DELFT UNIVERSITY OF TECHNOLOGY

FACULTY OF ARCHITECTURE AND THE BUILT ENVIRONMENT

Tiber Waterscapes

Drawing, directing, erasing

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To my parents,
for their unconditional love

TIBER WATERSCAPES

FRAMEWORK

Drawing lines

Directing lines

Erasing lines

PROBLEM STATEMENT

The relationship between land and water in the city

RELEVANCE

LITERATURE

Dilip Da Cunha / Anuradha Mathur Matthew Gandy

John Letherland

The ways in which rivers are identified, commodified and erased from the city has direct consequences on our freshwater availability and quality

Main Research Question:

Can the lines separating water from land be challenged through understanding and depicting rivers as a part of a ubiquitous wetness?
Can water be visualized in ways that lead from water to wetness and preserve its value within the city?

Drawn lines:

Flow of lines:

Erasure of lines:

METHODS

Hypothesis:
By challenging the lines that identify, direct and erase urban water, new modes of seeing and thinking through water may arise

Google Earth

Fieldwork and drawing, video-making

Archival mapping, overlaying

RELATION TO DESIGN

Fourth Nature
Tiber Waterscapes
Design Principles

“So what about water? Too often, in our effort to control it, economic expediency and technical efficiency have been the exclusive criteria to define the infrastructure that engages it. But water carries little respect for boundaries. Water is volatile / fragile / violent / serene /elusive / ubiquitous / nourishing / devastating and fundamental to life.”

Dilip Da Cunha | Anuradha Mathur

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Abstract

"Riverine settlements offer a particular challenge to representation. They embody a complex encounter of nature and city, where the water is not a border, as in coastal towns, but a vein of permanent strangeness. The river is subsumed by the city, even as it cuts through and shapes it, enacting a tension which never clarifies into a standoff, but is perpetually in the process of becoming."

(Stara, 2018)

Exploited as drains or waterways, canalised or culverted underground, rivers have served the cities built around their meanderings since the start of civilization, and most of them have become part of the city's cultural identity and iconography. With water-related hazards being at the forefront of present and future sustainable development goals, a re-awakening of interest in urban rivers calls for a paradigm shift from water management to water resilience. The latter has emerged as a new water paradigm in order to acknowledge and address "the complex, dynamic and uncertain nature of social-ecological systems" (Baird, 2021), which can no longer be expected to simply fluctuate within predictable ranges of variability.
This paper argues that in order to shape resilient riparian environments, a radical change in perspective needs to take place, concerning the ways in which we know, relate to and use rivers in the city. Investigating and questioning the notions behind the identification, commodification and erasure of rivers from the ubiquitous "wetness" (Cunha, 2018) that characterised the city of Rome before its industrialisation, the research offers alternative modes of seeing and thinking through water and the living organisms that directly or indirectly engage with it.

Keywords
Urban rivers, water, wetness, fourth nature, water culture

Introduction

"I began to suspect that the line separating water from land exists by choice, a choice not in where it is seen in a shifting and dynamic terrain but in the fact that it is seen at all"

(Da Cunha, 2018)

When one thinks of The River Tiber in the historic center of Rome, images of its neatly defined riverbanks come to the fore, framing the rather majestic view of San Peter's and the Angels' bridge with its ten Bernini's statues flanking marble parapets on both sides (Fig. 1). To the present spectator, this composition looks timeless, as though it has always been there. Further downstream, however, softer riparian edges separate land from water, dry from wet, high and low (Fig. 2). Here, boundaries become more blurred, irregular, and one could argue, closer in appearance to the edges portrayed in several historic pictures of the Tiber River flowing through Rome prior to its 19th century urbanization and the construction of embankment walls (Fig. 4,5). It is precisely along this softer, less defined edge that the research and the project unfold.

Research and design constitute an attempt to make sense of the complex relationship between Rome and its main river, the River Tiber, at the point along its course where it historically intersected River Almone, one of the few sections in which riverbank walls interrupt to give way to a softer river-edge. The site choice is motivated by the convoluted history of the Almone, witnessing its transformation from a sacred River to a sewage line, which at present continues to release dangerous by-products into the Tiber.

The relevance of this study goes beyond its immediate context. While the recent efforts to separate river Almone from the sewage line and restore its value as an important ecological and cultural corridor have in many ways determined the ambitions of the research and the project, the story of the Almone trascends its geographical boundaries, presenting similarities with multiple primary and secondary streams in urban centers worldwide. Culverted underground and relegated to lines of waste, water streams in cities are rapidly gaining attention, as issues of

water quality and quantity become increasingly urgent. Where does architecture stand in the unpredictable terrain of water? Can these challenges be turned into opportunities?

In order to understand the complex relationship between Rome and its water, I have had to trace the broader and more intricate correspondence between Rome and its wetness back to its early occupation by Etruscan settlements all the way to its 19th and 20th century modifications. Not only has the commodification of water in Rome left traces in the landscape, but it constituted an integral part of its development and transformation, in a process of becoming with; to prove this true, the historical background of Rome is outlined in the third chapter through the unfolding of its waterscapes, building on existing scholarship on Rome's water culture as well as drawing from the primary sources of Vitruvius, Frontinus, Seneca and Pliny the Elder. The ensuing theoretical background is presented through the contemporary scholarship of Dilip Da cunha and Anuradha Mathur and their definition of "wetness", encompassing the full hydrological cycle as opposed to an isolated moment of commodification. This framework informs the methods and the structure of the results, articulated through the notion of *drawing*, *directing* and *erasing* lines, which refer to the moments of identification, commodification and obliteration of urban rivers.

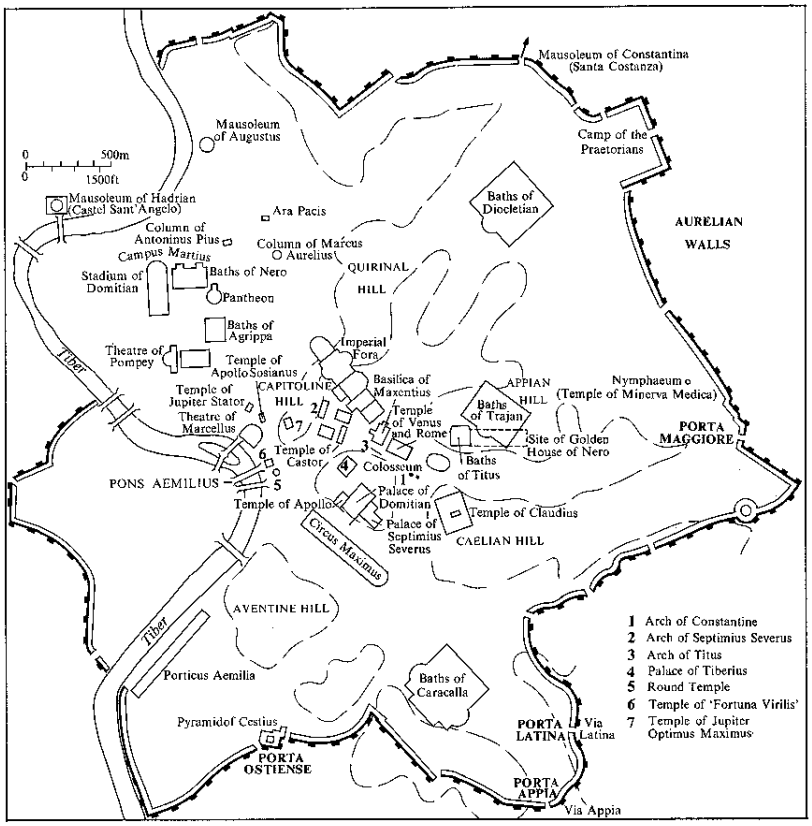


Fig. 1, Piranesi's view of Castel Sant'Angelo from North, 1748
Fig 2, map of Ancient Rome on the eastern bank of the River Tiber

Fig. 3, Flood at the Panteon, 1871

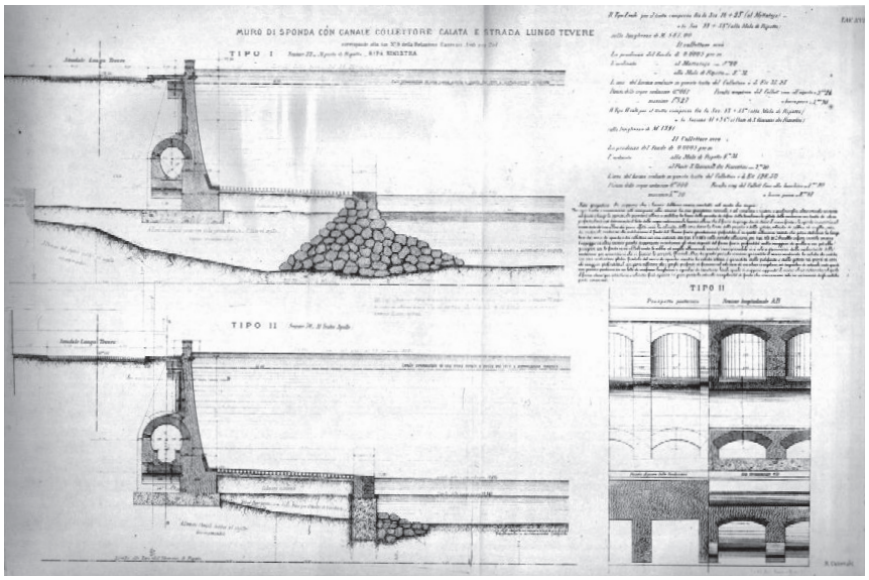


Fig. 4, Embankment wall drawings by Raffaelle Canevari, 1871
Fig. 5, Embankment Wall construction 1871

01 / Relevance

"Water is everywhere before it is somewhere" (Da Cunha, Mathur 2014);

At a moment when freshwater availability is at the forefront of global development goals, design disciplines are witnessing an unprecedented recognition of the untapped potential of urban rivers. Cities like Nantes have already been inverting their trends from "covering" to "uncovering" since the second half of the twentieth century, with operative plans to restore its watercourses as an integral part of the city's urban ecology (Borst, 2017). Similar ambitions inform projects such as the Fleet River competition entry by Richard Gooden, Forgotten Spaces: Fleeting Memories, envisioning a riverside park along the former Fleet section (Gooden, 2017).

If cities like Nantes and London have recently been devising plans to uncover and reintegrate some of the lost waterways in the urban water ecology, it is thanks to an unprecedented recognition of the importance of rivers beyond their use-values as "waste sinks" or navigable waterways. This holds true for both River Erdre (Borst 2017) and River Fleet (Gooden, 2017), but it is beginning to be acknowledged by communities and policy-makers for the River Thames too, with other cities such as Paris and Berlin paving the way. In Rome, the increasing pollution and subsequent culverting of some of the Tiber smaller tributaries has determined the loss of important ecological corridors as well as the increase in flooding risk and landslides (See "Lines of waste Map", pg. 18).

The River Almone, chosen as a case-study for the research, is therefore only one of the many River tributaries that have been partially or totally culverted underground and connected to the sewage system, within the last century of the city's development. The recent investments and stakeholder involvement towards an Almone River Contract testifiy an increased awareness of the role of riverine ecosystems within the city's urban ecology; analytic tools and publications are starting to pave the way towards the definite transition of the Almone from a sewage collector back to its ecological function as a river tributary. However, in order for changes

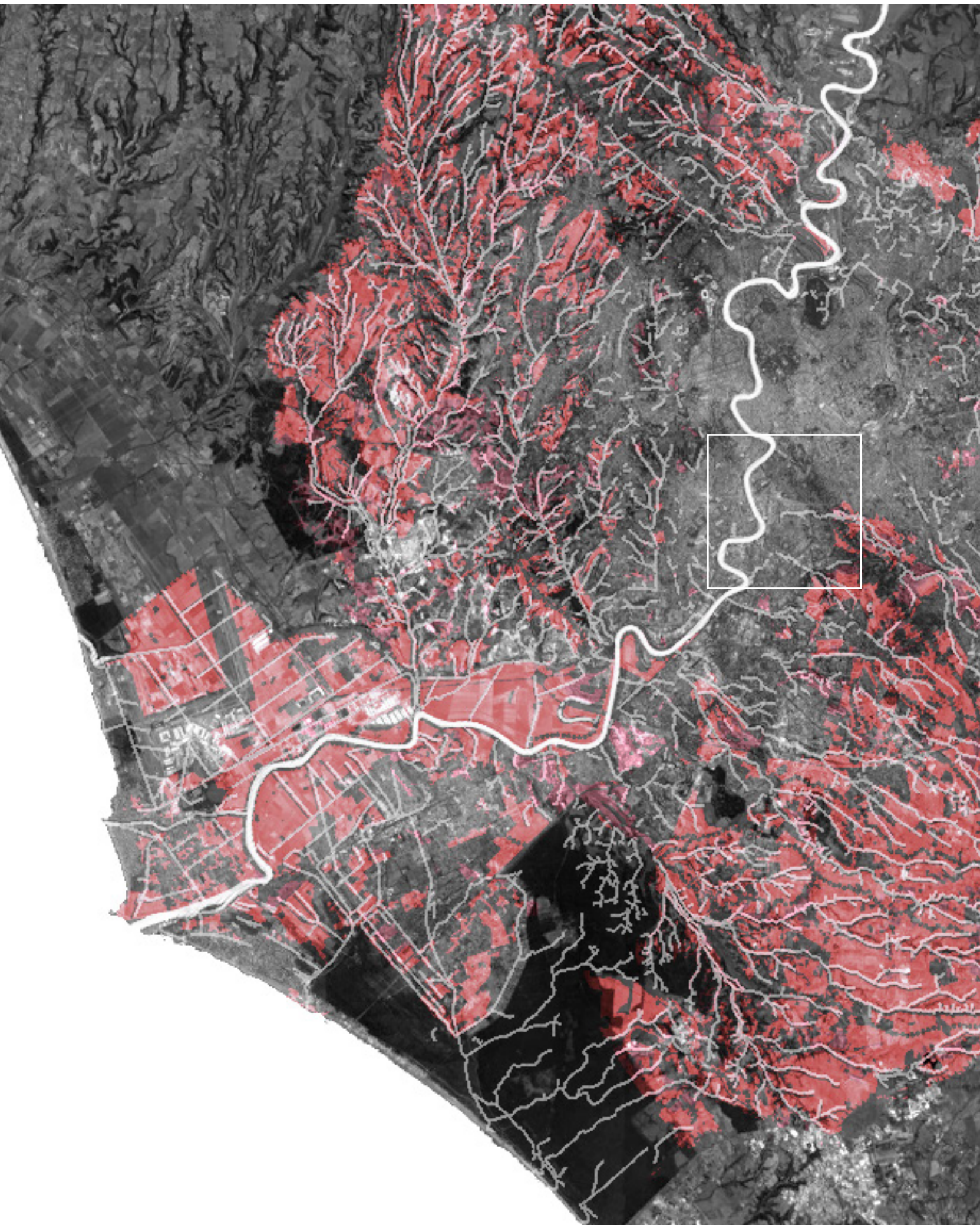
to take place on the ground, a different perspective on water needs to be brought forward.
This paper argues that as long as rivers are identified and represented by fixed lines which not only separate them from the rest of the water cycle but also notionally place them at its end, they are too conveniently confined within walls and underground channels, with the primary purpose to conveniently hide, dilute and flush away human by-products. Conversely, by highlighting the essential relationship between rivers' surface water, rainwater and groundwater as part of a single moment of wetness, we can start to envision different practices to design in its unpredictable terrain.

If it is true, as Da Cunha posits, that "the colonizing eye transforms landscape from ubiquitous wetness to a river, where land is divided by water, and the latter commodified as such", I have set out to trace the transformation from the former to the latter, through traces left in maps and monographies as well as on the constructed ground.

The research intends to critically look at common water management practices through the perspective of water as a living and dynamic system, a "ubiquitous wetness"(Da Cunha, 2021). Can the lines separating water from land be challenged through understanding and depicting urban rivers a part of a "ubiquitous wetness"? How does a city's water culture shape its urban landscape?

Fig. 6, Tiber watershed, Own drawing, research and project location

Fig. 7, Own drawing, "Lines of Waste". In red, Nitrogen concentrations carried through percolation and runoff; information source: Autorità di bacino del fiume Tevere.



02 / Tracing lines

The methods of the research aim to bring together aspects of water (hydrology), place (topography) and use (typology), which have traditionally been separately addressed by previous scholarship. Given that “landscape is composed not only of what lies before our eyes but what lies within our heads” (Meinig, 1979: 33) , the research is first and foremost a quest for a new mode of seeing, of thinking through water. Scientific reports only constitute the starting point of a research that strives to move away from water intended as mere chemical substance in its liquid and contained state, calibrated to certain flows, in favour of rain-fed, soaking, percolating, evaporating, living water, or from other scholarship “complete water”. In order to do this, the research looks below the ground and up to the clouds, through the creeks and ponds, to trace any presence of water around, below, above, before or after the moment and place we call river. This has been operatively applied through a week of fieldwork in the month of November, a notably wet period in Rome, by walking along one of the tributary of the river Tiber, River Almone. If surveyors choose a moment of fair-weather to take measurements of the exact river banks against the dry contours of land, for the purpose of the enquiry a rainy day was chosen instead, to read the landscape through its ubiquitous wetness, through its “oceans of rain”. Archival information and scientific reports have provided the “lines” that fieldwork and qualitative observations have subsequently attempted to blur.

Identification: What is a river?

If a river is defined as "a natural stream of water flowing in a definite course" (Dictionary.com), or a "in a long line across the land" (CollinsDictionary), the first step of the research seeks to question the temporal and spatial extents of that line, using the "illustrated layered section". This enables to analyse the dynamics of the course of the river, pertaining to the study of hydrogeology, in conjunction with the closely related aspects of topography and typology. The term hydrogeology or groundwater hydrology, encompasses the study of water "hydro" and soil "geology", thus addressing the ways in which groundwater moves through the rocks, soils and aquifers, through time. The method consists in harvesting existing hydrogeological surveys of the site and tracing changes in the location of the river and the surrounding geological strata. Inspired by the work of Gerard Richter (Fig. 15), the layering provides a detailed account of the shifting landscapes below the ground across time. The resulting section also provides the basis for the second aspect of the research, which puts the question of "use", and the associated typology, in relation to the previously addressed correspondence of water and topography.

Commodification: How is a river used?

Taking the relationship between water and topography as a starting point for the inquiry, the second part of the research is carried out during fieldwork in the months of November and December. The Caffarella valley and the River Almone that flows through it are chosen as a site for the process of mapping water commodification through archaeological remains dated as early as the I century AD. These are surveyed and re-drawn, using archaeological scholarship on the subject in order to illustrate scenarios for their potential use in relation to rain or aqueduct water interception, storage, settlement and mechanical power.

Although the abundance of archaeological remains in the Caffarella valley has been partially surveyed and documented by several different scholarly contributions, no previous work deals with the relationship between those and the topography in which they are set, nor do they provide illustrations over how each typology might have spatially housed and accommodated the flow of water. The method consisted in photographing and mapping the water-related infrastructure across the valley and re-drawing in relation to river proximity, water "use", typology and topography.

Obliteration: How is a river transformed, directed or erased?

The third step of the research follows the previous ones both conceptually and chronologically. Conceptually, given that in order to transform or erase anything, one has to first identify it and appropriate it; chronologically, since the erasure of the River Almone pertains to the process of urbanization in Rome between the 19th and 20th century. The last part of the research is carried out through a chronological analysis of the archival maps and documents in order to trace the modifications on the riverbed and the impacts on its biodiversity and geological stability in the last two hundred years.

Question & Subquestions	*Methods*
Can the lines separating water from land be challenged and can urban rivers be understood and depicted as part of a ubiquitous wetness?	
Drawing lines: the invention of Rivers	
What is a river? How is it different from an ocean of rain? Tracing shifting landscapes	*Literature study and Google Earth sections*
Directing lines: commodification of rivers	
How is a river used? How is rain used? River Almone: the traces of water in the Caffarella Valley	*Fieldwork and drawing , video-making*
Erasing lines: obliteration of rivers	
How is a river transformed, directed or erased? River Almone: mapping forgotten rivers	*Archival research and Mapping*

03 / Rome and its waters

"Rome was founded in a wilderness, and the wilderness was wet."

(Purcell, 1996)

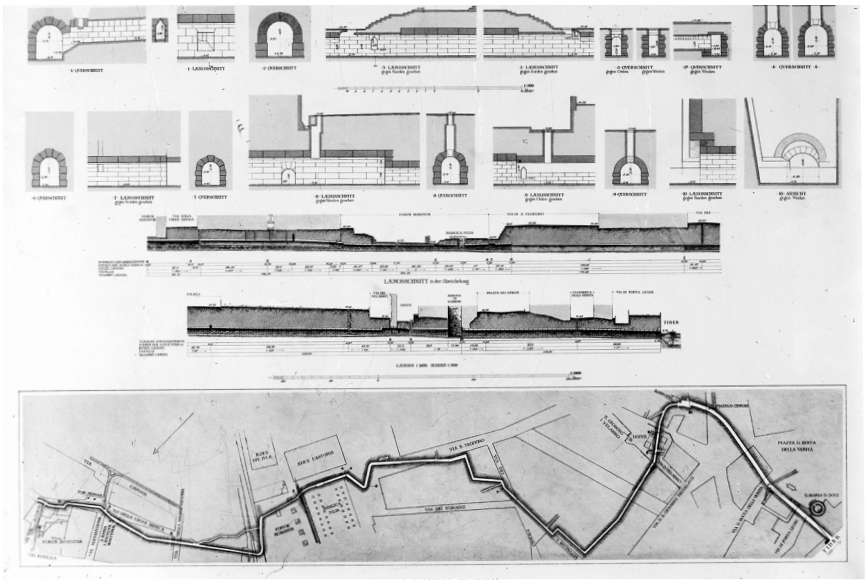
Foundation: "Draining the wetland"

The very foundation of Rome is profoundly related to its orography, defined by volcanoes and creeks, creating the ideal environment for water to gather in volcanic lakes, flow in gorges, erode the tuff rocks, and create a stratified and ever-shifting alluvial plane. Not by chance, both myths related to Rome's foundation are related to its river. According to tradition, Romolo and his twin Remo, abandoned and set afloat in a basket on the Tiber by the king of Alba, would have survived being nursed by a she-wolf and lived to overthrow the evil king. The other myth, related to the arrival of the defeated Trojans, is vividly described in the Aeneid, with the river as a protagonist of the first encounter with the city:

"Here gazing at the land, Enea's father sees a large forest, and within, a rapid river, both restless and quiet"

(Purcell, 1996)

The choice to settle on the Eastern bank of the alluvial plane represented both a blessing and a curse. In fact, if on the one hand the Tiber was the conduit through which the economic goods of the Empire were brought to the city, on the other hand it was also the cause of destructive floods which annually inundated the city, as testified by numerous city inscriptions and illustrations (Fig. 3). The need to drain the unpredictable territory of the wetland and expand settlements to accommodate a growing population, resulted in the construction of shafts and channels to make the floodplain inhabitable, inheriting from the Etruscan the necessary expertise to remove excess water from arable land. The Cloaca Maxima, still visible today, represents the earliest of these endeavours in Rome; stretching 100 m through the Fora all the way to the River Tiber, it started as a monumental, open-air channel and was later converted into a sewage line discharging into the river, where it is still visible – and partially in use – today. (Fig. 6,7)



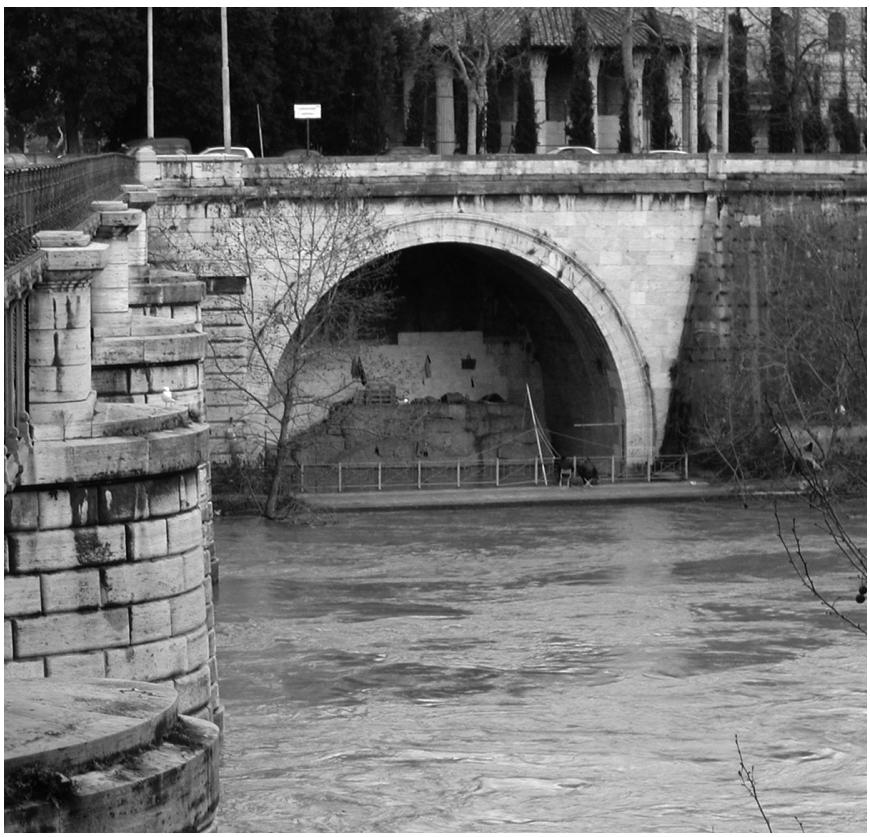


Fig. 8, The Cloaca Maxima in Rome. Various sections and a plan of its course. Wellcome Collection. Attribution 4.0 International (CC BY 4.0)
Fig.9, Cloaca Maxima today draining into the Tiber (Wikipedia)

Growth and expansion: "Collecting, transporting and distributing water, from cisterns to aqueducts"

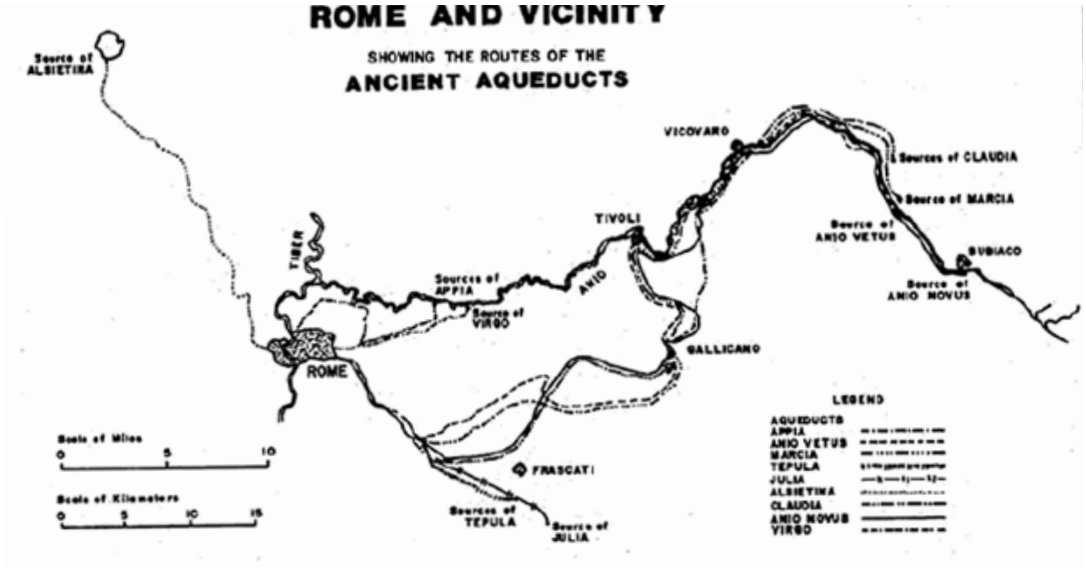
"If we only take into consideration the abundant supply of water to the public, for baths, ponds, canals, household purposes, gardens, places in the suburbs, and country houses; and then reflect upon the distances that are traversed, the arches that have been constructed, the mountains that have been pierced, the valleys that have been levelled, we must of necessity admit that there is nothing to be found more worthy of our admiration throughout the whole universe"

(Pliny the Elder from Deming, 2019)

If on the one hand muddy surface water had to be drained out of the city to turn wetland into inhabitable land, clean freshwater had to be brought into the city to satisfy the drinking and utilitarian demands of a growing population. *De aquaeductu urbis Romae* represents the greatest source of primary information regarding the collection, transportation and distribution of water through the city, given that its author, Frontinus, was appointed as curator of the cura aquarium, the administrative body for water distribution in ancient Rome. It is from his commentary that we can derive that from its foundation up until the construction of the first aqueduct, the Aqua Appia, in 312 BC, *"the Romans were content with the use of waters which they drew, either from the Tiber, or from wells, or from springs"*

(Frontinus 1899, 5)

However, with the increased growth and power of Rome and the advancement of Roman expertise in hydraulic engineering, the first aqueducts started to convey water from the nearby springs all the way to the public fountains, providing a considerably cleaner source of water than the riverine counterpart, the latter more prone to sewage contamination. In addition to the obvious water quality, bringing water downstream from upper springs would have been substantially easier than carrying it up the hills from the river valley. Although some aqueducts were tapping into surface water, most of them were drawing water from groundwater sources. By the 226 AD, the last of the eleven Roman aqueducts, Aqua Alexandrina, had been completed. Estimates of the amount of water brought by aqueducts range from 520,000 (Bruun, 2013) to 1,000,000 m3 daily (Bruun, 1991). Interestingly, it has been noted that more water flowed through the roman aqueducts at their height than that which flowed through the river itself. Once conveyed to the city, water



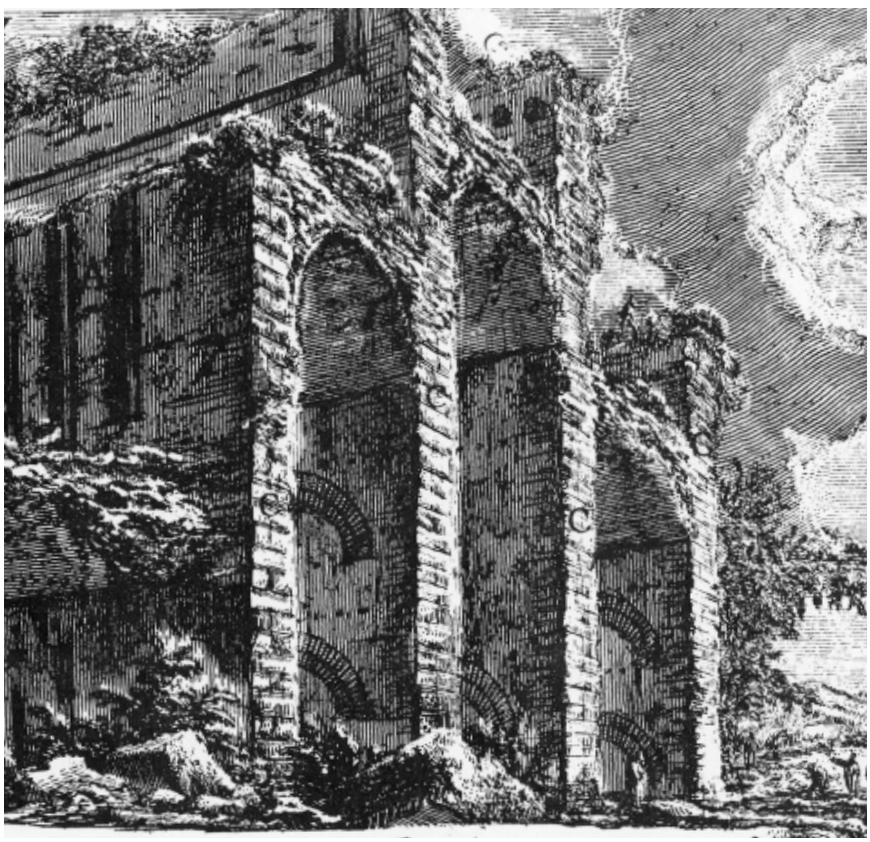


Fig. 10, The Courses of the Nine Aqueducts in Existence at the Time of Frontinus (Source: Smith, 1978).
Fig. 11, Castellum of Aqua Claudia aqueduct, Piranesi

was received by purifying tanks and *castella*, water reservoirs from which it was then distributed to the rest of the city. A monumental example of *castellum* survives today in Vittorio Emanuele square, the "Trophies of Marius", which seem to have received water coming from the nearby aqueducts of Aqua Julia and Claudia under Alexander Severus. The neglect towards aqueducts after the fall of the Roman Empire and the consequent droughts highlight the intimate relationship between control of water and power.

The height of the Roman Empire: baths and fountains

Although aqueducts undoubtedly constituted an important source of the daily household water supply, their primary function was to enable and sustain the Roman bathing culture, to the point that it has been concluded that bathing was "the greatest single reason" that aqueducts were built. (Hodge, 2002)

Similarly to the aqueducts, Roman baths have a Hellenistic predecessor, with Greek baths being dated as early as the second half of the fifth century BC. In order to understand the scale and the function of the Roman bath a distinction between *balnea* and *thermae* needs to be made. The former relates to a small scale bath complex which pertained to a domestic bathing facility or a neighborhood bathing complex, which was accessed upon entrance fee; the latter signifies the large scale bathing facilities which were provided by imperial benefaction and thus publicly accessible without entrance fee.
At the end of the first century BC there were 200 *balnea* in Rome but by the end of the fourth century BC the number approached 900, along with 10 or 11 *thermae* (Yegul, 2019, from Rogers, 2018). Among the most remarkable imperial *thermae* in Rome are those of Agrippa, Nero, Titus, Diocletian and Caracalla. The latter, constructed early in the third century AD by the Emperor Caracalla clearly shows its symmetrical organization with *frigidarium-tepidarium-caldarium* and two *palestrae* on opposite sides of the axis. In order to supply the great amounts of water utilised in the Baths, Caracalla tapped an additional spring to supplement the Aqua Marcia aqueduct (Ashby 1935, 14). An efficient overnight storage system made use of reservoirs that were filled over night in order to provide additional flow during daily operating hours (Wilson, 2008, 305). This is confirmed In fact, ancient Rome had "a number of large cisterns and reservoirs... in which water could have been stored during the night"

(Bruun 1991, 373)

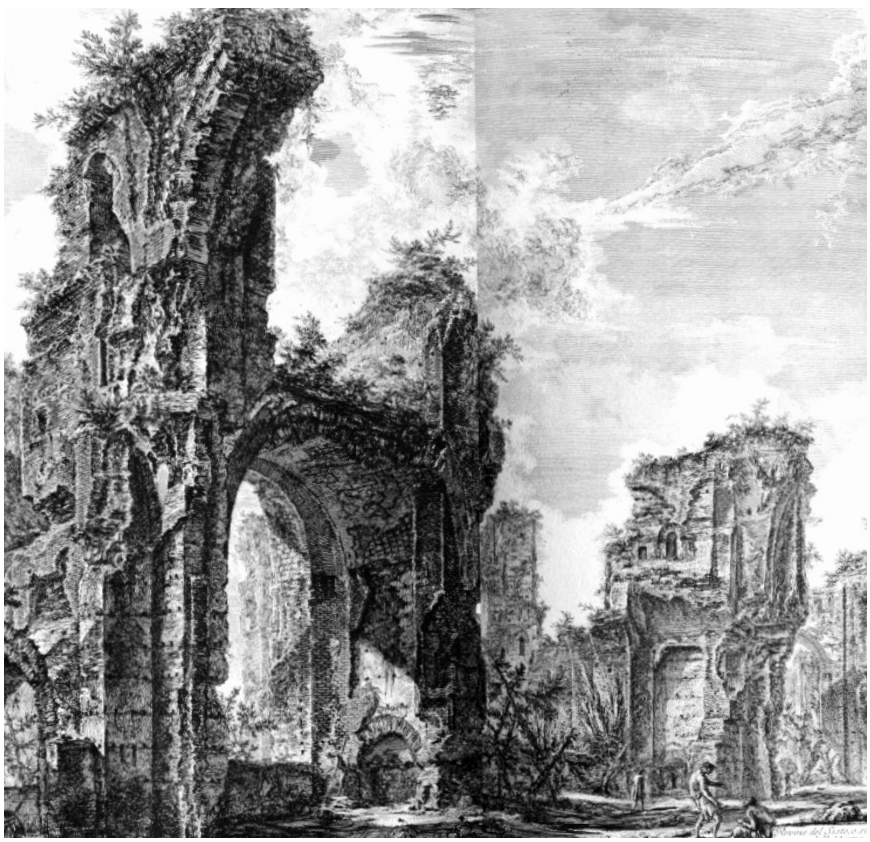


Fig. 12, The Baths of Caracalla, Sir Lawrence

Wastewater and sanitation

Although the focus of the research is the Tiber river, it has been posited that in order to define an outline of the relationship between the city and its river, an understanding of the full urban water cycle is needed. For this reason, this chapter has illustrated the ways in which groundwater and rainwater, as well as river water, played a mutually reinforcing role in the complex development of Rome's distinctive water culture. It is with the discussion on wastewater and sanitation, that the story of Rome and its waters is brought back to the river, where it all started. In fact, if the monumental aqueducts and cisterns represent the city's water intake, the less acclaimed waterworks of the sewage lines and the river Tiber itself represent the output, the flow out of the city and "away from it".

"The enormous flux of water entering Rome daily implies the existence of a corresponding system of drains and sewers to channel wastewater and overflow to the Tiber. Indeed, the chief sewer in Rome, the Cloaca Maxima, preceded construction of the first aqueduct by several hundred years".

(Deming, 2019)

If it is true that Romans did not invent sewers, it is undoubtedly true that they expanded them and advanced them in complexity. Interestingly for a discussion that tried to tie water practices and culture to topography, different types of drainage practices have been found to be linked to different topographical features. Using archaeological evidence from Pompeii, Ercolanum, and Ostia the scholar Gemma Jansen provides a valuable account of the different drainage systems according to the settlement topography. In fact, the steep gradients of Pompeii and the even steeper gradient at Ercolanum allowed for rainwater to flow through the city and wash out at the lower water gates in the former or directly into the sea in the latter. Human waste could be simply disposed through cesspits in Pompeii, simple holes in the ground for human waste which was later collected by the so-called *stercorarii*, who would empty the cesspits and sell waste as agricultural fertilizer. On the other hand, the relatively low gradient in Ostia coupled with the high water table lead to the construction of a complex sewage network to provide appropriate waste management. Given the proximity to the Tiber, a systematic sewer network was used to dispose human waste as well as rainwater and large amounts of greywater drained from the Roman baths.

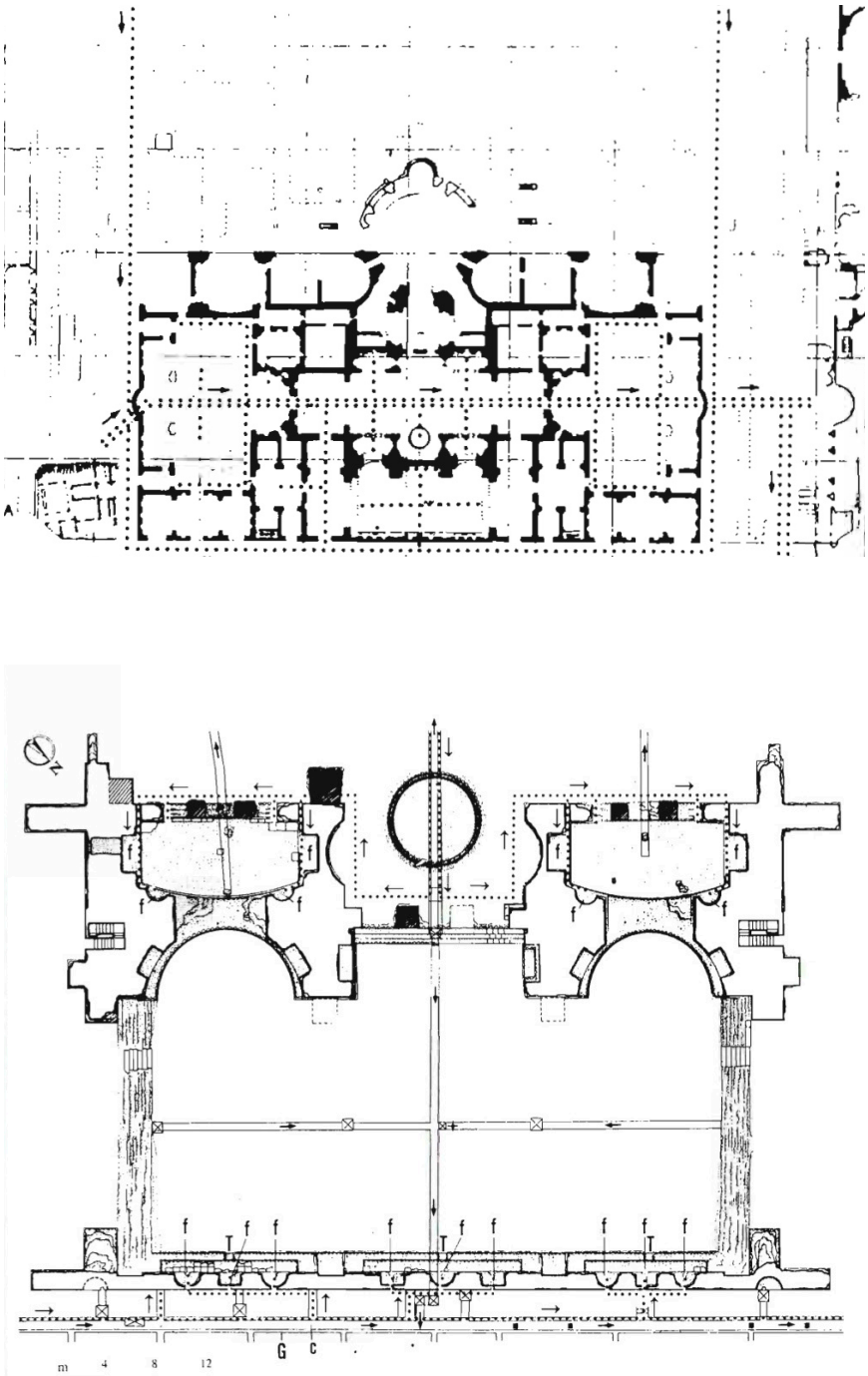


Fig. 13, The Baths of Caracalla, water supply and disposal (source: Corazza, 1997)

03 / From water to wetness

Historical accounts of the development of Rome, as of many other river-borne civilizations, accept the river as a benchmark of human development, without questioning whether the river itself may indeed be the product of that same culture and cultural disposition they intend to study. Indeed, drawing from the scholarly contributions of Dilip da Cunha and Anuradha Mathur, the premise for this chapter stems from the assertion that urban rivers are constructed landscapes; the "flowing water in a channel with defined banks" that we call river stems from a choice to separate water from land through a line of demarcation, which contains water to its place and it makes it possible to appreciate a linear flow with a source and a destination. This act of mental and physical separation is embedded in our understanding of urban geography to the point that rivers have become "part of our cultural consciousness" (Da Cunha, 2016).

The separation between water and land involves the choice of a specific moment in time within the hydrological cycle, that in which water is not rain, dew, clouds, precipitating, soaking, or percolating; that in which water is clearly identified as surface water and as such easily separated from land. The presented historical outline also highlights how the identification of rivers as opposed to rain and springs, had already been present in Seneca's work, and denoted as low water quality sources because of their further location from clean springs. This identification is at the core of their early association with wastewater conduits.

"Having shifted from a ground of wetness to a surface divided between land and water, from holding and soaking rain to flowing and draining water, from a field-like world where identities extend into one another for varying extents of time to a linear world where identities have a clear and distinct edge as rivers do".

(Da Cunha, 2018)

The research stems from the curiosity to follow this notion and with it the "ocean of rain" that precedes and follows the moment of wetness we identify as "river".

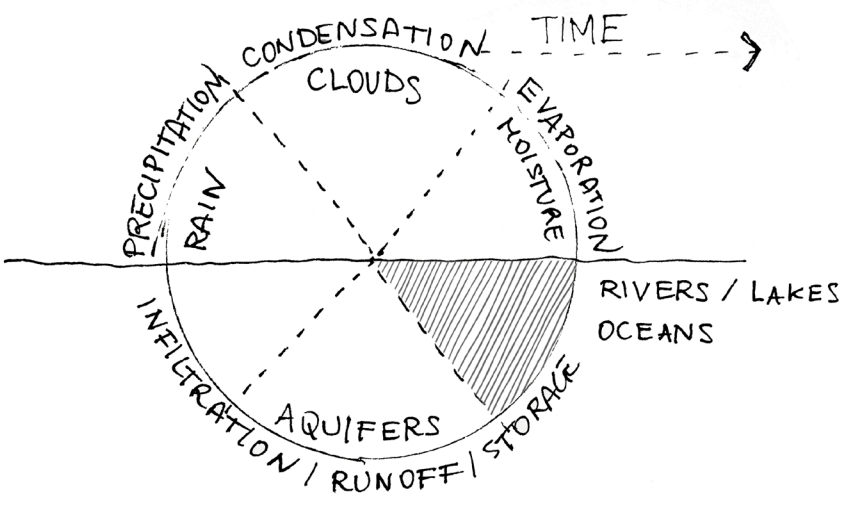


Fig. 14 (previous page) SOAK exhibition, Dilip da Cunha and Anuradha Mathur
Fig. 15 own drawing, hydrological cycle

04 / Drawing, directing, erasing lines

Drawing lines: the invention of rivers

If Rivers are constructed according to rigid riverbank lines, the qualitative method consists in challenging this notion through layering techniques, by means of printing sectional drawings of the chosen site on semi-transparent materials. The sectional drawings have been produced using a combination of analogue and digital painting techniques to include wetness above and below the ground, before being printed on semi-transparent materials. The intention with this part of the research is to show that rivers are not fixed in their liquid and contained state, but they are part of a shifting landscape that moves throughout time; this is due to an interplay between sediment deposition, erosion, and tectonic movement.
Thanks to the publication by Matteucci et al (2002), documenting the movements of the Tiber River from Post Imperial Rome all the way up to the present, it has been possible to illustrate this dynamic and temporal process combining this information with Google Earth sections. Inspired by the work of Gerard Richter, the layering techniques through panes of glass or other semi-transparent materials aim at transcending the limitations of "surface pictures" (Richter, 1971), such as maps and standard architectural drawings, which are constrained to a specific time-frame and leave out other moments of *wetness*. The resulting illustrations highlight the dynamic and ever shifting nature of riverine ecosystems, thus confirming the impossibility of permanent delineation.

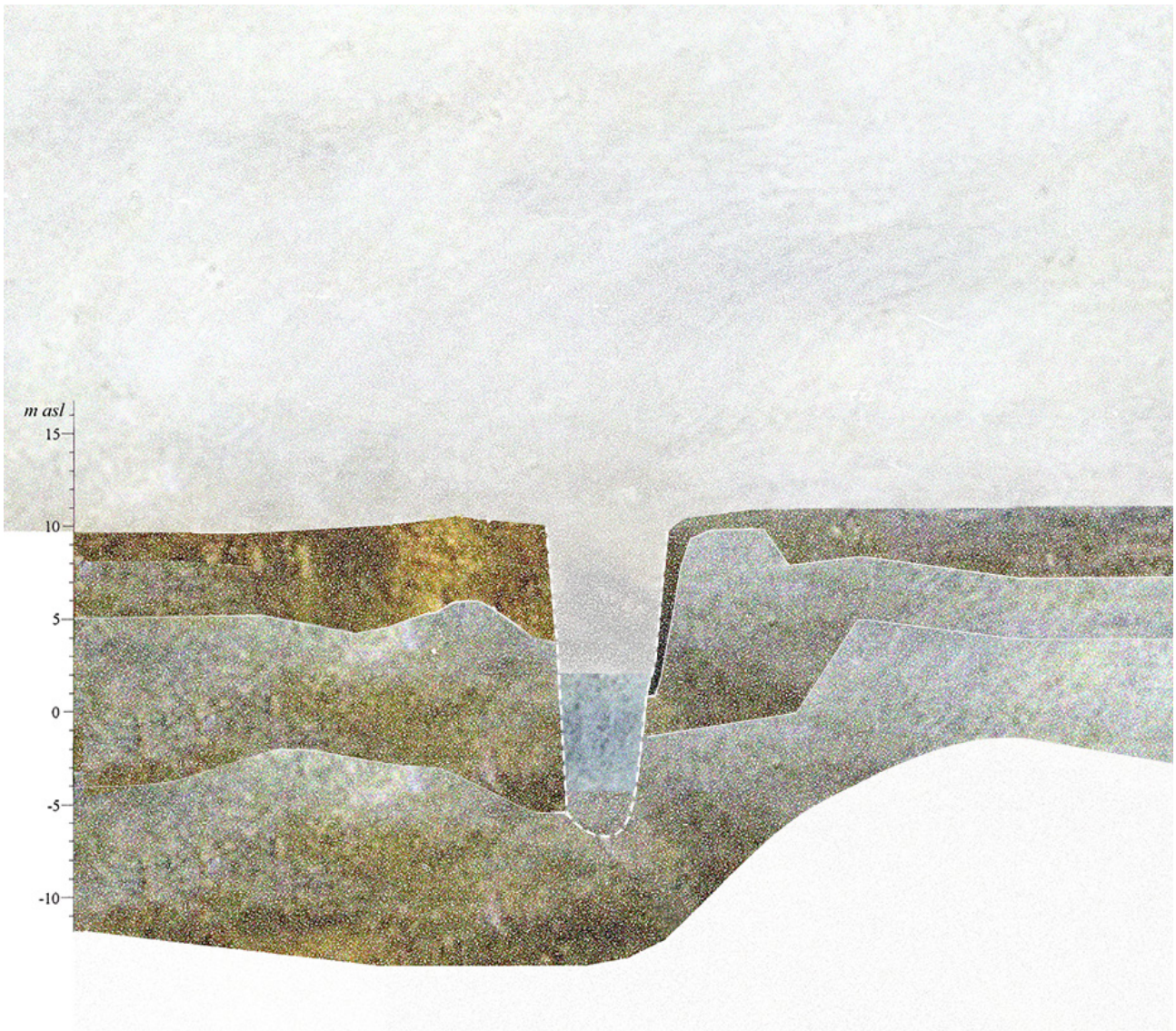


Fig. 16. Own drawing. Tiber River in Post Imperial Rome (info source: R. Matteucci, R. Sebastiani, C.Rosa, (2002) Indagine geoarcheologica nell'area dell'ITALGAS (Municipio XI), in BCAR,

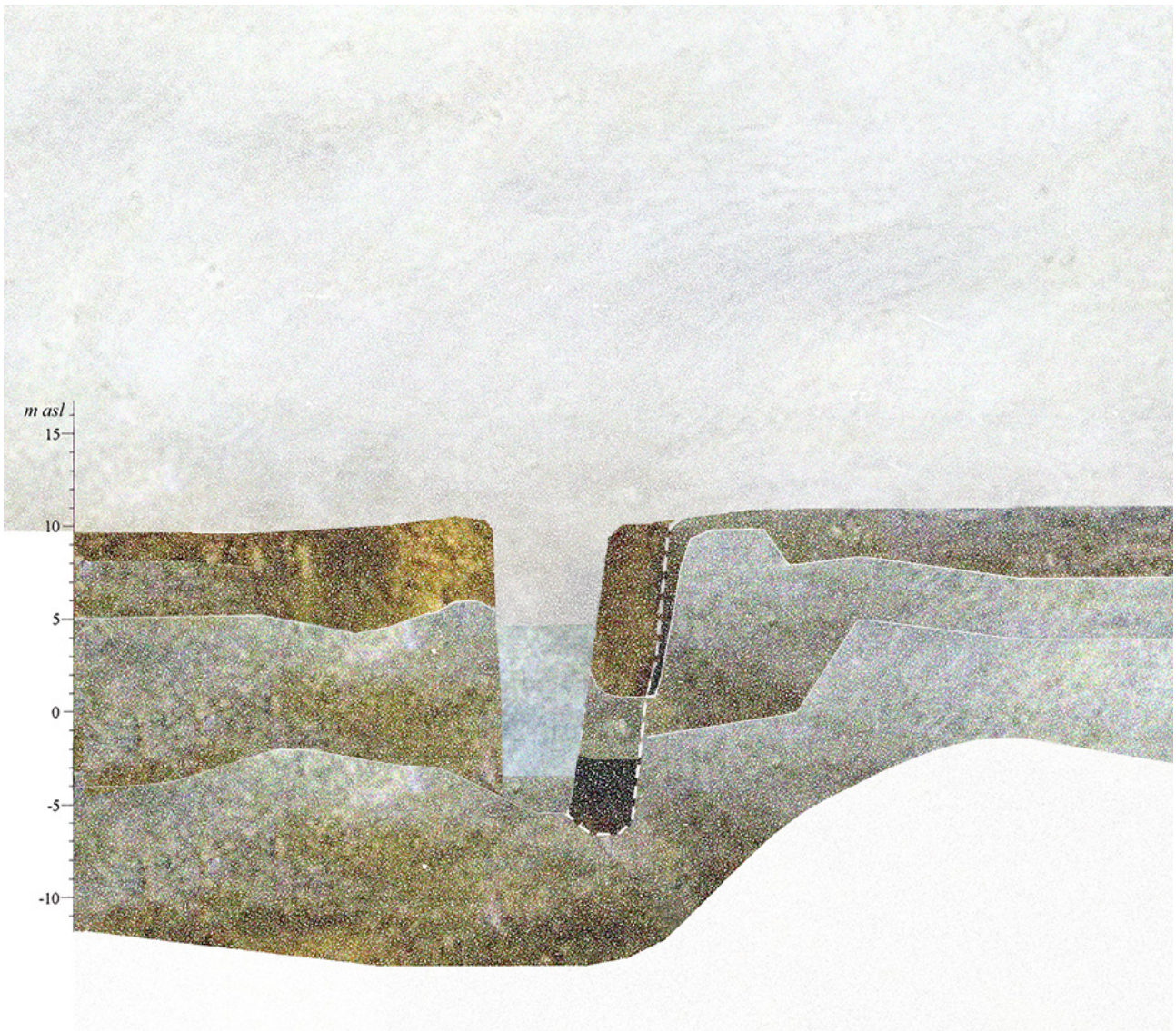


Fig. 17. Own drawing. Tiber River in the Middle Ages (info source: R. Matteucci, R. Sebastiani, C.Rosa, (2002) Indagine geoarcheologica nell'area dell'ITALGAS (Municipio XI), in BCAR,

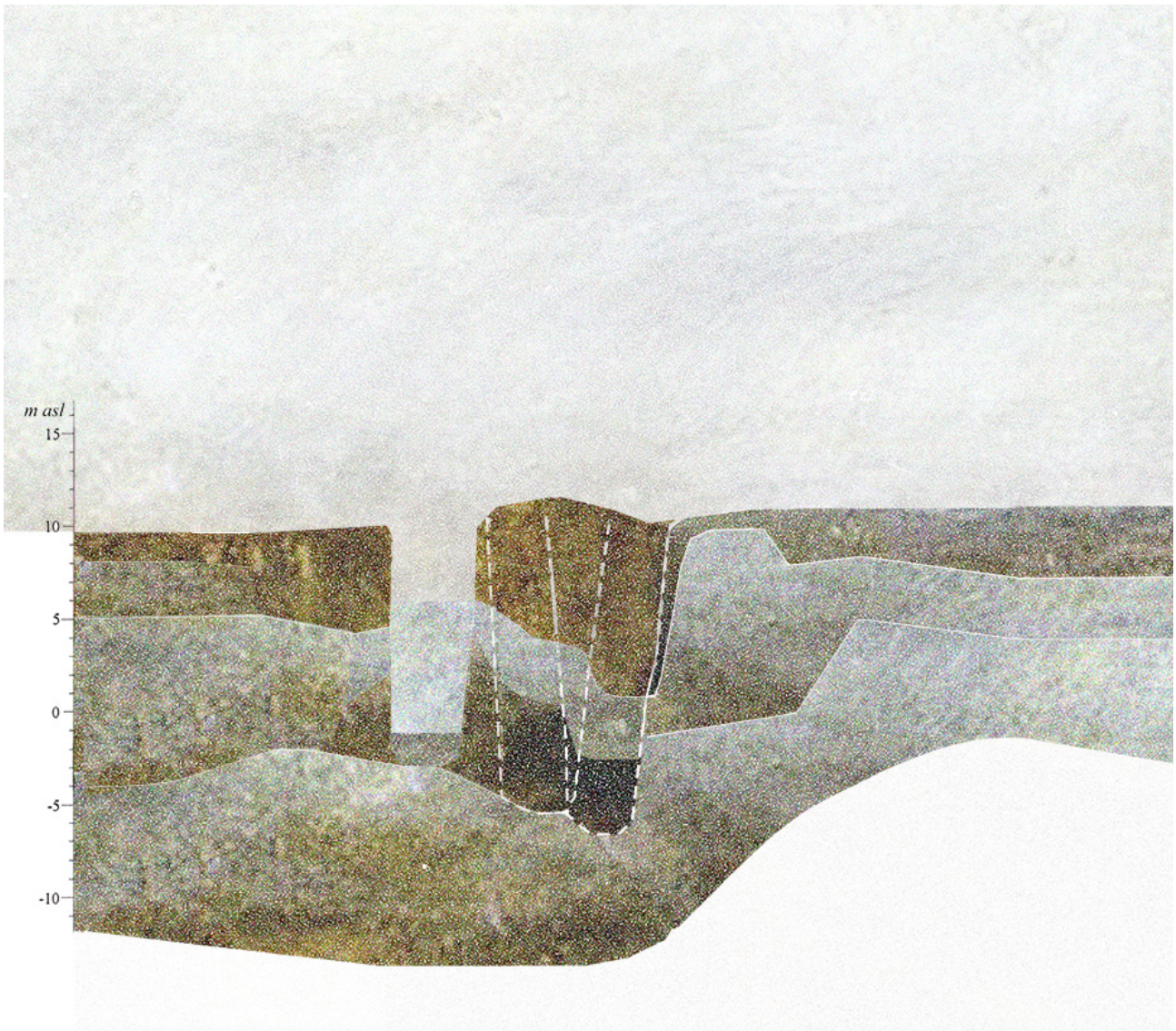


Fig. 18. Own drawing. Tiber River in the Reinassance (info source: R. Matteucci, R. Sebastiani, C.Rosa, (2002) Indagine geoarcheologica nell'area dell'ITALGAS (Municipio XI), in BCAR,

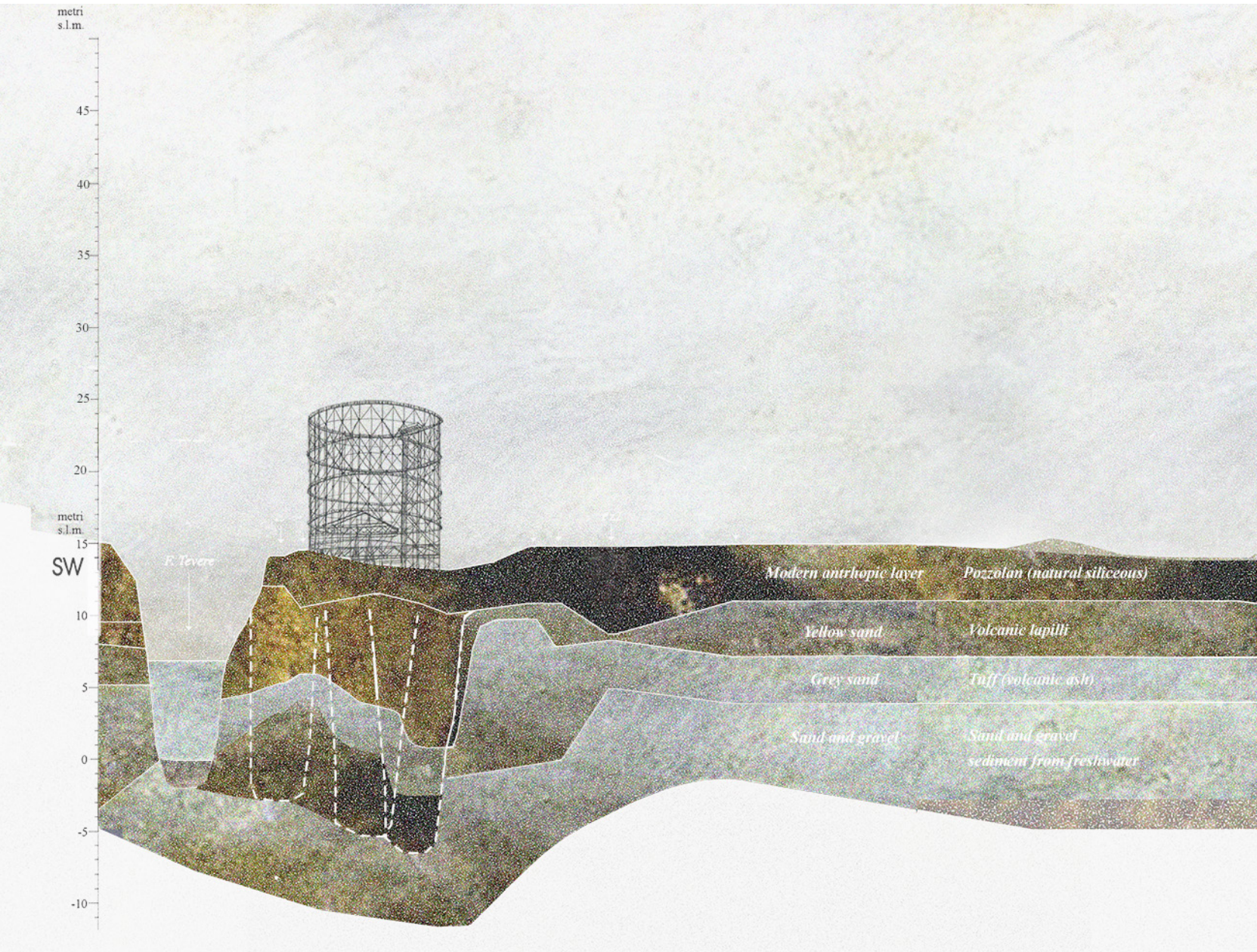
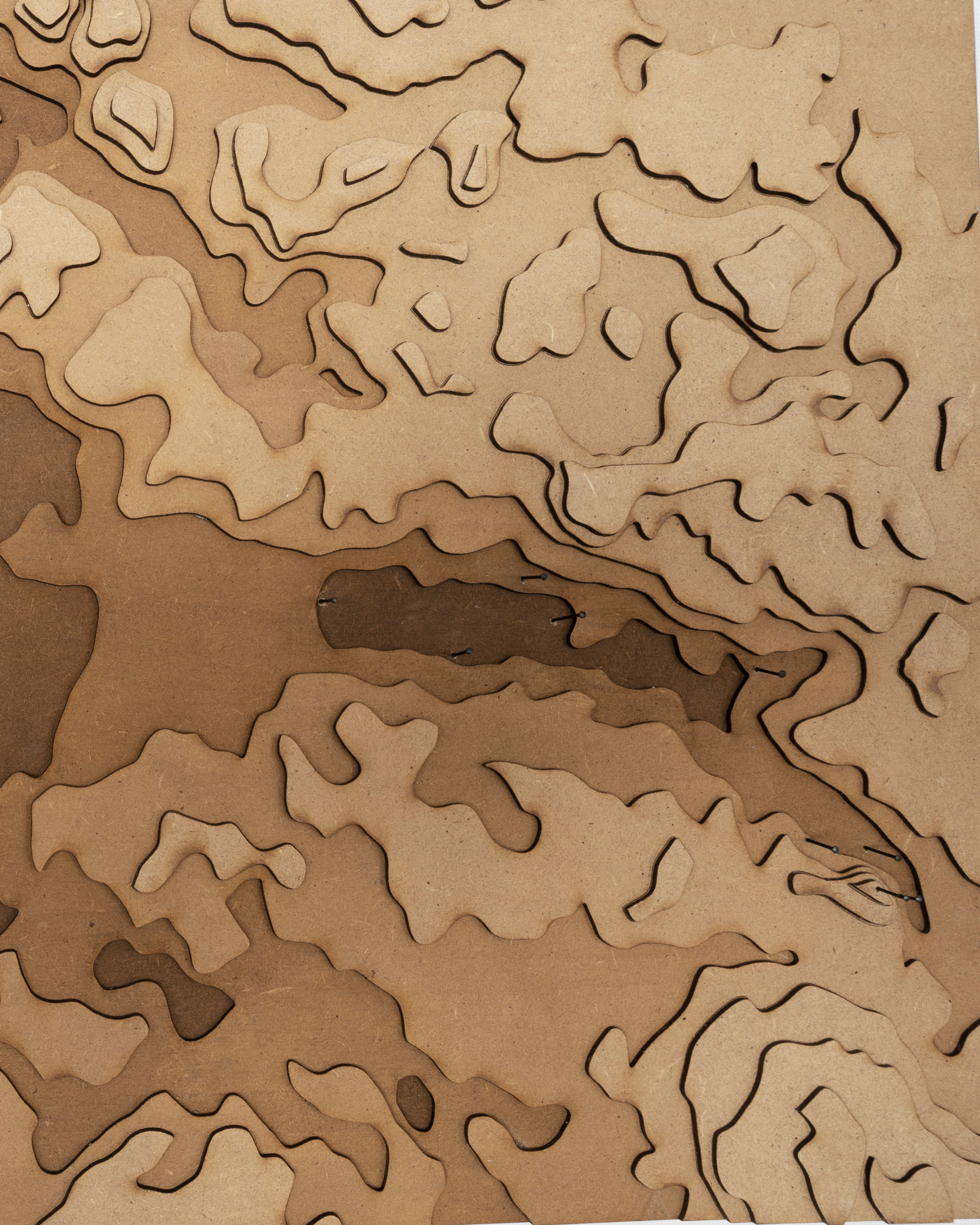

metri
s.l.m.
45
40
35
30
25
20
metri
s.l.m.
15
SW
F. Tevere
10
5
0
-5
-10
Modern antrhopic layer
Pozzolan (natural siliceous)
Yellow sand
Volcanic lapilli
Grey sand
Tuff (volcanic ash)
Sand and gravel
Sand and gravel
sediment from freshwater

Fig. 19. Own drawing. Tiber River today (info source: R. Matteucci, R. Sebastiani, C.Rosa, (2002) and Google Earth



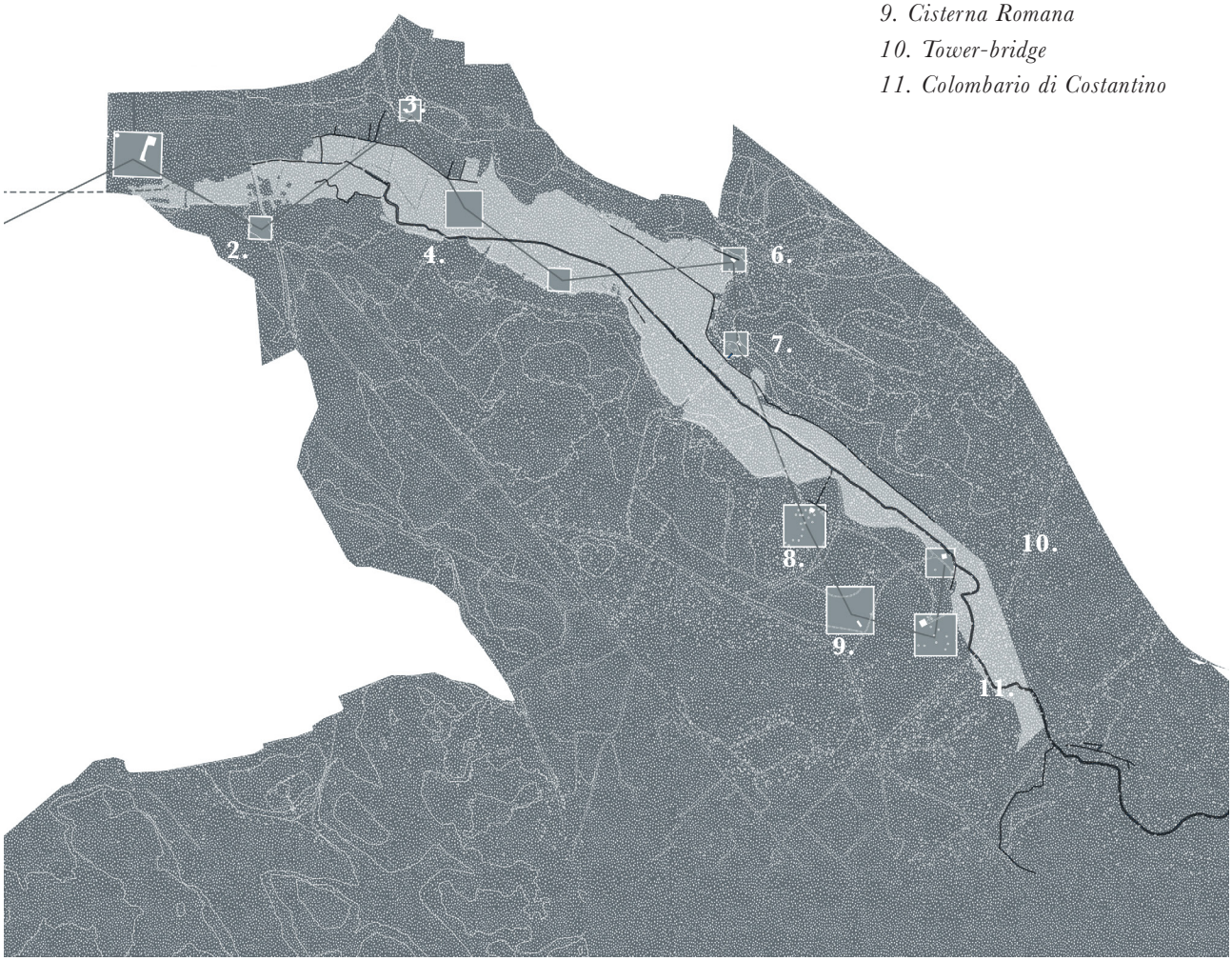
Directing lines: the commodification of rivers

The enduring exploitation of water for productive and recreational purposes finds some its most exemplar surviving traces in the Caffarella Valley, located in the Appia Antica Park in Rome. The Valley is nested between two of the oldest directing lines in Rome, Via Appia and Via Latina, and as such it has always represented a natural border, together with the River Almone that flows through it, sacred to Ancient Romans. Its agricultural character, favoured by the fertility of its volcanic soil and the abundant presence of water springs, has remained unchanged throughout the centuries, and the number of water traces with defensive and productive uses are often linked to this primary function (Rossi, 2016). Surveyed through fieldwork in the months of November and December, the complex system of cisterns and water mills creates a rich archaeological park. Resulting from Rome's water culture illustrated in the previous chapters, the water remains were constructed at different times, in a period comprised between the first and the third century AD. The research has highlighted the relationship between hydrology, topography and typology.These artifacts represent an early architectural manifestation of directing water flows. In order to illustrate how water would have seemingly inhabited these water traces, still survey drawings have been turned into dynamic animations, showing the direction of water through the tuff stones of the remains.

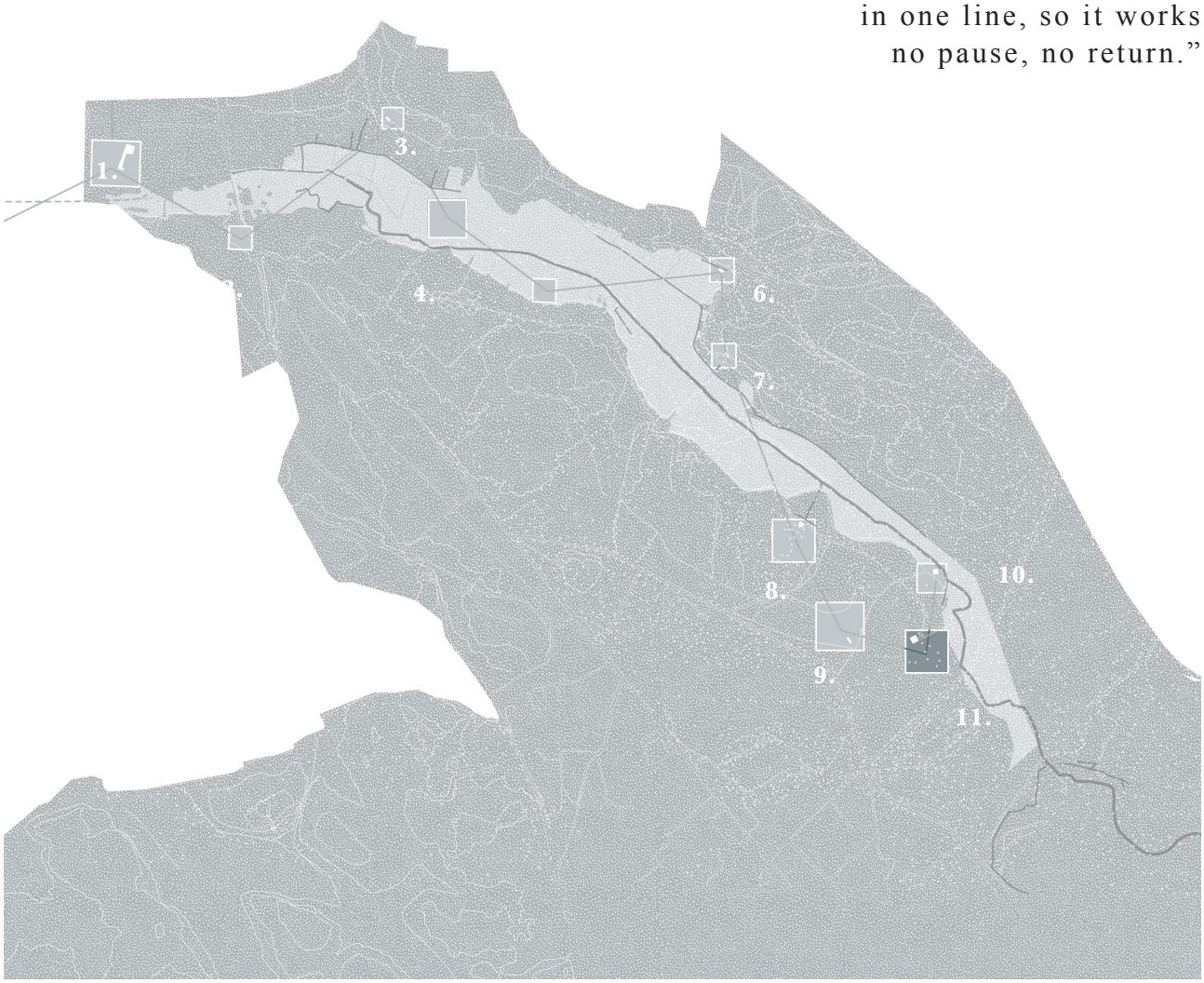
Previous page. Fig. 20-23
Own pictures in the Caffarella Valley

This pgae. Fig. 24: own drawing, Caffarella Valley

1. Paper Factory
2. Culvert Almone river
3. Cisterna Romana Monumentale
4. Pond
5. Spring
6. Cisterna Fienile
7. Casale della Vaccareccia
8. Cisterna ninfeo
9. Cisterna Romana
10. Tower-bridge
11. Colombario di Costantino

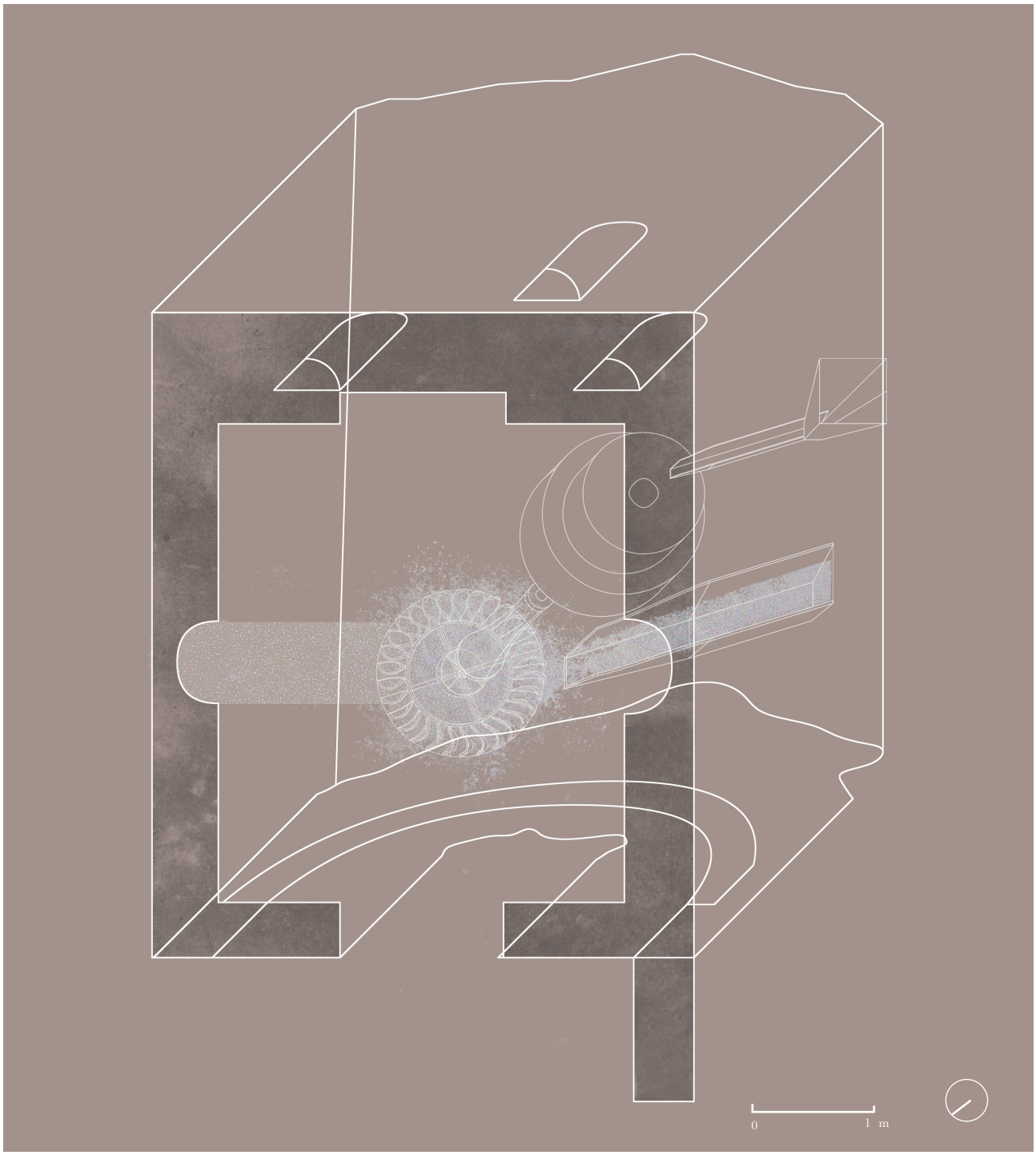


"Water in, water out
on it goes, as the wheel turns;
in one line, so it works
no pause, no return."



Colombario Costantiniano

Dated to mid II century AD and mistakenly attributed to Costantino (IV century AD), the Colombario Costantiniano was originally a collective funerary building, provided with niches in the wall to host the cinerary urns. With a rectangular plan and initially organised on two levels, the columbarium is entirely built in bricks, "opera laterizia".
During the Middle Ages, it was converted into a water mill for grain grinding, whose grindstone with paddles, set horizontally inside the structure, was driven by the force of the water that came along a channel that was controlled with a lock. ((Di Giovine, M. Mazzotta, B., Mucci, A., 2012)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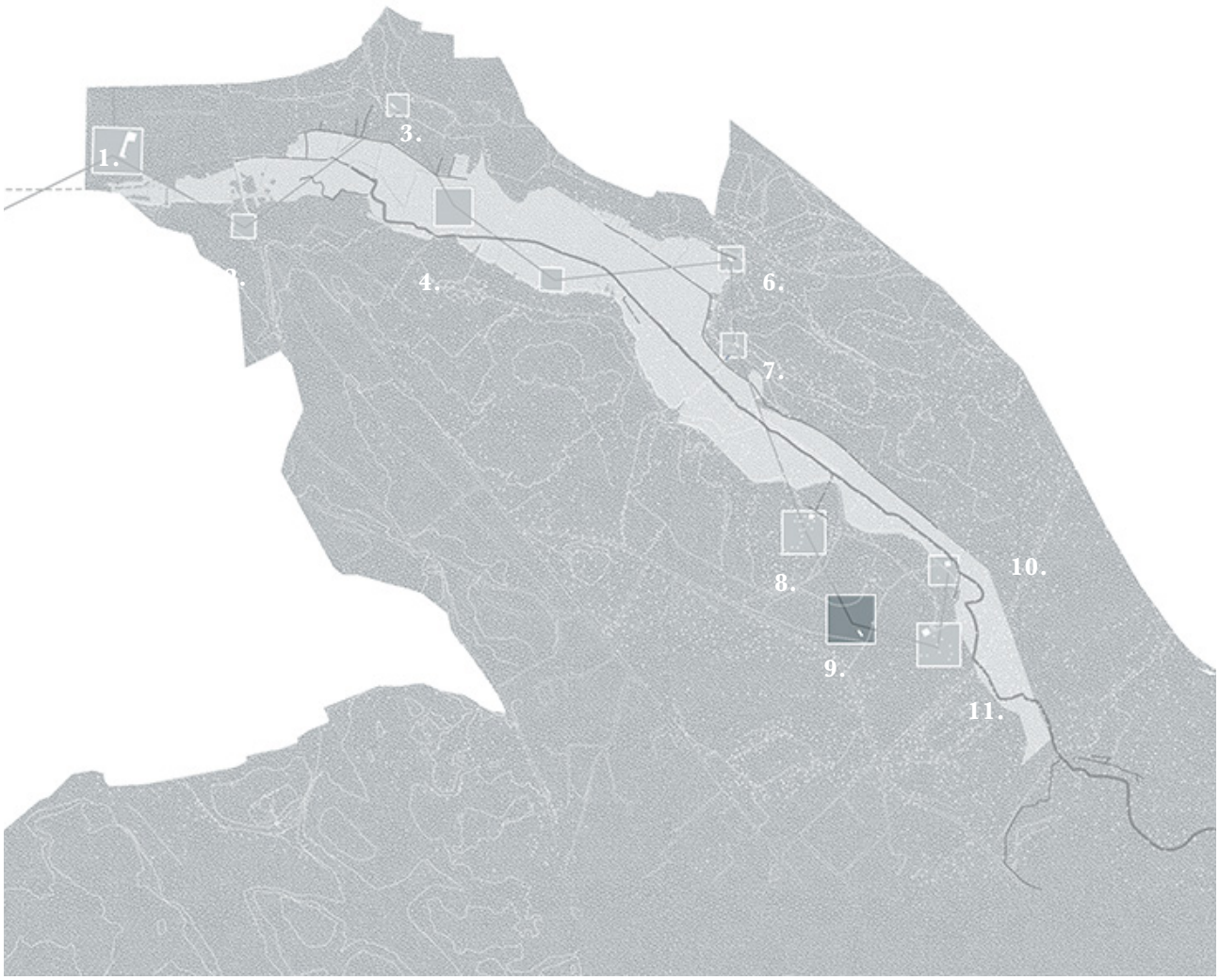
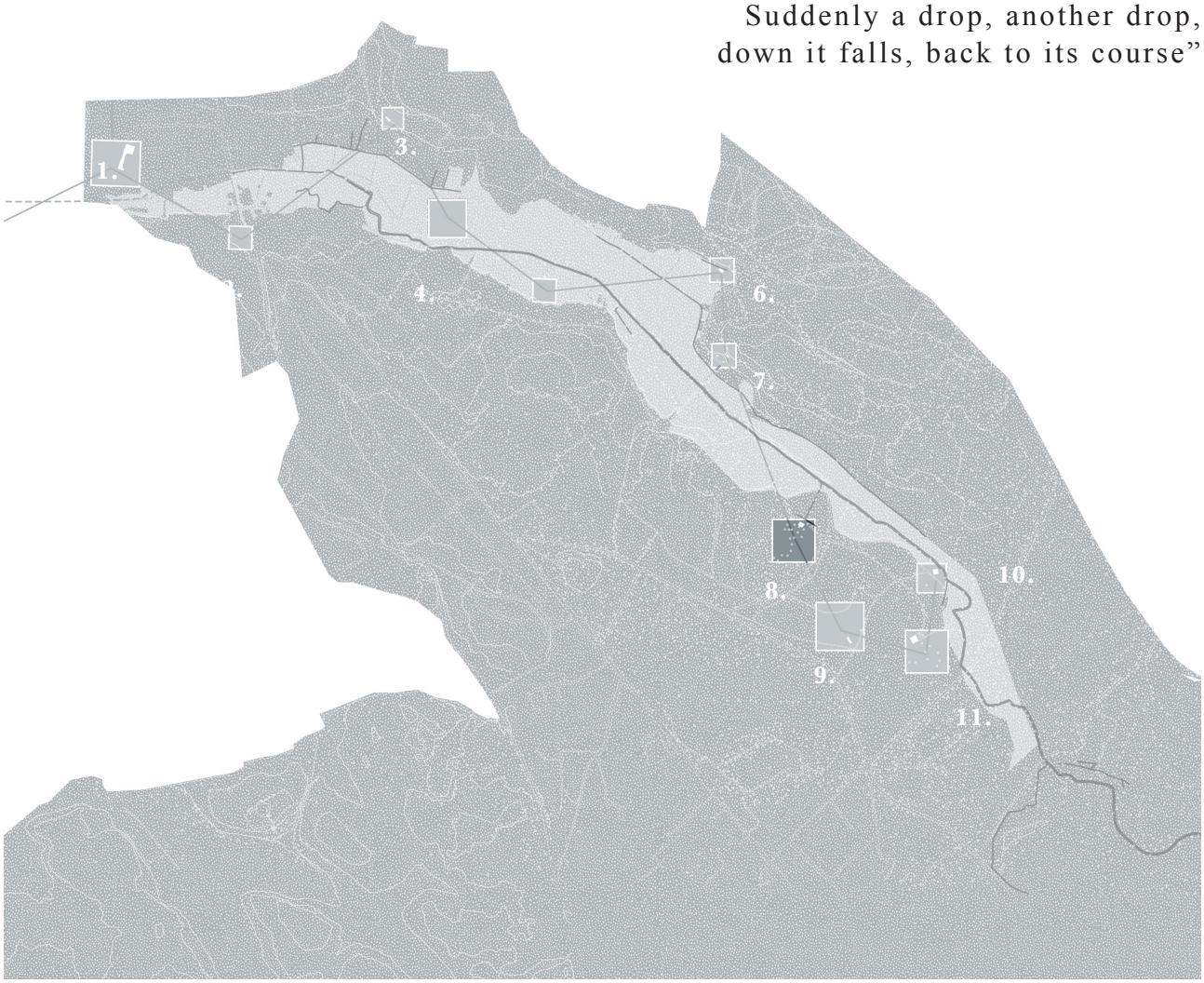


Roman Cistern (Appia Pignatelli)

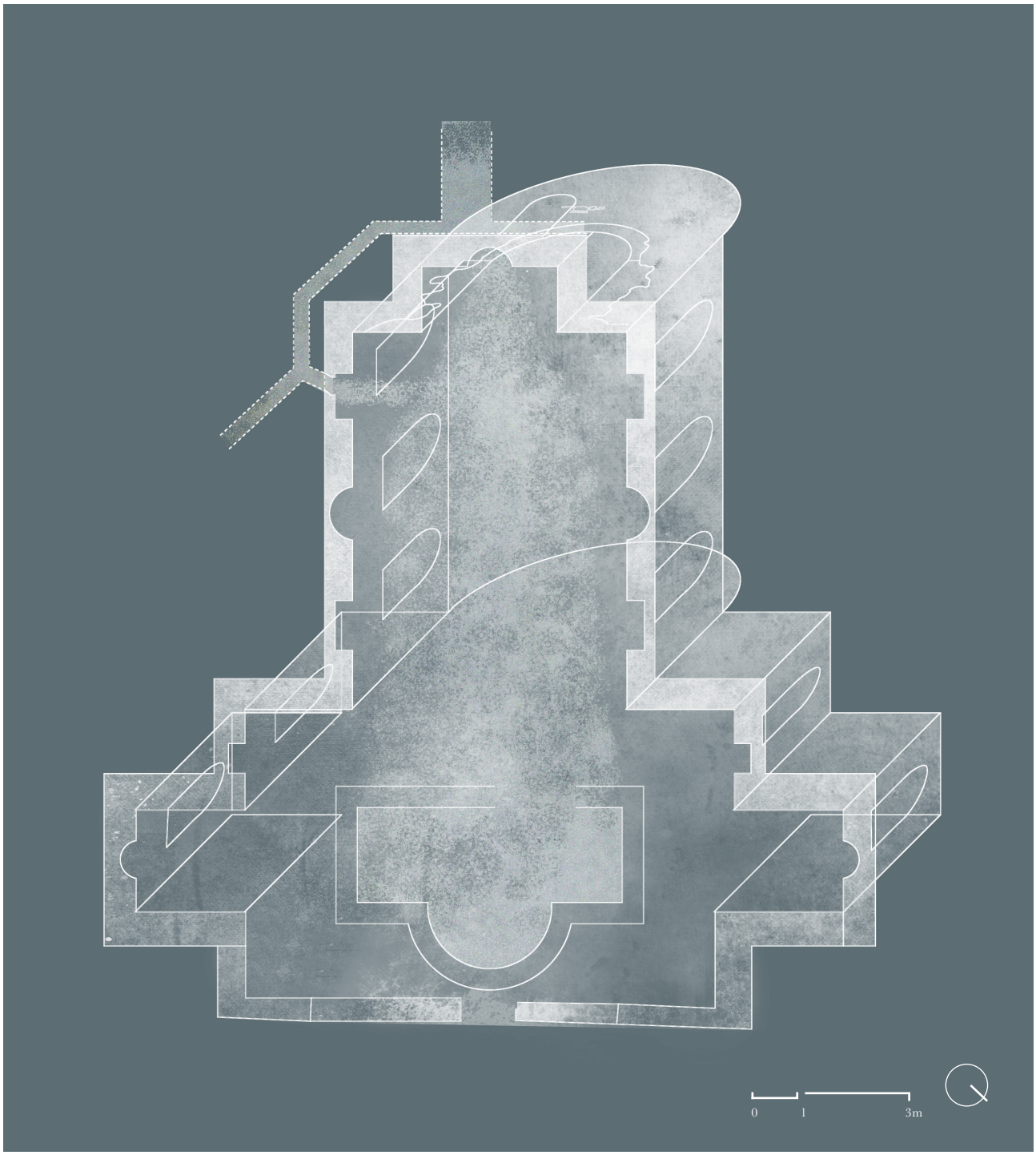
Dated to 44 a.C. - 40 d.C., this cistern is often referred to as "cisternone" for its great dimensions. Its peculiar plan is rectangular on the external perimeter (21, 4 x 8,6 m), but curvilinear on the inner side of the structure. The roof is unique within the park, with the eaves approximately at a right angle. This had been built using a wooden structure during construction. The structure, in "opus signinum", is left exposed, which brings to the conclusion that the cistern was originally buried in the ground.

"Water in, from far away
it slows down, evaporates
Suddenly a drop, another drop,
down it falls, back to its course"



Ninphaeum Egeria

Mistakenly associated with the "Egeria spring", after which it is named, this remain belongs to the typology of the "Ninphaeum", a recreational structure that intended to create a lush artificial cave, with water condensing on the white marble clad and dripping onto ferns. Built in the 2nd century AD, it provided a cool escape from the heat of the city, "locus amoenus" for the wealthy Roman banquets in summer. The structure contains the statue of the River Almone God. The ninpheum was discovered and repurposed in the Reinassance, when the Caffarella Park was unified under the Caffarelli family. (De Cristofaro, A., 2002)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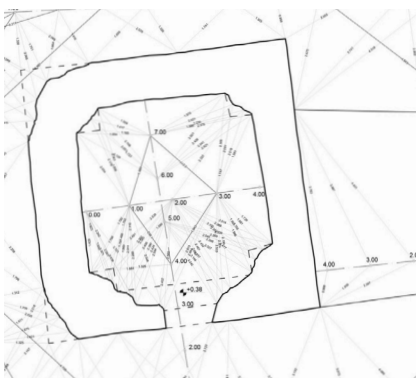
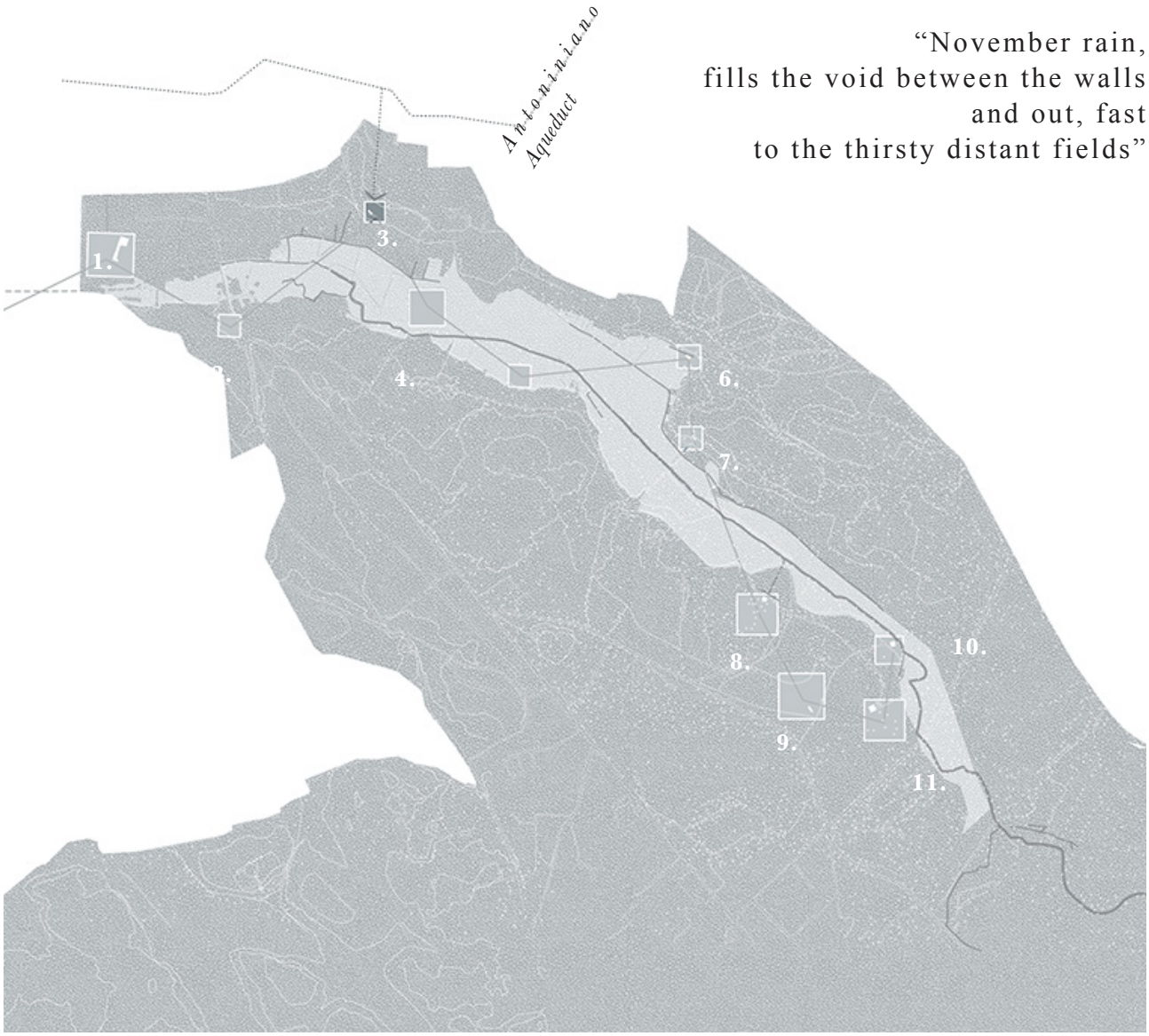
3m

Valca Tower

A few metres north of the Costantinian Colombarium, and supposedly once connected to it, is a medieval tower, rectangular in plan and constructed on at least two superimposed levels, employing an earlier Roman building. It was built to guard a bridge over River Almone but has later been turned into a "valca", a type of mill used to work and wash wollen clothing. This would have been one of three other similar structures assolving this function and detrmining a flourishing textile production in the valley. Under the plague in June 1656, the usual activity of working wool was replaced by that of disinfecting clothing. The building was no longer active in the 16th century. (Di Giovine, M. Mazzotta, B., Mucci, A., 2012)

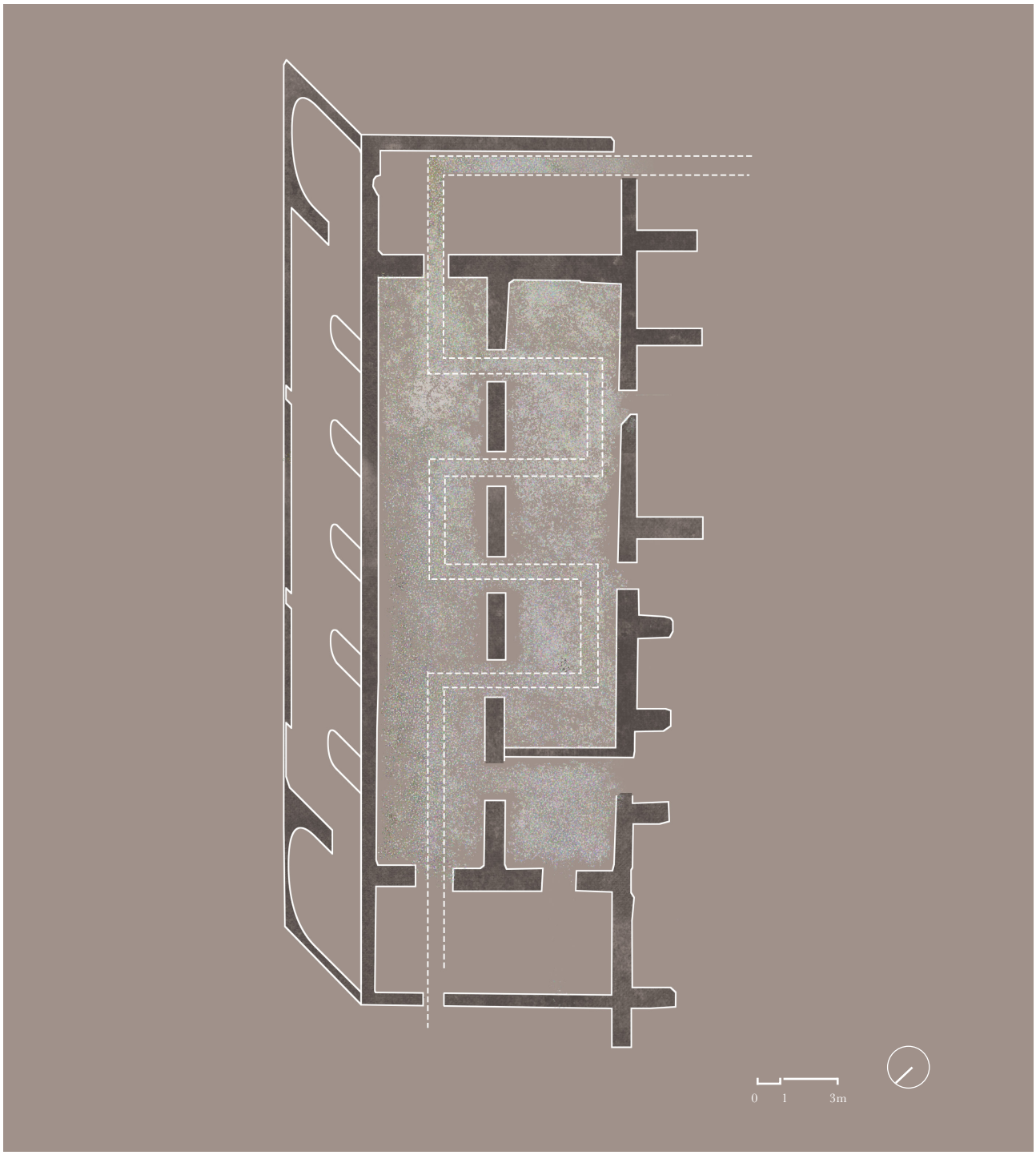


"November rain,
fills the void between the walls
and out, fast
to the thirsty distant fields"



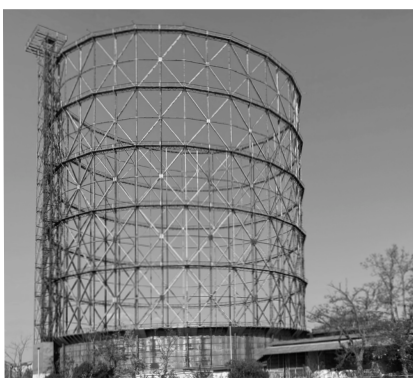
Monumental Cistern

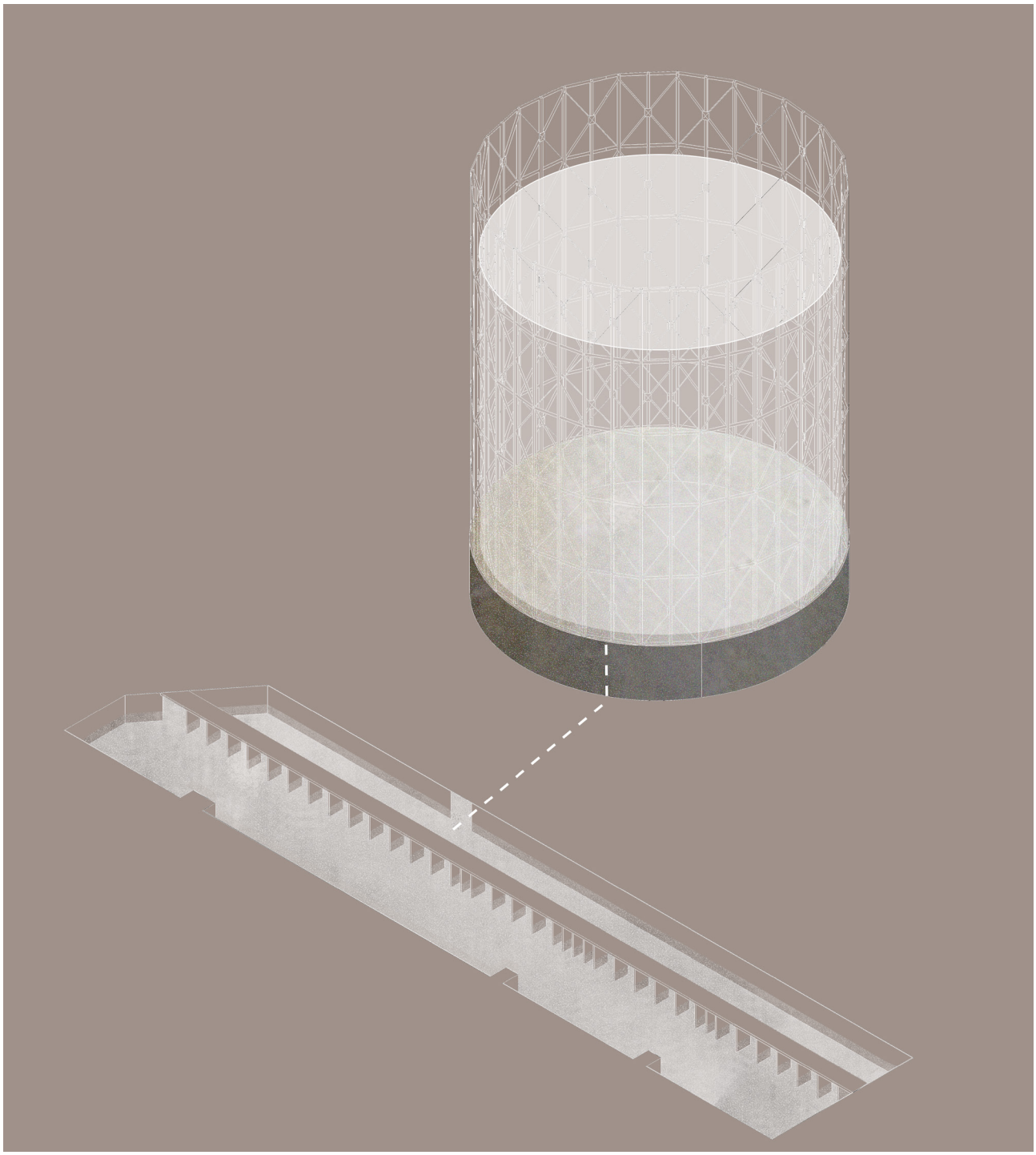
With its Eastern wall set against the valley in order to withstand the great water pressure it contained, the monumental cistern was built in the II-III AD. Sources attribute the source of the water for the cistern to the Antoniniano Aqueduct, which simultaneously brought water supply to the Caracalla Baths. The inlet has been located by archaeological studies on the NW wall, due to the limestone deposits on that wall as well as a visible aperture in the wall. The outlet has not been located, but has supposedly been identified in the opposite side of the cistern, along the SE wall. Given the dimensions of the cistern (37 x 12), it is unlikely that it served a single villa,but rather functioned as a "castellum", distributing water to the adjacent agricultural fields. (Rossi et al, 2016)


0 1 3m

The Gasholder

The last traces of water infrastructure along the former course of the Almone are located within the industrial area of the Gasholder Ostiense. The last of the gasholders on site was built in 1937, with the purpose of storing and measuring the quantity of gas that was needed to light up the city of Rome during the industrial revolution. The gas tank would float on the water tank and move vertically according to the quantity of gas contained. The settling tank next to it was used to store water in case of fire as well as gradually filter the carbon coke through sedimentation.





Directing lines:
hydrogeology - topography - typology

The results of the research for this section enable us to draw conclusions regarding the relationship between hydrogeology, typology and topography, reinforcing an idea of water that is directly linked to the land it flows through. At least three typologies have been identified:

- the water cistern, or *castellum*, collecting aqueduct water or rainwater for redistribution;

- the mill, directing water for woll washing and working, grain grinding or paper making

- the *ninphaeum*, a recreational building using water as a cooling device for leisurely activities;

Depending on the typology and the respective use of water, both altitude and proximity to the Almone River vary.
The cistern typology appears to be located higher up in the valley, between 23 m and 45 m above sea level. This is due to the necessity to exploit gravity to re-distribute water to the lower agricultural fields; on the other hand, the proximity to the river was of secondary importance, given that the main water sources were rain and water drawn from the nearby aqueducts; the mills, conversely, could employ lower-quality water and were dependent on stream speed for the mechanic function, and this the reason for their adjacency to the river, all around 22 m above sea level; the location of the ninphaeum, on the other hand, might have been dictated by the surrounding lush vegetation and the proximity to a freshwater spring.

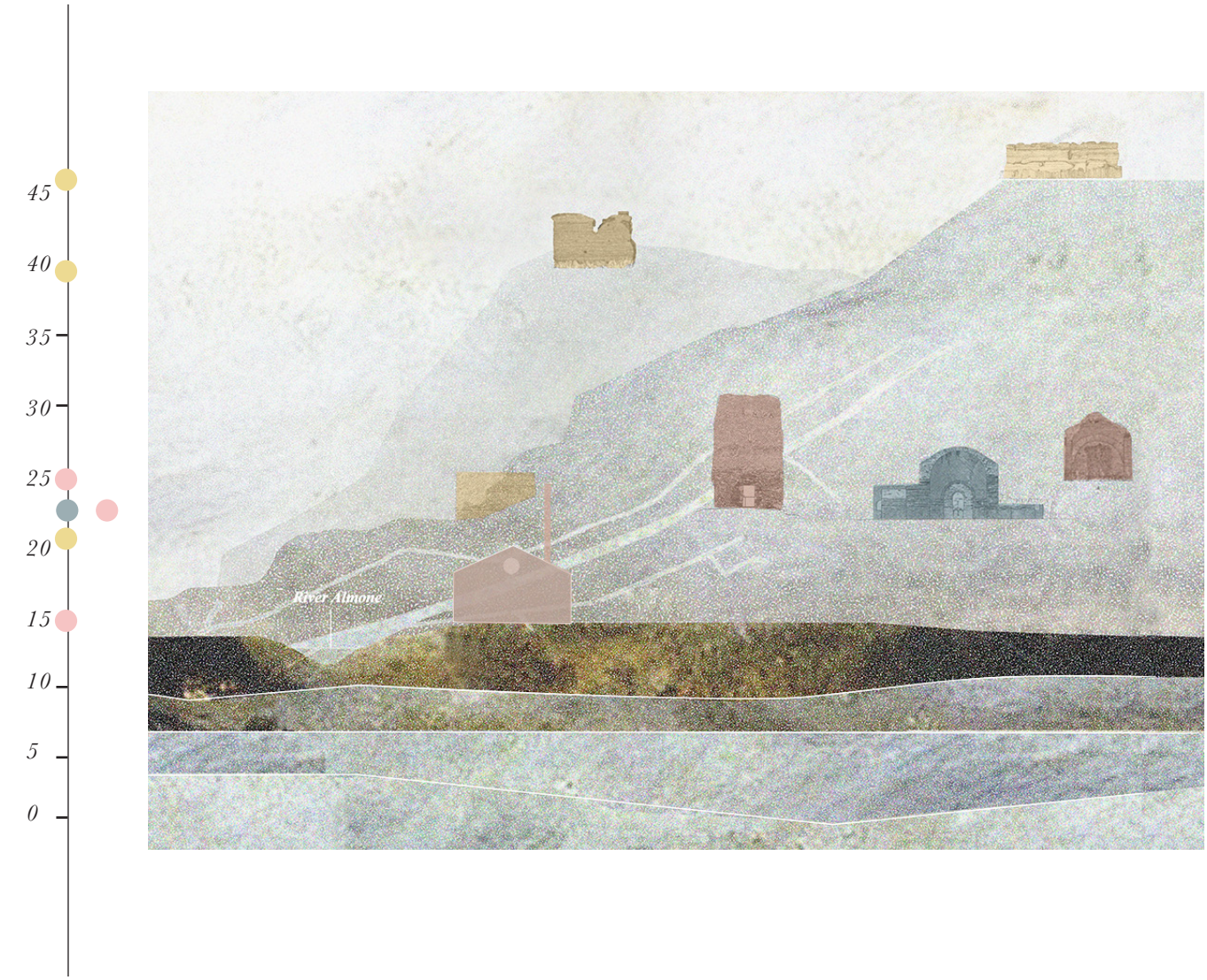


Fig. 37. Own drawing. Water typologies in the Caffarella Valley

Directing lines:
hydrogeology - topography - typology

The Gasholder site provides an example for a typology of its own kind, which no longer fits within the dynamic of "water in-water out", given the large amounts of toxic by-products released by the industrial facilities in the adjacent River Tiber. Similarly to the Caffarella Valley typologies, the position of the Gasholder is a direct consequence of the presence of water. However, unlike the Roman traces, built along the secondary stream Almone, the Gasholder was constructed along the main river, the Tiber, in order to ensure ease of transport of materials and carbon coke directly from England through the seaport Civitavecchia. In addition to this, the Tiber provided a convenient outlet to dispose of the toxic by-products from the industrial activity (Casciato, M. 2021), some of which are still percolating through the ground at present (interview, April 2022, site coordinator Gasholder Ostiense). As such, not only was the choice of location of the Gasholder determined, among other factors, by the hydrogeology of the site, but in turn, its presence has affected the quality of water released back to the Tiber.

With its construction in 1937, next to the older and smaller gasholders, the 90 meters' high "steel colossum" quickly became a symbol of progress and modernity. Not far from it, the Almone river still flowed into the Tiber, despite having been culverted in its last section. However, the ensuing events would alter this condition irreversibly, as the maps in the next section will reveal.

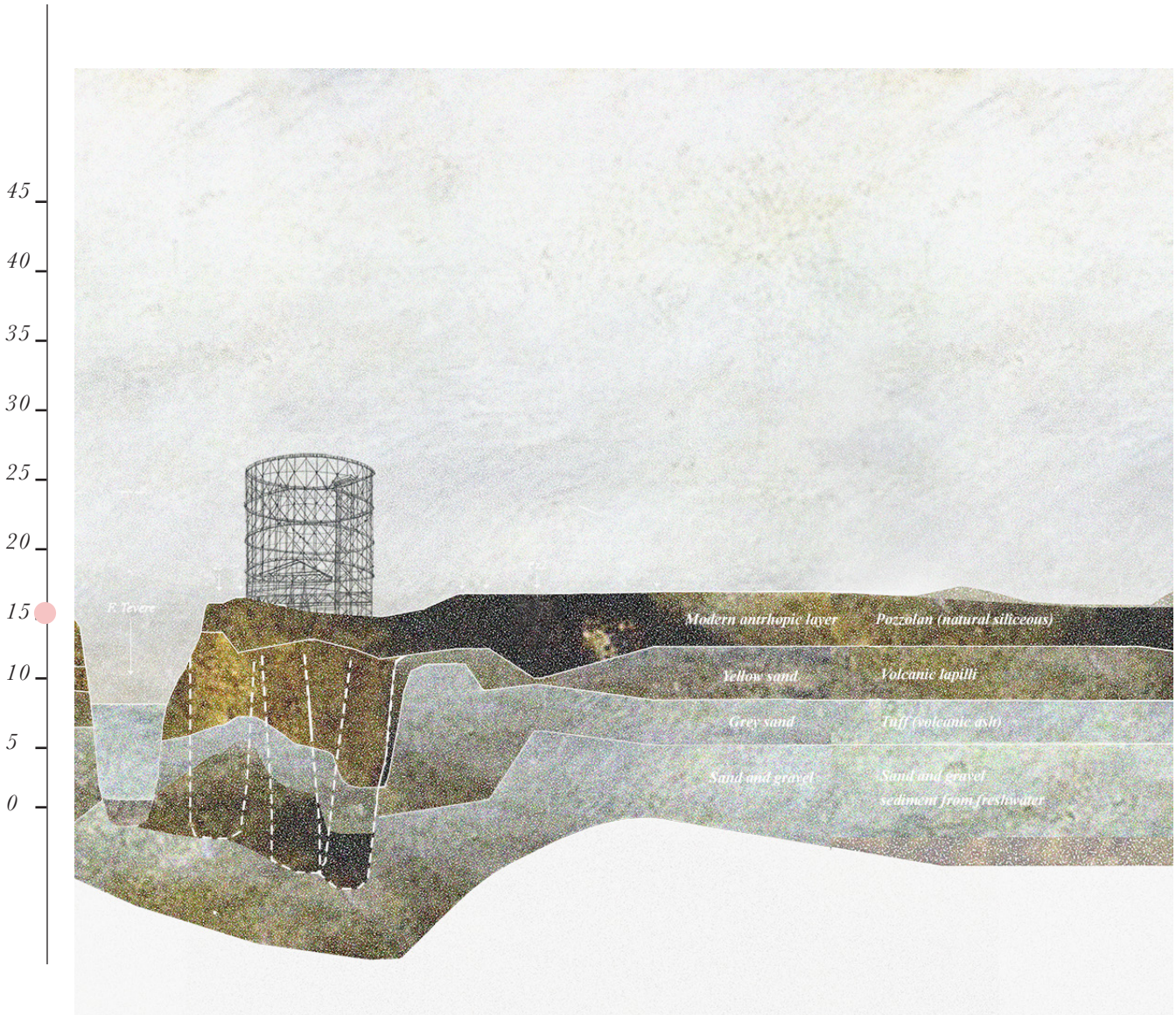


Fig. 38. Own drawing. Water typologies at the end of the Almone old course.

Erasing lines: the obliteration of rivers

Sacred to the Romans to the point of being associated with a deity - represented in the form of a marble statue in the Egeria Ninphaeum - the Almone River saw the Roman yearly ritual of the *Lavatio Matris Deis*, devoted to Cibele, whose sacred black stone was carried to the mouth of the Almone River and washed in its water every year on the 27th of March. Today, that ritual is long forgotten, together with the importance of the river it was historically associated with.

The research has traced the transformations to its course all the way up to the present, using archival maps and available surveys of its present location. The first considerable changes to its course date back to the beginning of the 20th century, and are linked to the extensive growth of the city outside the Aurelian Walls, that had represented the historic border of the city until the start of industrialisation. (Fig. 36). In fact, maps until 1909 show no substantial alteration to the agricultural fields that characterised the area during Post-Imperial Rome and throughout the Middle Ages (Fig. 40, next page). However, within the first decades of the twentieth century the area starts to acquire the urban connotations it still preserves today. Significant alterations to the River occurred due to the pressure of modernity, which lead to the construction of a first culvert for the construction of a railway in 1924. Later on, the construction of the Cristoforo Colombo motorway in 1937, and its frequent flooding episodes, resulted in the construction of a second culvert higher upstream in 1944 (Fig. 43). These anthropic modifications reinforce the notion that not only water quality, but also its course is affected by land activity throughout time. Today, the Almone River is directed to a wastewater treatment plant downstream (Depuratore di Roma sud) and the presence of its former mouth at the River Tiber is long forgotten.

The following section contains the results of the overlaying and abstraction process, while the original maps employed in the study are provided in Appendix III.

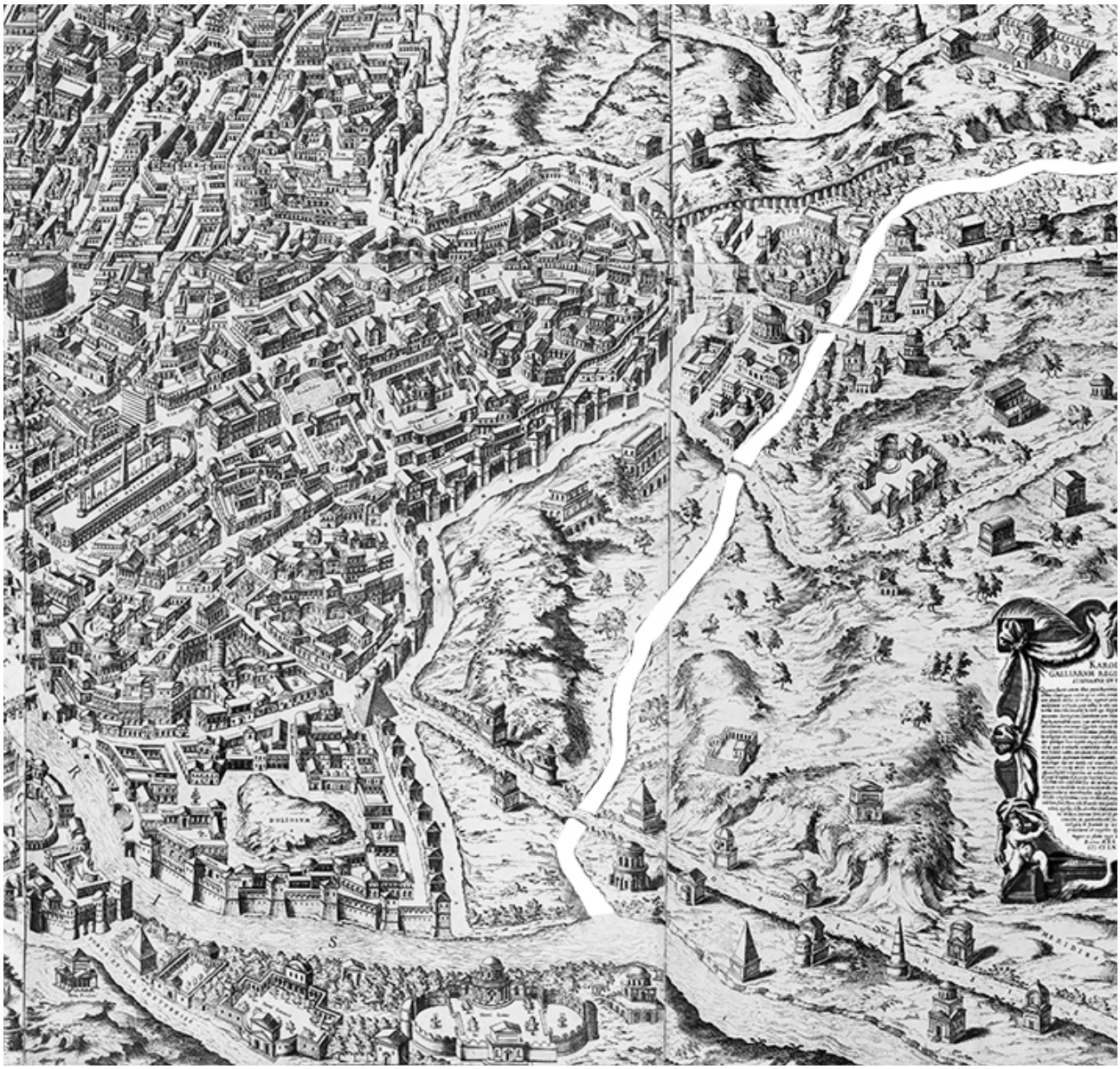


Fig. 39., next page. Almone River (in white) on a historic map of Rome by Du Perac Etienne, 1604

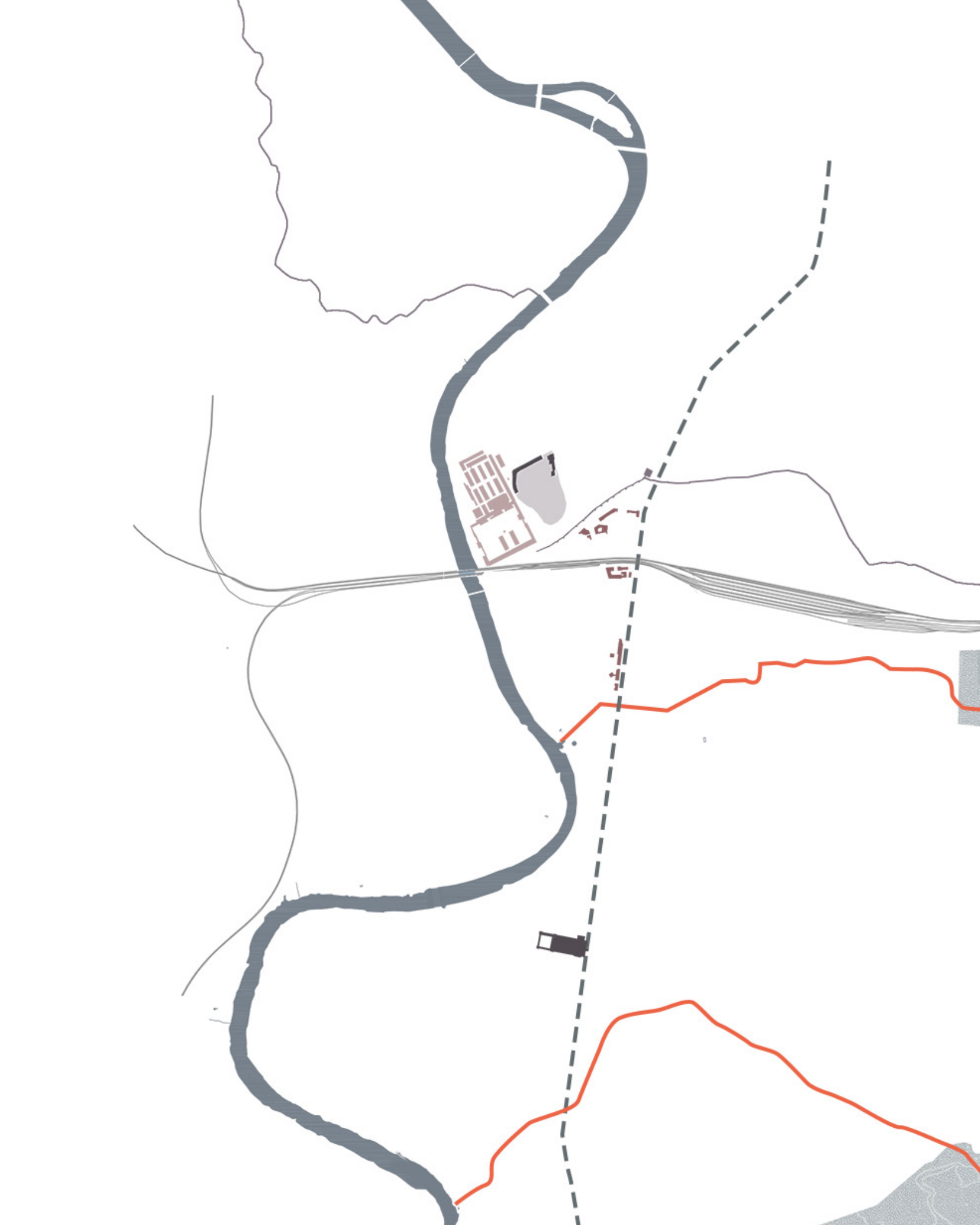


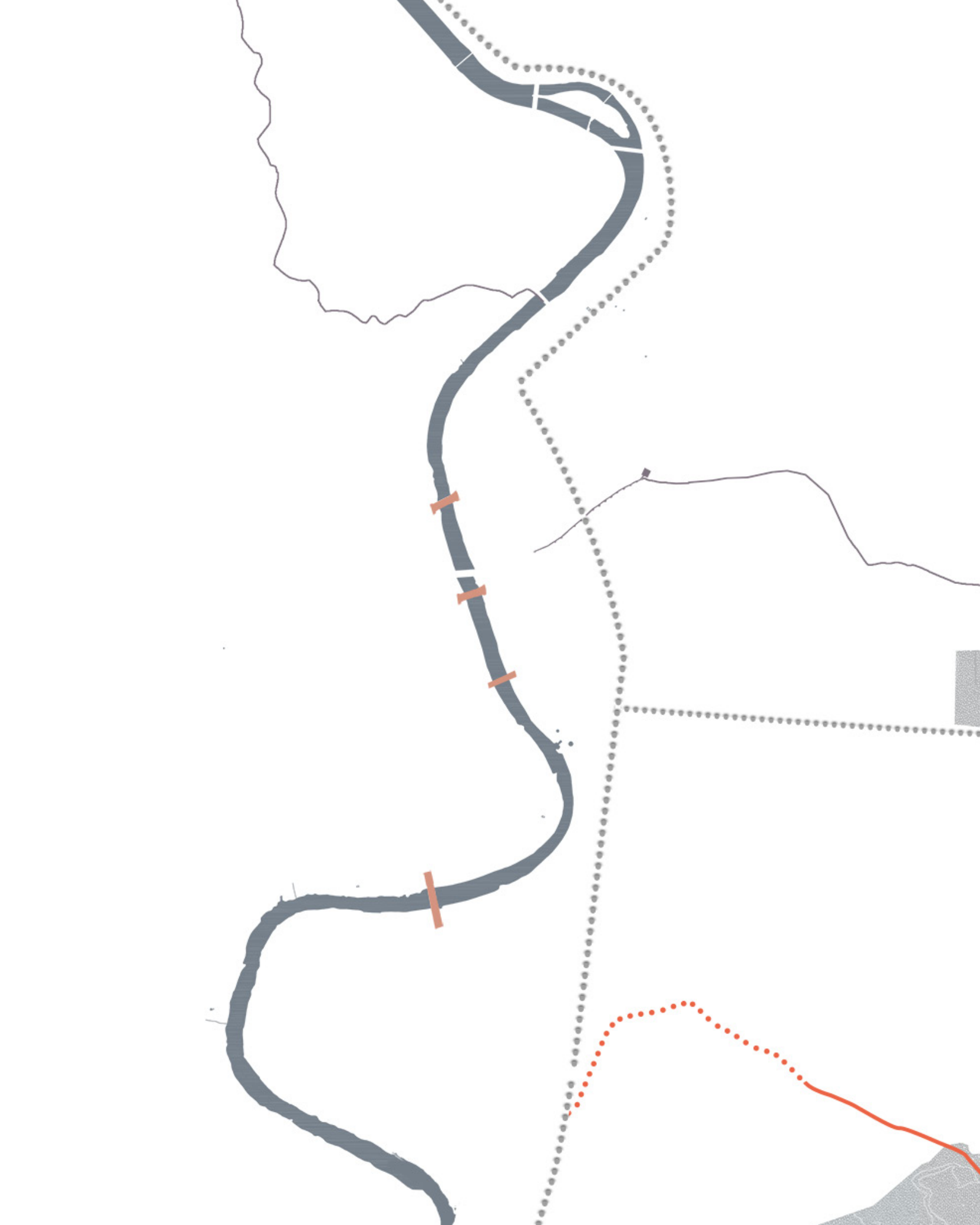
Fig. 40., own drawing, River Almone in 1909, derived from the study of the historic map by Wagner and Debes (see Appendix II)


S. Paolo
Piano di Pietra Papa
Colli di S. Paolo
S. Paolo fuori le Mura
S. Isidoro
F. Almone

Fig. 41., own drawing, overlaying a 1925 map of Rome and the Almone River (Historic map source: Ufficio Cartografico del T.C.I, see Appendix II)

Fig. 42., own drawing, Map 1925, resulting as an abstraction of the information from the previous map

Fig. 43., own drawing, Almone River in 1944, obtained from the study of the historic map: Rome 1944, source: geoportale cartografia storica di Roma (see Appendix II)



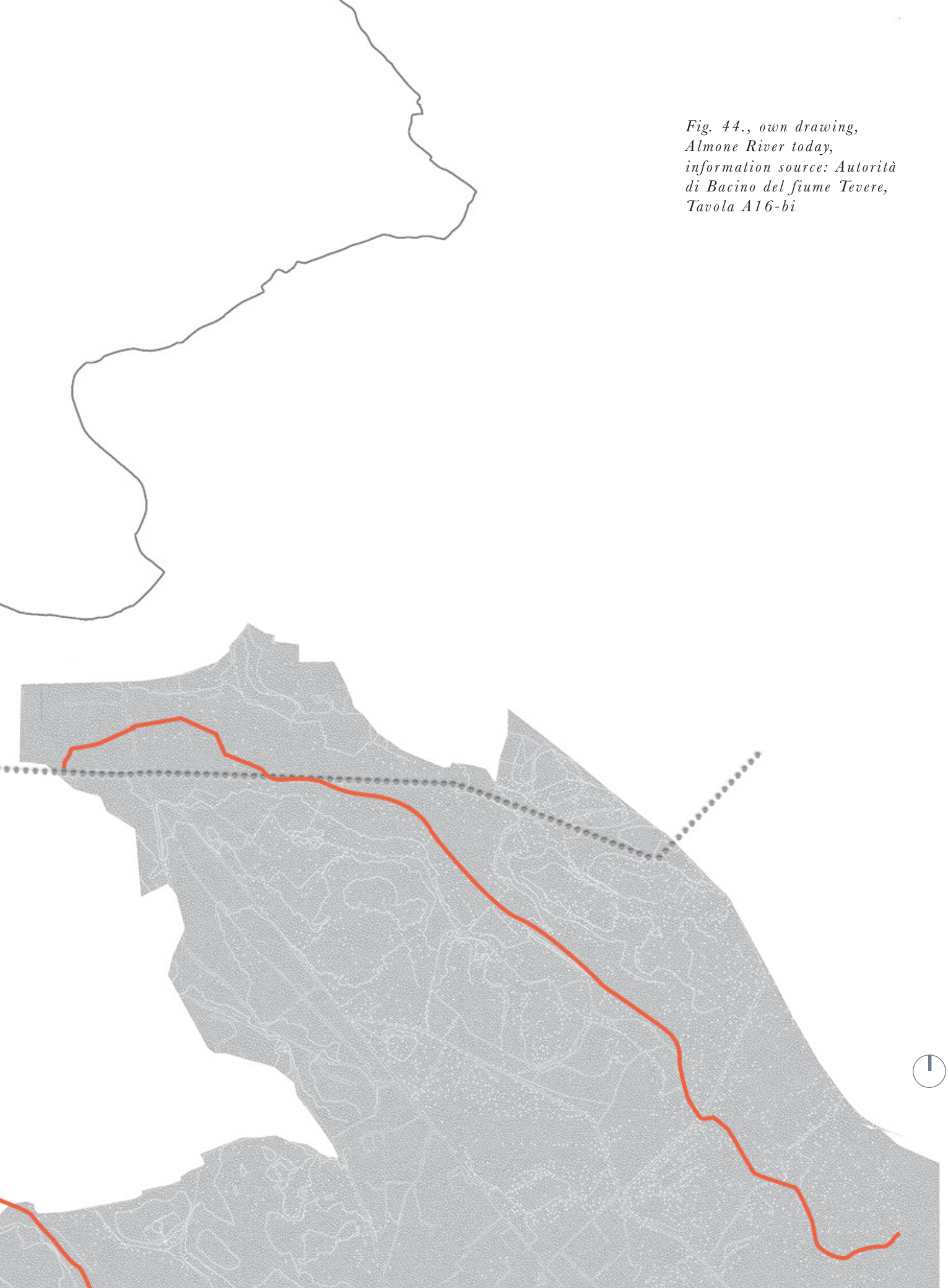


Fig. 44., own drawing, Almone River today, information source: Autorità di Bacino del fiume Tevere, Tavola A16-bi

05 / Conclusions

The aims of the research, explicated through the question, were manifold: on the one hand, the research aimed at understanding the relationship between urban land activity and water in the becoming of rivers, choosing the case of the Tiber and the Almone as a case-study. On the other hand, the research was also a quest for a different mode of seeing and thinking through the notion of wetness, the latter holding potential to inform the design process.

The findings can be articulated following the same structure as the research sub-questions and methods; the outcomes pertaining to the study of the Tiber's movement relative to the geological layers from late Imperial Rome up to the present day have shown the fluidity of rivers and the impossibility to clearly delineate and maintain a demarcation line between what we call "river" and what we call "land". The same results are confirmed by the second point of inquiry, exploring the relations between hydrology, topography, and typology in the Caffarella Valley. This has highlighted the possible correlation between the typology of water-related infrastructure and their location relative to land and water, namely altitude and distance from the river. As such, it was possible to infer that land, water and the resulting architectural typologies operating between them should be investigated and represented as one articulated whole. Finally, from an urban perspective, the study of the alterations to River Almone throughout the last century has clearly shown the impact that urbanization and land-related activity have had on the river, with its progressive canalization and culverting underground. Failure to acknowledge the river as an integral part of the landscape, which not only human activity but also non-human actors depend on, has determined a notional and physical transformation of the Almone from a river to a collector. Efforts to restore the status of the Almone as a river are currently in progress (interview, Federici, 2022), supported by the ambition to establish an Almone River Contract. Results from the research show that the design of water flows in urban interventions can not disregard the design and the articulation of land nor that of related buildings and infrastructure. This implies the simultaneous appraisal of what we refer to as "water" and what we refer to as "land-scape", in a newly found "waterscape".

The implications of the waterscape

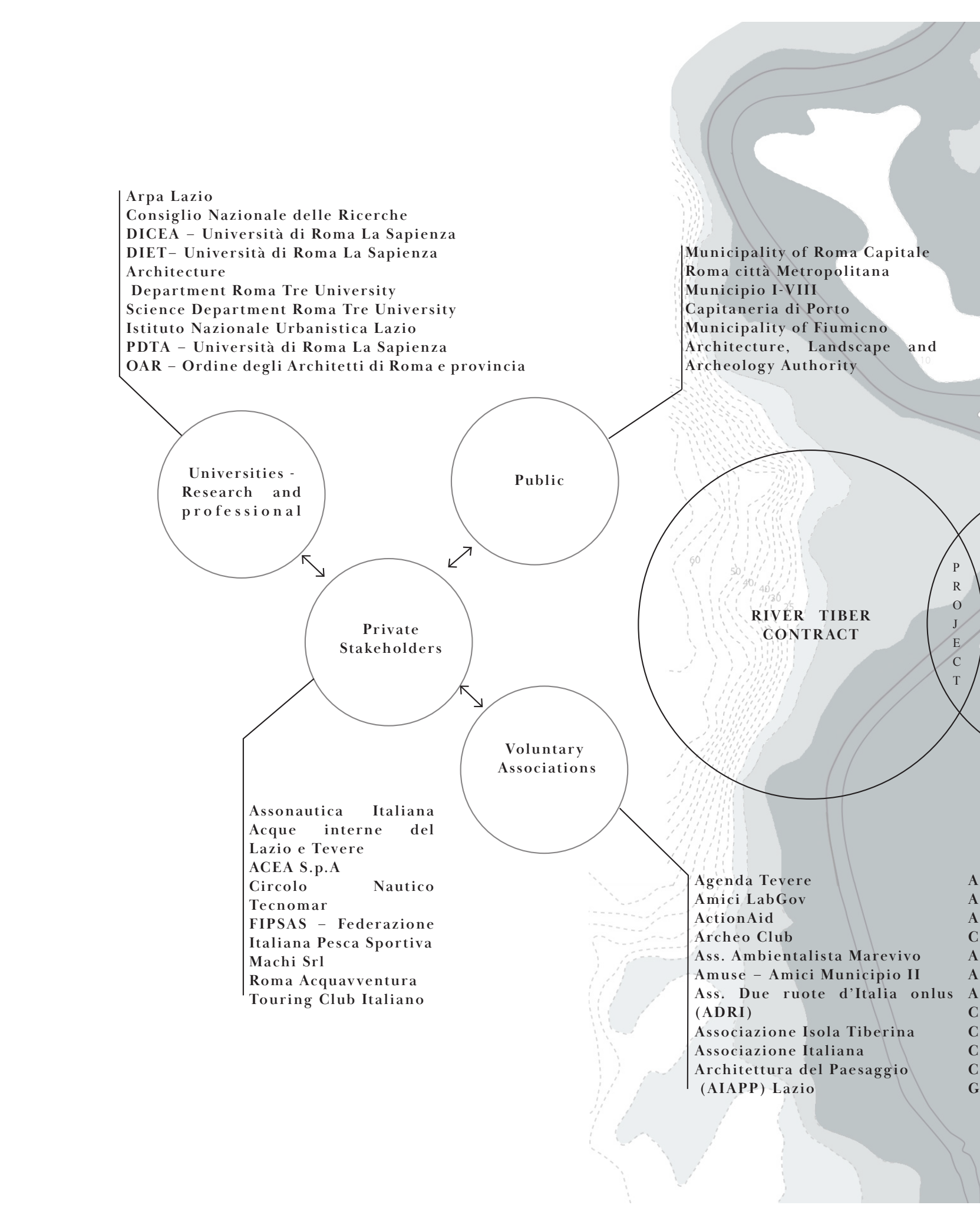
What are the implications of the waterscape for human and non-human actors and how can the combined design of landscape, architecture and infrastructure play a role in accommodating wetness?

The notion of the waterscape is often embedded in scientific literature within the very identification of the term "watershed".

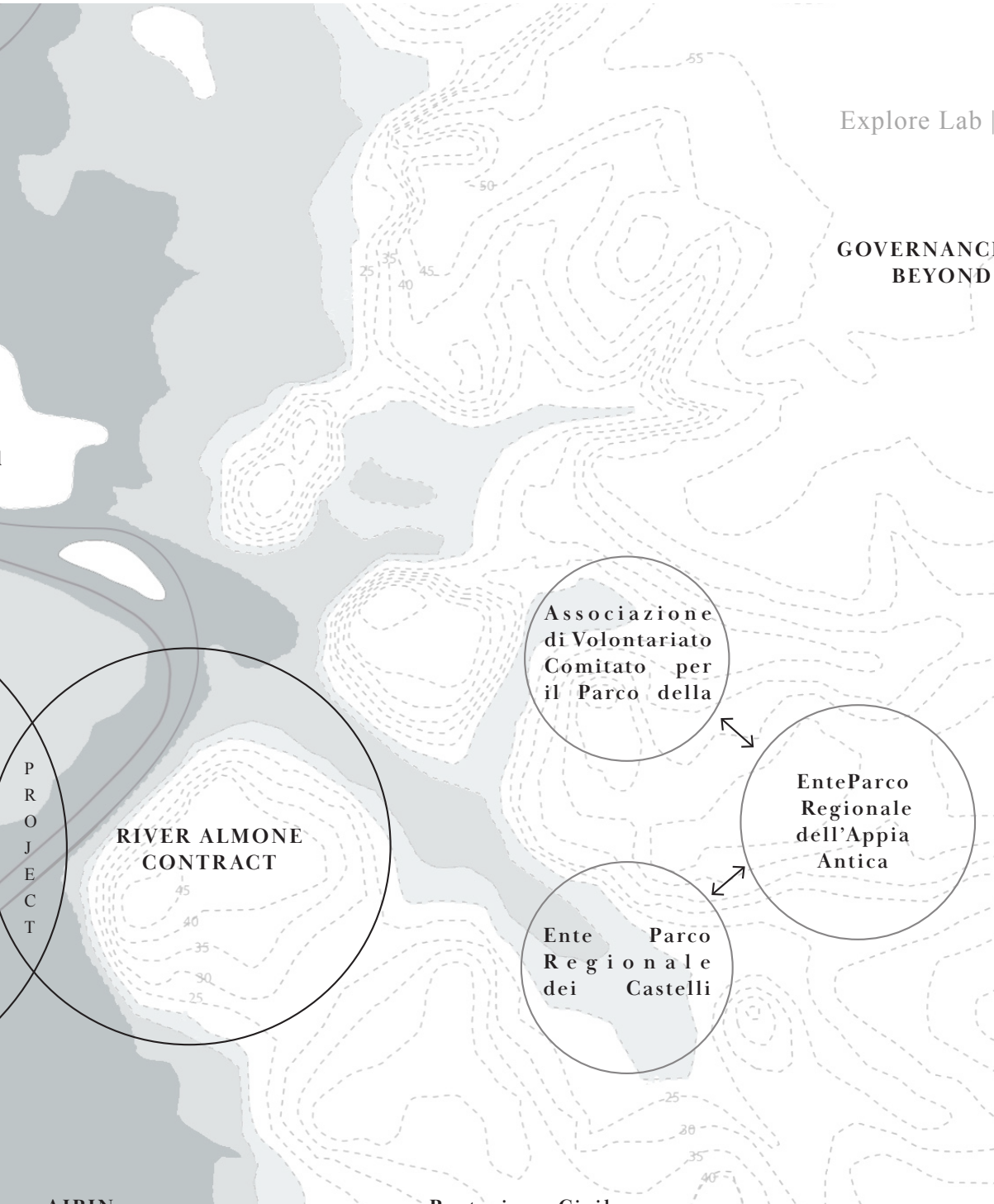
"A watershed is a territory whose boundaries are not political borders, but rather geographic and social, defined by human and non-human communities and ecosystems"

(UNEP, United Nations Environment Programme)

The research has shown that the extensive anthropic action on the watershed has considerably modified the natural course of the river, seriously compromising the river's ecological continuity. Although the research scope did not include an in-depth analysis of the consequences of ecological discontinuity on watershed biodiversity, recent scholarly contributions confirm this has an important impact on species' diversity and distribution. It has been observed that this affects, for instance, the movement of fauna within certain trajectories across the Almone watershed; the extensive urbanised areas, whose historical development has been illustrated within the research, fragment primary ecological corridors that connect upper stream and downstream ecosystems, thus weakening the natural downstream movement of fauna, and re-directing it towards other readily-accessible biodiversity pockets, such as Decima Malafede and Castelporziano. (Pacifici, M., Piccari, F., 2022). This is taken into account by the recent agenda of the Almone River Contract, which has among other objectives, that of re-establishing the lost connectivity across the watershed, by introducing wet areas in the Caffarella Valley and re-connecting the Almone with the River Tiber (Acea ATO2). In order to do this, it is understood that the primary step is that of reducing the solid and diffuse pollution across the Almone, within projects that combine the joint efforts of infrastructure, architecture and landscape and involve a wide stakeholder network (Fig . 45, next page).


Arpa Lazio
Consiglio Nazionale delle Ricerche
DICEA – Università di Roma La Sapienza
DIET– Università di Roma La Sapienza
Architecture
Department Roma Tre University
Science Department Roma Tre University
Istituto Nazionale Urbanistica Lazio
PDTA – Università di Roma La Sapienza
OAR – Ordine degli Architetti di Roma e provincia
Municipality of Roma Capitale
Roma città Metropolitana
Municipio I-VIII
Capitaneria di Porto
Municipality of Fiumicno
Architecture, Landscape and
Archeology Authority
Universities - Research and professional
Public
Private Stakeholders
Voluntary Associations
RIVER TIBER CONTRACT
PROJECT
Assonautica Italiana
Acque interne del Lazio e Tevere
ACEA S.p.A
Circolo Nautico Tecnomar
FIPSAS – Federazione Italiana Pesca Sportiva
Machi Srl
Roma Acquavventura
Touring Club Italiano
Agenda Tevere
Amici LabGov
ActionAid
Archeo Club
Ass. Ambientalista Marevivo
Amuse – Amici Municipio II
Ass. Due ruote d'Italia onlus (ADRI)
Associazione Isola Tiberina
Associazione Italiana Architettura del Paesaggio (AIAPP) Lazio

GOVERNANCE FRAMEWORK BEYOND OSTIENSE



AIPIN
Ass. Officine Fotografiche
Associazione Polisportiva
C. magistrati Corte dei Conti
Ass. Museo del Tevere
Associazione Tevereterno
Ass. Zappata Romana
Cittadinanzattiva Lazio Onlus
Com. la Voce di Porta Portese
Comitato Promotore SAI.FO
Comitato salvaguardia Borgo
Gruppo Soccorritori Sanitari
Protezione Civile
Italia Nostra
Legambiente Lazio Onlus
Retake Roma Onlus
Roma sceglie Roma
Salvaciclisti
Stati Generali dell'Innovazione
Testacciointesta
UISP
Una Finestra Laica sul Territorio

07 / Discussion

Strengths and limitations

One could argue that the research investigated the line of demarcation between water and land throughout time and across different fields of knowledge. One, merely geological, understanding rivers through tectonic movement and sediment deposition. The "natural state of things". The second one, simultaneously topographical and typological, starts to understand the intersectional fields between topography and human activity in the use and enjoyment of water in a mutually supporting system, and finally, the last line of inquiry pertains to the anthropic urban layer and how it determined the canalization and progressive erasure of the river, which has in turn affected natural parameters such as biodiversity and soil quality. This comprehensive and multi-disciplinary method has been effective in providing different yet complementary perspectives on water as a nature-culture. The premise behind this approach is that urban rivers are in fact constructed landscapes and they should be studied as such.

On the other hand, the research was limited by restricted access to the site and available tools. In fact, although a lot of the Caffarella Valley ruins have been restored and welcome public use, some of the water ruins are currently excluded from public access because of their neglected state and resulting safety hazards. More accurate surveys of the studied infrastructure would have been possible, had access been granted.

Further research

In addition to this, as it has already been mentioned, further research could investigate the consequences of the transformations of the river on biodiversity and its distribution across the watershed, as well as on flooding risk and the consequent landslides. In fact, it has been demonstrated that although culverts are in fact created to control and confine water within certain boundaries, they exacerbate the risk of flooding by reducing the flow to the piped sections, thus increasing the problem further downstream. The findings can inform architecture and landscape interventions in riverine settings.

Fig. 46 (Next page), own collag, vision

Reflection

The river as a cultural landscape

No other element in nature intertwines with and is influenced by human flows as much as water does. Its significance is cultural as much as it is biotic and material. Water-dominated landscapes, like riverine territories, are therefore cultural landscapes as well as ecological and in the case of post-industrial sites, material. This underpinning was the premise of the research as well as the design project, with its resulting dissolution of the nature-culture divide.

The object of the research stems from the study of the historic transformations of the Tiber watershed in Rome, which have lead to the progressive erasure of multiple secondary streams along its course, and to the delineation of a rigid water-land divide. In order to narrow down the scope of the research and the design project, I focused on one of these streams: River Almone, whose course would be long forgotten if it weren't for historic maps, the only repository of its presence on the chosen site.

Once sacred to the Romans and culverted throughout the industrialisation of the city, the Almone is the starting point for a reflection on the corruption and restoration of water within the city.

How has Rome been transformed from a ground of wetness to a city that draws, directs and erases its waterlines? Can those lines be intercepted by design to catalyse the discovery and preservation of water within the city?

Given that riverine settlements interweave aspects of architecture, landscape and infrastructure, the research and design demanded a multidisciplinary approach, which was made possible by the nature of Explore Lab studio and the choice of tutors, that enabled me to combine the physical with the intangible essence of water, interweaving aspects of land-form, built-form and personal encounter.

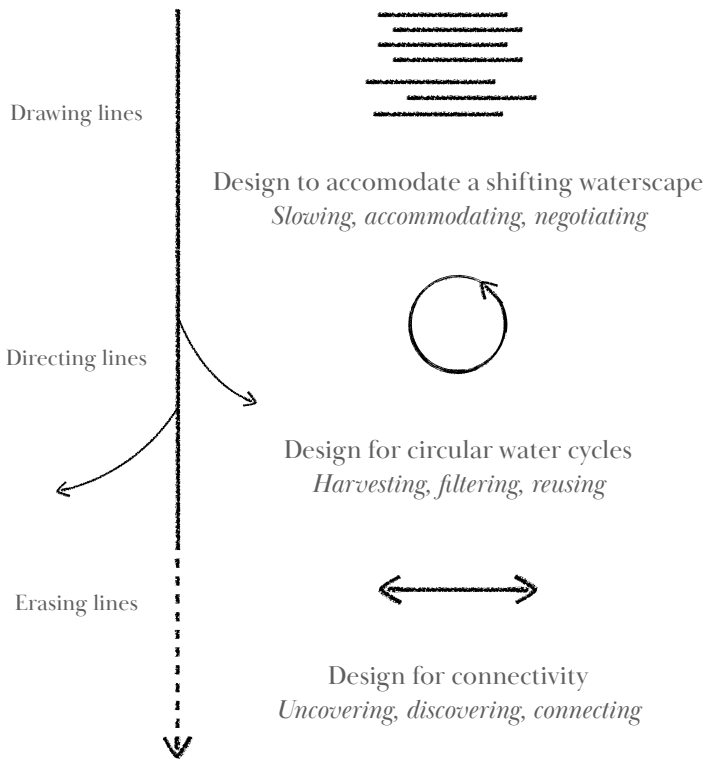
Research and Design: crafting a brief

The research investigated the line of demarcation between water and land across different fields of knowledge. One, merely geological, understanding rivers through tectonic movement and sediment deposition, following the "natural state of things"; the second one, simultaneously topographical and typological, started to unravel the intersectional fields between topography and human activity in the use and enjoyment of water in a mutually supporting system; finally, the last line of inquiry pertained to the anthropic urban layer and how it determined the canalization and progressive erasure of the river, which has in turn affected natural parameters such as biodiversity and soil quality. This comprehensive and multi-disciplinary method has been effective in providing different yet complementary perspectives on water as a nature-culture. The premise behind this approach, reinforced by the outcomes, is that urban rivers are in fact constructed landscapes and their material condition is directly linked to that of built-form and human activity along their course.

To the practice of drawing lines through embankment walls and dikes, the brief responded with the design principle of accommodating the shifting dynamics of the river, thus creating opportunities for water storage on site. This implied a shift from lines to "fields". The latter enabled entire portions of the site to accommodate water in a flooding scenario, as well as providing important niches for local biotopes.

To the practice of directing lines for the commodification of water, the brief anticipated the need to design for circular water cycles, intercepting grey water to filter it and reuse it on site. Constructed wetlands allow the natural percolation through the soil, thus returning filtered freshwater to underground aquifers.

Finally, the acknowledgment of the alterations that land activity and urban growth impose on minor streams and the consequences this has had on biodiversity loss and landslides, suggested the need to design for connectivity on a territorial scale, and the choice of the site embraced this notion, being situated at the interface between two streams.


Drawing lines
Design to accomodate a shifting waterscape
Slowing, accommodating, negotiating
Directing lines
Design for circular water cycles
Harvesting, filtering, reusing
Erasing lines
Design for connectivity
Uncovering, discovering, connecting

Choosing the site: crossing lines, architecture as interface

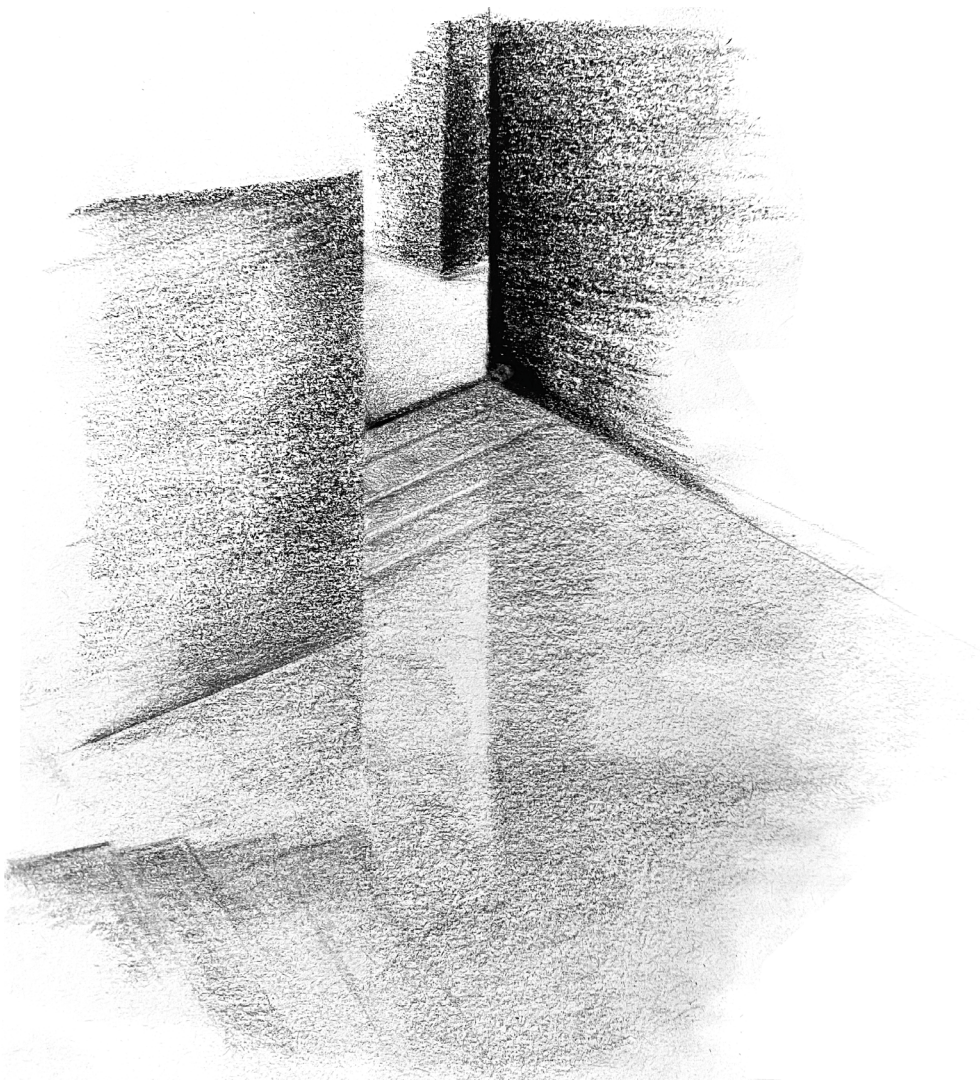
The site choice was a natural consequence of the research outcomes and design intentions: mapped in the scope of the research as a former crossing point between the Tiber and the Almone, the Gasholder park in the Ostiense neighbourhood offers the ideal ground conditions for the design project. A place frozen in time, whose proximity to water has shaped its built-form and programme throughout centuries of development in Rome. From a rural land at the edge of the historic fabric, outside the Aurelian walls, to an industrial site, central to the productive activity of the city, until its complete disuse in the present day. The current location of the site near the river Almone undeground culvert allows its interception, filtration, and encounter in the proposed intervention, before it is returned back to the Tiber.

In addition to its strategic location in relation to the former intersection of the two streams, and the historical relevance related to the sacred Roman ritual of purification through water on the site, this offers ideal physical ground conditions next to the intangible ones. In fact, it bares within its existing land-form and built-form the spatial qualities of the project: a horizontal void, the settling tank, and its 90 meters vertical counterpoint, the Gasholder, have provided the ideal condition for gravity to guide the flow of water through the site.

Tectonics: land-form and built-form

Rather than an addition on a "tabula rasa", the project was conceptualised and developed through the notion of sculpting land and infilling: soil is extracted from strategic locations, and its subtraction enables two simultaneous actions. On the one hand, the leftover space in the form of lower-level ponds or "backwater" act as additional water storage potential in case of flooding on site; on the other hand the extracted material is compacted on site to create the building blocks of the new programme.
The "leftover" land-form becomes as meaningful as the newly added built-form and the two play a complementary role in holding and revealing the presence of water on site.

Fig. 47 (Next page), own sketch, precedent study "Zumthor, P., Therme Vals"



Ethical dilemmas and professional relevance: the role of design in the terrain of water

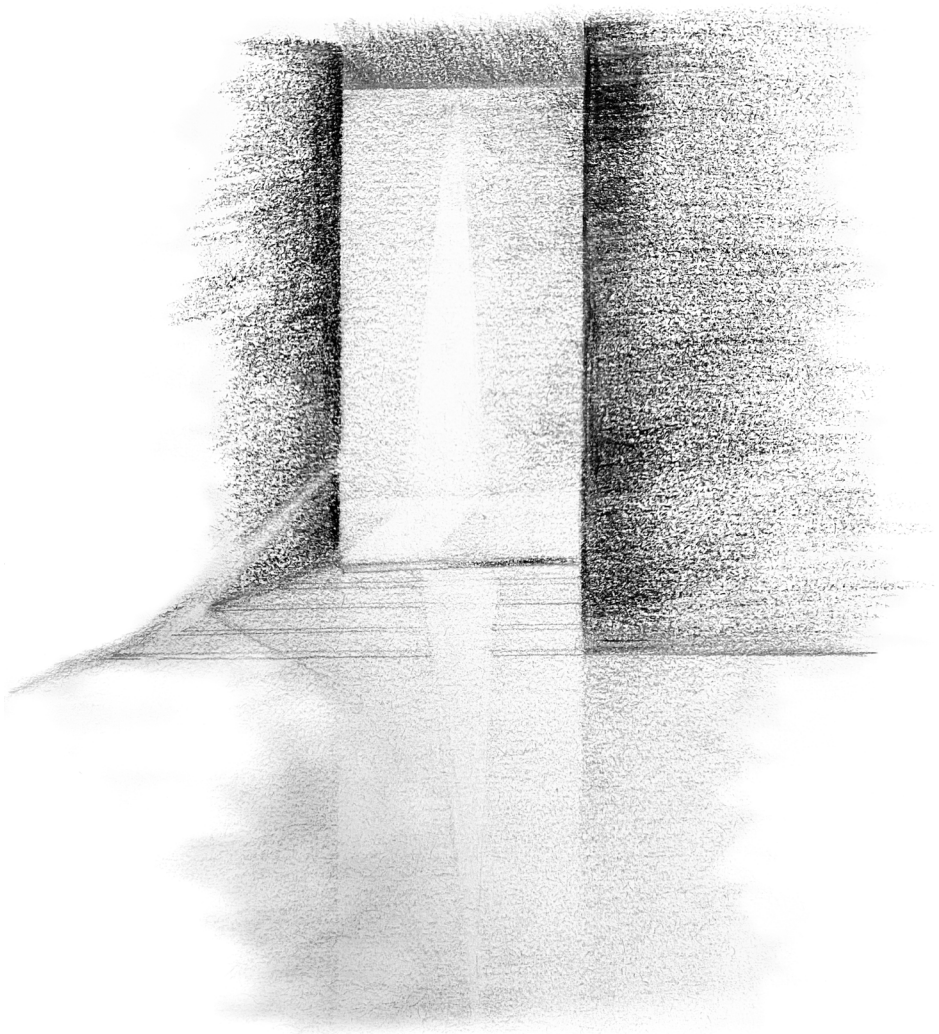
Research and design have informed one another through a fundamental shift: from a nostalgic and idealized view of "pure nature" (Bakshi, A., 2020), untouched and uncorrupted, which needs to be restored by design, to the notion of "Fourth Nature", the latter defined by recent landscape architecture scholarship as the simultaneous and often fruitful coexistence of native and newly introduced biotopes and ecological processes, as a result of anthropic activity (Bakshi, 2020).

River Almone can't - and perhaps should not - be restored to its Ancient Roman flow down the Tiber, but its legacy can be made apparent through symbolic and operative ecological interventions that accept and work with change rather than against it, combining ecological ambitions with cultural and material enhancement. Blindly restoring a prior condition would in fact be more energy consuming and detrimental for the social communities that have settled over its culvert throughout the last century. Design with Fourth Nature means accepting the impossibility of pure restoration in favour of open-ended solutions, that acknowledge the dynamic and unpredictable flow of nature-cultures.

Tiber Waterscapes is a wonder through the life-sustaining and fragile existence of urban watercourses such as the Tiber and the Almone River, with their inevitable palimpsest of anthropic layers and constantly evolving hybrid ecologies.

I hope this project will contribute to a more critical understanding of the role of water within the city and the potential of architecture in tracing, intercepting and culturing places for water encounter. Rather than representing a definite answer, Tiber Waterscapes intends to be a magnifying lens over an increasingly challenging question: that of designing in the terrain of water.

Fig. 48 (Next page), own sketch, precedent study "Zumthor, P., Therme Vals"



09 | SELECTED BIBLIOGRAPHY

Urban Rivers

Mathur, A., Cunha, D., Meeks, R. and Wiener, M., 2014. *Design in the terrain of water.* [S.l.]: Applied research + design Publishing.

Cunha, D., 2018. *The invention of rivers.*

Castonguay, S. and Evenden, M., 2012. *Urban rivers.* University of Pittsburgh Press. https://doi.org/10.2307/j.ctv10tq43d

Knoll, M., Lübken, U. and Schott, D., 2017. *Rivers lost, rivers regained.* University of Pittsburgh Press.

Talling, P., 2011. *London's Lost Rivers.* Penguin Random House.

Urban Waste

Gandy, M., 2004. Rethinking urban metabolism: water, space and the modern city. City, 8(3), pp.363-379.

Lofrano, G., & Brown, J. (2010). Wastewater management through the ages: A history of mankind. *Science of The Total Environment, 408(22)*, 5254–5264. doi: 10.1016/j.scitotenv.2010.07.062

Riverine Architecture

Adler, G. and Guerci, M., 2019. *Riverine Architecture.* 1st ed. London: Routledge.
Prominski, M., 2012. *River.space.design.* 1st ed.

River Tiber and tributaries

Comitato per il Parco della Caffarella e Associazione Culturale Humus_onlus, "Il Sacro Almone da fiume a discarica. Mito, storia, scienza e impegno civile per ridare vita al fiume del parco dell'Appia Antica", 2013

De Cristofaro, A. (2002). Bullettino della commissione archeologica comunale di Roma. Antiquity, 12(46), 233-237. doi: 10.1017/s0003598x00013788

Gowers, Emily. (1995). *The Anatomy of Rome from Capitol to Cloaca.* The Journal of Roman Studies, Vol. 85.

Hopkins, J. (2007) *The waters of Rome: number 4, March 2007.* The Cloaca Maxima and the monumental manipulation of water in Archaic Rome.

Saggio, A. and De Francesco, G., 2017. *Tevere cavo.*

Ecology

Gan, E. and Tsing, A., 2018. How Things Hold. *Social Analysis*, 62(4), pp.102-145.

Reed, C. and Lister, N., 2014. *Projective ecologies.* ACTAR, Harvard Graduate School of Design; Har/Chrt edition.

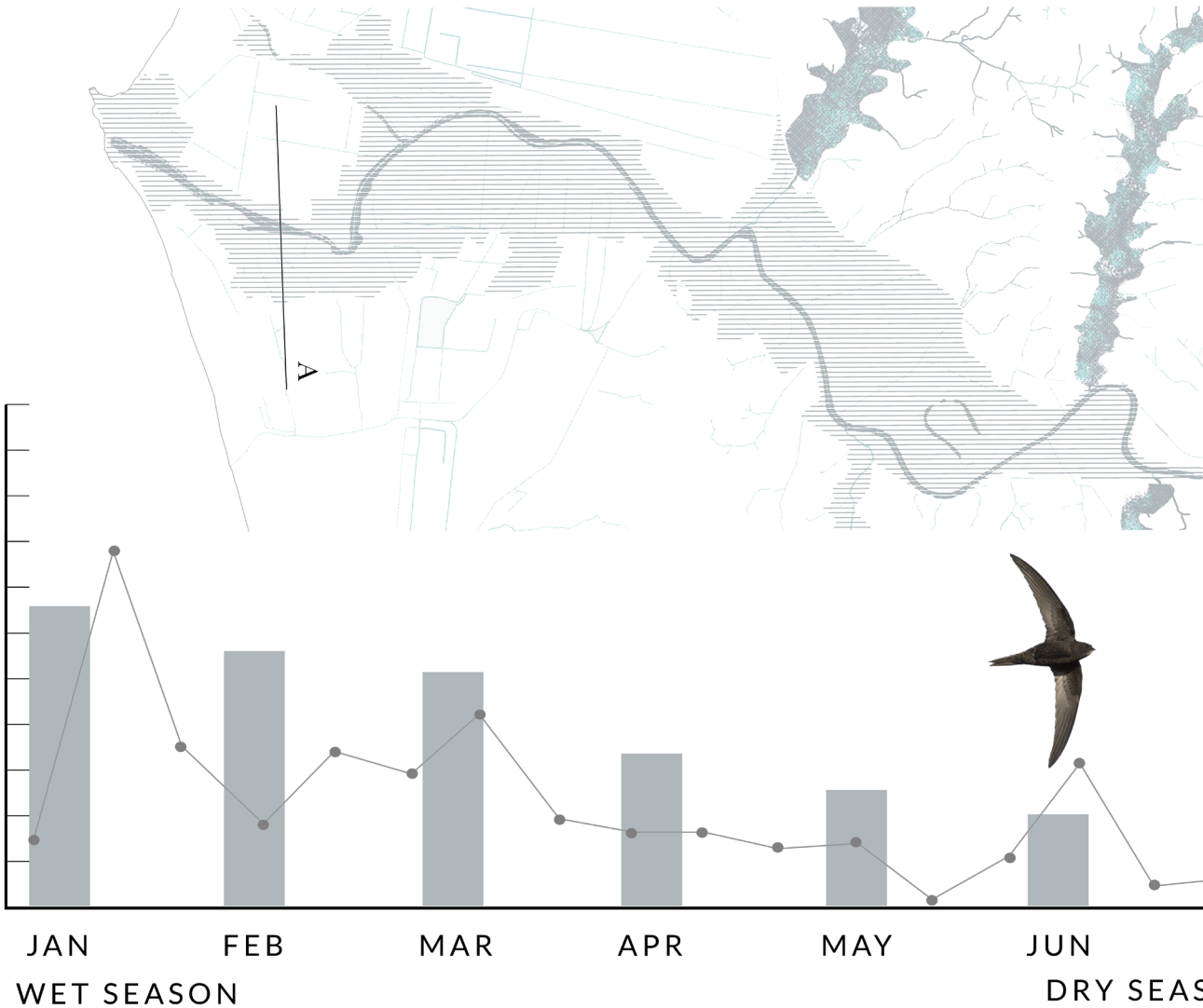
Fourth nature

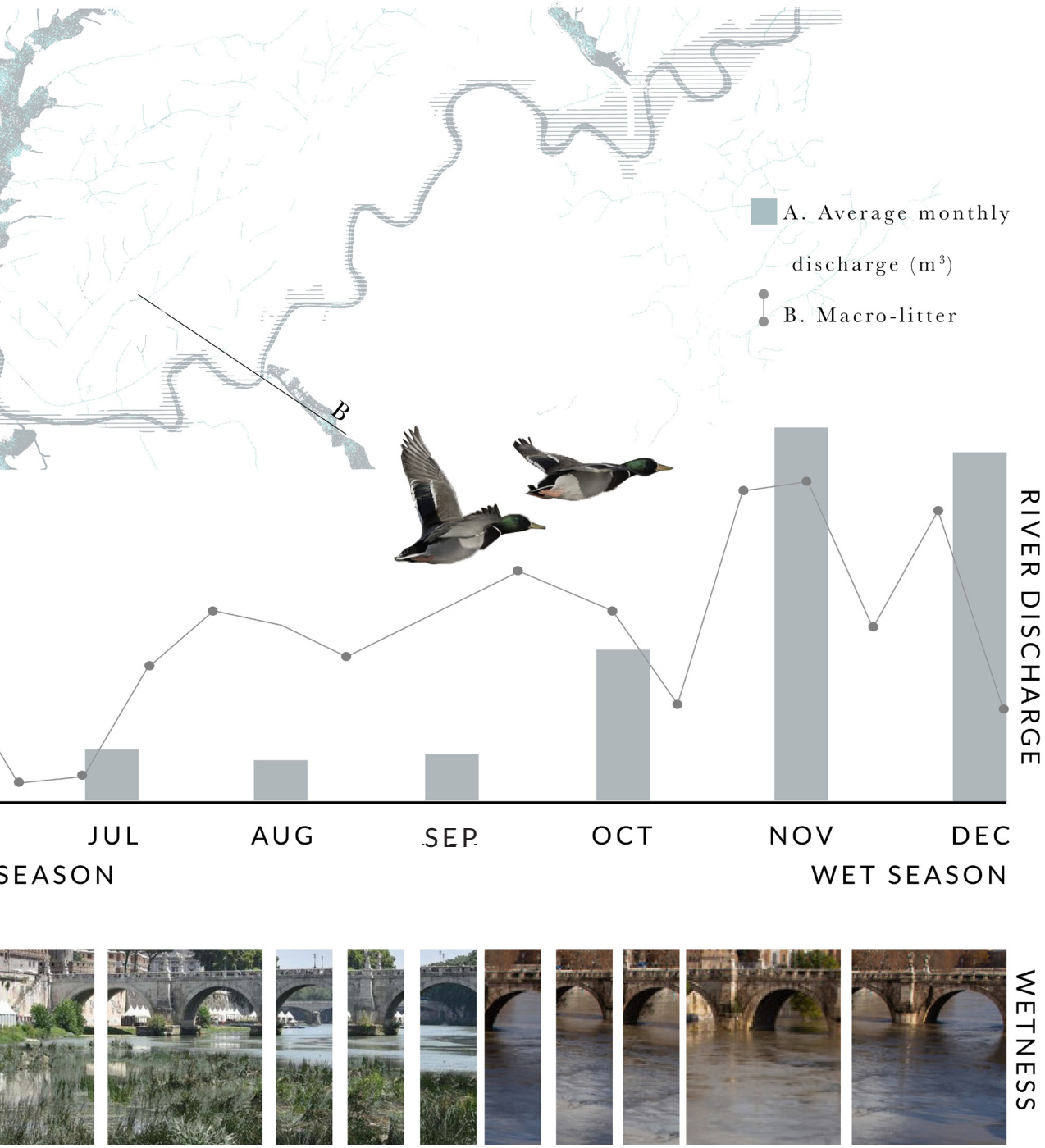
Bakshi, A., 2020. "Design with Fourth Nature", *Journal of Landscape Architecture*

10 | LIST OF FIGURES

APPENDIX I

Phenology: unveiling time and wetness




A. Average monthly
discharge (m³)
B. Macro-litter
B
RIVER DISCHARGE
JUL
AUG
SEP
OCT
NOV
DEC
SEASON
WET SEASON

WETNESS

APPENDIX II

Atlas of historic maps

Fig. 50 Wagner and Debes map of Rome, 1909. Source: antiqueprintsandmpas_nl

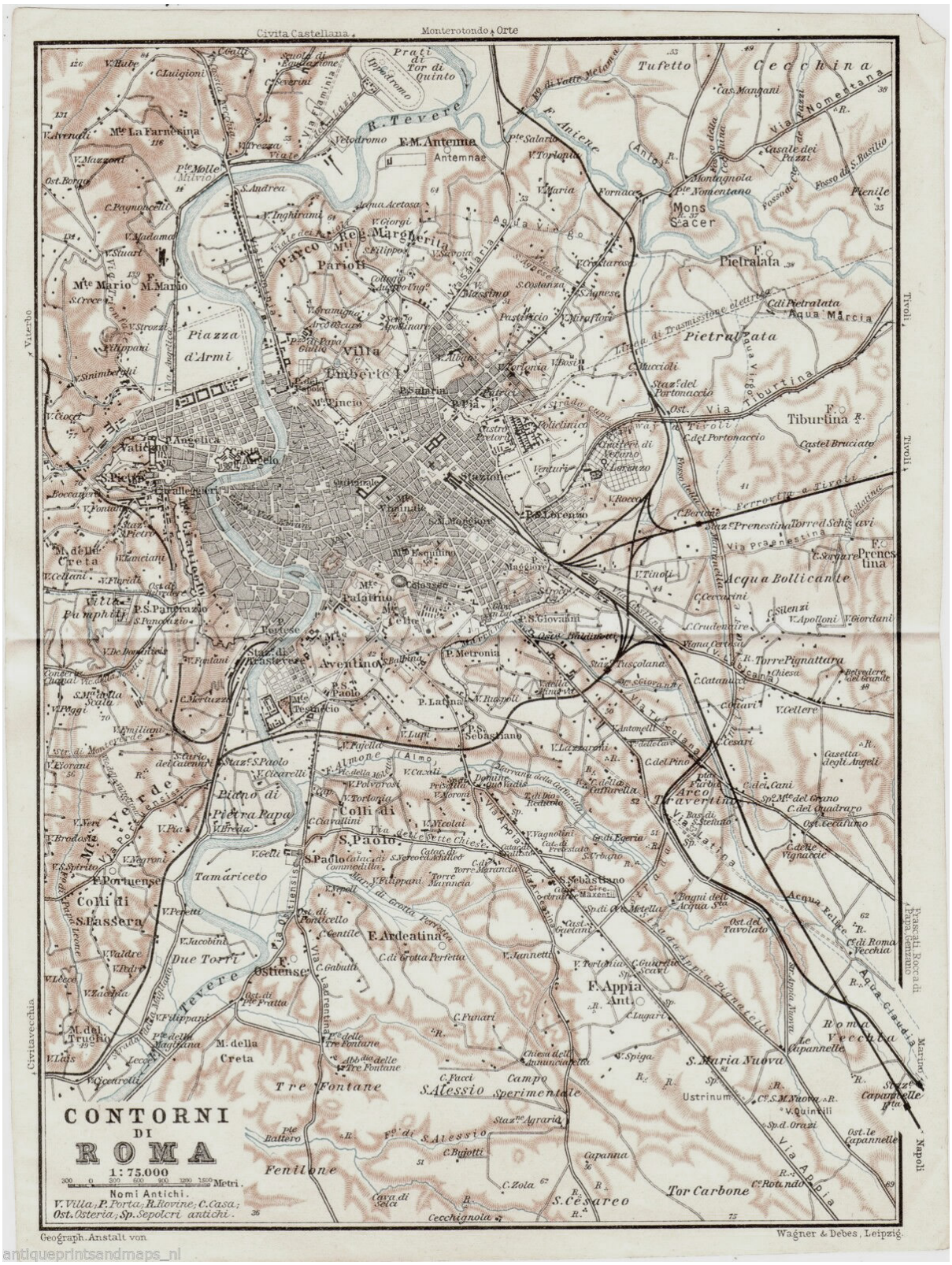
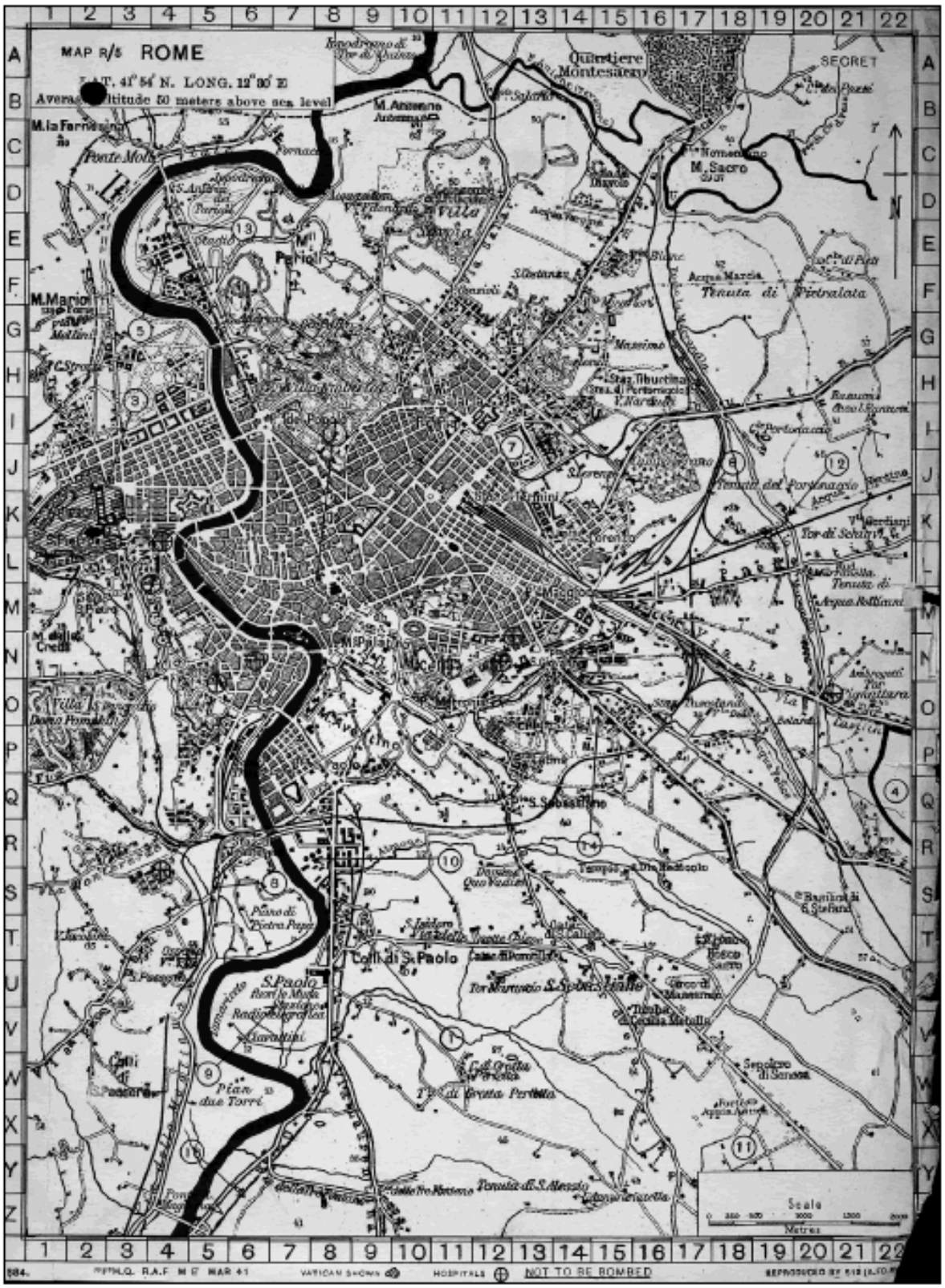

CONTORNI
DI
ROMA
1:75.000
Nomi Antichi.
V. Villa; P. Porta; R. Rovine; C. Casa;
Ost. Osteria; Sp. Sepolcri antichi.
Geograph. Anstalt von
Wagner & Debes, Leipzig
antiqueprintsandmaps_nl

Fig. 51 Map of Rome 1925, Ufficio cartografico Del T.C.I. Source: stagniweb.it


DINTORNI DI ROMA
Scala di 1:65 000
0 250 500 1000 1500 2000
Metri
Mad di Bracciano
Civita Castellana
Passo Corese
Tor di Quinto
Ippodromo di Tor di Quinto
Quartiere Montesacro
M. Antenne
M. la Farnesina
Ponte Molle
M. Sacro
Villa Savoia
M. Parioli
M. Mario
Acqua Marcia
Tenuta di Pietralata
Staz. Tiburtina
Staz. di Termini
Vaticano
S. Pietro
M. Palatino
M. Celio
S. Giovanni
Tor di Schiavi
Tenuta di Acqua Bollicante
M. della Creta
Villa Doria Pamphili
M. Aventino
S. Paolo
Staz. di Trastevere
Colli di S. Paolo
Catac. di Domitilla
Catac. di S. Calisto
Catac. Ebraiche
Grotta di Egeria
Bosco Sacro
Circo di Massenzio
Tomba di Cecilia Metella
S. Sebastiano
Colli di S. Passera
Pian due Torri
Forte Ostiense
Tenuta di S. Alessio
Abbazia delle Tre Fontane
Fiumicino
Ostia
Ardea
UFF. CARTOGR. DEL T. C. I. – Capo Cartografo: P. CORBELLINI
OFF. G. RICORDI & C. - MILANO

Fig. 52 Map of Rome 1944, showing the points of interest within the city to be protected during Second World War. Interestingly, the chosen site is indicated as "not to be bombed" for its importance as a productive industrial site source: https://geoportale.cittametropolitanaroma.it


MAP R/S ROME
LAT. 41° 54' N. LONG. 12° 30' E
Average altitude 50 meters above sea level
Quartiere Monte Sacro
SECRET
M. Sacro
Villa Ada
Villa Torlonia
M. Antenne
M. Mario
Ponte Molle
Tenuta di Pietralata
Tenuta del Portonaccio
Tor di Schiavi
Colli di S. Paolo
S. Paolo fuori le Mura
Piano di Pietra Papa
Piano due Torri
Scala
Metres
NOT TO BE BOMBED

APPENDIX III

Site pictures: April 2022


ALL ROADS