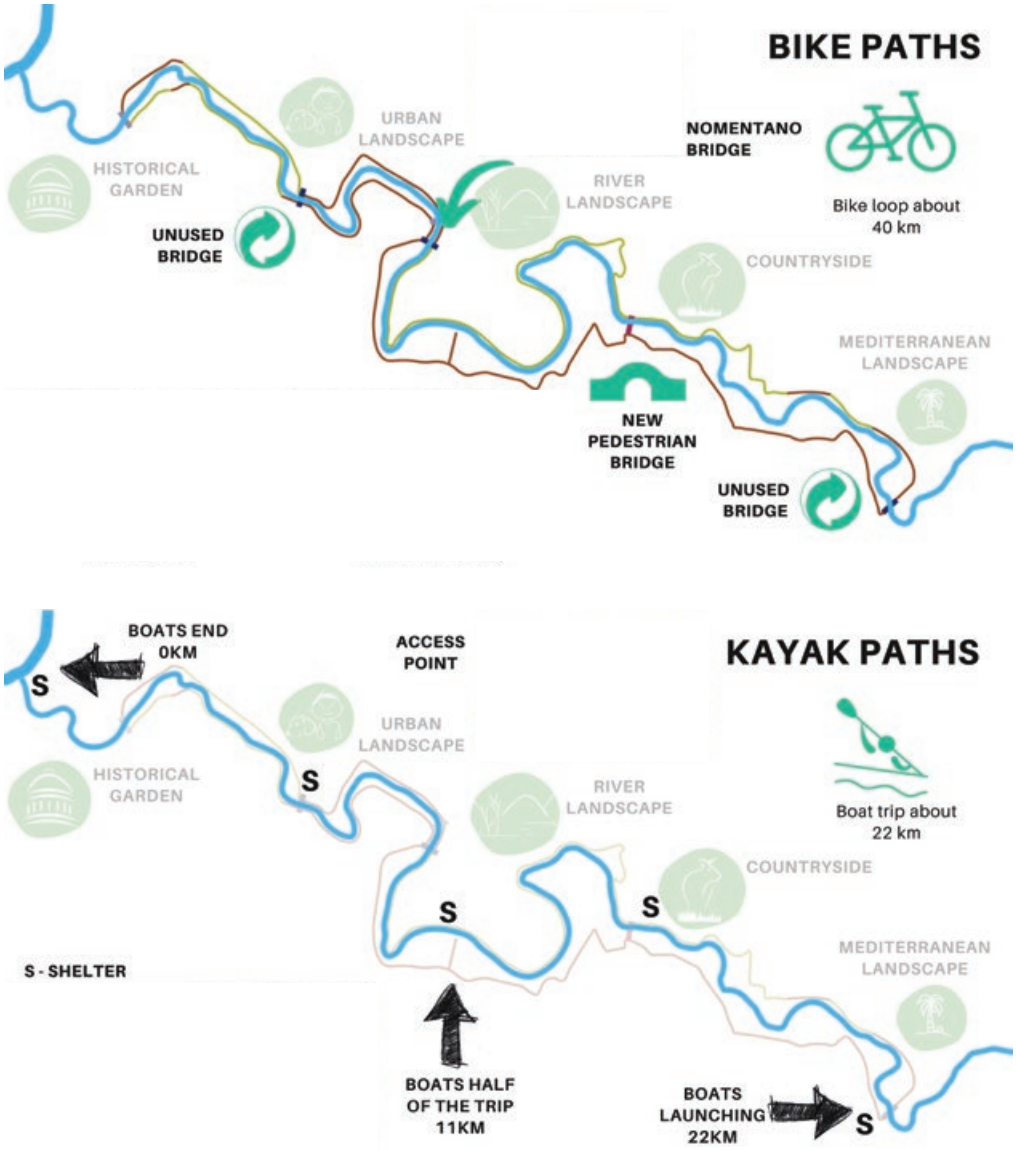


Figure 4. Project goals.

Figure 5. Specific goals.

Figure 6. Green areas.

Figure 7. Bike paths.

Figure 8. Kayak paths.

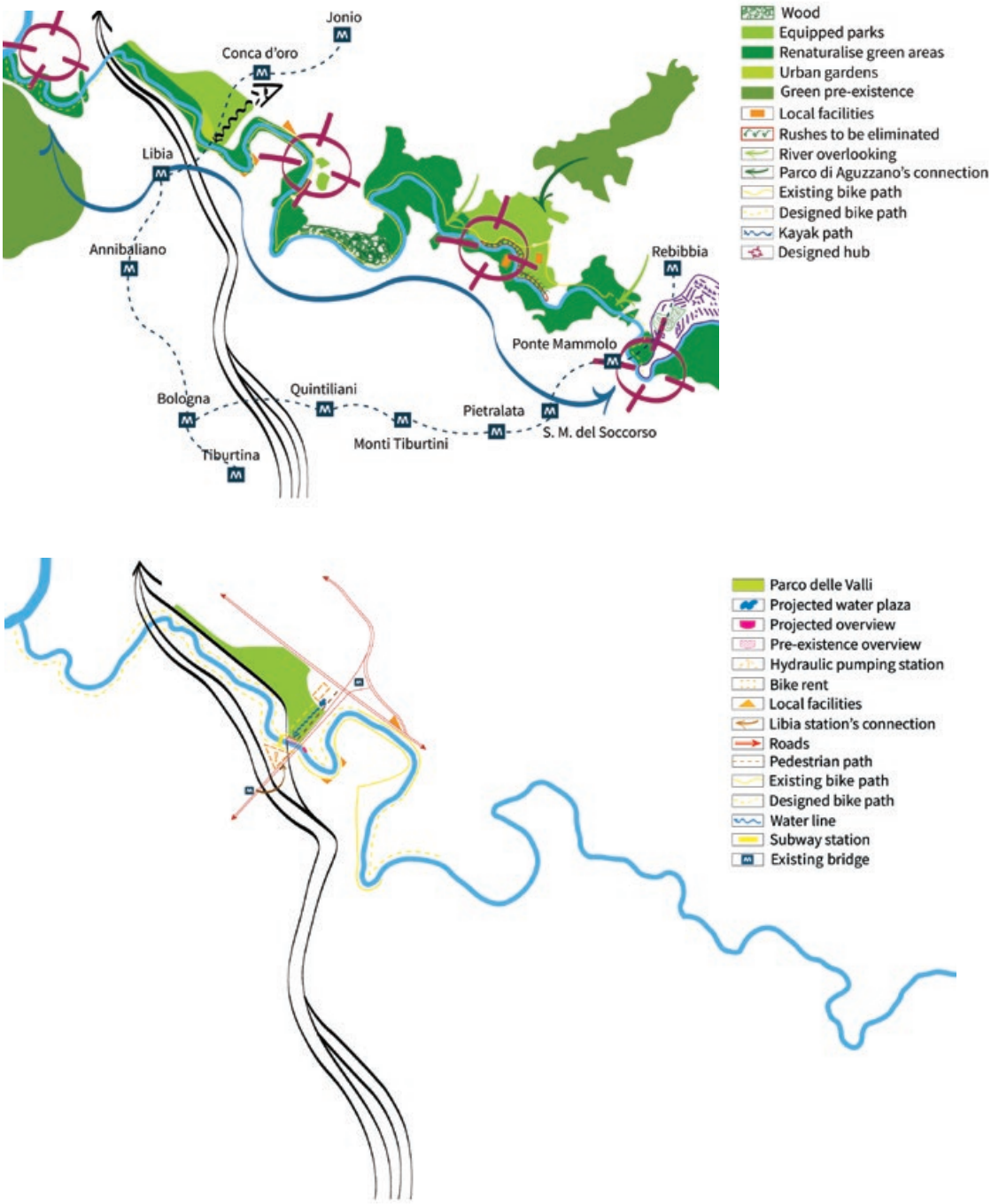


Figura 9. General planning schemes.

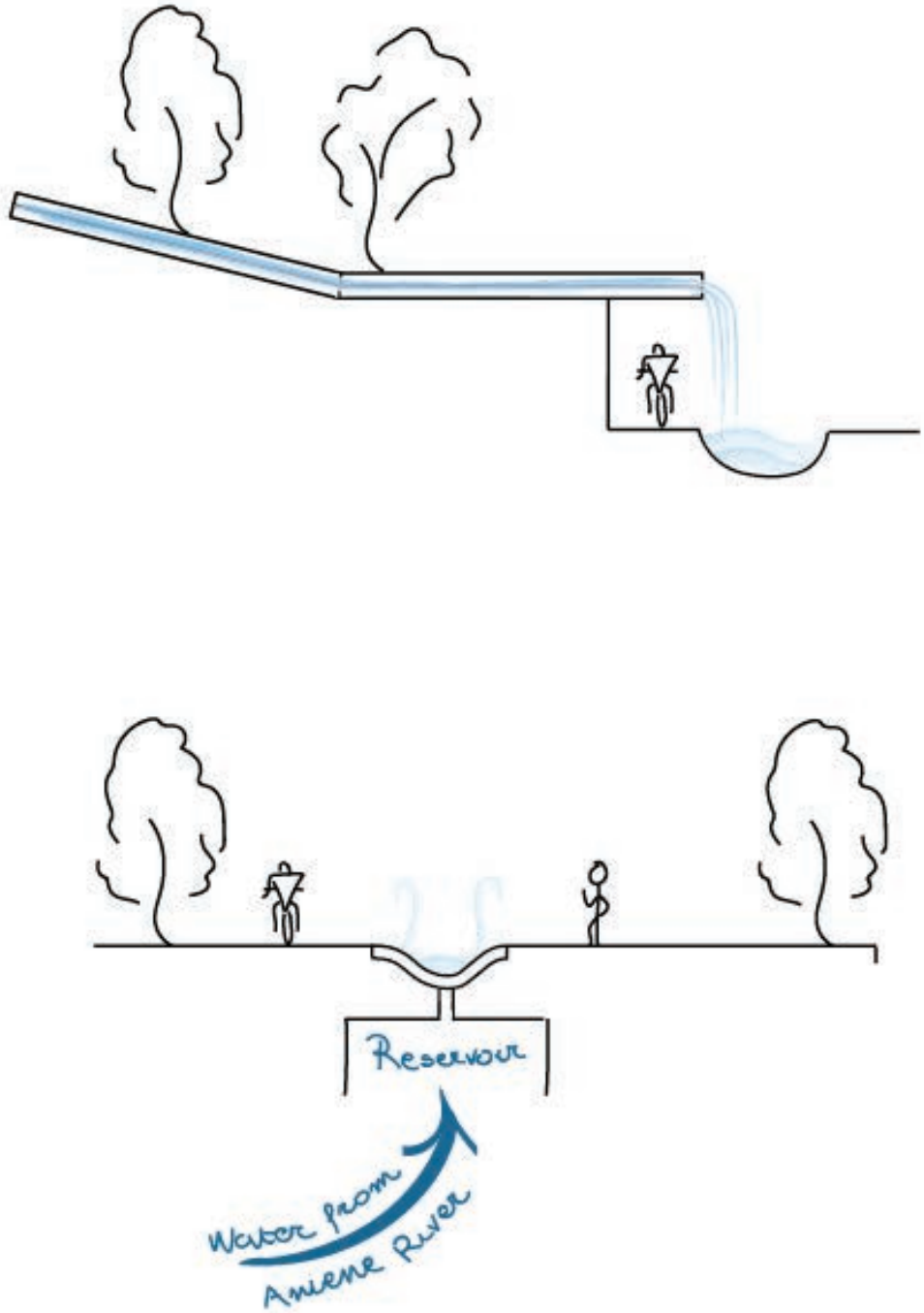


Figura 10. Cycle and pedestrian paths: relationship with water.

Projects results

Permeable Widen Aniene

Group Participants:
– Caterina Birilli, Anna Fracasso, Karen Sarabia
– Experts: Pedro Ressano Garcia, Lucyna Nyka, Jan Cudzik, Joanna Badach

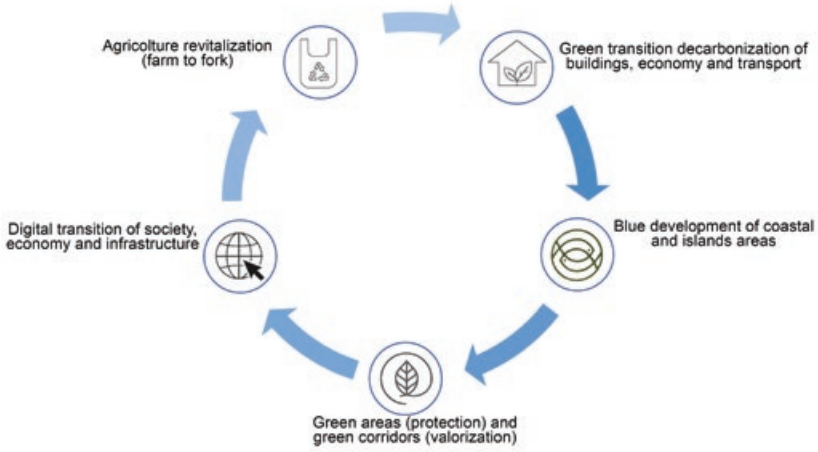
The proposed small-scale project focuses on the INA casa District located in the Eastern part of Rome, along the Aniene river. It is separated from the waterfront by barriers made of both vegetation and unauthorised construction, which block the access to the riverside and obstruct the view. On the other hand, the social building units and their layout are a great asset of the district. However, the buildings are not maintained according to the original plan. Parts of the ground floor, originally with an open plan to mitigate the risk of flooding, were fenced.

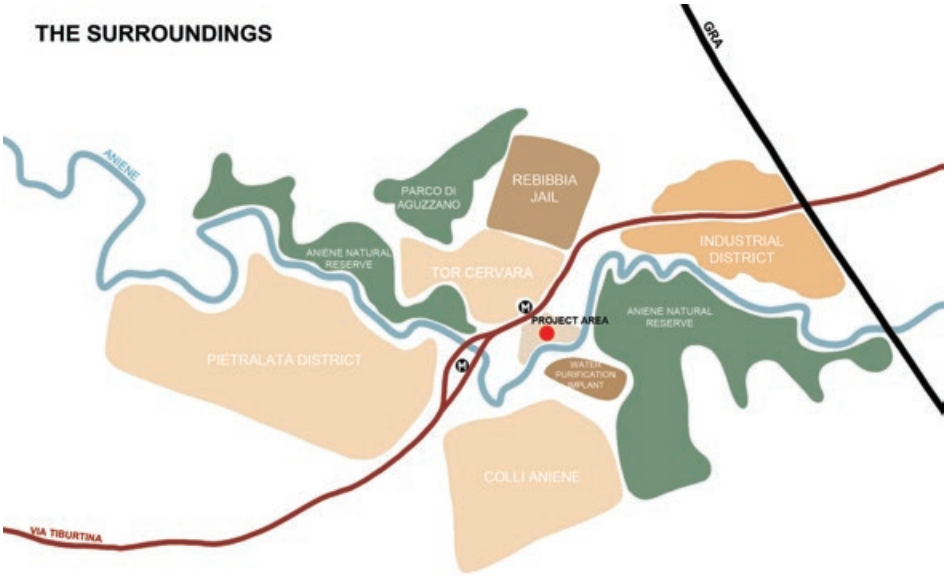
The initial goal of the proposal was to integrate the river with the neighbourhood by eliminating the existing barriers. Moreover, the spaces where water can be accommodated were designated. A set of small-scale, detailed solutions which constitute good practices were proposed. They can be implemented in other areas with similar characteristics. The project also suggested some passive energy solutions that could improve the energy efficiency of the buildings. Sustainable solutions were used such as rooftop solar panels, roof ponds that generate waterfalls to collect the water in special storage, and the Trombe wall to absorb thermal energy and to provide an insulating air-gap.

It was also necessary to define public space in the district, currently non-existent, to improve the quality of life of the residents and create a new hub within the city. Since the aim of the project was to make the dynamics of water visible inside the city, this public space was designed as a water square. Because of its central disposition inside the district, it can easily become the main place for encounters and give access to the riverside. It was additionally marked by a special pavement and the main path. The water square design combines both functional and aesthetic aspects. It was designed in the form of terraces: from the highest, more structured terrace with places to sit, to the lowest terraces with playgrounds. The lowest level, additionally equipped with a stone bench, has a more natural and permeable character. It was designed as a floodplain that can be used while the area is not covered with water. It corresponds with the level of the river: rising water permeates and eventually covers the rocks and the ground until it reaches the square.

The proposed layout of the river bank helps to prevent water from overflowing into the built-up areas. After removing the existing barriers, new bicycle and pedestrian paths with trees were designed along the waterfront. This provides visual connection with the river. From the main path, it is possible to descend to the river through ramps crossing the green terraces. Places to recline

along the terraces and an area for a small open-air amphitheatre were also introduced. At the lowest level, in direct contact with the water, plant habitats were designed with species typical of the Aniene river such as irises. In front of the river bank there is a green island that can be reached through suspended paths allowing access to the area in case of flooding. Finally, a system for collecting and reusing both rain and grey water, e.g. for plant irrigation or to feed the water into the river, was proposed.





SITE ANALYSIS

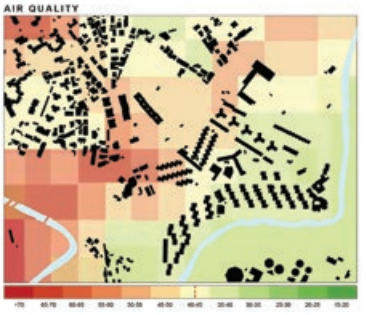
BUILDING QUALITY

GREEN

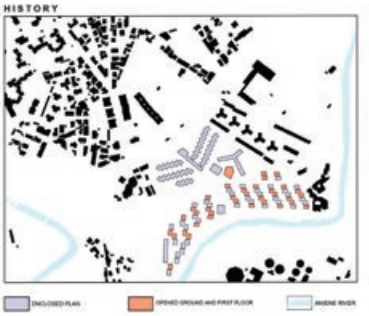
COMUNICATION

FLOODING

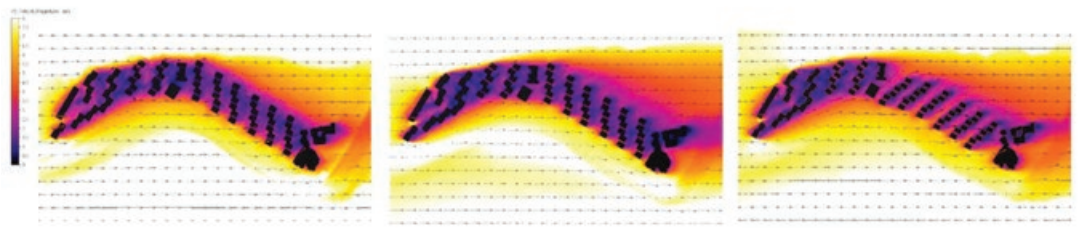
AIR QUALITY



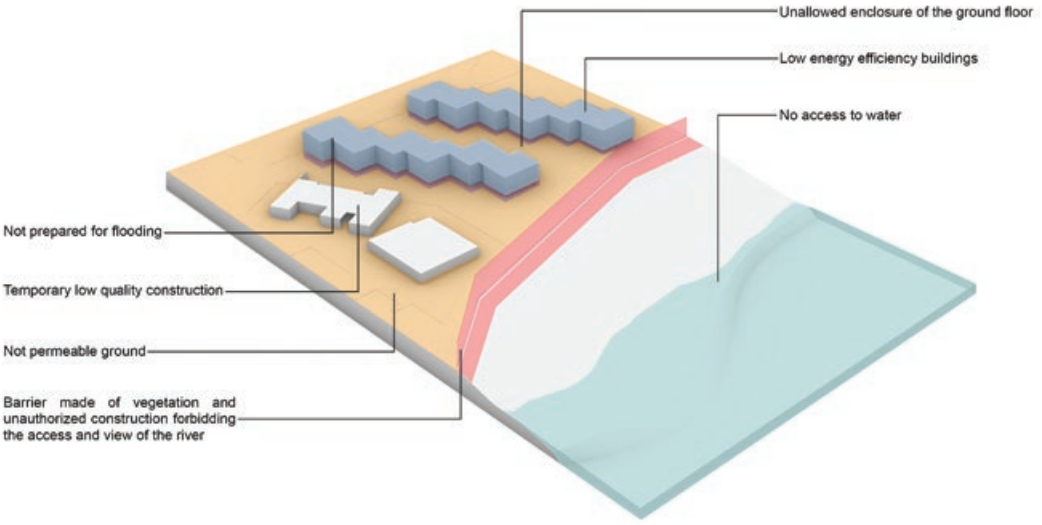
HISTORY

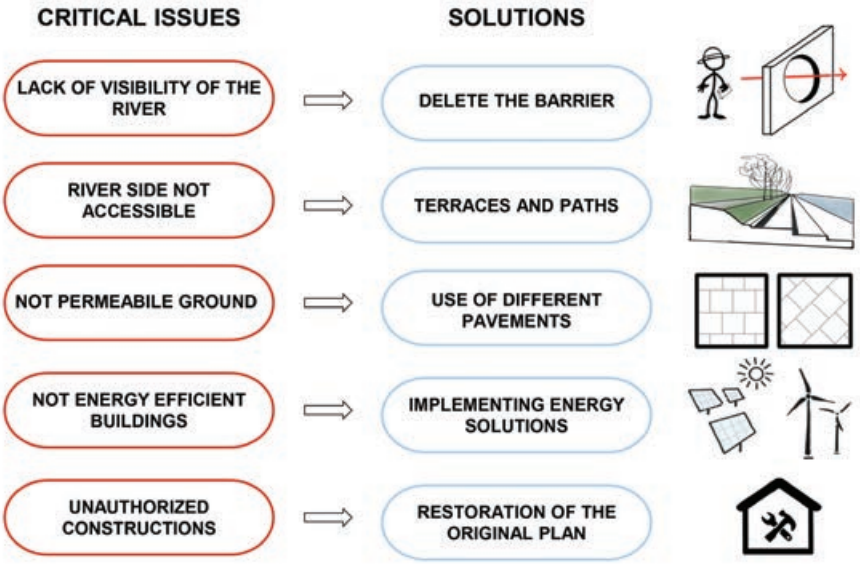


VENTILATION STUDIES

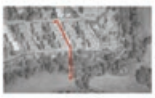


SUMMARY OF THE ISSUES INSIDE THE AREA





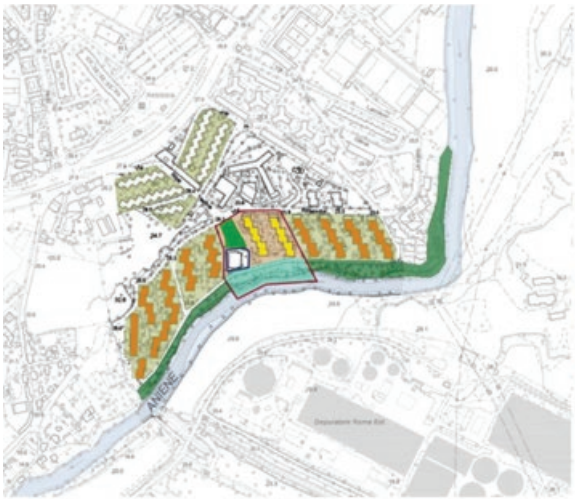
ACTUAL RELATION BETWEEN ANIENE AND BUILDINGS



Low level

High level

Flood level

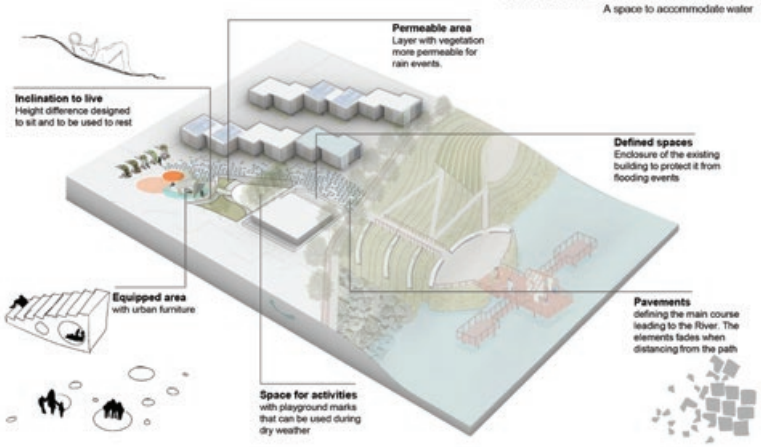


ASSET SCHEME

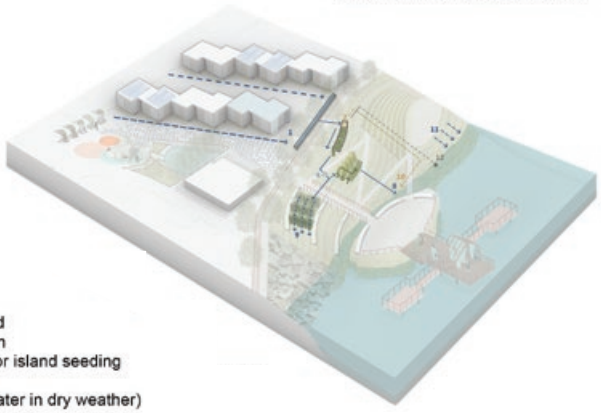
- Pilot Project area
- Sample buildings with energy system and renovation plan
- Buildings that will be implemented next
- Common space and space to accommodate water
- Pavements to make the ground more permeable
- Ground which needs to be permeable
- Waterfront plan
- Future expansion of the Waterfront plan
- Enclosure of the existing private building

ARCHITECTURAL SOLUTIONS

A space to accommodate water



GREY WATER REUSE SYSTEM



LEGEND

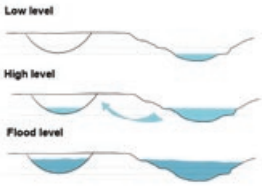
1- Neighborhood run-off
2- Collection + sedimentation
3- Wetlands (surface + subsurface)
4- Aeration
5- Filter strip
6- Polishing
7- Retention + detention
8- Riffle stream + bivalve bed
9- Remediation field irrigation
10- Cleaned sand + gravel for island seeding
11- Local runoff
12- Solar pump (to supply water in dry weather)

ARCHITECTURAL SOLUTIONS

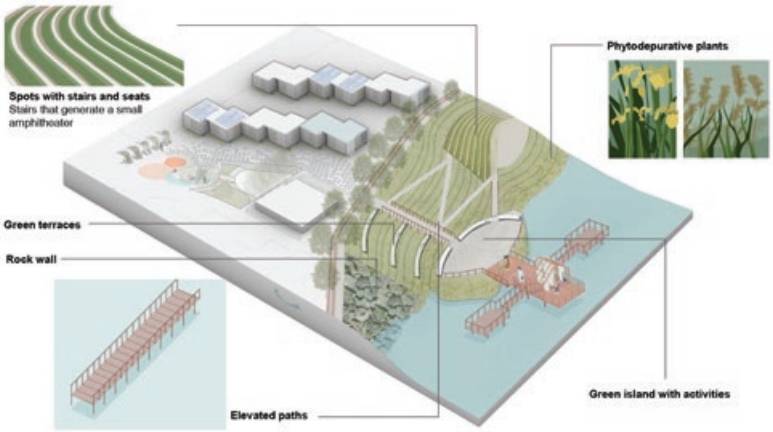
The water square makes the dynamics of water visible inside the city and enhances the value of the surrounding areas. The design is both functional and aesthetic.

The River and the Square communicate across a bench made of rocks. When the water rise it gets through the rocks and the ground until it comes back to the surface as reaching the square.

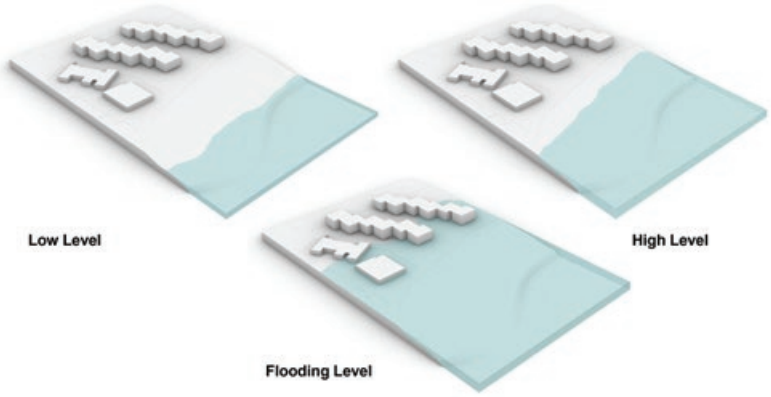
Combining this system with the Bench planning there's enough room for water to not overflow into the densely built-up urban area.



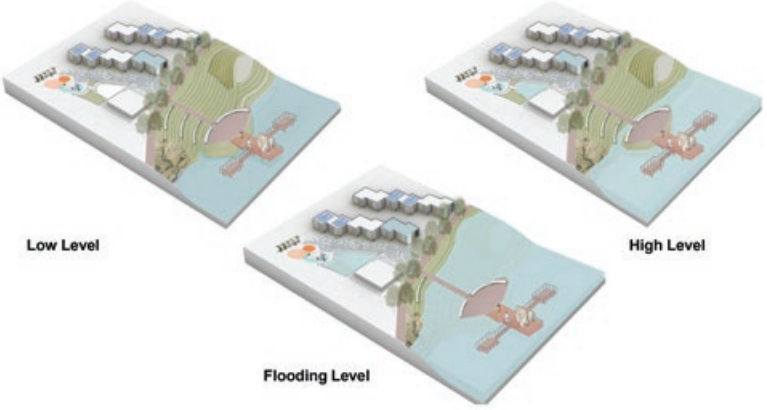
THE RIVER BENCH

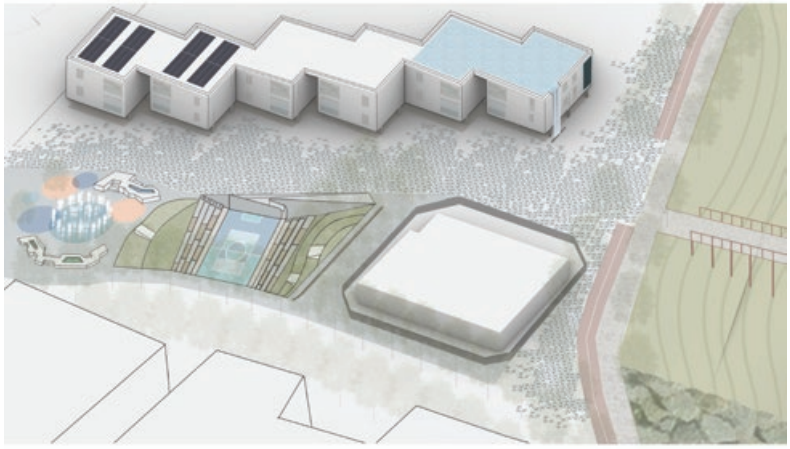


HOW THE RIVER GROWS - Existent



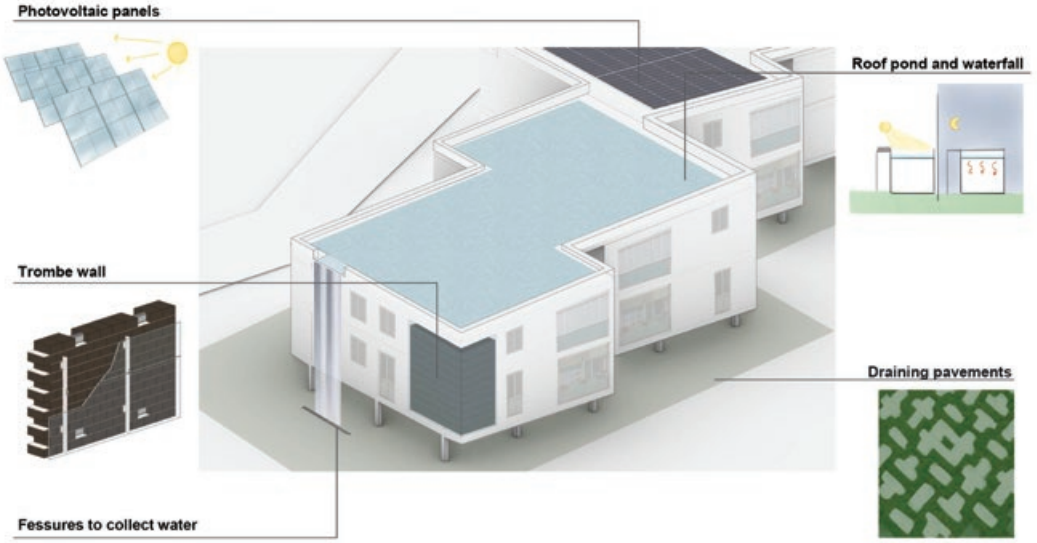
HOW THE RIVER GROWS - Project





VIEW OF THE WATER PLAZA

THE ENERGETIC SOLUTIONS



Part 4.
Water as a Lifeline for Rome

Germaine Sanders

Urban Watering by Nature: the Romans way
A graphic story

Through the eyes of someone from the low lands near the Northsea
How to translate traditional technique & idea for future urban innovation

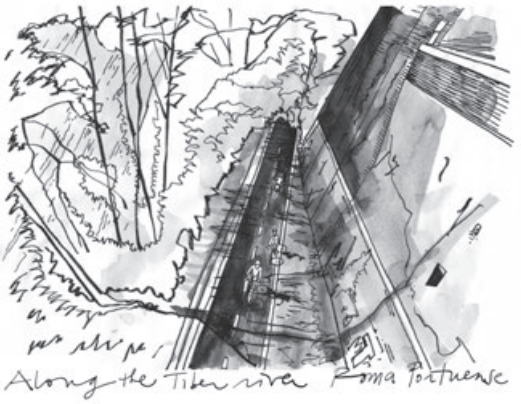
The waters of the Tiber are the lifeline of this eternal city. The city of millions from antiquity that after periods of decay, was repeatedly rebuilt with stones from the past and with the grandeur of every own time. The sea, receiving the meandering river water closer to the current city than the sea does now, brought salt to the city. Streams flowing from the mountains did not only offer fresh water to the Roman citizens but the Tiber on its way to the sea has flooded the city a lot. The Romans knew how to master these situations. The oldest squares and the Pantheon were located in the lowest parts of the city and they were built to allow flooding water to be part of the public space where people gathered to honour a variety of higher powers. Water mirrors shape special parts of the ritual spaces and drainage points for rainwater forming a decorative pattern in the floor of, for example, the Pantheon. Stepped stone banks provide flexible places for trade and water traffic. Sewer systems existed separate from clean water supply. Only after the flood of 1870 the Tiber got confined between solid high quay walls, in order to prevent future flooding of the city. Rigorous measures that are now being rethought of, with a focus on climate change. However, the question is whether flooding is the biggest threat to the future of the city. Although high walls do their protecting job, they ultimately threaten the value in terms of hospitality for people and the preservation of the priceless culture of the eternal city. The quay walls are one of the defining elements of great infrastructure, as are the city walls, the routes, the hills and of course the Tiber and Aniene rivers. Thinking of the future and of climate change raises the question how the risk of flooding can be balanced out with the risk of the city of Rome falling dry and overheated.

The magic of Rome will keep enchanting everyone who, with their own eyes, is seeing where histories converge in places that give new life to people time and again. But humans are part of nature in which they may or may not survive. My question is: how is Rome going to give new life to urban nature?

I explored that, I drew it and photographed it. I discussed that with many people within and parallel to the Sustainable Open Solutions Climate Waterfront Rome project.

Romans do love life, sweet life and they want to recreate future life, like the Romans did, by rethinking large scale infrastructures to guide the water, fast and slow. Also, not to forget what Baroque did to Rome by redefining small scale magic and shaping public spaces, for growing and flowing.

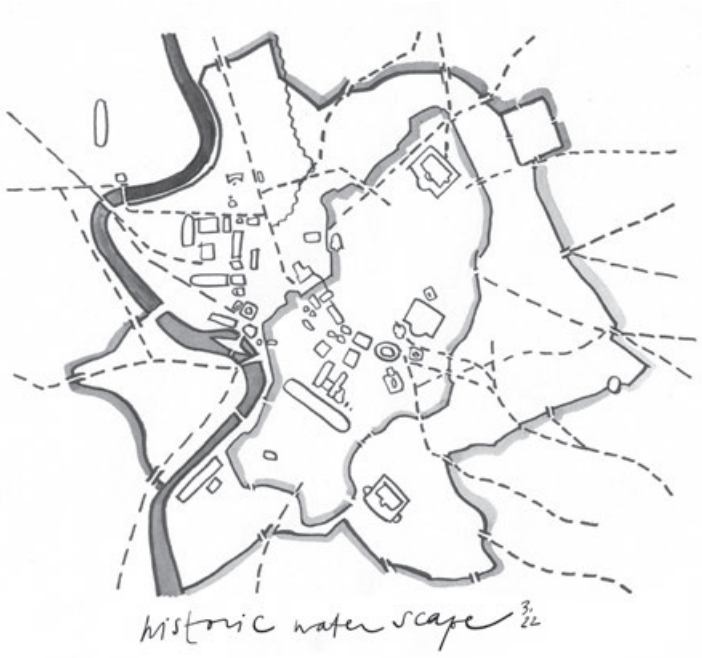

Re-use of public materials — public space


Along the Tiber river Roma fortuense

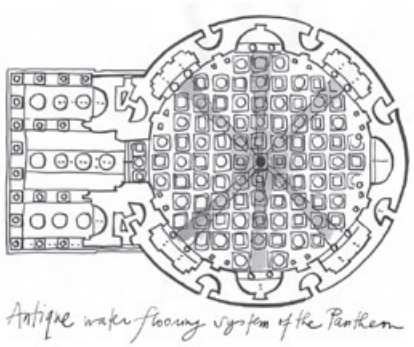
Let the waters bring salt and sediments for citizens

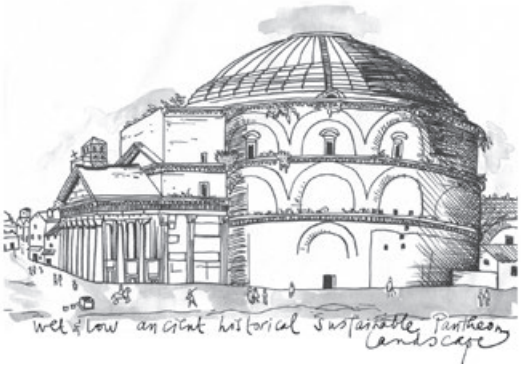
Lifeline to the eternal city of Rome are the Tiber and Aniene rivers. The city of millions from antiquity that after periods of decay, was repeatedly rebuilt with stones from the past and with the grandeur of every own time. The Tyrrhenian Sea, receiving the meandering river water closer to the current city than the sea does now[1], brought salt up to Rome. Thinking of the Salinae and of the via Salaria will clarify how the value of salt was crucial to the success of settlement between the hills along the river to meet the salt and save it for sale.

Streams flowing from the mountains downwards did not only offer fresh water to the Roman citizens but the Tiber on its way to the sea has flooded the city a lot. The Romans knew how to master these situations.



1. Prof Paolo De Giromamo explains how hydraulic constructions in the Tiber are now causing erosion of the coastline because they do not allow sediment transport towards the sea.





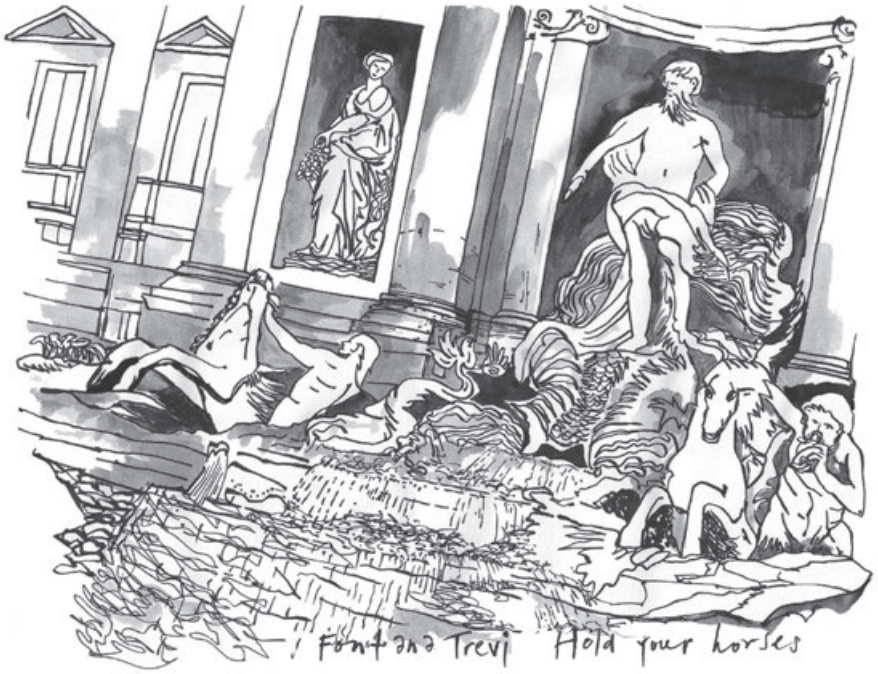
The oldest squares and the Pantheon were located in the lowest parts of the city, and they were built to allow flooding water to be part of the public space. Here people gathered to honour a variety of higher powers.

Water mirrors created special elements of the ritual spaces in monuments and buildings. Or drainage points for rainwater composing a decorative pattern in the floor of, for example, the Pantheon[2].

Sewerage systems existed separate from clean water supply.

Stepped stone banks of Porto di Ripetta on the Tiber did provide flexible places for trade and for water traffic.

This Baroque River harbour, facing south down the river, is now hidden under the pavement of the actual riverbank cut through by the Muraglione[3].



2. Prof Guido Calenda (Roma Tre University) explains 40 inundations of Rome in 14 centuries but also asks: "what do we know?".
3. Prof Annalisa Metta (Roma Tre University) explains that "Rome is a city in the Tiber and not on the Tiber".

Multifunctional fountain irrigates the Gianicolo

A marble fountain from the 17th century that was created to celebrate the reopening of an old Roman aqueduct became the source to water the Giardini including Sapienza botanical gardens at the hillside. This is just another example of never-ending playing by nature, like the Romans did, knowing that water will always find a way. Meanwhile the streaming connects places and traces of time thus creating new places and spaces to celebrate the soil as well as the water. It is the great idea of natural flow to keep life cycles going. Water to bring energy and spirit for all species to flourish. Only after the flood of 1870 the Tiber got confined[4] between solid high quay walls, in order to prevent future flooding of the city. Rigorous measures that are now being rethought of, with a focus on climate change. However, the question arises whether flooding is the biggest threat to future safety of the city. Although high walls do their protecting job, ultimately, they threaten the value of hospitality for people and also the preservation of the priceless culture of the eternal city. The quay walls are one kind of the defining elements of great infrastructure, as are the city walls, the roads and trails, the hills and villas and of course the Tiber and Aniene rivers.

How strict and solid do the Muraglione need to be?

4. Prof Annalisa Metta (Roma Tre University) explains that: "a caged Tiber is a river that does not exist". Prof Luna Kappler (LUISS University) explains that shared strategy is needed for a river to be a common good".

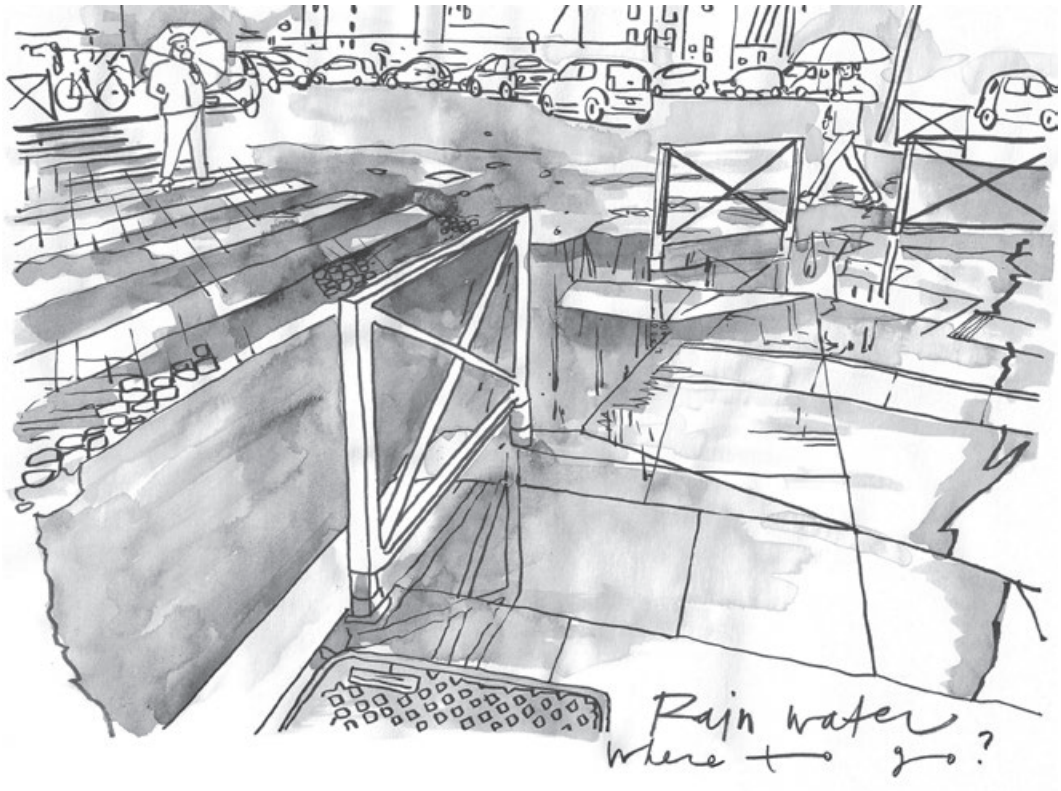
Too hot and too dry

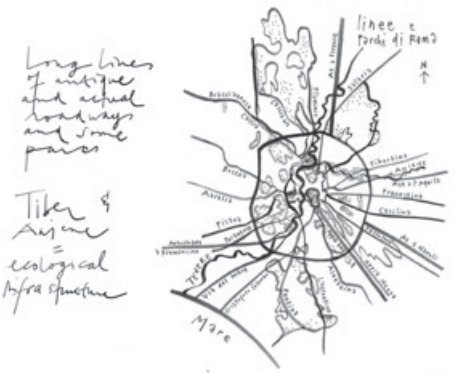
Thinking of the future and of climate change does raise the question how risk of flooding can be balanced out with the risk of the city of Rome falling dry and overheated. Summer is very hot now with no end and all over. In Rome you will find symbolic indication of water climate change from time ago. Fishes and boats of all size and shapes, fountains, animals and plants to remind the power of water to change and of the glory of nature. Moving around the newer parts of the city you might bump up to technical indication of climate perception. Not to increase the awareness of climate change much but to stimulate consumption of natural environments. This also could be a challenge to one's imagination. Imagine, while waiting and rushing, the value of nature...

Or to picture common places close by to go to, where would you go?

What would it look like, how must it feel, who will you meet there?

These are questions to be answered to renature the urban climate and keep Rome flexible and future proof.





Ecological infrastructure

All roads lead to Rome is the saying. Nothing new but to renew maybe.

The magic of Rome will keep enchanting everyone who, with their own eyes, is seeing where histories converge in places that give new life to people time and again.

But humans are part of nature in which they may or may not survive.

My question is: how is Rome going to give new life to urban nature?

I explored that, I drew it and photographed it. I discussed that with many people within and parallel to the SOSCW Rome project.

There will be future life to the monumental open and green spaces of a great variety in size and inside Rome, I understood. Public space and places, ran by public responsible citizens together with government and open mind investors, to be clever (re-)connected by waterways with their wide surroundings and to the coastline.

Cultural infrastructure

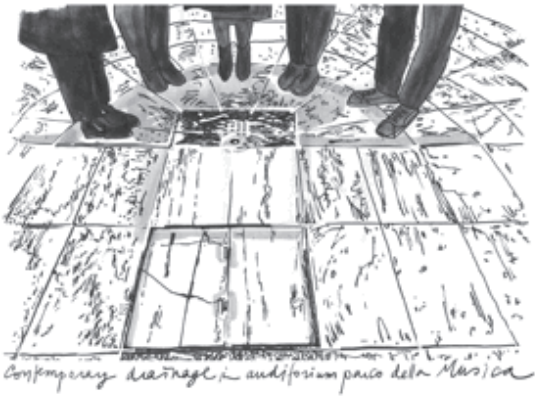
A fresh mind in a healthy body of course! Feel free and find enough space to learn and to relax[5].

Where to learn about cultural identity? There are numerous examples in Rome from antiquity until life in the periphery districts.

In Flaminio there is the example of compact/ social housing that allows for climate change. Look at some traditional pocket gardens that can easily revive and even be extended. Do take care of nature more than of cars.

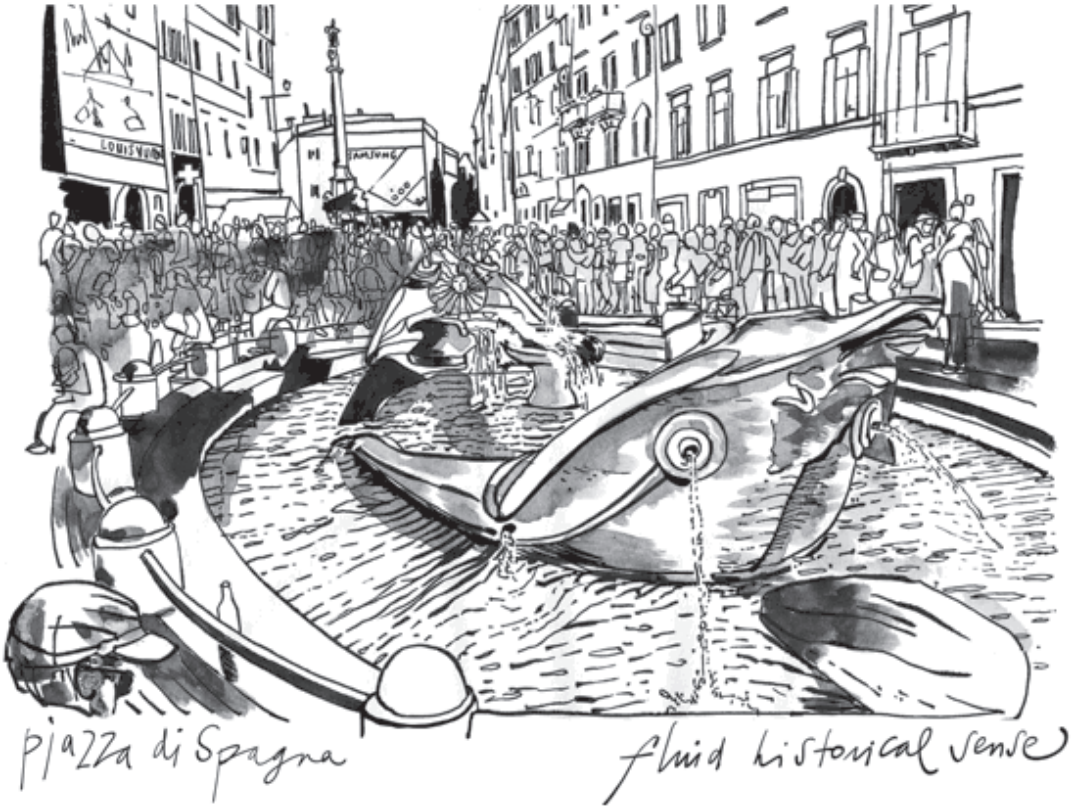
Public space and public transport will make the difference. Show don't tell is what local people stated clearly.

5. Prof Bruno Manardo explains the compact urban fabric with large monuments and cultural identity to be a social economic, vulnerable part of the city with specific hydro ecological potential.



Water magic

To see the water and to reach a riverbank,
crossing wandering, wondering let it flow let it go.
All about natural attraction that makes sense.



Water play

Mirror mirror of the water.

Of all times in every season. Exciting spectacles.

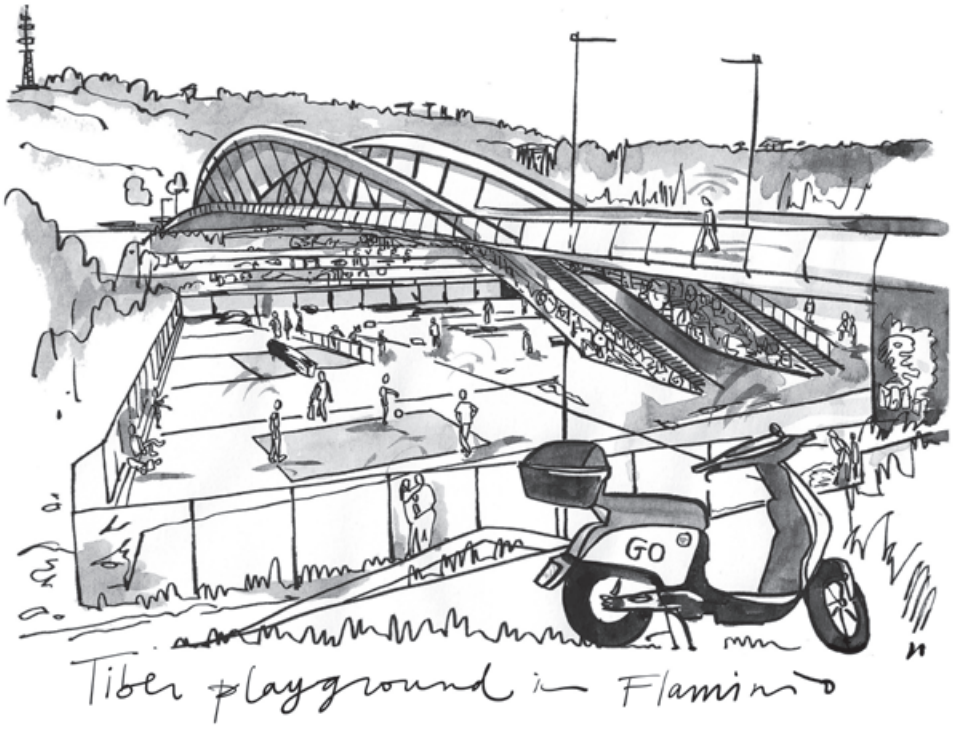
We love it, we need it, we can share it all.

Imagine wonderful adventure and inspiration

Sapienza University of Rome originated from Studium Urbis, founded in 1303. In 1642 the curved Sant'Ivo church, by genius Borromini was built to fit in the surrounding squares and solid square buildings of this oldest university, with many universal symbols of knowledge and of nature[9].

Romans do love life, sweet life and they want to recreate future life, like the Romans did, by rethinking large scale infrastructures to guide the water, fast and slow. Also not to forget what Baroque did to Rome, re-defining the magic by designing dedicated places and public spaces, for growing and to keep flowing.

The strongest idea to live with climate change that I came across all over Rome: re-invent Baroque thinking about space about knowledge and about human nature with focus on and of Nature.



6. Prof Claudia Mattogno explains the history of Sapienza and of the faculty of Engineering, along the line of many historical women, such as Livia Drusillia Claudia and Licina Eudossia.

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Maria Rosaria Boni
Full Professor at the Department of Civil, Building and Environmental Engineering of Sapienza University of Rome. Her expertise encompasses from remediation of contaminated sites and wastes valorisation to emerging micropollutants in the water cycle.

Guido Calenda
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Since 2020 he has been Editorial and Artistic Director of Seascape, an international magazine of architecture, urban planning and geomorphology of coastal landscapes.

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Waterfront Dialectics.
Rome and its Region Facing Climate Change Impacts
Edited by: Pedro Ressano Garcia, Claudia Mattogno,
Bruno Monardo, Antonio Cappuccitti

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editor: Marcella Manelfi
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One of the most complex discussions concerning climate emergency is the sustainable water management. How to deal with the risks generated by climate change where the presence of cultural and environmental assets is highly stratified over time?
How to manage large densely populated areas rich in environmental and human resources, ensuring their protection and development?
It's now time to integrate the connections between the different territorial scales and to ensure the balance between public and private interests in a framework of sustainable strategies.
SOS Climate Waterfront is an interdisciplinary project that aims to explore waterfronts in Europe that are facing climate change. The volume presents the results of the workshop held in Rome in spring 2022.

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