Roman Travertine is the stone of the empire, it has characterised the city of Rome, and unexpectedly conditioned the Tiburtine hinterlands. This thesis reveals the hidden scars and enduring legacies of material extraction on landscapes, centering on the ancient yet persistently exploited Roman travertine quarries near Rome. Unfolding the tension between rugged extraction sites and polished urban spaces, the study critiques architecture's reliance on a "Western Paradox" where development and destruction coexist. It places the landscape discinpline right in the middle, an accomplice and an active actor in the consequences of material consumption, attempting to answer the question: How can the landscape discipline represent the **ecological and social conflicts caused by resource extraction, and what impact does extraction have on how landscapes are understood?**

Through political ecology and interdisciplinary analysis, it unearths the rich ecological, historical, and political narratives surrounding travertine, attempting to reveal its consequences through a mapping project. In three sections, the research first establishes the theoritical framework, addresses Necropolitics of Extraction, exposing architecture's detachment from the material realities of production and spotlighting the social and environmental costs of material consumption. The second section, Lapis Tiburtinus, turns to travertine itself, tracing its symbolic and structural roles across millennia, from shaping Rome's grandeur to a globalized commodity that transformed its landscapes. The final section, Mapping Travertine Extraction, uses dynamic cartographies of water, waste, and labour to bring the invisible forces of extraction into stark relief, illustrating both local devastations and global dependencies.

SARA RADI AHMED

MAPPING the VOID

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LANDSCAPES OF ROMAN TRAVERTINE EXTRACTION

PhD thesis in Landscape and Environment **XXXVII cycle**

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The cover is a conceptual map of the site of the case study elaborated by the author

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PREMIS

This research stems from my personal interest in studying historical industrial quarries, following my Masters in Architecture Landscape and Archaeology, asking the question, where do the travertine blocks that dress the monuments of Rome come from? The question referred to specifically ancient Roman travertine quarries between Rome and Tivoli, known as Cava del Barco. The traces and archaeological remains of the ancient quarries, documented in bibliography[1], no longer exist due to the continuation of today's extraction activity. Today, the travertine quarries of the Acque Albule cover an area of around 400 hectares, the area equivalent to 490 football fields. The direction of research pivoted focusing on how extracting travertine in this context is not only a source of profit but also a source of crisis, as it reaches the limits of natural resources, socio-economic depletion and destruction of archaeological heritage[2]. This is where it became impossible to ignore the ways in which the mining industry has shaped the ecological and social transformations of the regions where it operated, by creating new landscapes, territories, and labor regimes.

This topic is significant to landscape disciplines, as complicit in the making of extraction economy with its reliance on the use of natural materials, but yet the practice so far seems to be externalized and distanced from its consequences. Extraction infrastructures are indeed often "invisible" to most, located outside major urban centres. The paradigm of invisibility permeates the world of waste and discards; the extraction system needs to be invisible to most in order to function, yet its consequences are far from invisible to many.

This discourse can be applied to the extraction realities of materials used to build new buildings, structures, and roads, further popularing this already heavily constructed world. Where does that material come from, what journey has it taken, on whose shoulders—metaphorically and literally—has it traveled?

This thesis therefore aims to explore the profound landscape, social, urban, and environmental implications of travertine extraction in the Tiburtina landscape whose effects result in severe landscape transformations, exposing this fragile territory to several irreversible social and environmental risks. This situation is exasperated by the increasing cost of extraction and its dependency on the fluctuating global market of today, leading to the social and economic precariousness of an industry that is in decline.

1 Rodolfo Lanciani extensively mapped forms of the ancient quarries of the Barco, now traces of where the quarries would have been are completely erased by the on going extraction activities(LANCIANI, 2018; Mari, 2002)

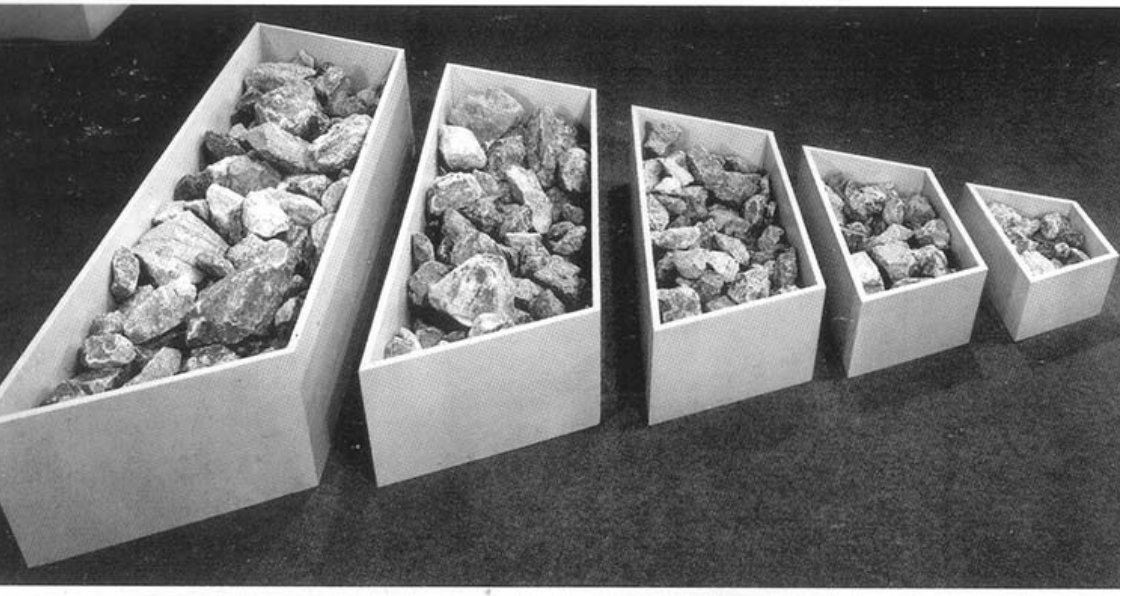
2 Svampa, Maristella. Neo-Extractivism in Latin America: Socio-Environmental Conflicts, the Territorial Turn, and New Political Narratives. 1st ed. Cambridge University Press, 2019. https://doi.org/10.1017/9781108752589.

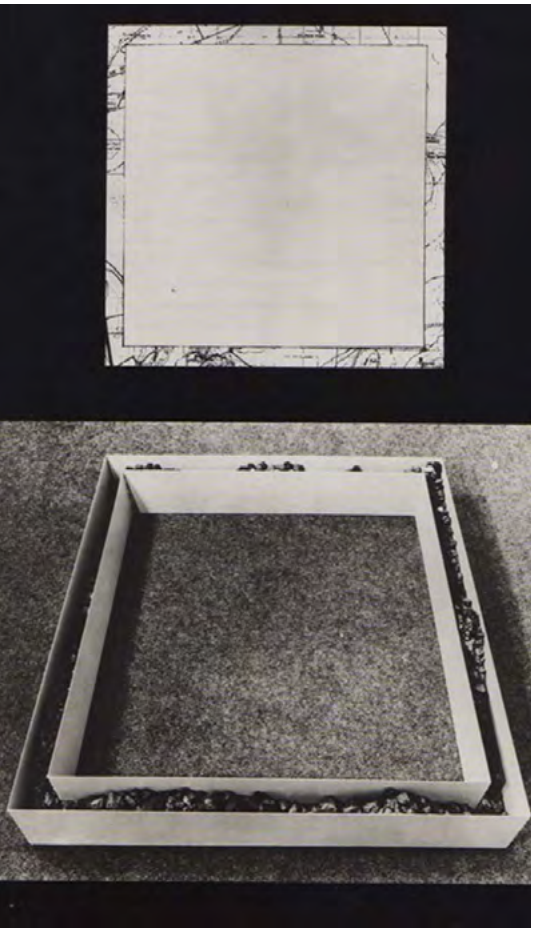
INTRODUCTION

RESEARCH QUESTIONS

METHODOLOGIES

OBJECTIVES





Materials travel, but their sources are unknown, and the traces they leave behind are unimaginable

Robert Smithson, the American artist, conceptualized material extraction processes in his some of his artistic projects, shedding light on faraway landscapes from which material comes from. Extraction landscapes were the main subject in his non-sites art series as he portrayed materials traveling, where he collected schist pieces from different quarries in New Jersey, which he called the sites, and then he placed them in metallic containers in museums, given the name non-sites. These pieces were more than fixed objects; they referred to the sites that they came from, and to their histories of geological and human transformation. The sites and non-sites were linked by material displacement from one to the other, but also through their differences. Sites were peripheral, overlooked spaces that supplied materials for urban development, while non-sites were central concentrations of cultural capital. Sites were real and physical, non-sites were abstract. Sites were the signified, non-sites the signifier. For him, “The nonsite exists as a kind of deep three-dimensional abstract map that points to a specific site on the surface of the earth. And that’s designated by a kind of mapping procedure... these places are not destinations; they kind of are backwaters or fringe areas”[1]. The sites and non-sites are "two separate landscapes – the material’s source and the urban site where the material ended up – together, this dichotomy explores themes of unequal ecological exchange, labor, and material

FIGURE 01

Robert Smithson: Monolake Non-Site 1968

Robert Smithson: A Nonsite, Franklin, New Jersey, 1968

Robert Smithson: Oberhausen (Ruhr, Germany) Non-Site 1968

1 Robert Smithson, ‘A Tour of the Monuments of Passaic, New Jersey’, 1967.

flows[2]".

The dichotomy and detachment between the sites and non-sites explored by Smithson are still far from the landscape and architecture design process. Architecture has long been focused on creating eternal monuments[3], but it often overlooks the lasting voids left behind by temporary production methods, especially through extraction. The mining industry has turned excavation into a short-term production process, leading to a significant increase in the number of mines worldwide, however with permanent impacts on the landscape. This research asks the question, if we'd imagine a hole in the territory for each structure we erect, how would that shift the way we perceive our extraction based discipline? Once the temporary mode of production is discontinued, what happens to the permanent traces of material production in the earth? Also, how does territorial representation, beyond a sort of nostalgia of their past forms, define new futures in the case the present condition persists?

Architecture and construction have an existential relationship with extraction, we are in an endless debt to the geographies of extraction. The thesis places its core attention to the conflictual and deeply disturbing relationship the landscape practice has with resource extraction. On one hand, it is one that has always been externalized to the processes of landscape production, over-aestheticization of the urban landscapes, has resulted in the systematic

2 Hutton, J. Reciprocal Landscapes - Stories of Material Movements. Routledge, 2020.

3 Antoine Picon, "Architecture Was Arrogant towards Nature — This Must Change to Humility. Smart Cities Can Be Green", The Times of India, 12 September 2020, https://timesofindia.indiatimes.com/architecture-was-arrogant-towards-nature-this-must-change-to-humility-smart-cities-can-be-green/articleshow/78064994.cms.

de-aestheticization of the (productive/extractive) landscape itself[4].

Naomi Klein's coined the term *extractivism*[5], referring to Francis Bacon as the "patron saint" of this concept of the planet as machinery at our disposal as an object and as a resource. The Belgian philosopher Lieven De Cauter[6] made the same connections as he quotes Bacon's extractive depiction of nature: "For you have to follow and as It were hound nature in her wandering and you will be able, when you like, to lead and drive her afterwards to the same place again. ... Neither ought a man to make scruple of entering or penetrating these holes and corners, when the inquisition of truth is his sole object?"

"No modernity without mining and oil drilling[7]" Extraction is a story of modernity, and development, of the way we have constructed our contemporary built cities and places. Gavin Bridge wrote about the wormholes of alternative worlds created by energy extraction and production, and our current consisted relationship with them. He quotes the sociologist Lewis Mumford's description of the human transformations of the planet: "mine, blast, dump, crush, extract, exhaust;" as the "syntax of modernity." Bridge has then expanded Mumford's analysis by thinking about the ways in which the logics and spaces of extraction inform urbanization: technologies of surveying, lifting, and construction pioneered in mining become imported into the city; the rationalities of ecological simplification and radical abstraction

4 Alessandra Capuano et al., eds., The Landscape as Union between Art and Science: The Legacy of Alexander von Humboldt and Ernst Haeckel = Il Paesaggio Come Unione Tra Arte e Scienza: L'eredità Di Alexander von Humboldt e Ernst Haeckel, Auflage (Marcerata: Quodlibet, 2023).

5 Klein. This Changes Everything

6 Lieven de Cauter, Ending the Anthropocene: Essays on Activism in the Age of Collapse, Reflect, #12 (Rotterdam: Nai010 Publishers, 2021).

7 Naomi Klein, This Changes Everything.

that underpin geological science become a hallmark of urban design; and the dominance of "artificial means" epitomized by the mine come to characterize the experience of urban life.

The landscape discipline's reliance on extraction is full of contradictions, as it occurs in the realm of important ecological and ecopolitical urgency. This is perfectly portrayed at the heart of what Donald Worster calls the "Western Paradox"[8] that explores the contradictions and tensions inherent in the development of the American West, one that is mythically characterized by notions of rebelliousness from capitalist model, frontier spirit, freedom, and opportunity, contrasts with the harsh realities of economic exploitation, social inequality, ecological damage, and heavy reliance on resource extraction.

This paradox is elaborated by Patricia Nelson Limerick in The Altered Landscape: "A tree falls, and nature has been improved, developed, settled, made profitable, put to good use, tailored to fit with human needs. A tree falls, and nature has been degraded, reduced, devastated, damaged, raped, castrated."[9] When resource production occurs, the landscape practice, bearing the role of landscape stewardship, struggles to figure out what to do with leftover landscapes; they are treated to prevent any further damage to culture or the environment itself. This contradiction, is presented as the core of this thesis research, revealing how the issue of extraction is extremely complex to confront, and requires multi-layered form of investigation.

This thesis will start from the problematic and

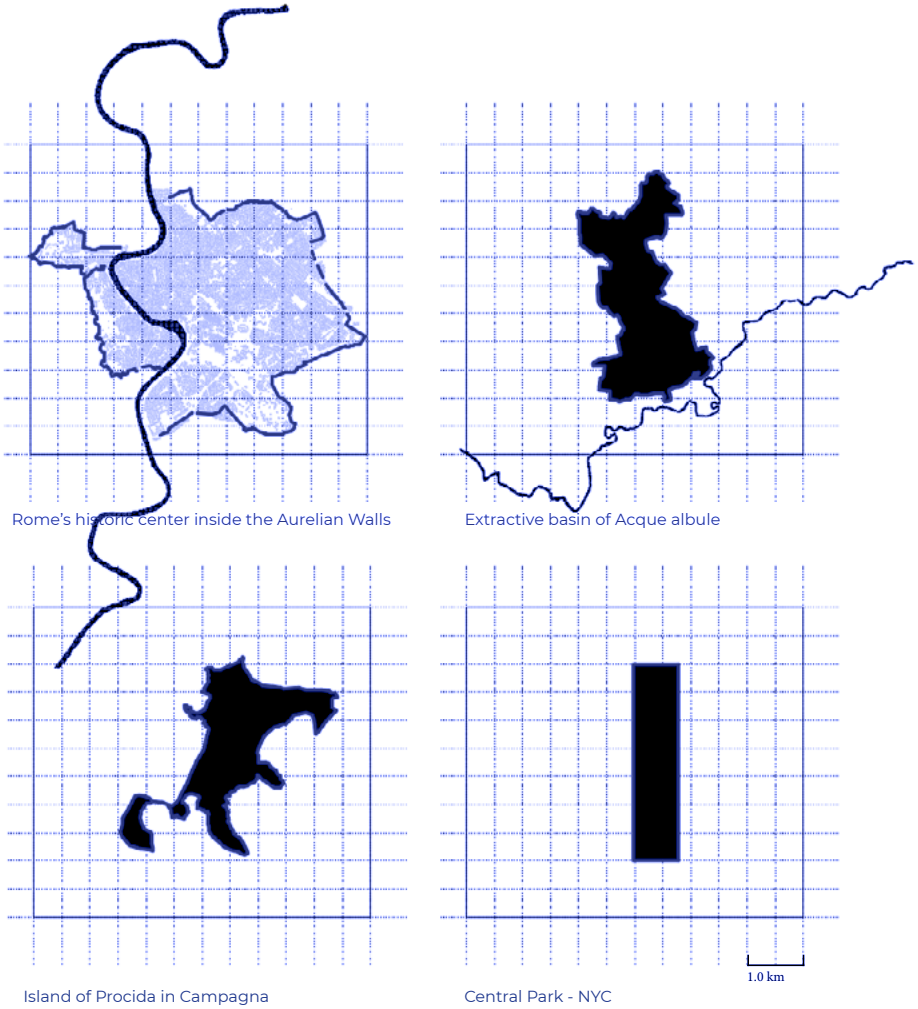


FIGURE 02

The scale of the extraction basin of the Acque Albule, that spans for 400 hectares, and in comparison with the surface areas of comparable other sites, like the center of rome and the Island of Procida (that has a surface area of 400 hectares)

8 Donald Worster, Under Western Skies: Nature and History in the American West (New York ; Oxford: Oxford University Press, 1992).

9 Peter E. Pool, Patricia Nelson Limerick, and Nevada Museum of Art, eds., The Altered Landscape (Reno: University of Nevada Press [u.a.], 1999). p. 11

complex relationship between the landscape and architectural practice with material extraction. It will critically examine, deconstruct, and demonstrate the complex, often invisible systems of extraction, with a focus on a specific case study related to the architecture and landscapes of Rome. The material of interest is Roman travertine, a natural sedimentary limestone that has been extracted from the regions between Rome and Tivoli for over 2,000 years. The extraction landscape under investigation spans 400 hectares, as shown in figure 02, larger than New York's Central Park, and lies just 20 kilometres from Rome. Today, travertine is a widely exported commodity that not only shaped the historical landscapes of Rome but also continues to clad influential contemporary architecture. While it's difficult to visualize the logistics networks tied to the global movement of stone—networks much larger than the quarries themselves—the ongoing extraction of Roman travertine is controlled by a fragmented, privatized market driven by global export demands, with consequences far exceeding the local context of the quarry.

Objectives and Research Questions

The myriad of complications related to extraction requires a multifaceted approach, one that might be exemplified by Bruno Latour's essay "Why has critique run out of steam" about "matters of fact" as straightforward, factual solutions to problems, like when our systems try to avoid and hide extraction sites because they see them as unpleasant. Latour contrasts this with "matters of concern," which look at the bigger picture. Instead of just managing or hiding problems, matters of concern involve considering everything around the issue, like in a theatre where you don't just focus on the stage, but also the entire setup behind it. This broader view can shake up how we understand and deal with the issue[10].

The objective of this research is not related to the presenting natures to be protected against extraction practices, it is to present the landscape as a field of conflicts. Extraction often dominates, coercing other actors, including non-human ones, and dominating

10 Bruno Latour, 'Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern', Critical Inquiry 30, no. 2 (January 2004): 225–48, https://doi.org/10.1086/421123.

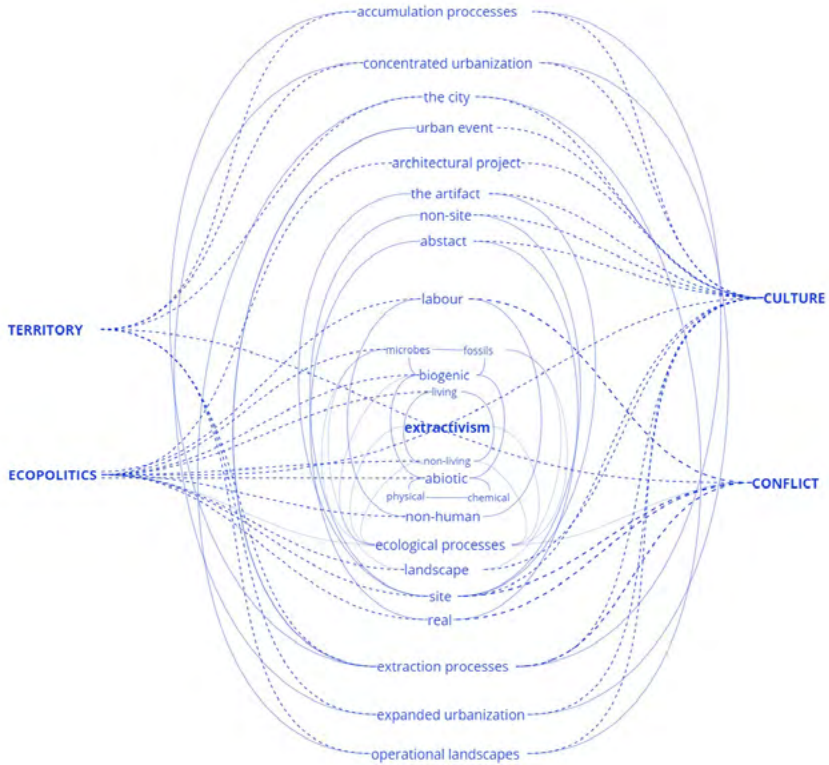


FIGURE 03

The entangled relationships between architecture and extraction, the dynamics from which it generates and it results in. The diagram summarises the key concepts delved into this chapter and the research in a general sense.

a narrative of territorial transformation beyond its market boundaries of exploitation under the ruling of *extractivism*. The thesis places emphasis on how architecture and landscape practices are involved in these conflicts, and are an active part in the extractive aspect. The diagram in figure 03 centers *extractivism* as a key generator of the conflicts and consequences that are entangled between cultural, territorial and ecological actors, and that results in different scales.

The central aim of this thesis is to explore the multifaceted representation of extraction processes, focusing on landscapes, territories, cartographies, and inserting of ecopolitical investigation to include the Non-human actors. Through this, it seeks to examine the historical, geopolitical, and ecological dimensions of travertine extraction, addressing questions that collectively provide a deeper understanding of its impact across different scales and contexts. The research questions that arise from laying out this problematic are therefore the following:

How do the consequential extraction landscapes of Roman Travertine look like?

Travertine, extracted since Roman times, has shaped Rome's architecture and achieved global acclaim. The unique geological properties of the Tiburtine plain have profoundly influenced its landscape. The metaphor "Necropolitics" of extraction is employed to convey this dichotomy between landscapes that are alive, and others that are deemed dead, or dying, as a result of the extreme transformation extraction processes carry out. While quarrying leaves lasting scars, travertine's landscape and geological formation fosters unexpected ecological traits, revealing incredible biodiversity. With this

in mind, the thesis starts with exploring a paradigm shift, the extent of viewing the material as vibrant and regenerative to create a new approach to viewing resources in the landscape discipline.

However, the complicated travertine extraction processes and their consequences, that can not be simplified. They are discussed in order from theoretical frame work and epistemological stand, one that requires an understanding of the extraction havoc and its landscape consequences, to the deeper understanding of the agency the material itself has in the architectural, and urban event, that has consequences on the territory. For which the sub-questions explored in every chapter would be:

- How can the landscape discipline represent the ecological and social conflicts caused by resource extraction, and what impact does extraction have on how landscapes are understood?
- How has the symbolic, characteristics and political significance of Roman travertine influenced its extraction, and what role does it play in the global stone market?
- What kinds of landscapes emerge from travertine extraction, and how can they be effectively mapped and represented?
- How can the landscape discipline foster alternative, ecologically driven narratives that integrate natural processes and resist exploitative territorial practices?

Methodology and Data Elaboration

This research investigates the extraction basin of the Acque Albule, specifically examining the unique characteristics of Roman travertine and the condi-

tions under which it is extracted. The methodology adopts an interdisciplinary approach, blending landscape studies with political ecology and topographical geological analysis. Landscape studies provide both natural and cultural interpretations, offering a lens through which the physical and historical aspects of the landscape are analyzed. The analysis takes place tracing the extraction of travertine throughout historical documents and cartography, selecting few maps that highlight main events that archive the landscape's transformation with respect to mining. The maps include the main projects of depicting the territory in historical moments by Eufrosino della Volpaia's *Il Paese di Roma e tutti i luoghi particolari d'intorno Roma per XX miglia* . (1547), Athanasius Kircher's L*atium. Id est, Nova & Parallela Latii tum veteris tum novi Descriptio* (1670), Diego De Revillas' Diocesis et Agri tiburtini Topographia (1739), Cabral e del Re (1778), Luigi Canina's and Rudoflo Lanciani's reconsturctions of the *Via Tiburtina* (1856 & 1885), and aerial footage from the military institute, *IGM* (1908, 1944 and 1954).

To further enrich the study, the research draws on the methods and frameworks of political ecology, focusing on how human and environmental interactions shape the extraction process, particularly through the lens of environmental humanities. The approach also highlights the environmental and ecological significance of the travertine landscape elaborated through botanical studies of the travertine's capacity to home and generate biodiversity. Through the elaboration of diagrams that include the tiny actors in this landscape, in addition to studies of biological and chemical composition of the limestone.

Additionally, topographical and geological (hydrological, archaeological and geological) investigations play a key role in understanding the embeddedness of natural resource extraction, specifically by examining the thickness of the soil and the minerological features that underpin the mining of travertine. This study would be crucial to understanding the landscape alterations carried out by extraction, that are otherwise only studied in depth in other disciplines that only enriches the landscape discipline. By integrating literature from these fields, the thesis attempts to build a cohesive, interdisciplinary structure that seeks to provide a holistic and comprehensive reading of the territory and its exploitation. The maps, attempts to put together these various information, rendering them available in the terminology and representation code of the landscape architect, merging the rigor of otherwise only available in strictly geologic, hydrological, hydro-geological, and botanical fields and other scientific disciplines what is most needed to read and interpret a landscape under heavy transformation that is not always very visible.

For which, a key part of the methodology involves contrasting the miners' practical techniques—planimetric and sectional readings used to quantify, predict outcomes, and assess the economic value of their operations—with academic methods of interpreting and representing the landscape. The research employs a range of representational tools, including cartography, diagramming, and photography. These systems of representation serve as both analytical tools and learning methods, offering ways to visualize and interpret the complex interactions between natural, cultural, and industrial forces that shape the landscape.

Fieldwork plays a crucial role in gathering primary data. Site visits to the extraction zones

allow for direct observation and documentation of the landscape, as well as the extraction processes. Furthermore, interviews with stakeholders across various sectors—miners, local communities, urbanists active in the area, and industry representatives—are a vital component of the research results. These testimonies, found in different parts throughout the research, are essential for gaining insider perspectives, particularly in a context where secrecy prevails due to concerns over public criticism and mistrust toward academic inquiries. Navigating this atmosphere of fear and resistance has been challenging, but these interactions have yielded invaluable insights into concerns and the hidden dynamics of the travertine industry and its impact on the local landscape, specifically when the lack of published reliable and available data is a great limitation in this context.

Division and Structure of Narration

The thesis starts every chapter with a keyword and definition, with an emphasis on the use of that specific keyword as an entry point to the chapter. The keywords chosen chronologically are: Extract, Territory, Necropolitics, Travertine, Terraforming, Void, Waste, *Fossante*, Resistance and Common. As they introduce the theme of each chapter, they also focus on a subject, an actor, that played an important role in the breaking apart the processes of extraction in this territory.

The research is divided in three parts: in the **first part**, Necropolitics of Extraction, introduces the theoretical framework on which the thesis stands, first from an architectural perspective. This part explores the state of the art, critically addressing the current

FIGURE 04

The extracive basin of the Acque Albule, as seen from google earth.



FIGURE 05

Image from the quarries owned by Poggi in 2022, with the sequence of the keywords described in the third section, Labour, Water and Waste.

ongoing research of architecture of extraction, its unchecked consumption of resources, and the detachment of the architectural landscape design practice from the conditions of the materials production. Then it applies concepts of territorialization of the landscape as a necessary shift to its investigation, as these territories describe the consequential ecologies of socio-economic and environmental precariousness created through the extraction model.

The **second part,** Lapis Tiburtinus centers on the material itself, analyzing the historical and contemporary territory through Roman travertine stone extraction, as a case study of architectural material extraction in a western European context. This generates the need to answer that respects the complexity of the matter itself, starting with the material culture of Roman Travertine and the ways it has symbolically used through history shaping a role in its extraction. We attempt to understand the material's persistence as an architectural material, and its role in its own extraction, which resulted in the subsequent transformation and conditioning of the entire territory for over two millennia. The analysis takes a drastic jump in scale, from very local and micro scale of travertine formation and ecological setting, to its political, historical and economic force.

Finally, in the **third section**, Mapping Travertine Extraction, we use three main key words to summarise the main processes that are involved in the Roman Travertine Extraction: **Water**, **Waste** and **Labour**. The use of critical cartography to illustrate the current spatial forms of these processes, giving a physical dimension to this otherwise abstract concepts. They provide scenarios of invisible systems if the present domination of extraction processes were to continue. These visualizations tell stories centering one topic, bridging technical natural sciences to landscape representation, to facilitate an understanding of what extraction at this scale entails. The

map introduces the text that explains the complexity of the key players in each map or each scenario, answering the question, how did we get here? Or how to avoid arriving there, in terms of possible catastrophic destructive scenarios, that play on imaginary based on high impact factors that have an actual weight in the landscape.

The diagrams and maps employed in this chapter attempt to provide a comprehensive reading of the impact of extraction on different scales and across diverse contexts, and how global market pressures have devastating local consequences. The thesis then presents cartographies of resisting landscapes, highlighting invisible ecosystems and cultural efforts to transform exploited sites into dynamic entities, fostering resilient alliances for ecological regeneration.

The thesis concludes by reflecting on the limitations of this research and therefore the need for future scenarios of this diminishing resource and the complex, uncertain realities that years of quarrying have created within the region. It emphasizes landscape approaches that introduce a new vocabulary of Abandonment and Reclamation, that could uncover connections between human and non-human agents within a heavily anthropocentric context. Although the study highlights key aspects of extraction, further research is needed to address the final question: how can landscape studies advance ecologically focused narratives that integrate natural processes and resist exploitative practices? This question calls for continued research and deeper exploration in the future of the this territory.

PART 1

NECROPOLITICS OF EXTRACTION

Extract (v.)
"to draw out, withdraw, take or get out, pull out or remove from a fixed position, literally or figuratively," late 15c., from Latin extractus, past participle of extrahere "draw out," from ex "out, out of" (see ex-) + trahere "to draw"

To understand the havoc caused by extraction from a landscape perspective, this thesis begins by critically extraction and its resultant territories with landscape and architectural theory and practice. It does so through the narration of Western quarrying practice unfolding in real time, not in some distant environmental dump, but on the margins of a European capital, under the supervision of European regulation. These quarries, out of sight therefore out of mind, are seen as reserves measured in cubic meters rather than surfaces, are subject to a different form of landscape perception. These landscapes, often referred to as "territories," exist outside cities, beyond urban scales, and are excluded from the ontologies typically associated with landscapes. As undesigned spaces, they are a direct consequence of capital accumulation facilitated through architecture and construction in cities, functioning as fuel for urban growth and reflecting humanity's technological dominance over nature through their capacity to turn the landscape into a construction material to be extracted and processed.

Naomi Klein presents a compelling argument "Beyond Extractivism" in her book This Changes Everything, who in her coining of the term "*extractivism*" as an economic model, that results in "sacrifice zones" that she describes as: "suicidal results of building our economies on the polluting extraction (as terrains) disappearing from the inside out"[1]. *Extractivism* is non-reciprocal, dominance-based relationship with earth as purely taking, as the opposite of stewardship, which involves taking but also taking care that regeneration and future life continues. It is also the reduction of human life into either labor to be brutally extracted, pushed beyond limits, or into a social burden, once their jobs are depleted and the disease from the laborious extraction manifests in their bodies.

The term "*Necropolitics*" is one that best describes the resulting management of such harsh reality. *Necropolitics* is a term coined by political theorist Achille Mbembe[2] that refers to the use of political power to dictate who lives and who dies, here, we combine elements of *Necropolitics* with the context of resource extraction. It refers to the intersection of political power, death, and the extraction of natural resources. The term suggests the pursuit of resource extraction, particularly in industries such as mining, oil, or other forms of intensive exploitation, political structures may prioritize economic interests over the well-being of local communities and ecosystems. This can lead to environmental degradation, displacement of communities, health hazards, and social conflicts,

1 Naomi Klein, This Changes Everything: Capitalism vs. the Climate

2 Achille Mbembe, Necropolitics, trans. Steven Corcoran, Theory in Forms (Durham London: Duke University Press, 2019).

creating conditions where the extraction process itself becomes a source of harm and death.

The analysis of the necropolitics of extraction from the landscape discipline perspective is elaborated through various processes, first it requires the shift from landscape to that of territory. We are referring to the paradigm change resulting from the ontologies of landscape, to viewing the landscape as a resource, a reserve, to be measured and valued in economic terms. The concept of territoriality, as elaborated by Stuart Elden, is purely animalistic, with a background in animal ecology, where animals "claim" specific areas as their hunting and mating grounds and defend them often with physical violence. This shift represents a move from a more passive and aesthetic appreciation of space to a politically charged and strategically managed definition of territory. Territory is measured, politicized, marked, and bordered to have an economic attachment based on capitalist market supply and demand logic. The shift to territory adds its political implications, as well as nature politics, where the direct distinction between human and non-human leaves no room for active participation of non-human agencies/beings in how territories are managed, leaving them as inert elements in a particular ecological setting to be extracted[3]. The resultant dynamics of extraction are precarious, even for the extractors, and their frequency in different contexts is an indication that our systems must change the ease with which these landscapes are exploited, managed, and altered.

For the landscape discipline to take an active approach in analyzing the subject in scientific terms, the thesis uses this chapter as a necessary political and theoretical entry point. This chapter lays out these theoretical bases, before examining the case study of the thesis,that are elaborated as three key hypotheses and theoretical readings. These readings are developed in this section to present the state of the art, establish the theoretical framework, and declare the research's epistemological stance. These are described in the first three chapters as the following:

1. Describe the intricate and complicated relationship between architecture and landscape practices with extraction
2. Establishing the theoretical framework on how the landscape ontologies shift to territorial conflict spaces
3. Illustrate the literary review that demonstrate uneven precarious socio-economic and ecological landscapes resulting from the extraction model

3 A. Ghosh, The Nutmeg's Curse: Parables for a Planet in Crisis (London: John Murray Publishers, 2021).

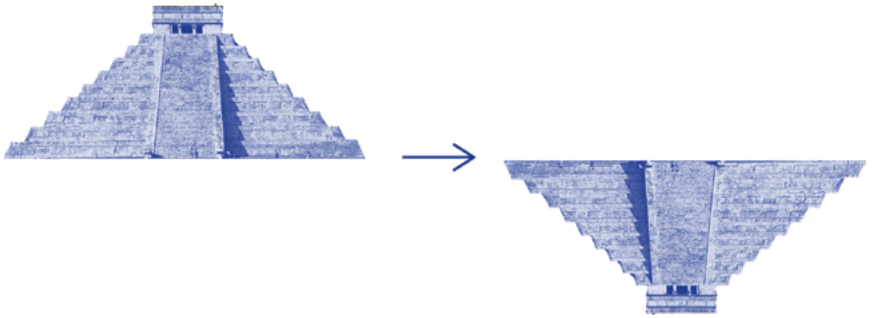


FIGURE 01

An inverted monument is perhaps the closest thing we have to imagining the permanent lacerations architecture creates in extractive landscapes. Image modified, original by: no-office.us

1.1 EXTRACTIVE ARCHITECTURE OF INVERTED MONUMENTS

In a conversation between Antoine Picon and Srijana Mitra Das titled "Architecture is arrogant towards nature[4]", presents one of the many complex discussions emerges as it becomes more and more evident the relationship between the architectural and landscape practices, on which our discipline is based, and its consequences. Indeed, architects have an increasingly troubled relationship with earth, with an intricate relationship between construction and the destruction of the environment. Today, architecture's relationship with nature is becoming increasingly critical on a global scale. Indeed, architecture and construction alone are responsible for 39% of global annual greenhouse gases emissions and consumes up to 40 per cent of total energy[5]. The environmental degradation caused by architecture since the 19th century, driven by industrialization and urbanization, has contributed to the current ecological crisis. The extraction of materials, such as iron, steel, and concrete, has exacerbated this issue. While preindustrial societies built in harmony with nature, the Industrial Revolution introduced the belief that human ingenuity could override natural constraints, leading to a disregard for geography, soil, and environmental limits. This hubris has resulted in ecological disasters such as urban flooding and landslides, underscoring the need to re-establish a sustainable relationship between architecture and the natural world.

Architecture and construction, while itself responsible for and benefiting from decades of extraction and colonialism: through exploited labour, land and extraction capitalism, is paradoxically detached from the consequences of this practice. Aldo Rossi's concept of the "urban event" refers to the idea of a single event playing a pivotal role in shaping the city's evolution. While rooted in architectural discourse, the transformation of a common urban element into something extraordinary can extend to other fields, as it extends beyond the limits of the city itself. What Pier Vittorio Aureli describes as "the Difficult Whole", describes this duality, the resultant architectural and urban context, and the rational of its economy of production[6], one that relies on the excavation of materials in other contexts. This research does not aim to reverse the vast extractive landscapes that have resulted from that urban event but to envision new narratives to its creation. It spe-

4 Antoine Picon, "'Architecture Was Arrogant towards Nature — This Must Change to Humility. Smart Cities Can Be Green'," The Times of India, September 12, 2020, https://timesofindia.indiatimes.com/architecture-was-arrogant-towards-nature-this-must-change-to-humility-smart-cities-can-be-green/articleshow/78064994.cms.

5 Khamseh, Negar Sheikh Mohammadi. "Global Need for Low Carbon Architecture." Journal of Sustainable Development 7, no. 1 (January 25, 2014): p161. https://doi.org/10.5539/jsd.v7n1p161.

6 Pier Vittorio Aureli, "The Difficult Whole. Typology and the Singularity of Individuality of the Urban Artifact in the Early Work by Aldo Rossi. 1954-1964" Log 9 (2007): 39–61.

cifically focuses on the relating the two events, given the urgency caused by growing number of abandoned surface and underground mines, which pose significant environmental, economic, spatial, and social challenges to the cities and landscapes they occupy. Rather than asking when or how mining will end, the research seeks to radically describe in detail these resultant landscapes. It explores how they can be connected as essential parts of the environment through urban events and disruptions to the existing trajectory of mining. These disruptions should not be isolated interventions but a series of transformations over time, addressing ecological, historical, social, political, economic, infrastructural, and architectural dimensions.

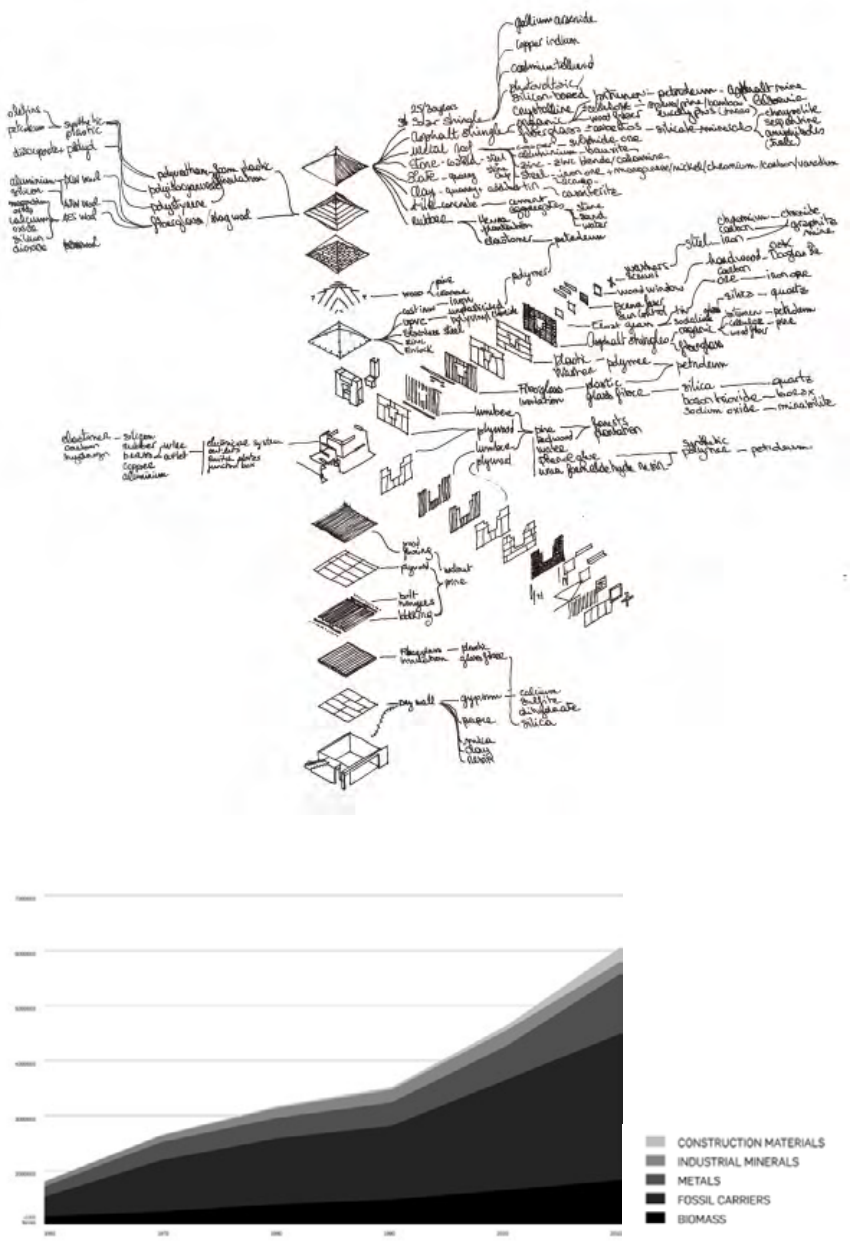
Every decision made by planners in the design phase of a project exerts profound consequences upon implementation, affecting not only the construction site but also the locations of extraction and production. Whether concerning the window frames of residential buildings, the concrete pillars of bridges, the flooring materials within homes, or the pavement of urban thoroughfares, each choice in the material composition of the built environment reverberates globally. Despite claims of objectivity, design disciplines often disengage from political responsibilities, overlooking the origins of their material sources. Yet, the expansive global enterprise of resource extraction operates across all scales, influencing landscapes—mountains, rivers, forests—and human populations alike. Donna Haraway's concept of "the appropriation of nature as a resource for the production of culture[7]" underscores how historical

7 Donna Haraway, Simians, Cyborgs, and Women: The Reinvention of Nature (New York: Routledge, 1991). Pg 150

colonial practices persist in contemporary urban and infrastructural development, revealing entrenched neocolonial dynamics within capitalism extraction. The impacts of modern mining and exploitation are profound and far-reaching, affecting both human and non-human entities, with marginalized communities bearing disproportionate burdens amidst severe environmental degradation and socio-political complexities.

The discourse has been gaining attention in architecture and landscape studies. Indeed, the urgency of addressing these landscapes increases when the constant rise of construction of new structures, ensuing the increase of the demand for construction materials obtained by extraction of resources. This argument is indeed not new, the research parts from the important works of Charlotte Malterre-Barthes and Jane Hutton, that have both explored the dilemma of extraction and landscape architectural practice from different angles and have highly influenced this research.

Barthes research explores how the scale of Extraction in **Figure 02** attempts to illustrate the scale of materials assembled to build a single small housing unit of 35 sqm measuring this detached-architectural-extraction rapport. "Architecture of Extraction" discusses current neocolonial expansion in relation to the extraction industry as a planetary project. Here, Barthes describes how architecture provides a salient entry-point, as a space-making process that requires in its materialization numerous mineral resources acquired via extraction and the reallocation/relocation of the Earth's resources such as limestone, clays, sand, gravel, iron ore, aluminium diatomite, kaolin, bentonite, silica, barite, gypsum, potash, pumice, and talc; as well as processed min-



erals in the form of aggregates (i.e.. crushed stone, sand, gravel, cement)[8]. It is an essential study on the impacts of a seemingly very small scale, one that renders extremely difficult to grasp the extracted materials that result in big architectural and urban projects.

The scale of architectural increasing reliance on extraction is just the tip of the issue, the extraction/ architecture narration includes the dynamics of material productions, ones that are invisible, external and very detached from the architecture landscape practice. Indeed, Over the last decades, the global trade in primary commodities - such as agricultural and forestry products (biomass), fossil fuels, industrial minerals, metals and construction materials - has increased more than threefold. This reflects the increasing globalization of construction material trade, one that according to the figure 03 exceeds other materials[9].

The material flows are center to Jane Hutton's research, that on the other hand, is about the detachment of material production processes before they hit the shelves. Five material movements are traced in Hutton's Reciprocal Landscapes, in figure 04 that highlights the material sources centering Manhattan Island and where the materials in Olmsted's Central Park, Oudolf's the Highline and other major landscape projects, are transported from extremely far territories of cheap labor and material, what Jason Moore calls cheap natures, reflecting on global mate-

FIGURE 02 - 3

Scales of Extraction, after Morphosis Charlotte Malterre-Barthes, "The Devil Is in the Details- Who Is It That the World Belongs To?," in Non-Extractive Architecture- Designing without Depletion, ed. Space Caviar (Berlin: Sternberg Press, 2021).

From a study done by Niel Brenner and Nikos Katsikis on the globalisation of trade of basic materials

8 Charlotte Maltere-Barthes, "The Devil Is in the Details: Who Is It That the World Belongs To?," in Architecture of Extraction: On Designing without Depletion, by Space Caviar, Non-Extractive Architecture / Edited by Space Caviar, vol. 1 (Moscow: V-A-C Press, 2021).

9 From a study done by Niel Brenner and Nikos Katsikis on the globalisation of trade of basic materials, data extracted from: F Krausmann, S Gingrich, N Eisenmenger, K-H Erb, H Haberi and M Fischer-Kowalski, 'Growth in Global Materials Use, GDP and Population During the 20th Century', Ecological Economics, 68 (10), 2009, pp 2696-705.

rial flows and comparing two different landscapes that are often not "equal", landscapes of extraction, and landscapes of accumulation.

The five materials stories narrated in Hutton's work were: Tropical hardwood from Para Brazil to New York's Highline, the Central Park's Guano fertilizer from the Peruvian Chincha Islands and its consequential production of slavery, the Granite from Vinalhaven, Main to Broadway and the workers' rights movements, Steel from Pittsburgh to Riverside Park, and London's Plane Trees from the Rikers Island to Seventh Avenue. These stories have in common the unlikeliness of the material origins, the unjust stories about ecological depletion, and the social uprising related to the decades' long reliance on coerced exhausted workers in different forms. These stories have in common the careful and deliberate selection of the architectural material but the indifference of the design process to the processes of the material production.

Indeed, Hutton's provocative title "Reciprocal Landscapes" describes landscapes that are not reciprocal at all, the designed constructed landscapes, and the landscapes of unequal hierarchal social and ecological injustices from which the materials were stripped from. Hutton interrogates: "what if we saw construction materials not as fixed things but rather as physical continuities of matter, connected to land and people? Second, what if we conceptualized material production as part of the project, rather than external to it?[10]" Her research would then be focused more on the specificities of material itself, in

10 J. Hutton, Reciprocal Landscapes - Stories of Material Movements (Routledge, 2020).

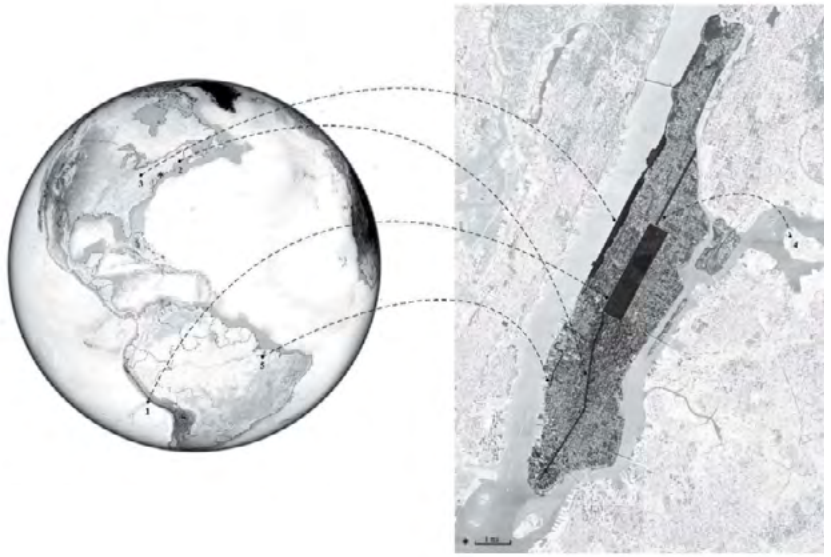


FIGURE 04

Five material movements traced in Jane Hutton's Reciprocal Landscapes book, pp 12 - 13

Material as Method[11], suggesting that we should view materials as having value beyond their market price and as active participants in the world, rather than just passive resources for human use. It encourages us to see urban development as a collaboration between humans, other species, materials, and distant ecosystems. By unlearning the idea that materials are inert and only serve human needs, we can better understand the dynamic relationships and interdependencies between construction and the natural world.

Ecopolitics and Landscape Architecture Pedagogy

As we confront the consequences of unchecked resource use embedded in architecture and landscape practice, the need for a new architectural

11 J. Hutton, "Material as Method," in Landscripts 5: Material Culture, Assembling and Disassembling Landscapes, ed. J. Hutton (Berlin: Jovis Verlag GmbH, 2017), 13–21.

pedagogy becomes apparent, one that integrates ecopolitics and critically examines the systems of extraction on which the discipline is built. This is where ecopolitics comes in—a framework that integrates ecological knowledge with political action to promote an aware and intentional human interaction with ecosystems. In the humanities and social sciences, ecopolitics refers to the interdisciplinary study of the relationships between political, social, and ecological systems. Ecopolitics extends beyond technical or scientific expertise; it calls for a trans-disciplinary understanding that includes knowledge from geology, sociology, culture, and even poetry . It examines how power, governance, and human behavior intersect with environmental concerns, focusing on issues like resource management, environmental justice, sustainability, and the impacts of human activity on ecosystems[12]. Ecopolitics critically analyzes how political ideologies, economic systems, and cultural practices shape environmental policies and attitudes. This would shift the focus from architecture as an isolated discipline of design to one that recognizes its embeddedness in broader social, political, and environmental systems. Teaching ecopolitics would allow students to explore the complex relationships between architecture, resource extraction, and environmental degradation, encouraging them to consider how their designs impact natural systems and human communities. This would foster a holistic understanding of architecture's role in shaping not just buildings but ecosystems and resource flows that are beyond the final destination of such materials, and their impact extend way beyond the reach of the final resultant architectural project.

The insertion of ecopolitics is pivotal in this research, as landscape practitioners exist within a complex, interconnected system that includes animal and plant life, as well as organic and inorganic matter. These components interact continuously through various exchanges and transformations. When any part of this system undergoes changes—whether chemical, physical, or biological—it inevitably alters the balance, affecting other parts of the ecosystem and the agent of change itself. The challenge lies in ensuring that these transformations lead to mutualistic, symbiotic exchanges, fostering a sustainable balance and coexistence.

This vision challenges the outdated designed landscapes-productive landscapes divide, advocating for a holistic approach to the environment. Achieving this balance requires a comprehensive understanding of how ecosystems function and the role we play in them. Beyond material use, ecopolitics in architectural education would also examine the broader systems of exploitation tied to extraction, including issues of labor, land rights, and environmental justice. The extraction industries that supply architectural materials often exploit vulnerable communities and ecosystems, especially in the Global South. Teaching architects to think critically about the social and ethical dimensions of extraction connects the discipline to issues of social justice, encouraging a more equitable approach to urban development.

Additionally, the concept of architecture as a co-production with other species, materials, and landscapes must become central to landscape and architecture pedagogy. This would help unlearn the idea that materials are inert resources to be extracted and used solely for human needs, and instead view

12 Conte, Andrea. "ECOPOLITICHE." Edited by G. Perin. Roma, 2023.

them as active agents within ecological systems. By shifting the focus toward interdependence between the built environment and the natural world, future practitioners could design with a deeper awareness of the environmental flows and material cycles that sustain life.

In eastern Germany, the Ore Mountains and Lusatia regions were extensively mined for uranium and lignite (brown coal), respectively. This intensive industrial activity caused widespread environmental damage, leaving behind pollution, degraded landscapes, and severely disrupted ecosystems. To address these challenges, large-scale rehabilitation initiatives were launched to reimagine these post-industrial areas as sustainable and recreational spaces.

In the Ore Mountains, cleanup efforts focused on addressing radioactive contamination, restoring natural habitats, and repurposing the area for mixed recreational and ecological uses. In Lusatia, a different approach was taken, involving the flooding of massive open-pit mines to create the Lusatian Lake District, a sprawling network of interconnected artificial lakes. These newly formed lakes are now a hub for tourism, water sports, and wildlife habitats, contributing to the region's economic revival. Water management played a critical role in both cases—stabilizing and decontaminating radioactive sites in the Ore Mountains and designing advanced hydrological systems to sustain Lusatia's lakes and prevent flooding or contamination. These projects demonstrate how deeply scarred landscapes can be transformed into vibrant opportunities for ecological regeneration, economic diversification, and a sustainable future, offering a model for post-industrial rehabilitation worldwide[13].

The insertion of ecopolitics in understanding and representing landscapes will play a role in the politicization of landscape. Extraction asserts a territorial reading of the landscape. A perception that demands a political agency, bordering, economic measuring, and is beyond the connotation and scope of landscape studies in their ontological forms. We will argue that extraction territories are conflictual in their essence, and the depoliticization of these discourses into only environmental terms reduces the degree in which actual perception of these harsh realities can be obtained.

13 TU Dresden. 'Research Studio: GHOST MINES – Sensing Pasts / Casting Futures'. Document. Accessed 28 December 2024. https://tu-dresden.de/gsw/slk/germanistik/digitalcultures/forschung/research-studio-ghost-mines-sensing-pasts-casting-futures.

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Maltere-Barthes, Charlotte. “The Devil Is in the Details: Who Is It That the World Belongs To?” In Architecture of Extraction: On Designing without Depletion, by Space Caviar. Non-Extractive Architecture / Edited by Space Caviar, vol. 1. Moscow: V-A-C Press, 2021.

“Material World : Charlotte Malterre-Barthes.” Accessed October 7, 2024. https://www.charlottemalterrebarthes.com/research/critical-thinks-seminars/material-world/.

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Territory (n.)
a geographic area belonging to or under the jurisdiction of a governmental authority;
a geographic area (such as a colonial possession) dependent on an external government but having some degree of autonomy; a field of knowledge or interest; an area often including a nesting or denning site and a variable foraging range that is occupied and defended by an animal or group of animals. Definitions by Merriam Webster dictionary accessed in 2024.

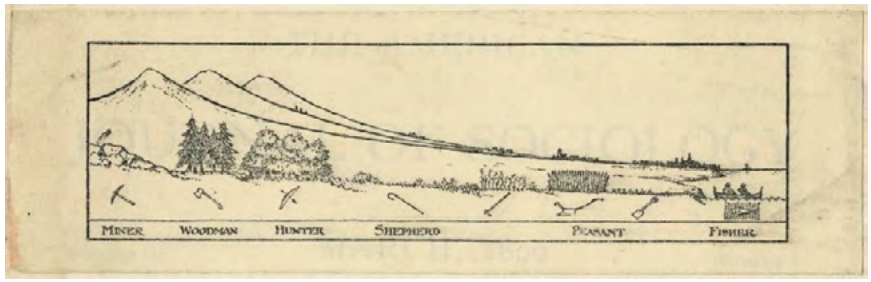

FIGURE 05

Valley Section, 1909
Patrick Geddes.
image sourced from
Wikipedia commons

1.2 FROM LANDSCAPE TO TERRITORY

J.B. Jackson defines the most common understanding of landscapes as a composition of man-made or man-modified spaces to serve as infrastructure or background for our collective existence. A landscape is not a natural feature of the environment but a synthetic space, a man-made system of spaces superimposed on the face of the land, functioning and evolving not according to natural laws but to serve a community[14]. In which the distinction between image and landscape represents a deliberately shaped perspective on the world throughout history. It is a consciously crafted method of perceiving and influencing the environment, involving the dynamic interaction between the observer and the physical surroundings. The interplay of subject and object in creating landscapes leads to a communal human alteration of nature. In essence, landscape becomes both the subject and object of human agency in forming a cultural and ideological representation of the interconnection between society and nature[15].

The diagram in figure 05, titled Valley Section Patrick Geddes in 1909, is one that describes the laborious relationship with the landscape, describing the foundation of how human societies organize themselves along a natural landscape, focusing on the interactions between geography, ecology, and economy. Geddes' "Valley Section" uses mining to illustrate the fundamental relationship between geography and human society. The mining region serves as an example of how humans exploit natural resources in a specific geographical zone, contributing to a larger, interconnected socio-economic system. Through mining, societies are not only extracting value from the land but are also shaping and organizing the landscape into distinct territorial regions. This idea resonates with Geddes' broader concept of regional planning, where geography dictates the economic functions and social structures of human settlements.

In architecture and critical urban studies, Territory carries diverse and multifaceted meanings. It encompasses the physical aspects, and the vitality of territories shaped by both human and non-human activities and labor. In this context, territory is seen as a socially claimed space infused with social significance, where historical production processes, social relations, power dynamics, and ecological factors are embedded[16].

Landscapes when viewed as a mine are measured as a volumetric resource, purely geometric geographies of geological processes that accumulated and

14 John Brinckerhoff Jackson, Discovering the Vernacular Landscape (New Haven: Yale University press, 1984).

15 D.E. Cosgrove, Social Formation and Symbolic Landscape (London: The University of Wisconsin Press, 1984). Pp 14-15

16 Christian Schmid and Milica Topalović, Extended Urbanisation: Tracing Planetary Struggles (Basel: Birkhäuser, 2023).

sedimented through time, soft and convenient for ease of extraction and transport. Seen is seen as objective and measurable inanimate environment to be appropriated and extracted, terrains to be claimed. Three dimensional geographies of millennial that are cut through in terms of minutes and seconds in today's technologies. Landscape as subject of scientific measurement of matter and material is territorialised, as in transitions from aesthetics to territory. Here, it is important to denote a clear transition between landscape to territory. A landscape and a territory are two different ways of looking at a portion of land or earth. A landscape is a visual and aesthetic representation of the land, as seen by an observer. It can be natural or man-made, and it can be influenced by cultural and ideological factors. A territory, on the other hand, is a political and economic concept of the land, as controlled or exploited by a governing entity. It can be measured, divided, and claimed by different groups or individuals.

The transition to the term that will be used to describe the environments of quarries, mines and material extraction will be territories is based on Stuart Elden's deliberate definition of territory as spaces that are "produced", and bordered through economic, political sovereignty and measured to the extent of human technology. I find the application of the term territory as a description of extraction landscapes given their inherent capitalistic (therefore economic) nature, and the extension of this economic activities to the political dimension (the state) that allows/regulates such activities to take place in the first place.

The diagram in figure 06 elaborates the territorialization of landscapes, where Elden suggests that the shift from landscape to territories involves a

FIGURE 06

Territory's several connotations, and their representative meaning.

transformation in the way individuals and societies perceive and interact with space. This transformation is closely tied to political and power dynamics. In "the Birth of Territory[17]" Elden introduces the concept of "territorialization," which is the process by which space is organized, regulated, and marked as territory. This involves the imposition of political and social order onto the physical landscape, leading to the creation of boundaries, borders, and divisions.

Territorialization goes beyond appreciating the aesthetic qualities of the land; it involves the establishment of authority, control, and governance over a defined space. The transition to territories highlights the political significance of space. Territories become not just physical areas but also instruments of political power and control[18]. The demarcation of boundaries and the establishment of territories are key ele-

17 S. Elden, The Birth of Territory (Chicago and London: the university of chicago press, 2013).

18 Elden.

ments in the consolidation of state power. States and political entities use territories strategically to assert sovereignty, manage resources, and regulate populations[19]. The concept of territory becomes intertwined with political and geopolitical considerations, concepts that will be exasperated as the expansion of the colonization era in the global south, as landscapes of cheap natures[20].

From Landscape to territories represents a shift from a more passive and aesthetic appreciation of space to a politically charged and strategically managed understanding of territory, measured, marked and bordered to have an arbitrary economic attachment based on capitalist market supply and demand logic. This definition highlights the current dominance of humans over landscapes, where technology has greatly enhanced our ability to transform natural environments into capital resources. The transition to landscape as territory involves the use of mapping and the creation of borders as tools for territorialization. Technology that manifest in the development of our capacity to map, measure, and demarcate landscapes. For this reason, mapping and cartography are complicit in the creation of territories. The history of the development of cartography is one that is intertwined with the history of territorialization. Mapping becomes a way to visualize and control space, and borders serve as physical and symbolic markers of territorial boundaries. The act of mapping transforms the abstract notion of landscape into a concrete and regulated territorial space, reinforcing the idea of boundaries and exclusivity.

19 S. Elden, "Territory: Political Technology, Volume, Terrain," in Landscape as Territory: A Cartographic Design Project, ed. C.O. Sanjuan (London: Actar Publications, 2019), 20–34.

20 J.W. Moore, Capitalism and the Web of Life (London; New York: Verso Books, 2015).

Quarries, as territories of extraction, are an extreme example of this transformation. These landscapes are heavily altered, becoming passive objects that serve as resources for human technological exploitation. The excavation of a hole is a fundamental aspect of extractive landscapes, but it is only the beginning of the transformation process.

The shift of landscape as territory adds its political implications, as well as nature politics (or the lack thereof), where the direct distinction between human and non-human, leaves no room for active participation of non-human agencies/beings on how territories are managed, leaving them as inert elements, in a particular ecological setting, to be extracted[21]. The act of applying Stuart's model of landscape as territory in terms of jurisdiction, territory as political/legal/economic/strategic/and technical, has led to the complicit advancement of the science of cartography (quantifying and measuring land), and therefore what can be measured, can be occupied, claimed, and colonized. Colonization of land initiated as extractive logic, imposing a monopoly of legitimized violence on natures that either were "unclaimed" or with various degrees has been previously territorialized by other social groups, in an act of (unnatural selection) and elimination based on superiority of violent technologies. Indeed, Amitav Gosh has noted the reveal of the word "new" in maps in the Americas and Australia marks the extent of European expansion, and their claiming the right to terraform and transform environments. Indeed, these ideas about nature, as manifested by Joyce Chaplin, are the foundation of English coloni-

21 Amitav Ghosh, The Nutmeg's Curse: Parables for a Planet in Crisis, Paperback edition (Chicago: The University of Chicago Press, 2022).2022

zation[22]. European perceptions of what constitutes as "proper" use of the environment, or as William Cronon would put it, is to improve land, by making it productive in ways that are familiar, is in the ideology of European conquest[23], through margining, bordering, and working through European paradigms, that manifested as the earliest forms of capitalism and that were very different from the way land was perceived by the indigenous that they encountered in the earliest attempts to colonization. Territorial thinking is crucial for understanding socio-environmental conflicts, especially when considering scholars who focus on territoriality as the practices, relationships, and situated knowledge that social groups use to sustain a collective way of life. From this perspective, territories are also seen as relational entities and lived experiences[24], the thesis expands on this topic in the chapter about Labour, and landscapes of tensions.

22 Chaplin, Joyce E. Subject Matter: Technology, the Body, and Science on the Anglo-American Frontier, 1500-1676. Cambridge: Harvard University Press, 2009.

23 Cronon, William. Changes in the Land: Indians, Colonists and the Ecology of New England. Revised ed. New York: Hill and Wang, 2003.

24 Salvatore Paolo De Rosa, "A Political Geography of 'Waste Wars' in Campania (Italy): Competing Territorialisations and Socio-Environmental Conflicts," Political Geography 67 (2018): 46–55, https://doi.org/10.1016/j.polgeo.2018.09.009.

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Necropolitics (n.)
The term was introduced by political theorist Achille Mbembe, defines is the use of social and political power to dictate how some people may live and how some must die.

1.3 THE CREATION OF PRECARIOUSNESS

It is impossible to ignore the ways in which the mining industry has shaped (and hides) the ecological and social transformations of the regions where it operated, by creating new landscapes, territories, and labour regimes. The logic of extraction treats nature as an infinite and free resource, resulting in environmental degradation and social inequalities, creating layers of precariousness[25]. However, rather than economic sustainability and prosperity that justifies the irreversible socio-ecological transformation, we're often faced with the "resource curse" or "paradox of plenty" concept. In political science, this concept refers to resource-rich territories that, ironically, experience slower development, weaker economic growth, and higher levels of corruption compared to regions with fewer natural resources[26].

Gavin Bridge a leading scholar in human geography, examines the socio-political and environmental dynamics of global resource extraction, focusing on how industries like mining and oil shape landscapes, economies, and governance, highlighting the uneven distribution of benefits and harms within the global political economy. He describes a pattern of how the effects of extracting resources on the livelihoods of people residing in and near newly valued energy resource areas are increasingly worrisome. The simplistic notion that extracting oil automatically leads to generating wealth is now acknowledged as a result that largely depends on specific conditions. More commonly observed is a situation akin to the "cobbler without shoes," where local communities are not only excluded from benefiting economically from resource extraction but also from utilizing the resources themselves. For instance, in parts of Siberia, while natural gas flows through gleaming pipelines near their homes, local residents continue to heat their houses using peat and wood[27].

This dynamic was explained by the Argentinian Sociologist, Maristella Svampa, debunking the myth of the economic prosperity brought by the extraction in resource rich regions in Latin American context. In her book, Neo-extractivism in Latin America, elaborates the resource paradox as tactile results of the extraction model employed anywhere. First, extraction, to degrade local environments—forests, rivers, and soils—upon which communities depend for their livelihoods. The extraction of minerals, oil, or timber often leads to deforestation, water contamination, and the depletion of natural resources, creating long-term ecological damage. These processes, instead of fostering development, undermine local agricultural practices and subsistence economies, forcing communities into dependency on the extractive industries for work, while eroding the very landscapes that supported them.

In addition to ecological degradation, in economic terms Svampa argues that the wealth generated by extractivism tends to be concentrated in the hands of local quarry owners, rather than being equitably distributed. This exacerbates social inequality, as the

25 Leading scholars of the field are the Latin American scholars such Alberto Acosta, Maristella Svampa, Eduardo Gudynas, Martín Arboleda, given the rise and urgency of the ecological issues in frontiers of extreme reliance on extraction economies.

26 Benjamin Smith and David Waldner, Rethinking the Resource Curse, 1st ed. (Cambridge University Press, 2021), https://doi.org/10.1017/9781108776837.

27 G. Bridge, The Hole World: Scales And Spaces of Extraction (SCENARIO 05: Extraction, 2009).

profits from resource extraction rarely trickle down to the affected populations. Instead, local communities often face displacement, loss of access to land, and worsening living conditions, with few long-term economic benefits. Jobs in extractive industries tend to be precarious, often dangerous, and short-lived, leading to a boom-and-bust cycle that leaves communities vulnerable once resources are exhausted or commodity prices fall. Instead of brining sustained growth and social welfare, extraction manifests in environmental degradation, social inequality and economic instability[28].

This precarious dynamic creates what Jason Moore calls "cheap natures[29]" exacerbating exploitation by centers of material consumption and economic accumulation while exporting ecological hazards to resource-rich territories. In *Capitalism and the Web of Life*, Moore explores how capitalism has historically relied on cheapening essential elements—labor, food, energy, and raw materials—by treating them as disposable resources. These socio-ecological risks manifest locally in extraction-intensive landscapes, causing geomorphological damage such as soil erosion, pollution, loss of biodiversity, and agricultural land degradation. The result is a necropolitical relationship with the environment, where certain territories are sacrificed for capitalist gain.

Moore's concept of capitalism extends beyond being an economic or social system; he argues that capitalism actively organizes and creates nature by

28 Maristella Svampa, Neo-Extractivism in Latin America: Socio-Environmental Conflicts, the Territorial Turn, and New Political Narratives, 1st ed. (Cambridge University Press, 2019), https://doi.org/10.1017/9781108752589.

29 Moore, Jason W. "The Rise of Cheap Nature." In Anthropocene or Capitalocene?, Sociology Faculty Scholarship.:78–115. PM Press, 2016. https://orb.binghamton.edu/sociology_fac/2.

imposing its logic on the material world. Through his "world-ecology" framework, he rejects the dualistic and anthropocentric view of nature and society, instead proposing a holistic understanding where human and non-human natures are part of a single, interconnected system. He advocates for recognizing the agency and diversity of all forms of life, emphasizing a more relational approach to how we understand ecological processes. He also traces the deep connection between capitalism and the mining and extraction industries, highlighting how European colonial powers in the 16th century exploited the mineral wealth of the Americas, Africa, and Asia. The extraction of resources like silver, gold, copper, and iron was crucial for the development of capitalism, supporting trade, warfare, and industrialization. However, these industries did not simply generate profit; they also reshaped landscapes, created new labor regimes, and faced natural limits and human resistance, revealing the intrinsic crises that accompany capitalist expansion.

The resulting landscapes are further sustained by the concept of uneven planning highlights the structural injustices embedded in the processes of extraction, where landscapes are systematically transformed and exploited to serve global capital, reinforcing disparities between centers of accumulation and peripheries of extraction. This imbalance creates a geography of injustice, as extraction territories—often invisible and overlooked—become the backbone of urban and industrial growth, yet remain marginalized and precarious. The physical manifestations of such processes are elaborated in a new reading of these territories of production, described as operational landscapes.

These territories, as operational landscapes, are

integral to sustaining urbanization and industrial growth but, like Moore's example of colonial extraction, they reveal deep inequalities. They represent the precarious, often invisible, spaces that support global trade, infrastructure, and production. In both historical and modern contexts, the landscapes of extraction illustrate the ongoing crises inherent in capitalist expansion—crises not only of resource depletion and environmental degradation but also of social inequality and spatial injustice. The process is operationalisation of the landscape, one that involves rationalisation and automation of agricultural production, Extractivism, energy production, and infrastructure expansion, which are manifest in the vast geographies of what Smith and Katsiki refer to as "Operational Landscapes[30]".

Nikos Katsikis and Neil Brenner define operational landscapes as consisting of a mix of logistic corridors, quarries, dumps, warehouses, supply areas, office complexes, data centres, and transport depots, which play an increasing role in defining urban and peri-urban areas[31]. Extraction territories here manifest themselves beyond the mine in other forms, such as mining towns/dormitories, processing laboratories, and transportation infrastructure, that are often invisible and not considered when representing extraction processes.

The operationalization of these industrialized landscapes extends beyond the geographic margins of the resource itself and creates interplanetary correlations. They elaborate this through Planetary

30 Brenner, Neil, and Nikos Katsikis. "Operational Landscapes: Hinterlands of the Capitalocene." Architectural Design 90 (January 2020): 22–31. https://doi.org/10.1002/ad.2521.

31 N. Brenner, New Urban Spaces: Urbanization Theory and the Scale Question (New York: Oxford University Press, 2019).

urbanization theory that show how extractive landscapes have the capacity to address and be influenced by planetary global market pressures. The use of the term Operational Landscapes places the contemporary reality that urbanization processes are interconnected globally and are influenced by transnational flows of capital, information, and people. It is theorized to capture the complexity and interconnectedness of urban development in the context of globalization. Their study results in extensive planetary scale cartography, one that equivocally takes the argument to the landscape representation dilemma, to consider the planetary oceanic flows of container ships and their logistics an integral part of the local landscape of production within its limits. To proof the capacity of the global market to overcome impossible geographic distances for market costs.

Another key aspect of operational landscapes of material extraction is their direct comparison with centers of material accumulation, specifically disparities of development. What Neil Smiths would elaborate on in his: *Uneven Development: Nature, Capital and the Production of Space*. Smith argues that under modern capitalism, geographical differences don't anymore depend on the particularities and unique qualities of a specific geography or inherited intrinsic differences among regions. Spaces throughout the world are instead "produced" distinguished and interconnected in a see-saw movement of equitation and differentiation. This framework entails differentiation between cores and peripheries, spaces of centrality and marginality, inclusion, and exclusion[32].

Extraction of production, with its pursuit of

32 N. Smith, Uneven Development: Nature, Capital and the Production of Space (University of Georgia Press, 1990).

profit, plays a central role in determining where and how development occurs, in an economic system is a driving force behind the geographical disparities in wealth, infrastructure, and resources. Smith argues through deep analysis of the evolution of capitalism, resulting in structures of uneven development of equalization and differentiation of dualities such as core/periphery division of labor has been grounded, city and countryside opposition and modalities of ecological appropriation. This notion and conceptual framework allow the perception of such spaces of uneven development as systematically polarized organization of socioeconomic resources not only among populations, but also geographies. These manifest and present themselves as city/hinterland relations, geographies of industrial development / and infrastructure investment. As Edward Soja in *Postmodern Geographies* explain: "Extraction capitalism... intrinsically builds upon regional or spatial inequalities as a necessary form for its continued survival.[33]" The described city and countryside, or city and industrial counterpart, is an almost universal model in which capitalism has intensified as it evolved. Processes described by Brenner as peripherlization and underdevelopment of non-metropolitan zones, in their reading of the operationalization of planetary urbanization has become the essential uneven spatial development.

While theories of city planning, and city growth theories of development are heavily studied in urban and landscape theories the territories that feed these accumulations of material in cities are invisible and seldom studied. As they are in a way the negative of cities: they are what ensures the development, prosperity, and consolidation of cities, but are themselves the emblem of deployment and precariousness. These lateral landscapes, are perpetually enclosed, operationalized, industrialized, destroyed in the support of our global capitalism profit-driven metabolism, for specialized purposes like agriculture, extraction, energy generation, logistics, infrastructure, and waste processing, etc...

The complexity of extraction landscapes extends beyond physical transformations, symbolizing the deep entanglements between capitalist expansion, socio-ecological degradation, and global inequities. These landscapes are not just sites of resource extraction but represent the systemic imbalances that fuel urban prosperity while perpetuating precariousness in marginalized areas. By framing extraction through concepts like "cheap nature" and "uneven development," the interdependencies between global centers of accumulation and exploited peripheries come into sharp focus. Understanding these landscapes demands a recognition of the hidden geographies of exploitation, commodification, and environmental destruction that sustain modern capitalist economies.

33 Edward W. Soja, Postmodern Geographies: The Reassertion of Space in Critical Social Theory, Radical Thinkers (London New York: Verso, 2011).

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PART 2

LAPIS TIBURTINUS

Travertine (n.)

the word “travertine” is a corruption of the Latin expression ***lapis Tiburtinus***, i.e., the stone of Tivoli, as the most important quarries are located in the territory of the ancient Tibur. It is a kind of limestone with properties which make it particularly suitable for building.

Architectures and open spaces are man-made environments. The materials with which they are built are often the result of extraction practices. Designers are not necessarily concerned with the aspects related to the origin of the materials used, but upon closer inspection, places are the result of multiple intertwining of human actions and local contexts. To disentangle these complex relationships, a deep analysis of the logic of extraction of the material is required. For which we employ a material culture[1] approach, that is narrowly understood as the study of human artifacts and their cultural, this approach can offer hidden constellations of material and political relations. In this context, material culture offers tangible evidence of human activities, technologies, and behaviours associated with extraction.

Bruno Latour considered the process of extraction to be a multifaceted web of relations

1 Material culture is a term borrowed from archaeological and anthropological studies, where the artifact is studied in relation to its social, geographical, and historical context, here we directly apply the study curated by Jane Hutton, in her Reciprocal Landscapes and Material as Method in Material Culture J. Hutton, "Material as Method," in Landscripts 5: Material Culture, Assembling and Disassembling Landscapes, ed. J. Hutton (Berlin: Jovis Verlag GmbH, 2017), 13–21.

that includes both human and Non-human actors. He highlighted the participation of both living and non-living entities in these processes, suggesting that the act of extraction is not solely a human endeavor but also involves the active participation of the resources, technologies, and systems employed in the extraction activities[2]. The active participation of non-human actors does not necessarily mean they are represented. The anthropocentric hierarchy dominates, neglects ecological ethics, and does not recognize the agency and rights of non-human entities[3]. The microscopic organic peculiarity of travertine, the one that results in its aesthetics and properties, is a complex ecological setting that is seldom represented, since representation in political ecology is the first act for democratic management of earthly biospheres[4]. If we part from the hypothesis that representation also generates affection – Can the micro scales have territorial impacts that shift human economies of unbalanced and precarious extractive ecologies? Attempting to answer questions beyond the logic of travertine extraction in the *Acque Albule*, the research starts from the microscopic peculiarities of travertine that not only have determined the material's characteristics, but can also shapes its ecological setting, and can have an impact in of the future of the territory[5].

2 Bruno Latour and Catherine Porter, Politics of Nature: How to Bring the Sciences into Democracy (Cambridge, Mass. London: Harvard University Press, 2004).

3 C. Merchant, The Death of Nature, Women, Ecology and the Scientific Revolution (New York: Haroer & Row, Publishers, Inc, 1980).

4 Anthony Burke and Stefanie Fishel, 'Across Species and Borders: Political Representation, Ecological Democracy and the Non-Human', in Non-Human Nature in World Politics, ed. Joana Castro Pereira and André Saramago, Frontiers in International Relations (Cham: Springer International Publishing, 2020), 33–52, https://doi.org/10.1007/978-3-030-49496-4_3.

5 Romeo Di Pietro and Duilio Iamonico, 'Plant Ecology for the active conservation and sustainable management of the territory. The question of the "Travertini Acque Albule" protected area' (Plant Sociology, n.d.).

Material culture can be used as an entry point to disentangle the complex architecture-material-extraction landscapes. It begins with a specific concentration on the matter's formation and non-human components as active actors. As this would move beyond the anthropocentric, social construction of nature point of view, and begin to view how the non-human world reacts and pushes back[6]. The innovativeness of the material as method, and material culture discourse extends beyond the mere narration of how its formed and obtained. Hutton argues that examining material flows can help us conceive the very abstract connectivity between distant sites, (the designed landscape, and the extraction site, forest or quarry). As material culture in archaeological studies place emphasis on how the artefacts were constructed, material culture of construction material includes other hidden narratives such as human labor in landscape design narratives, as an inherent and often forgotten aspect of architectural production. This adds the political active scholarship in a moment where complicity of architectural practice and unjust material production conditions is blurred. All of which, as Hutton argues, allows an approach to "make with" rather than commodify and exploit social and material landscapes. Material culture may unsettle anthropocentric limitations, as it focuses on how landscape is made, going beyond the mere description and narration, but as an entry point to transform how the discipline operates.

The thesis analyses the case study by centering the Roman travertine material as a key player in the territorial transformation. We start from the smallest scales, to explain the specificity of this limestone, its

6 Hutton, "Material as Method."

unique geological and geographical formation, and relationship with the territory. Then to elaborate the political global role of this stone, from the economic logic of the material, simplified in scales of in empirical values, to understand the scales of extraction in the Italian context.

FIGURE 01

A small fraction of the Zabaglia print of the lower left side, displaying quarry men at work, and the mining and carpenting tools, most of which still used right before mechanisation.

XIV, Cave di travertino e operai al lavoro, da ZABAGLIA 1743.

2.1 LAPIS TIBURTINUS' MATERIAL CULTURE

The name travertine comes from the Latin tivurtinus, a late imperial-era designation of the Tivoli area; the Romans called the ornamental stone quarried there: lapis tiburtinus. Travertine is a corruption of the Latin expression lapis Tiburtinus, i.e., the stone of Tivoli, as the most important quarries are located in the territory of the ancient Tibur[7]. The Roman-era architect Vitruvius speaking of this stone thus expressed himself: "Tiburtine stones, and those that are of the same species resist everything, yes to the weight, yes still to the ravages of time."[8] Travertine as a material has never been neutral, passive, and docile, instead, it has always had a role in shaping the economy of the Tiburtine territory that conditioned its subsequent industrialization and transformation. The sedimentary material's formation is associated with an area of rich and dense vegetation, of a very biodiverse context. For which the material culture of the Lapis Tiburtinus[9] has distinguished it from other kinds of travertine[10] and contributed to its exploitable characteristics: soft to cut and therefore easy to extract, but sturdy, resistant to high compression and surface erosion[11].

Il Paesaggio della Pietra

There are 20 types of different travertines quarried in Italy, with the largest of the travertine deposits in central Italy, only present in few areas, along the river valleys of the Arno, the Tevere, the Aniene and the Sacco. The uniqueness of the Roman travertine is due to the exceptional geological formation of its site, occurring in the extremely fertile, biodiverse bed of

FIGURE 01

Google map image of the territory, accessed in 2024

Tivoli, named the Acqua Albule, Albule Water Basin. The Acque Albule basin, defined as the "Tiburtine Lake" by the geologist Giuseppe Ponzi and Abbot Rusconi due to its unique shape, is a large limestone plain, one of the largest travertine reserves in Lazio [12].

The Tiburtine territory, situated close to Rome, is home to one of the oldest and most expansive travertine quarries. Travertine quarries can be found in different places on the planet. However, only Roman travertine can count on specific technical properties, which make it one of the most durable materials in nature. In fact, due to its compactness, it is easy to work among all other types of travertine. The reason lies in the depth of the quarry basin, which has a great influence on the hardness and weight of this natural stone. The extraction of Roman Travertine in the Tivoli area takes place tens of meters deep, where geological conditions result in the generation of a thick texture and high compactness. This, in turn, allows Roman travertine to be worked in both stratum and counter stratum cuts and is a guarantee of durability. Not all travertines are suitable for working in the two cuts, making this type specifically unique.

This Acque Albule basin, located about 20 km east of Rome, right under Tivoli geologically appears to be a flat basin covering an area of about 45 km². The travertine reserve itself geologically is a recently formed depressed structure, covering an area of only about 30 km², and an average thickness of 60 meters. Its topographically flat bed, where the precipitation of carbonate units from surrounding mountains (Cornicolani, Lucretili, and Tiburtini Mountains) accumulated and sedimented on the banks of the

12 Ceruleo Piero, "L'ecosistema Preistorico Delle Acque Albule Presso Tivoli (Roma)," vol. «Annali Associazione Nomentana di Storia e Archeologia Onlus», 2005, 34–57.

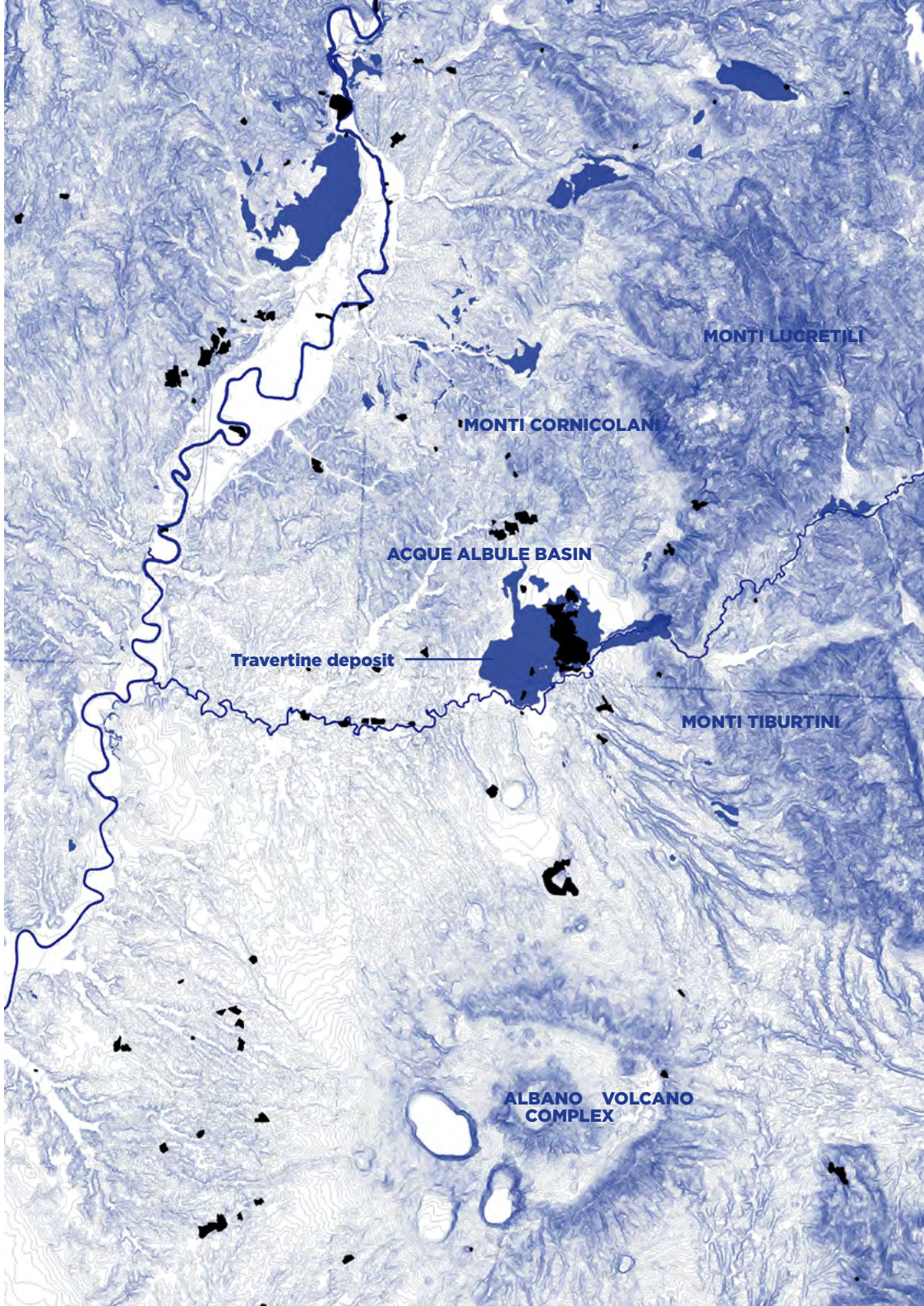


FIGURE 02

Contour lines relief that describe the topographical setting, highlighted are the surrounding mountains, and travertine reserves in the territory, along with the extraction basins.

- Extraction Basins
- Travertine Reserves
- Aniene and Tiber Rivers

Aniene River[13], overlapping the volcanic bed of the Alban Volcano. The overlap between the volcanic tuff bed, and various water resources, thermal, fresh and ground, rich vegetation, was fresh grounds to the deposition and accumulation of this specific form of travertine.

The geological conditions adapt for the formation of travertine, makes the territory rich for other resources. In the area, the quarrying of limestone, other forms of marble, tuff, volcanic rocks and other construction materials such as gravel, clay, silts, pozzolana, gesso (plaster), has been frequent. This has been basing the economy of the region on building and construction contracting. The abundance of natural resources, specifically thermal ground waters and building material, and their centuries long extraction has always characterized this territory, resulting in topographic sculpturing of massive open pits of white basins of depths that range from 20 - 60 meters. This fascinating lunar scape of the travertine quarries has been noted by scholars such as Pirro Ligorio, who referred to it as *Il Paesaggio della Pietra* "The Stone Landscape"[14]. "Le Fosse" has been a place name since the 16th century, indicating an area with long, narrow ditches resulting from stone extraction in the Acque Albule basin. Furthermore, travertine quarries can be found at "Barco" and "Caprine," though the latter is no longer operational, near the entrance of Guidonia. Then this is followed by the estate of Martellone up to the Lucano bridge (figure 01) and the so called ditch "de' prati" (of the mead-

FIGURE 03

Geological formation of the territory, lithological map

- Extraction Basins
- Contour lines (75 meters)
- Aniene and Tiber Rivers
- Travertine Reserves

Lithologic Strata

- Alluvial colluvium
- Breccia
- Limestone
- Cinerite
- Clay
- Conglomerates
- Dolomites
- Fill soil
- Gravel
- Lava
- Slit
- Marl
- Pozzolan
- Pumices
- Red soil
- Sand
- Sandstone
- Slag
- Tuff

13 Travertine is a river sedimentary stone, the Aniene River not only is crucial for its formation due to its continuous flooding, but also a defining element of the territory.

14 Pirro Ligorio, Libro dell'antica città di Tivoli e di alcune famose ville: Cod. Ja. II.7, libro XXII, ed. Alessandra Ten, Edizione nazionale delle opere di Pirro Ligorio, 20 : Libri delle antichità, Torino (Roma: De Luca, 2005).

FIGURE 04

Ponte Lucano and the transhumance Re-edition by Giovanni Brun (dedicated to His Excellency Mons. Stanislao Sanseverino) of the collection of burin engravings made by Domenico Pronti in 1795. Source: www.info.roma.it

ows), with deep and solid stratifications[15].

This territory has been consistently also defined by its transitional nature. This is the landscape that historically has been conditioned by its position between Rome, and Tivoli (the historical geopolitical center), and topographically ease of transition, making it an obligatory crossing by Grand Tour artists in the 17th century. In addition, Transhumance allowed the development of the economy, trade and road networks, as it sits on the route that shepherds used on their way down from Abruzzo to the fertile pastures of the Roman countryside. This manifested in elements of transition (natural and infrastructural), the once navigable Aniene River, on which Romans shipped the travertine blocks to the center of Rome, and the Antique Tiburtina Road, military and commercial road still in use[16].

Several historical maps of territory outline four major and unique consistent elements that determine the character of the territory. The maps reveal how **[1]travertine and limestone extraction**, **[2] thermal water resources, ,[3] the Aniene River** and **[4]the Tiburtina Road** constitute the synthesis of the processes and memory of this territory as an important transitional landscape rich of resources. The analysis was carried out thanks to the existence of several research on the various landscape phenomenas, including Ninna and Vivalda's Acque Albule streams analysis of 2018[17]. The two maps selected highlight historical moments in which the territory was used. While quarrying initially started in the Roman epoch, as early as 200 BC, it was interrupted in upper medieval periods. Volpaia's map (figure 2) in the period in which the quarries were active

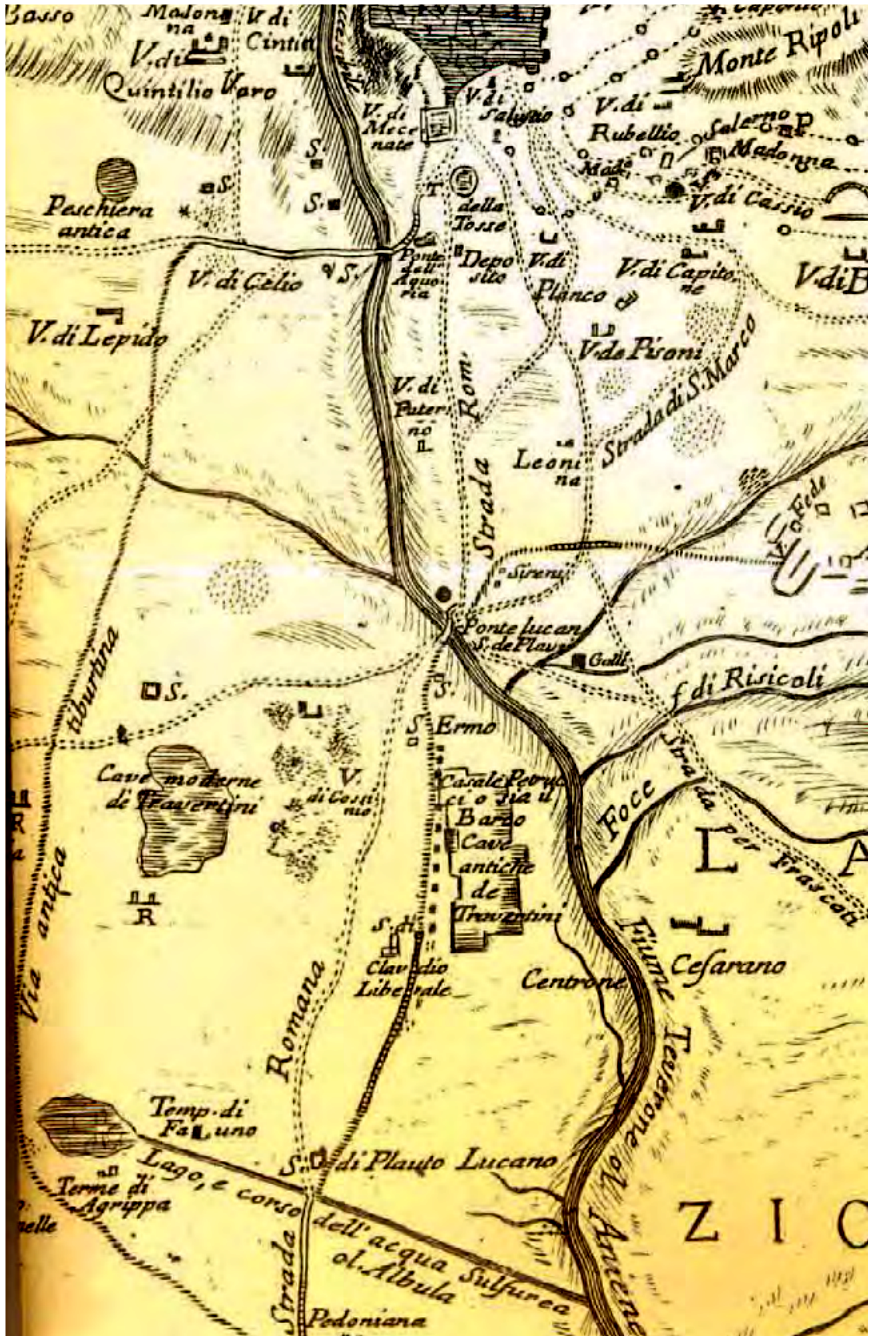
15 R.B. Maria Antonietta Tomei, Lapis Tiburtinus: La lunga storia del Travertino - The long history of travertine (Tivoli: TRITYPE srl, 2020).

16 The ancient Roma Tiburtina Road stretches, sometimes overlapping with the current road connection between Rome and Tivoli, Via Tiburtina. M. Erbani, 'Il Territorio Manoscritto, Strumenti per un'indagine territoriale lungo la via tiburtina da Tivoli a Roma' (Roma, 2023).

FIGURE 05

A fragment of Volpaia's map: Il Paese di Roma e tutti i luoghi particolari d'intorno Roma per XX miglia (quadro d'unione dei fogli da 1 a 6) - 1547 Eufrosino della Volpaia

17 Nanni, Livia, and Paola Vivalda. "Dalle mappe cinquecentesche all'attuale cartografia un percorso storico nell'analisi del rischio idrogeologico di aree antropizzate" Geologia dell'Ambiente, no. 2 (2018): 18–27.



again yet, and travertine was reused (as spolia[18]) from other monuments in Rome. The Acque Albule were then used to produce lime locally by exploiting the flakes of the "*testina*" - head, so called because it constituted the superficial -and therefore “head” - layer of the Travertine bench, the whose extraction was easier because of its less compactness. The lime was first destined for the construction in Tivoli (and Montecelio), then also to that which took place in Rome. Volpaia's map also depicts the “Romandia” as well, where it could be assumed that the memory of the existence of the ancient *lapidicina*, from which travertine destined for the edifices of Rome was extracted, still lingered, hence the name “Romandia” given by the 16th-century cartographer. The ancient quarry then became a lake, as it refilled with ground water seeping inside, which occurs still today in abandoned quarries, a topic that will be discussed in detail in upcoming chapters.

The boundaries of Roman quarry, *Cava del Barco*, is outlined in Bombelli's map, traved in the 18th century, one that will be repeatedly mentioned in texts and studies by Rudolfo Lanciani in the Agro Romano[19], but its traces completely erased now as extraction proceeded. The Bombelli's map highlights also "*cave moderni di Travertini*", (modern quarries of travertine) which would be the quarries of the Fosse, northern part of the reserve, where the travertine of

FIGURE 06

Pietro Leone Bombelli
1737-1809
Table containing a map of the agro tuburtini, a plan of the city of Tivoli, and a plan of Villa Adriaana. From the volume : Delle ville e de piu notabili monumenti antichi della città, e del territorio di Tivoli nuovo ricerche di Stefano Cabral, e Fausto Del Te'.

18 Art historians use the term spolia refering to the re-use of building materials, sculptures, or decorative elements taken from older structures and incorporated into new buildings, particularly in architectural or artistic contexts. The term originates from Latin, meaning "spoils" or "plunder," and is often associated with the practice in ancient and medieval times where materials from older, often ruined buildings were repurposed for new constructions.

19 Lanciani, Rodolfo Amedeo. Ruins and Excavations of Ancient Rome: A Companion Book for Students and Travelers (Classic Reprint). S.l.: Forgotten Books, 2018.

the major baroque projects was supposedly extracted from the beginning of the 15th century.

The territory's extractive "nature" has always been depicted in the paintings and prints of major artists from the late baroque to the 17th-18th century grand tour artists, as the most dominating image of the Tiburtine Plain. These include examples that range from Enrico Coleman's (1846 - 1911) moving paintings to the dutch painter Carel Max Quaedvlieg (1823-1874) and Ettore Roesler Franz (1845 - 1907) that were fascinated by the mixture of the already highly anthropic plain and the dominance of the water systems in the formation of its wide swampy fields in a romanticized version.

FIGURE 07 E. Coleman - Le cave di travertino

FIGURE 08 E.Roesler Franz - Le antiche cave del Barco

FIGURE 09 C.M. Quaedvlieg - Il trasporto di travertino

Travertine, the Living Stone

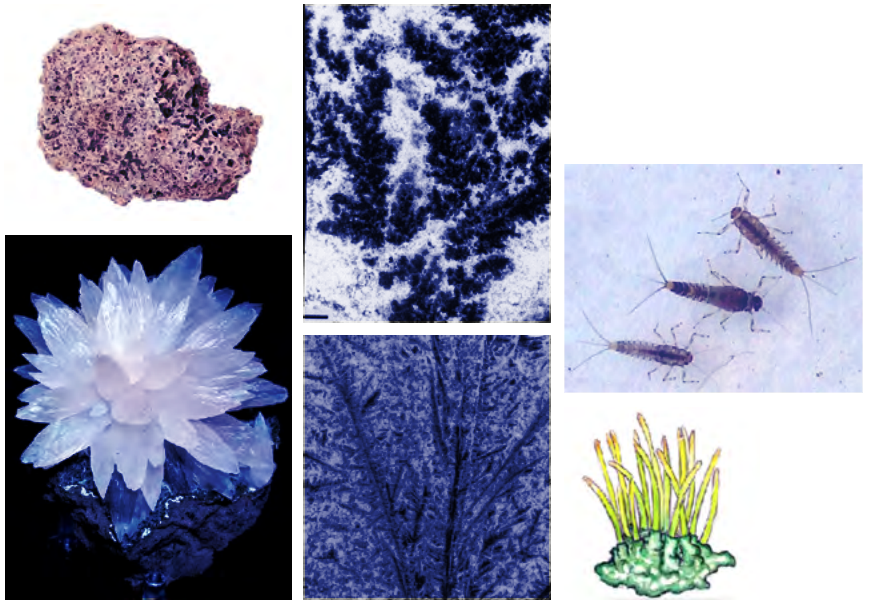
The Polish sculptor Igor Mitoraj, who frequently used travertine for his works, described the consistency of the stone as follows: "It is a stone that lives, quivers, vibrates, breathes, transpires. A carnal, sensual stone. It is born from water, or from a blend of water, earth, and debris. One must bend it to their own intentions...[20]"

Travertine, given its sedimentary nature, is a particularly useful rock type: for the geologist, it provides clues to the dynamic history of the Apennines and adjacent sedimentary basins; for the hydrologist, it reveals information about the evolution of the spring waters.[21] Fossils are commonly found in travertine, with imprints of leaves, gastropod shells, and vertebrate bones visible on the stone surface, giving travertine its porous structure its famous for. The characteristics of this kind of travertine, its formation in relation to the natures of its origin, may answer questions related to its persistence as a material to be selected beyond its aesthetic, for over 2000s years.

Travertine rocks form a relatively uniform group of stone types. Their diversity mainly lies in their color and the layers in which they are found. This stone is a product of elevated temperatures and spring waters, where there's spring water overlapping with volcanic beds, there's travertine. Nearly all travertines on Earth is formed through four key chemical reactions. The majority of travertine originates from the release of carbon dioxide as groundwater rich in the gas, with

20 R.B. Maria Antonietta Tomei, Lapis Tiburtinus: La lunga storia del Travertino - The long history of travertine (Tivoli: TRITYPE srl, 2020).

21 Renato Funiciello, The Seven Hills of Rome: A Geological Tour of the Eternal City, ed. Donatella De Rita, trans. Grant Heiken (Princeton: Princeton University Press, 2005).



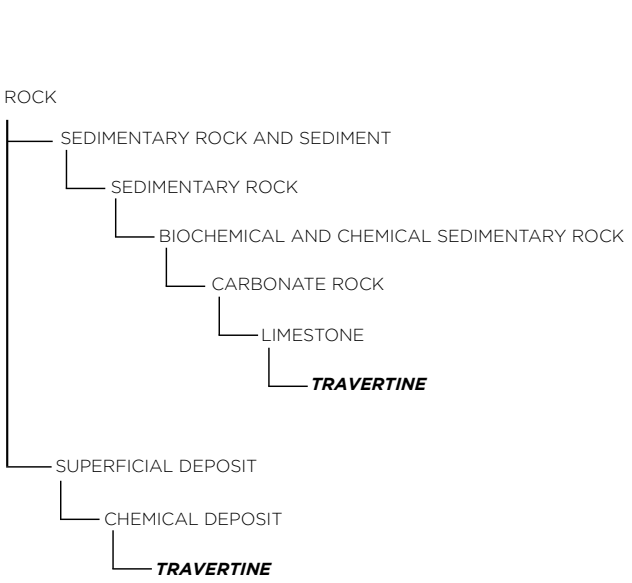


FIGURE 01

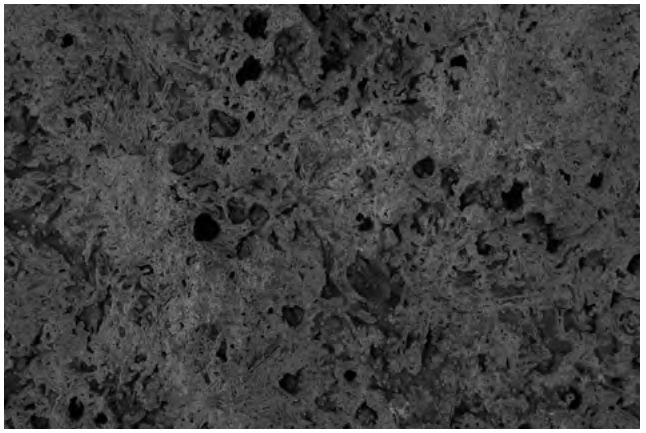
Inorganic and Organic components of Travertine
Natural specimen of Travertine limestone tufa
Crytalized Calcium Carbonate (Aragonite) © Rob Lavinsky irocks.com
Bacterial Shrubs or Crystal shrubs associated with Travertine formations
Byrophytes Vegetation (74% proportions of life-forms as taxa on European travertines)
Invertebrates living in Travertine systems: Baetis nymph (Ephemeroptera)

FIGURE 2

Classification of Travertine, by (mindat.org) project of the Hudson Institute of Mineralogy

FIGURE 3

Zoomed in image in the tiny creatures that make up the porous structure of travertine. Photo by: Bahareh Kheyreh, at the Getty Foundation, 2024



more than 80 ppm of calcium, surfaces. This type of groundwater, which can deposit travertine, arises when dissolved carbon dioxide (also known as 'carbonic acid') reacts with carbonate rocks, resulting in a solution filled with calcium and bicarbonate ions, referred to as 'calcium bicarbonate'[22].

The travertines of the Acque Albule have always been home to historical, archaeological, and natural reserves[23]. Fossilized plant imprints are crucial to the appearance of travertine. Bacteria and other microorganisms get trapped, as travertine sediments forming the lacy pattern it is known for, forming its stripes and irregular openings. These voids vary to the travertine's sedimentation history and type, and they can make up to 45% of the rock's volume[24]. The appearance of the stone is strictly determined by the organic and inorganic processes of this calcareous

22 the described chemical reaction is: $CaCO_3 + CO_2 + H_2O = Ca^{2+} + 2(HCO_3^-)$ – more about travertine's formation is in Pentecost, A. Travertine. London: Springer, 2005.

23 Romeo Di Pietro et al., 'Floristic and Coenological Data from the Travertine Substrates of the SAC "Travertini Acque Albule (Bagni Di Tivoli)" (Lazio Region – Central Italy)', Plant Sociology 59, no. 2 (30 December 2022): 51–70, https://doi.org/10.3897/pls2022592/05.

24 Alfonso Acocella, 'TRAVERTINE, AN ITALIAN STONE Location and characteristics of the material', Architetturadipietra, 31 March 2011, 303.

FIGURE 4

two fossilised leaves in travertine, photo from the official website of the Getty Foundation, Photo: Erin Migdol

incrustation; as vegetation becomes embedded and decomposes during the stone's formation, leaving behind distinct marks and voids that reveal the wildlife that made up the territory in the epoch it had formed.

Rocky and soil-free surfaces are not usually associated with high presence of biodiverse ecosystems, due to the limited space for roots, and scarcity of water. However, this is not the case of the unmatched capacity of generating rich biota of travertines[25], despite the challenging chemical diversity of its source waters. Its thin soils result in these micro-scale ecosystems, composed in lichens, flora and fauna of very small volumes, with an elevated environmental interest, rich of species that are rare and protected[26].

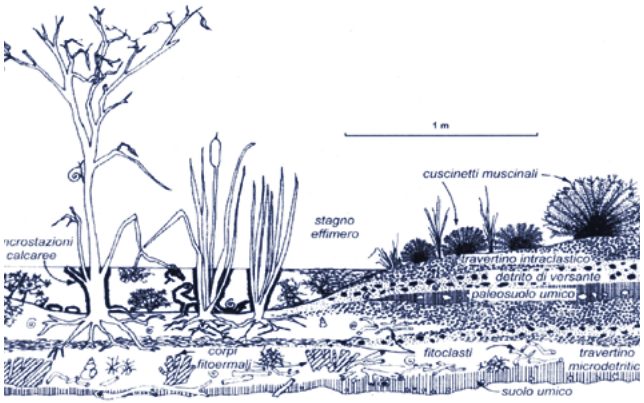
Travertine, under the right circumstances, forms in real time. Its calcareous encrusts and englobes organic matter, rendering the stone a transforma-

25 A. Pentecost, Travertine (London: Springer, 2005).

26 Marco Giardini, 'Aspetti Floristici e Vegetazionali Dei Travertini Delle Acqua Albule (Tivoli, Roma)' Cura di M. Giardini-Atti del convegno sil tema: "Il Trvaertino, aspetti naturalistici e sfruttamento industriale all'inizio del terzo millennio" (2002): 46–66.

FIGURE 5

Diagram illustrating the most common travertine formation environments, (from PEDERY, 1990; modified).



tive agent of the landscape. However, the formation and continuous sedimentation of travertine highly depends on specific environmental conditions. Sites in which travertines continue to formulate, are called "Active Travertines", and are often very fragile environments, they are calcium-abundant settings in freshwater bodies, and when these areas are densely vegetated, they provide sufficient nourishment and habitat for several flora and fauna.

Indeed this specific travertine deposits at an average rate of about 0.43 mm/year, meaning it takes about 25 years to form a crust one centimeter thick[27]. As for the thickness of the reserve that ranges between 60-80 meters on average. The deposit is between 165,000 and 480,000 years old, making it very young compared to other stones such as granites whose origins go back billions of years in the geological eras. The speed in which travertine deposits is also due to the depression (subsidence) of the plain, a natural phenomenon that occurs in limestone deposits.

The plant and animal life found in areas where travertine is actively forming has captivated biologists for over two centuries. The unique physical and chemical conditions of these areas support a wide variety of life forms, many of which have developed unusual adaptations to thrive in an environment where deposits accumulate quickly. Consequently, fossils are commonly found in travertine, with imprints of leaves, gastropod shells, and vertebrate bones visible on the stone surface. This turns this sedimentary stone into a living-archive, making it a useful rock type for geologists, as it supplies clues of the Apennines; and the hydrologists as they detect patterns of evolution of spring waters; as well as for archaeologists and art historians, as it archives in its folds sculptures of past inhabitants of the territory.

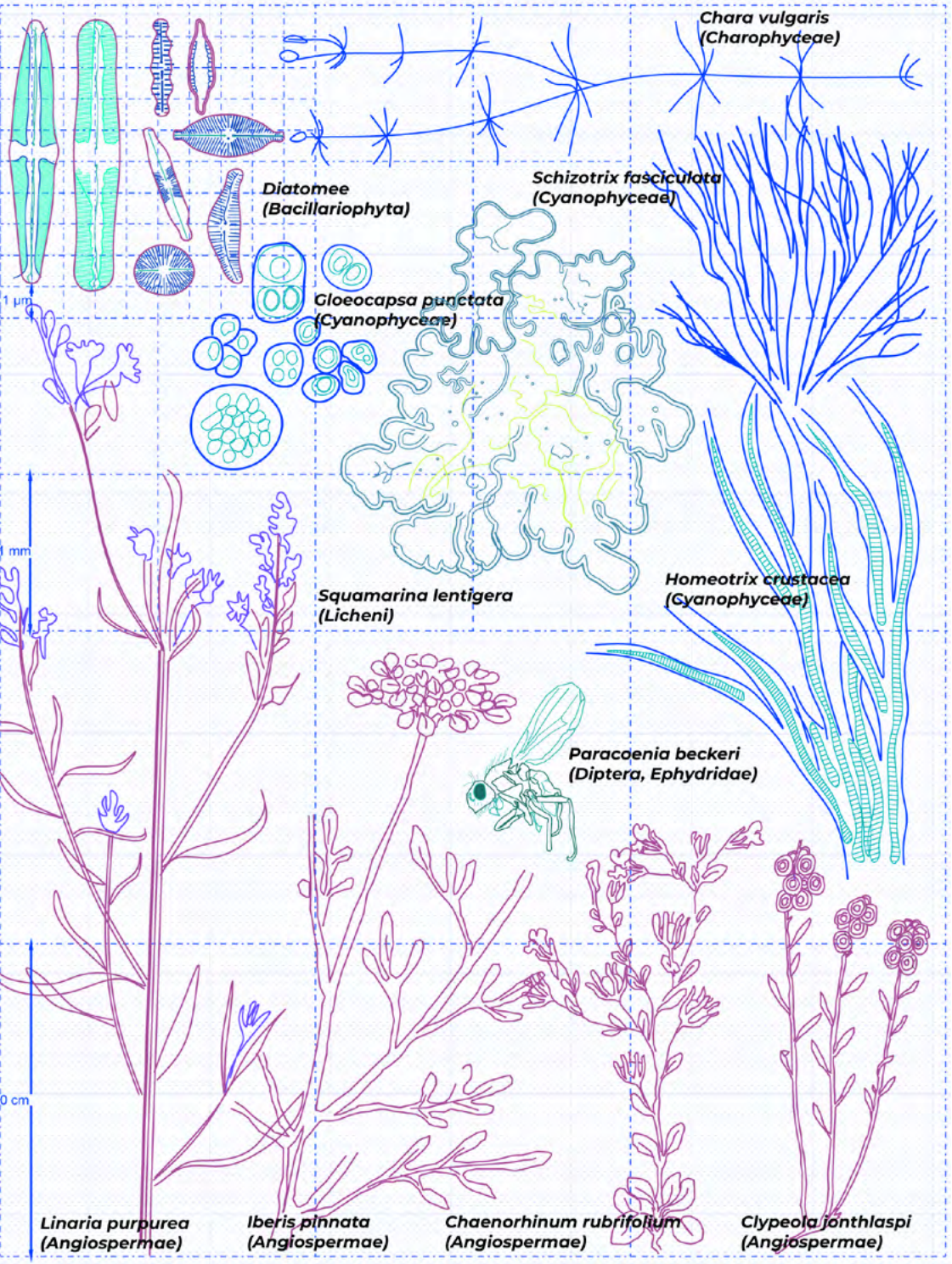
The diagram of the tiny creatures, Figure 6, with some only observable through the microscope, are organized in a way that takes inspiration from the panels of ecologists that study relationships like E. Haeckel, Jacopo Ligozzi[28] and A. Scilla. The background is the travertine, the habitat, for which these creatures were situated for their "collective entirety, in their general and continuous mutual interrelationships[29]". They're arranged in the diagram with liberty of arranging them to scale, for the interest of landscape architectural discipline, taking creative liberties beyond the natural sciences disciplines.

In Tiburtina's travertine basins at the smallest

27 Giampaolo and Aldega, "Il Travertino."

28 Jacopo Ligozzi is a natural painter, who along with Ulisse Aldrovandi, have had an impact on floral and fauna illustrations and contributed greatly to the botanical collections in the 1500s C.T. Gallori and G. Wolf, 'Three Snakes, Three Birds and Some Plants: Jacopo Ligozzi's "inimitable" Drawings and Their Copies or Translations between Ulisse Aldrovandi Projects and Semiprecious Stones' 57 (January 2015): 213–51.

29 Heackel, Generelle Morphologie, vol.02, pg: 240, as reported in Rainer Willmann's Nature Science and Art in the Work of Ernst Haeckel, Capuano et al., The Landscape as Union between Art and Science.



scales, prokaryotes like *Chromatium* dominate[30]; they form a carpet of 2-5mm on the travertine surface, creating a cushion to accommodate other creatures[31]. These creatures include oxygen producing tiny plant shrubs cyanobacteria: the microbes that have the remarkable capacity to generate oxygen, they're the ones that changed the chemical composition of the planet[32]. In its waters variations of green algae thrive, ones that rarely survive in sulfide rich hot waters, but here, twenty species in travertines have been observed. These include *Charales Vulgaris*, creating the travertine plant-like hairy texture[33], as the chemicals attach and deposit on them.

In this territory we find plant entities of high interest because of their rarity, such as *Iberis pinnata L.*, for which Montarozzo del Barco was until recently its only known location in Lazio, along with five other species present in the hill (B*iarum tenuifolium, Iberis pinnata, Linaria purpurea, Onosma echioides*). Some of the rare and protected species in Lazio include *Linaria Purprea (L.) Miller*, *Clypeola jonthlaspi*, and *Chaenrhium Rubrifolium*[34]. All the mentioned plants are reported here for those whose maximum heights don't exceed 10 centimeters.

Their observation requires additional sensitive effort, kneeling, lying down, making visible a range

30 Paolo Tortora and Allan Pentecost, 'Bagni Di Tivoli, Lazio: A Modern Travertine Depositing Site and Its Associated Microorganism', Bollettino-Societa Geologica Italiana 108 (January 1989): 315–24.

31 Giovanna Della Porta et al., "The Influence of Microbial Mats on Travertine Precipitation in Active Hydrothermal Systems (Central Italy)," The Depositional Record 8, no. 1 (February 2022): 165–209, https://doi.org/10.1002/dep2.147.

32 Kartik Aiyer, 'The Great Oxidation Event: How Cyanobacteria Changed Life', ASM.org, accessed 12 June 2024, https://asm.org:443/Articles/2022/February/The-Great-Oxidation-Event-How-Cyanobacteria-Change.

33 A. Pentecost, Travertine (London: Springer, 2005).

34 Marco Giardini, 'La flora vascolare del Montarozzo del Barco Tivoli (Tivoli, Roma)', in Annali Del Museo Civico Di Roverto, vol. Sezione: Archeologia. Storia.Scienza Naturali, 28 (Tivoli, 2012), 161–97.

FIGURE 6

Tiny creatures of travertine, are here visualized some of the species found in travertine ecosystems, botanic data is revised by Marco Giardini, categories include green algae, diatoms, lichens, and rare vascular plants in the region, diagram by Sara Ahmed, 2024

of other very rare lichens, such as *Squamarina lentigera*[35], along with tiny animals, and worlds that are otherwise unnoticeable. Small animals that resist in these carbonate-depositing habitats include the incredible rediscovery of the endemic fly *Paracoenia Beckeri*, which has been reported for the first time after almost 60 years, a species that doesn't exist anywhere else in the world[36].

Some of the most significant species mapped by the extensive work of the Italian botanist, one of the most relevant in the 20th century, Giuliano Montelucci[37], from Guidonia, who since 1947 highlighted the elevated biodiversity of the flora associated with travertine beds. That work is then extensively picked up and updated by botanists like Marco Giardini, who mapped the elevated rich habitats of at least 420 species. They outlined travertine's specific capacity to generate biodiversity, including the numerous mappings of the botanical and fauna species that thrive within travertine's ecosystems. Ones that also include natural monuments such as: the *Montarozzo del Barco*[38], an ancient Roman artificial small hill, known as the "Hill of the Hanged" due to the executions that once took place there[39]. This hill, formed through the scraps of the travertine residues by the Romans extraction activities 2000

35 Romeo Di Pietro and Duilio Iamonico, 'Plant Ecology for the active conservation and sustainable management of the territory. The question of the "Travertini Acque Albule" protected area' (Plant Sociology, n.d.).

36 E Edoardo Pulvirenti et al., "Rediscovery of Paracoenia Beckeri (Kuntze, 1897) in the Acque Albule Plain, Italy: Implications for Conservation and Ecosystem Restoration," 2024, https://doi.org/10.13140/RG.2.2.17154.49609.

37 Marco Giardini, Le 'Conversazioni Di Ecologia' Di Giuliano Montelucci.

38 Montarozzo (Roman Italian) is a Mound, low relief; mound, heap (of earth, stones, debris or other), as defined by the Italian Dictionary Treccani, https://www.treccani.it/vocabolario/montarozzo/

39 Mari Z., La cava del Barco e la piana delle Acque Albulae nell'antichità, in Il Travertino. Aspetti naturalistici e sfruttamento industriale all'inizio del terzo millennio, atti del convegno (Guidonia 2000), a cura di Giardini M., Guidonia 2002.

FIGURE 7

Moterozzo del Barco, photo by Giuliano Montelucci taken in the 1930s

years ago, took its shape from the accumulation of stone debris from quarrying activities over time. It stands out in an otherwise flat landscape dotted only with haystacks. Travelers heading to Tivoli were often captivated by the atmosphere of the site, which is remembered in various works of art that have survived. Historical records describe how the *Montarozzo del Barco* formed from stone fragments that fell during the cutting of large travertine blocks, a process that contributed to the hill's distinctive shape. Not far from here, another small, cone-shaped hill is thought to have been created from similar stone fragments from nearby ancient quarries. These stones were transported to Rome via the *Teverone* River (now the Aniene) for use in Roman buildings. The hill's striking appearance, now wrapped in thick vegetation, dates back to the early days of quarrying in the region. Over the centuries, the landscape of the Acque Albule has changed as quarrying activities waxed and waned. In the 18th and 19th centuries, when the quarries were no longer in operation, the area became a popular destination for artists and travelers. Now this hill is home to some the most

unique fauna and flora in the territory and described as a "living bank" of biodiversity in the Tiburtine Territory[40].

We're currently facing a simultaneous de-aestheticization of (operational) landscapes[41] and an over-aestheticization of landscape architecture[42]. In the current cultural geography, landscape research relies on representation that determines space, power and knowledge through images, maps, and texts[43]. Representation can play an important role in highlighting the small and fragile realities of the quarrying landscape, the protection of which has been neglected by travertine production processes. Emphasis must be placed on non-human forces, on 'vibrant matter' and the role it can play in transforming the landscape. A 'vital materialism' to be represented in order to be able to practice and support political ecologies[44] in the pedagogy and practices of landscape restoration.

Babette B. Tichleder in an essay "Theorising Things, Building Worlds: Why the New Materialisms Deserve Literary Imagination" builds on theories of new materialism[45] criticizing and extending Latour's

40 Giardini, 'Aspetti Floristici e Vegetazionali Dei Travertini Delle Acqua Albule (Tivoli, Roma)'.

41 Operational landscapes as defined by Brenner and Katsikis in Neil Brenner and Nikos Katsikis, 'Operational Landscapes: Hinterlands of the Capitalocene', Architectural Design 90 (January 2020): 22–31, https://doi.org/10.1002/ad.2521.

42 Alessandra Capuano et al., eds., The Landscape as Union between Art and Science: The Legacy of Alexander von Humboldt and Ernst Haeckel = Il Paesaggio Come Unione Tra Arte e Scienza: L'eredità Di Alexander von Humboldt e Ernst Haeckel, Auflage (Marcerata: Quodlibet, 2023).

43 Olivia Mason and James Riding, 'Reimagining Landscape: Materiality, Decoloniality, and Creativity', Progress in Human Geography 47, no. 6 (December 2023): 769–89, https://doi.org/10.1177/03091325231205093.

44 J. Bennett, Vibrant Matter: A Political Ecology of Things (Duke University Press, 2010).

45 Babette B. Tischleder, 'Theorising Things, Building Worlds: Why the New Materialisms Deserve Literary Imagination', Open Cultural Studies 3, no. 1 (1 February 2019): 125–34, https://doi.org/10.1515/culture-2019-0011.

notions of nonhuman agency[46], and Jane Bennet's "things power[47]", where Bennet suggests focusing on the trajectories of the material things themselves, rather than the human subjectivity of them. Bennett's essay on the 'power of things' begins with a narration by Robert Sullivan, who recalls the vitality of rubbish, emphasizing that living materiality cannot be 'thrown away':

"The garbage hills are alive . . . there are billions of microscopic organisms thriving underground in dark, oxygen-free communities. . . . After having ingested the tiniest portion of leftover New Jersey or New York, these cells then exhale huge underground plumes of carbon dioxide and of warm moist methane, giant stillborn tropical winds that seep through the ground to feed the Meadowlands' fires, or creep up into the atmosphere, where they eat away at the . . . ozone."[48]

This passage brings to life the idea that even waste, seemingly discarded and unwanted, continues to exhibit its own vitality and agency. The debris within landfills remains active, constantly engaging in processes that affect the environment. Through Tichleder's lens, Bennett's concept of "thing-power" reveals a dynamic interaction between human discards and the natural processes that transform them, urging us to reconsider our relationship with the material world. These representations of microscales of bacteria and tiny beings in travertine's foils advocate for an affective shift of the material from dead to vibrant, regenerative and incorporating vari-

46 Benjamin Noys, 'Matter Against Materialism: Bruno Latour and the Turn to Objects', in Theory Matters, ed. Martin Middeke and Christoph Reinfandt (London: Palgrave Macmillan UK, 2016), 81–93, https://doi.org/10.1057/978-1-137-47428-5_6.

47 J. Bennett, Vibrant Matter: A Political Ecology of Things (Duke University Press, 2010).

48 R. Sullivan as Cited in Jane Bennet, pp 06, Bennett, Vibrant Matter: A Political Ecology of Things.

ations of life forms. Engaged empathy with the more-than-human worlds[49], can be one of the ways one can stimulate the awareness to take action towards territorial conservation, environmental monitoring and a democratic management of natural resources.

Tichleder's essay analyzes the inherent limit of narration and storytelling for nonhuman actors, exploring how we can engage in other alternative forms of representation, aesthetics, and interactions. Nonetheless, in these contexts, new materialism frameworks are also limited by their highly theoretical degree, which have been very useful for the reinforcement of a theoretical attempt of viewing materials as "living actants".

Using Bennett's political ecology abstractions was conceptualised by the Canadian author and designer Mau exemplifies clear communication of sustainable design ideas, in his talk, "How Design Can Change the World". What resonates most with this research is Mau's focus on empathy as the driving force behind transformative design. By emphasizing empathy, a universally understood human emotion, he offers a practical and realistic way to motivate society at large. His insights not only make sustainable design more accessible but also inspire a shift in thinking, encouraging both designers and the wider public to approach building a better future with creativity and empathy[50].

49 Lori Gruen, 'Attending to Nature: Empathetic Engagement with the More than Human World', Ethics & the Environment 14 (September 2009): 23–38, https://doi.org/10.1353/een.0.0032.

50 Mau, Bruce. "5 prinsipper for hvordan design kan forandre verden." Accessed September 20, 2024. https://doga.no/aktuelt/fem-prinsipper-for-hvordan-design-kan-forandre-verden/.

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Terraforming (n.)

Terraforming is the hypothetical process of transforming the environment of a planet, moon, or other celestial body to make it habitable for Earth-like life. This involves altering its atmosphere, temperature, surface topography, and ecology to create conditions similar to those on Earth, such as breathable air, stable climates, and liquid water.

2.2 FROM THE STONE OF THE EMPIRE TO THE EMPIRE OF STONE

Mining and quarrying are estimated to move over 57 billion tons per year world wide, which is 10 times as much as glaciers and a little more than the amount moved by water erosion each year[51]. Indeed, mining and quarrying is—perhaps the largest landscape project of the twenty-first and twenty-second centuries[52]. These theoretical frameworks expand the scale of quarrying to planetary scale transformation[53], applying the metaphor of *terraforming*[54], in the sense of the planetary transformation as an adaptable place for the life of humans, to the way in which capitalist extraction transforms and exploits the landscapes in a planetary scale.

In an epoch of evident planetary paradigm shift, it is now taken for granted the need to view and measure everything from a global lens, to understand the depth and extension of extraction processes. The documentary produced in 2018 with the term coined by Curtzen, discussed in the previous chapters, "Anthropocene: the Human Epoch (2018), describes as a cinematic meditation on humanity's massive re-engineering of the planet. Extraction and its landscapes features as a main component of what the filmmakers chose to portray the transition of this form

MAP 01

The map describes the distances and distinations that the Roman Travertine extracted from the Acque Albule crosses. They range from Miami to Los Angeles, to New Delhi and Shanghai on the east, on a short story of the globalization of this stone.

51 Bridge, The Hole World: Scales And Spaces Of Extraction.

52 A. Berger, "Representation and Reclaiming: Cartographies, Mappings, and Images of Altered American Western Landscapes," Landscape Journal 21, no. 1 (January 1, 2002): 1–22, https://doi.org/10.3368/lj.21.1.1.

53 M. Arboleda, Planetary Mine: Territories of Extraction under Late Capitalism (London, Brooklyn NY: Verso, 2020).

54 Terraforming as a concept was first popularized in science fiction, notably by authors like Jack Williamson, who coined the term in a 1942 short story called "Collision Orbit." The idea has since been explored by many other writers, including Kim Stanley Robinson in his Mars Trilogy, where he describes the terraforming of Mars in great detail.

FIGURE 1

Edward Burtnsky's Tyrone Mine, Silver City in New Mexico, USA, 2012. Scene from the documentary Anthropocene, source of the image: https://www.edwardburtynsky.com/projects/photographs/anthropocene

of human domination, using the dramatic but very real photography of Edward Burtynsky of the faraway but massive stretching extraction landscapes from Potash mines in Russia's Ural Mountains, to Martian landscapes sculptured by German monsters machines to extract coal in North Rhine, to surreal lithium extraction pools in Chile's Atacama Desert, a Carrara's marvelous marble sculptured landscapes of the Alpine, all visualised thanks to Burtnsky's wide landscape lens that allows the perception of the scale of extraction. What the documentary through the shocking tool of photography tells the story of one thing these Extractionscapes have in common: they are all larger than human perceivable local scale, they all operate and feed on a globalized market, and they operate as batteries and storages for the global economy. They feed a planetary scale: of a scale and speed of transformation that is in no way describable or justifiable, other than planetary

terraforming.

To read the territorial impact of travertine extraction, one must look at the empirical values of material produced, in the national context, and in comparison with other extracted building material to get a sense of the scales of extraction. This section will focus on the pragmatic economic and quantifiable aspect of stone production as the scope of this thesis, to then place it in its specific economic and political context that occur in this case in a global scale. It is very difficult to estimate the volumetric quantities of travertine removed from the territory. Some scholars tried to estimate this quantity to be 103 million m^3 in total, since extraction started, half of which was extracted only from in the span of 50 years, 1954 to 2005[55]. To put this in other terms, the Colosseum's volume is 1.3 million m^3, that makes them almost around 80 Colosseums worth of travertine removed from the basin.

The corridors of stone discussed by this chapter indicate movement, transition, motion of material, in other terms material flows. The corridor is a metaphor for the spatiality that this flow of material creates, while operational landscapes of logistics of resource extraction have tangible physical realities, those of transition and motion are harder to imagine. They occur in a temporary transitional fashion without creating boundaries or spaces, but their consistency, repeated occurrence renders this imaginary corridor permanent to the ends of their exhaustion. The spatial dimension

55 According to a study conducted by Ruggero Martines in 2020, the urban assessor head of the PUGT project of 2016, 50 million cubic meters were estimated in Giampaolo, Ciriaco, and Luca Aldega. "Il Travertino: La Pietra Di Roma." Rendiconti Online Della Società Geologica Italiana 27 (July 2013): 98–109. https://doi.org/10.3301/ROL.2013.23.

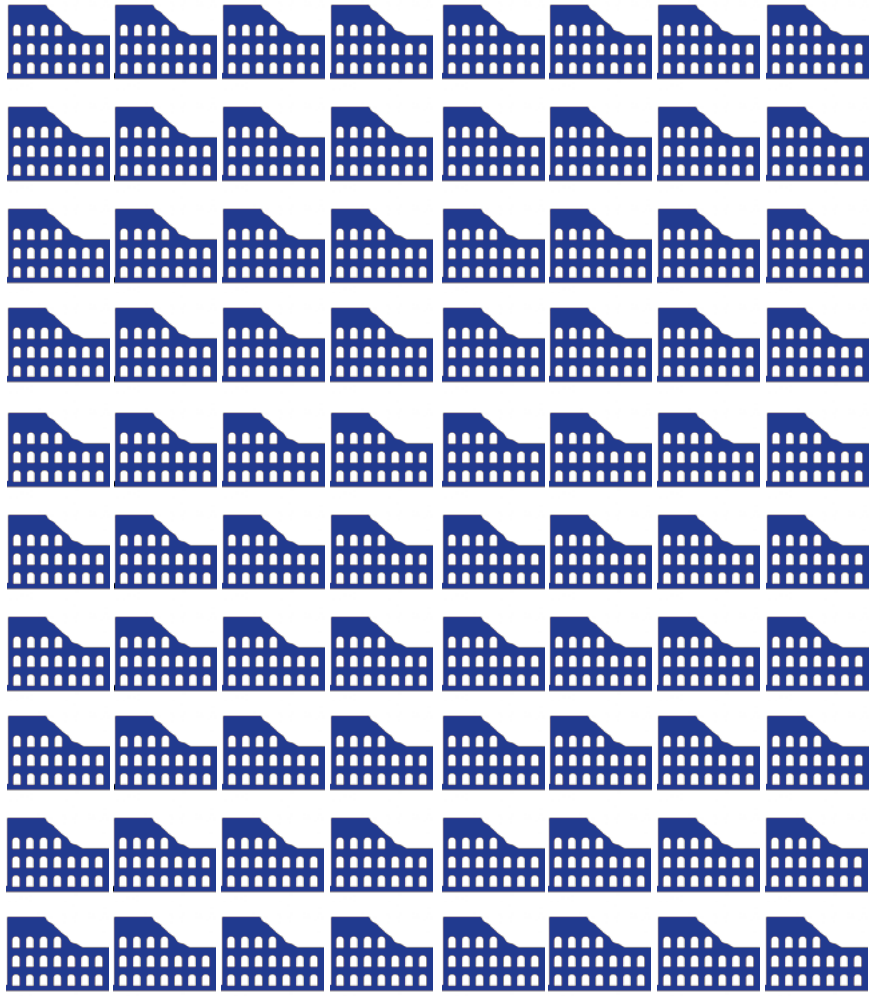


FIGURE 2

From the Roman era, it is estimated that the basin of Acqua Albule produced 103 million cubic meters of raw travertine the equivalence of 80 colosseums (the colosseum weighs around 1.3 cubic meters)

of the cargo ship that takes the material from one continent to another is temporary, but temporary is when the demand is constant and therefore the corridor dedicated to this material flow becomes permanent.

We have established in the first chapter processes of landscape territorialization in terms of its commodification and turning natures into measurable cubic tangible resources. However, in the planetary extraction of globalization, extraction goes through processes of deterritorialization, building on Mazen Labban's notion of planetary mine, extraction "vastly transcends the territoriality of extraction and wholly blends into the circulatory system of capital, which now transverses the entire geography of the earth[56]. As extraction involves more than the mere spatiality of the mine, or as touched by Gavin Bridge in his paper about energy extraction "the Hole World" Global de-territories of extraction, touched upon by this section, extend beyond the physical manifestations and transformation of extractive capitalism. "The hole is an essential part of extraction, but the hole is just the start"[57].

Strong connections emerged as a result by this research, between the architectural project, territorial organization, and its planetary production structures. The activity surrounding the travertine quarries demonstrates the urban demand's ability to dictate how available resources and capital were utilized and to encourage a rational allocation of resources. Architectural material selection transforms territories, even if material selection seems arbitrary to availability and aesthetic, we argue that travertine selection has always been political. The travertine may be an excellent material for mediterranean climates, it is not exactly perfect for other climates. Despite its structural material flaws, due to its porosity and permeability, travertine does not react well for instance to chemicals, or frosting and cold climates, it is still selected in varying contexts around the world. The stone's convenience of geographical vicinity has not been the case for other political architectural projects[58].

This section investigates on how this material continues to be among dominating architectural material trends internationally in the first part, secondly, it argues for the rather very political symbolic value of this stone, that has transformed into an economic global value today. In the third segment we place this study within the stone extraction industry in Italy, which is essential to read the economic conditions that condition the territory to an unsustainable socio-ecological practices. It finally places the Italian context within the planetary scale of *terraforming* scales of urbanization that result from the extraction model.

56 Labban, Mazen. "Deterritorializing Extraction: Bioaccumulation and the Planetary Mine." Annals of the Association of American Geographers 104, no. 3 (May 4, 2014): 560–76. https://doi.org/10.1080/00045608.2014.892360.

57 Bridge, G. The Hole World: Scales And Spaces Of Extraction. SCENARIO 05: Extraction, 2009.

58 Vaquero Pinero.

Politicizing the history of Stone

This is the stone praised by the most important buildings and historians of history. Giorgio Vasari praised the properties of travertine because "it is very useful for building and making carvings of various kinds," and particularly notes that the best deposits were those located near the "*Teverone* (Aniene) River at Tivoli"[59]. Vitruvius considered the stone to be of excellent quality due to its extreme resistance to weight and the passage of time[60]. However, its material and aesthetic characteristics alone don't justify or explain on their own the ongoing international demand for this material up to this day, despite its material flaws in colder and frozen climates, and its relatively higher price than other local materials.

Indeed, travertine has starred in architectural movements, from the representing stone of the ancient Roman Empire to the Baroque and Fascist movements, this stone proves to have more than an aesthetic role. Tracing some stories history of travertine construction, might provide an explanation for the timeless trendiness and continuous use of the material. Some of these trends might be caused by the architectural contributions of architects like Richard Meier and Pietro Belluschi[61] in perpetuating the significance of this stone internationally in the contemporary era. The symbolic dimension is inevitable in architectural projects, neither is political dimension of the consistent use of travertine. We argue that it carries more significance than a mere

59 Giorgio Vasari, Le vite de' piú eccellenti architetti, pittori et scultori italiani, da cimabue insino a' tempi nostri: nell' ed. per i tipi di Lorenzo Torrentino, Firenze 1550, ed. Luciano Bellosi, I millenni (Torino: Giulio Einaudi editore, 1986).

60 Vitruvius Pollio et al., De architectura, I millenni (Torino: Giulio Einaudi, 1997).

61 Maria Antonietta Tomei, Lapis Tiburtinus: La lunga storia del Travertino - The long history of travertine.

FIGURE 3

Travertine from
the courtyard of
Barcellona's pavillion
the Colonade of piazza
dei colonadethe great
mosque, algeria, photo
by: Viola Corbari
the colonade of Saint
Peters,
Palazzo della civiltà,
Roma
Casa dei Crescenzi

continuation of the use of the material that represents the aesthetics and genius loci of Rome. " This political agency is inseparable from the materiality of architecture" as Antoine Picon elaborates on this argument using the political symbolic significance of the ornament[62].

During the Imperial era, travertine became the most utilized stone in monumental architecture due to its durability against external elements, ease of workability, mechanical properties, and convenient transportation along the Aniene river. It was prominently used in structures such as the Theatre of Marcellus (10 BC), the Colosseum (80 AD), and various temples and arches. While the Romans may have heavily used this stone for its geographical vicinity, this is not necessarily the case for which the subsequent architectural movements relied on it for.

With the fall of the Roman empire, travertine has been a famous subject of spoliation, stripped from buildings throughout the medieval period, to be placed as precious ornaments in aristocratic structures, as evidenced in various upper medieval period monuments. Spoliation practice would continue until its ban by Pope Pius II in the 15th century, as one of the earliest acts of protecting archaeological monuments, began to prohibit the destruction and reuse of marble and travertine blocks[63]. The famous banning of *"Demoliri, destruere, seu comminuere, aut rumpere, seu in calcem convertere"*[64] that travertine has been subject to, has resulted an increase in the demand of this stone, leading to the reopening of quarrying for travertine again in the Acque Albule, this time, on the Northern edge of the quarries. The quarries would be called "*Le Fosse*" or the ditches as labeled in several cartographies of the 15th - 17th century, and would occur in the northern part of the travertine basin.

The Renaissance projects aimed to the revival of ancient values led to the planning of a new Rome using the same materials once favored by the its ancient emperors. Travertine, therefore, regained its former prestige, and with it, the Roman quarries, after centuries of inactivity, once again became bustling centers of work and labor[65]. The opening of San Pietro project in the 15th century has created a historical dominating force in the territory of the Acque Albule. This large-scale supply of materials in addition to the intense navigability of the Aniene River, turned the previously lime kilns and swampy transitional area to an industrial extraction site animated with movement.

Other historical urban events in the new capital of the now united Italy caused other openings of the quarries after a period of decrease of demand. Major distinctive development projects of Rome in the 18th and 19th centuries relied on large quantities of travertine, for instance the Tiber Embankments project following the devastating flood of the late 18th century cladded the shores of the Tiber River with kilometers

62 Picon, Antoine. "Architecture, Materiality, and Politics: Sensations, Symbols, Situations, and Decors." In Political Theory and Architecture, edited by Duncan Bell and Bernardo Zacka, 1st ed., 277–94. Bloomsbury Publishing Plc, 2020. https://doi.org/10.5040/9781350103771.

63 Mannoni, Chiara. "Protecting Antiquities in Early Modern Rome: The Papal Edicts as Paradigms for the Heritage Safeguard in Europe." Open Research Europe 1 (May 13, 2021): 48. https://doi.org/10.12688/openreseurope.13539.1.

64 "To demolish, destroy, or break apart, or shatter, or convert into lime." - Fea C: Relazione di un viaggio ad Ostia e alla Villa di Plinio detta Laurentina fatta dall'avvocato Carlo Fea Presidente delle Antichità Romane e al Museo Capitolino.Roma: Fulgoni. 1802.

65 Manuel Vaquero Pinero, "Lavoro e Lavoratori Nelle Cave Romane Di Travertino in Età Moderna," n.d.

FIGURE 4

Film titled: *Le Cave di Travertino a Tivoli* (Travertine quarries in Tivoli) April 1931 IX. for the working of a vascha for the fountain in Piazza Viminale Film by Istuto Luce, which was was an Italian film corporation, created in 1924 during the Fascist era; snippets sourced from its online archive: https://www.archivioluce.com/

of Travertine walls of 5 meters high.

The Fascist architecture heavily employed travertine for its symbolic appearance that recalls the Roman Empire. Its deliberate revival and use through the impressive architectural rationalist movement's entrusted star architects, Marcello Piacentini, Enrico Del Debbio, Mario De Renzi, in the EUR expo city, Sapienza's University city campus in San Lorenzo, and the Foro Italico (just to name a few examples) have the instrumental the use of travertine that has become incorporated in its ideology[66].

The travertine cultural importance to the fascist movement is strongly demonstrated by the extensive documentation of the *Istituto Luce,* the Italian film corporation, and the fascist propaganda machine, one that now archives tens of documentaries, films associated with travertine used in fascist projects and extraction. One of these most important productions is *Le Cave di Travertino A Tivoli*, of 1931, one that explains the process of carving out the basin of the fountain of the Viminale in the center of Rome from the quarries of Tivoli. These are some of the various other examples of the invaluable cultural significance this limestone had in the architecture that was instrumental to the movement's ideologies.

Rome is indeed the city of travertine; Paolo Portoghesi described travertine as "...the material which, more than any other, contributes to determine the character of Rome". Travertine, even after falling in and out of trend, is still a defining element in Rome's post-contemporary architectural projects. Key projects include Richard Meier's Jubilee

66 Dal Falco, Federica. "Italian Rationalist Design: Modernity between Tradition and Innovation." Arts 8, no. 1 (February 22, 2019): 27. https://doi.org/10.3390/arts8010027.

Church (formerly known as *Chiesa di Dio Padre Misericordioso*) in Roman hinterlands and the Ara Pacis, with its long history and controversial association with the Duke. Even the seemingly apolitical projects like Portoghesi's Grand Mosque of Rome and Piazza San Silvestro, in the historic center, the cladding in travertine has a specific Site-historic value. The examples are endless and the common denominator of the use of travertine does not only relate to its aesthetic, or ease of extraction. It is indeed a material that has been instrumentalized, valued and used in a political sense.

Today, Roman Travertine is a heavily exported commodity that depends on the fluctuating global market. After a brief economic dip as it competed with other travertines from Turkish and Chinese quarries, the Getty project has refreshed travertine's material international trendiness. Carlo Mariotti, an important quarry owner from Tivoli, is known for having popularized the use Tivoli stone in the US, creating one of the most important travertine markets. His three generation travertine industry was employed for other projects in the US such as Lincoln Center for the Performing Arts, MetLife – 200 Park Avenue, Walt Disney Concert Hall and many others.

Roman Travertine's liveliness, fossils, and porous properties had a strong international presence, that would determine the market trends of the stone in the upcoming decades. Indeed, travertine's appearance was determinant for Richard Meier's materials selection for the Getty Foundation Project. When travertine was first suggested to Meier, it was immediately refused due to its recognizable veins obtained through the stone cutting across its sediments, allowing the material to resist compression. That was until a rough finish was proposed and successfully

FIGURE 5

Travertine's rough texture resulting from the guillotining in Getty Foundation Project's exterior, by Richard Meier, photo CC: Wil Stewart

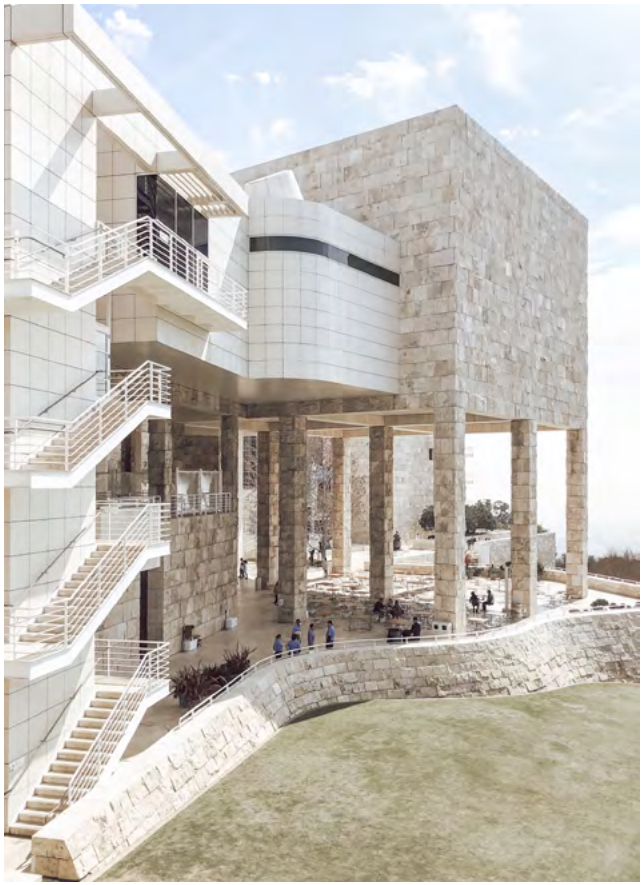


FIGURE 6

Travertine's rough texture resulting from the guillotining in Getty Foundation Project's exterior, by Richard Meier, photo CC: Kim Stewart

obtained through use of the cutting parallel to its veins, a technique developed specifically for the Getty project first, then in other projects, including the Ara Pacis Museum in Rome. This is mainly due to the cutting (guillotining) technique developed specifically for this project to reveal the kinds of natures sedimented within the stone's foils, like opening the stones "pages" like a book.. The stone, like open perpendicularly disclosed fossils, and forms of life of the Tiburtine landscape from 400,000 years ago[67]. Today, Getty's visitors tour the campus to treasure-hunt for visible plant fossils within the stone's foils that Meier referred to as "feature stones", that were carefully placed at eye-level throughout the campus.

The Getty's Project 300,000 travertine blocks, 50,000 tons and 160,000 m² of this limestone stone[68] has crossed the ocean from central Italy's biggest travertine extraction basin: the Acque Albule. The project's success was due to the warm Mediterranean atmosphere that it conveyed through the excessive use of the this limestone in the warm and sunny weather in Los Angeles. Its use in the United States was however not popularized by the Getty Foundation, we argue that it was actually Pietro Belluschi who introduced and popularized the Roman Travertine in the American Architectural scene.

Pietro Belluschi (1899–1994) was an influential Italian-American architect known for his significant

67 Travertine started depositing relatively recently, giving it its soft-to-cut and easy to extract, in addition to its visually compelling natural qualities, Luigi De Filippis and Raniero Massoli-Novelli, "Il Travertino Delle Acque Albule (Tivoli): Aspetti Geologici Ed Ambientali," Geologia dell'ambiente Sigea, no. SIGEA 2/98 (n.d.).

68 The data and numbers were reported by Fabrizio Mariotti, the grandson of Carlo Mariotti that had supplied travertine to Getty and other Meier projects throughout the 1980s-2000s. Fabrizio Mariotti, 'The architecture of travertine in our time', in Lapis Tiburtinus: La lunga storia del Travertino - The long history of travertine, by R.B. Maria Antonietta Tomei (Tivoli: TRITYPE srl, 2020), 130–58.

contributions to modernist architecture in the, is also responsible for popularizing the use of travertine in the United States. He later became a leading figure in the architectural scene, particularly in the Pacific Northwest, where he championed modern design blended with regional materials and sensitivity to the environment.

Pietro Belluschi used Roman travertine in several significant architectural projects to balance modernist design, offering an organic counterpoint to modern materials like steel and glass. Key examples include the Cathedral of Saint Mary of the Assumption in San Francisco (1967), where travertine added warmth and a serene atmosphere to the interior. In the Pan Am Building (now the MetLife Building) in New York (1963), travertine was used to soften the imposing steel-and-glass façade. Similarly, at Lincoln Center's Juilliard School (1969), Belluschi incorporated travertine to align with the complex's classical modern aesthetic. In the Zion Lutheran Church in Portland (1950), Belluschi employed travertine to create a welcoming and sacred space, while the Equitable Building in Portland (1948) used it in the lobby, providing a luxurious feel. The Bank of California Building (1969) also featured travertine, adding elegance and a sense of permanence to the structure.

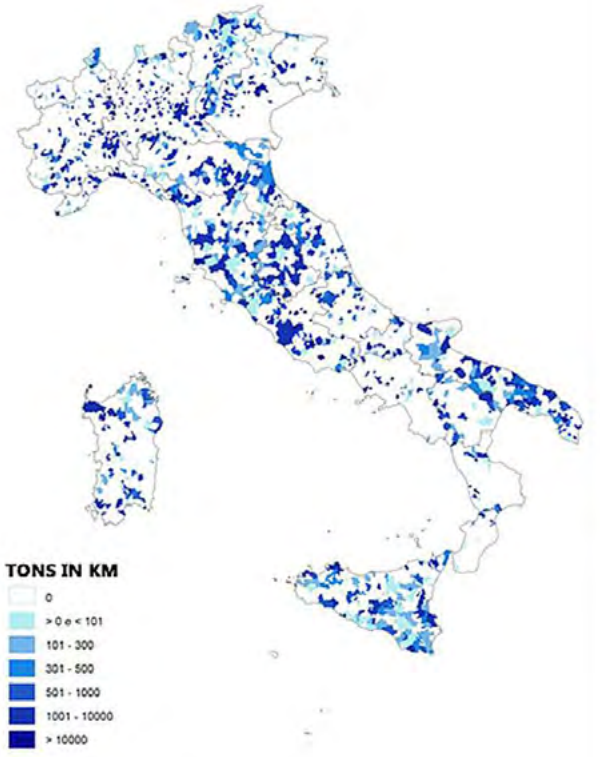
Now, the global market of travertine consumes around 75% of the material produced in the Bagni di Tivoli[69]. It is virtually impossible to map the immense quantity of projects that have used the Roman Travertine from the Acque Albule. We know that this is the same stone reserve from which trav-

69 Testimonies by quarry owners and marketing managers in Bagni di Tivoli, conducted by the author from 2022-2024.

ertine adorns other projects: the Krasnodar Stadium, the Barcelona Pavilion, Bank of China Headquarter Building, Grand Mosque of Algiers, just to name few projects[70].

FIGURE 7

The Production of natural stone in tons per kilometer in the National territory, data elaborated from the Italian Institute of Statisitics Report of 2017, and from Cave Report by Legambiente of 2021.



70 An extensive atlas of Roman Travertine's projects was the subject of the book of the exhbition: The Long Story of Roman Travertine, Maria Antonietta Tomei, R.B. Lapis Tiburtinus: La lunga storia del Travertino - The long history of travertine. Tivoli: TRITYPE srl, 2020.

Italian Stone Market

The Roman travertine industry is a business that generates quarry owners around 250 million euros a year, Travertine extracted from Tiburtina it is 5% of Regione Lazio's GDP. In an area of round 400 hectares between the municipalities of Guidonia Motecelio and Tivoli[71], that produce 40% of the amount of travertine mined nationally. Even with travertine's use demoted from construction purposes to ornamental stone as stone became less and less of use in architectural construction. Merely in the second half of the 20th century, travertine is usually now only used as thin slabs for wall cladding or floor paving. Roman travertine, for its price, is luxury material for the consumption of private and public projects world wide. Estraba's quarry marketing manager's[72] in Tivoli's municipality, did mention that they are capable of selling travertine blocks for up to 25,000 euros, depending on their clients, for which they rely mainly on international market.

To understand the scale of extraction, one must first establish a setting in which travertine is situated within architectural construction materials in the Italian peninsula. Extraction material in the Italian context is categorized in various aggregates, and it is based on their intended purpose, as outlined in regional plans for extractive activities or quarry operations. These plans distinguish between two main categories of extracted stones and rocks:

1. Materials used for industrial purposes and those used in construction and civil engineering projects;

71 Report Cave di Legambiente of 2021

72 Site visit in October 2023.

2. Decorative materials used for creating blocks, slabs, and similar products. Materials for industrial use are further classified into two types: valuable and less valuable materials[73].

Valuable materials include fossil meals, silica sands, various clays, peat sands, gravel, conglomerates, and crushed products like diabases and basalts, as well as limestones. Less valuable materials are used for producing aggregates, small stones, architectural dressings, and small blocks, such as marls, clays, clayey shales, fine sands, tuffs, jaspers, and weathered ophiolitic rocks.

The most produced aggregate nationally in Italy (by the statistics of 2017) by weight (45.1 percent of the national total extracted from quarries) is "limestone, travertine, gypsum and sandstone" with 68.8 million tons (-7.3% on 2017)[74]. Italy produced over 825 thousand tons of Travertine in 2018 alone, mined mainly at the Centre[75], as shown in figure 7. In 1995 alone, the basin of the Acqua Albule Quarries has produced the equivalent of 1,5 million tons of "raw" travertine[76], the equivalent of 15 Colosseums, each weighing 100,000 tons. Travertine industry has created an immense economic empire of stone in global markets. The focus of this material is also due to its economic force with respect to the territory[77].

Ornamental stones such as, marbles, sandstones, granites, slates, syenites, alabasters, limestones, travertines, tuffs, basalts, porphyries, and ophiolites, are considered rare due to their commercial value and the difficulty of extraction. In terms of ornamental stones, Tuscany, Lombardy, and the Province of Trento contribute 54.2% of Italy's total extraction, equating to 3.36 million cubic meters out of 6.2 million[78]. Following them are Lazio and Sardinia, regions known globally for their high-quality stones and long-standing traditions. In the key regions for ornamental stone extraction, materials range from Trentino's porphyry, Botticino marble in Lombardy, the globally renowned Carrara marble and Apuan marble, to travertine from the Acque Albule, and other travertine quarries in Siena.Among the regions with the greater number of sites designated for mining activities are Sicily, Veneto, Puglia, Lombardy, Piedmont and Sardinia, all with at least 300 authorized quarries present in the 2021 report by Legambiente[79]. While the Northern part of the Italian peninsula has been known for intense resource production, regions of Sicilia, Puglia, and Calabria have

73 Elena Paudice, Paesaggi Interrotti, La rigenerazione delle cave dismesse, vol. PhD Thesis-Sapienza, 2021, https://iris.uniroma1.it/handle/11573/1706532.

74 ISTAT, Istituto Nazionale di Statistica. "Report Istate Attività Estrattiva Da Cave e Miniere Anno 2018." Istat, 2020.

75 ISTAT report: attività estrattive da cave e miniere, anno 2018, page 4.

76 Ciriaco Giampaolo and Luca Aldega, "Il Travertino: La Pietra Di Roma," Rendiconti Online Della Società Geologica Italiana 27 (July 2013): 98–109, https://doi.org/10.3301/ROL.2013.23.

77 In 2016, the Italian extraction sites were 2,295 (2,227 quarries and 68 mines) from which a total of about 167.8 million tons of minerals non-energy minerals (-3.2% compared to 2015). Domestic ex-tractions, including mineral waters, consist of 83.8 percent by minerals from quarries, with 154 mil-lion tons (-3.2% compared to 2015); the aggregate "limestone, travertine, gypsum and sandstone" is the most representative (48.6% of the total extracted from quarries). About 44% of national extrac-tion from quarries is concentrated in the North of the country (68 million tons); led by Lombardy, by number of quarries in production (273) and extractions (14.4 percent of total withdrawals).

78 Edoardo Zanchini and Gabriele Nanni, Rapporto Cave 2021 - La Transizione Dell'economia Circolare Nel Settore Delle Costruzioni (Ufficio clima di Legambiente, 2021).

79 Zanchini, Edoardo, and Gabriele Nanni. 2021. Rapporto Cave 2021 - La Transizione Dell'economia Circolare Nel Settore Delle Costruzioni. Ufficio clima di Legambiente.

FIGURE 8

Major Carrara Marble Extractive basin near the historical center of Carrara. It must be noted how extraction in this context entails the removal of millions of tons of forests and soil from a protected natural reserve, one that destabilizes the mountain bed, and causes other major environmental deadly risks. CC Google Earth, 2024

been subject to intense natural stone extraction. Parts of the Puglian region, with vast voided territories of ex-quarries of different natural stones. The three geographical 'ambits' of Cursi, Trani and Apricena, which are significant in the regional extractive economy, are in fact representative of the relationships that quarries establish with the Apulian Landscape (in these cases the physical geography of the Salento, Murge and Gargano plateau) because of the differentiated characteristics of its orographic substrate. Tuff, limestone and specifically for the famous Pietra Leccese, the white lime stone that the city of Lecce and many other urban centers in the region are constructed from. Abandoned natural stone quarries pose a territorial issue in the southern regions, and are subject to various initiatives of recovery and reuse.The extraction of this stone poses similar issues posed in this chapter in different scales, with similar social and economic dependencies.

The largest portion of ornamental stone extraction and exportation would be concentrated in

FIGURE 9

Area of Cervaiole in the 1960 and in the 2014. From the Activist collective: “Alpi Apuane: le montagne che scompaiono” active against extreme extraction of Carrara Stone in Alpi Apuane region.

stone basins of Carrara, Massa (Carrara Marble), and Roman hinterlands (Roman Travertine). These two types of white stone, Carrara Marble from Massa and Carrara, and Travertine from Acque Albule, are often compared due to the similarities in their extraction global economy and the scales of their environmental impact. However, the scale of extraction at the Acque Albule quarries is merely only around 10% of that of Carrara Marble, which is mined from the Apuan Alps in Tuscany.

The quarries of Carrara are an emblematic extraction situation with the greatest number of authorized quarries in Italy, seventy-three active quarries as of 2021. These quarries produce from four to five million tons of marble blocks per year, that is equivalent to more than 50 colosseums per year, more than all of what was extracted of travertine in

the Acque Albule from 1954 to 1995. The Carrara marble has also been extracted from the quarries since Roman times, the quarries that now span over 1500 hectares, have an economic value of one billion euros per year (of raw, elaborate marble and its aggregates). Pretty much like Travertine, most of the raw marble produced in Carrara is also exported, processed, and elaborated elsewhere[80].

The Apuan Alps are famous for marble extraction, but this has caused significant environmental and social issues, particularly in the municipality of Carrara, where there are 73 authorized quarries. These quarries have led to damaged landscapes, water pollution, and exposure to dust, noise, and vibrations from heavy vehicle traffic. A positive development came in April 2012 with the opening of the €120 million "Marble Road," which redirected heavy traffic away from Carrara. However, the new Quarry Plan approved in July 2020 raised concerns as it increased the allowable percentage of waste material from extraction, bowing to the marble lobby rather than encouraging sustainable practices. Data from 2005 showed that 83% of extracted material was waste, with 36% of quarries producing over 90% waste. A 2007 regulation required quarries to have at least 25% of their production in marble blocks, with annual checks for compliance[81].

The case of Carrara Marble in the Italian context emphasizes the extractive model in the west, one that creates a system of economic dependency based on social-environmental degradation. It is highlighted to point out that the case of marble and travertine extraction are specific cases of historic natural Italian stone, but still represent a similar model of extraction based economies. These economies share in common the same socio-economic and environmental waste dynamics, ones that are justified by economic precariousness, and governed by few entrepreneurs that seem to dictate the futures of entire territories.

80 Chiara Braucher, "L'ESTRATTIVISMO APUANO. STORIE DI UN TERRITORIO IN OCCIDENTE," n.d.

81 Zanchini, Edoardo, and Gabriele Nanni. Rapporto Cave 2021

The travertine market is unsustainable, even on a global scale

The Roman travertine is mostly internationally exported, its increasing cost of travertine extraction has led to quarry owners to shift and focus on a global market, since the local market no longer compensates the high cost of extraction, while exporting the stone internationally is feasible given its high value abroad. This stone produced in Tiburtina landscapes, now with over 75% percent sold in international markets[82], creates an interesting tension between global market fluctuating trends and local-scale repercussions.

In 2016, the Italian stone industry exported 3,751,894 tons of ornamental stone ford a total value of about 2 billion euros of which about 1.6 billion euros came from export of processed stone, and about 400 million euros were generated from the export of raw materials[83]. The local economic value generator of travertine exportation comes from its processing and elaboration, where a large number

82 Testimonies of site visits and interviews conducted with the main exporters of the region, along with data extracted from OPEC in 2024: quarry Italy is the biggest world exporter of Roughly trimmed Marble and Travertine with 50% of the global share followed by Greece, then Turkey, while the biggest importer would be China, importing 58% of the global share, followed by India with around 10%, then by Italy in third position by 5.67%.

83 among raw materials 58 million corresponds to the value of exports of granulates and powders, data sourced from "Banca dati dei siti estrattivi del travertino romano - UNINDUSTRIA."

of artisans would be employed. However, the global market tendencies that influence the local economy of travertine, specifically ones related to labor, that is now outsourced for cheaper workforce in other countries. In 2021, Italy was the biggest world exporter of roughly trimmed Marble and Travertine with 50% of the global share followed by Greece, then Turkey, while the biggest importer would be China, followed by India, then Egypt. Half of the exports of raw stone materials, approximately 100 million euros, were destined for the Chinese market.

These markets do not necessarily represent the destination of the stone, it is also an indication of where the "roughly trimmed" blocks are processed and elaborated, before they end in consumer markets. As some quarry owners explain, as the high market value of Italian labor, stone elaboration costs are outsourced, resulting in the decline of refining artisan labor of losses on intangible 2000s years of tradition in the area.

Therefore, we maintain that extraction market is economically unsustainable, even internationally, as proven by the fluctuating numerical data of the Italian stone market. In 2019, Italy's natural stone industry saw a decline in exports, with a 5.3% drop in value and a 5.9% drop in weight exported. Despite the reduced extraction volumes, the extraction industry in Italy still made 1.78 billion euros, slightly down from 1.87 billion euros in the previous year. This downward trend continued in 2020, with the pandemic contributing to a 25% decrease in exports compared to 2019[84].

While these market trend did not correspond

84 Zanchini and Nanni, Rapporto Cave 2021 - La Transizione Dell'economia Circolare Nel Settore Delle Costruzioni.

to the travertine market, it is interesting to note the increase of extraction of travertine, despite decreases through the various economic hits that influenced the construction market. Of which there was in 2014 a substantial increase (+29.8 percent) reaching 3.7 million tons extracted per year.

Yet, the market of travertine export globally is of a highly fluctuating reality, the competitiveness of the Travertine Turkish market in the early 2000s corresponded with the replacement of the Italian currency lira with the euro. These economic decisions paradoxically resulted in increasing precariousness of the socio-economic conditions in the territory. The compensation with these economic trends led to the increase in automation and mechanization of extraction increasing the travertine production. The increase of travertine production does not unfortunately correspond to an increase in employed labour. As the quarries of Acque Albule employed over 2,580 workers in the 1980[85], the numbers only steadily decreased to around 236 as of 2021[86].

85 Giampaolo and Aldega, "Il Travertino."
86 Paudice, Paesaggi Interrotti, La rigenerazione delle cave dismesse.

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PART 3

MAPS OF TRAVERTINE EXTRACTION

From house bands to murals, from industrial sites to imagined futures, landscapes are shaped, altered, and often contested as people position themselves within their environments and in relation to each other. Everyday practices like work, commuting, eating, drawing, imagining, dismantling, as well as more disruptive actions such as resistance and strikes, all contribute to the creation of landscapes. While it can be argued that everyone plays a role in shaping landscapes, there are individuals, communities, and organizations actively involved in leveraging landscapes to enhance their influence: revealing political motives behind territorial claims, navigating contradictions in border areas, addressing ecological challenges like climate change, exploring alternative world possibilities, critiquing urbanization processes, and experimenting with visual representations. These engagements go beyond traditional disciplines such as art, architecture, geography, or ecology, expanding into a dynamic field that challenges, reinterprets, and generates landscapes. Landscape, often seen as a 'way of seeing,' according to Denis Cosgrove citing John Berger, extends beyond visual aesthetics to encompass modes of thought, action, and existence. If we consider ourselves as landscapes—material manifestations of daily practices intertwined with visions for the future—then it becomes crucial to explicitly explore the myriad ways landscapes are formed[1].

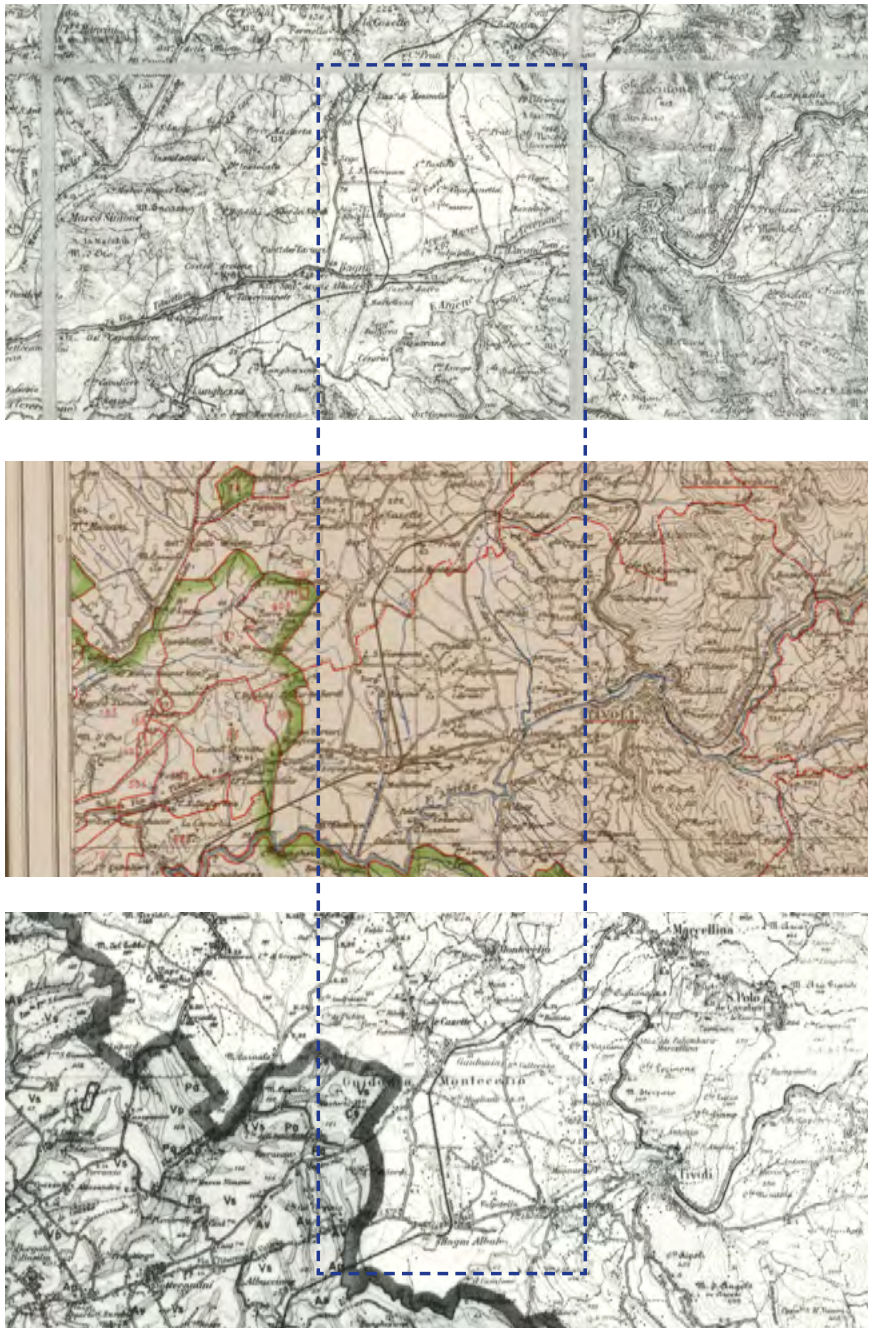
For which this section interacts with extraction through fundamental landscape analysis and representation tools, cartographic representation. Revealing what technical aspects hidden other disciplines: geologic analysis, hydrological state readings, botanical and other technical charts that will be simplified and overlapped in the design-based task of mapping in the landscape practice. These practices can encourage a mode of 'thinking geologically': that is, among other things, a way of thinking about landscape as a set of inter- and intraconnected conditions[2], one that is essential to reading the beyond territorial impacts and conflicts created by the travertine extraction.

In this unit, the research takes a deeper look on how the Tiburtina Landscape externalized and industrialized, what are the physical dimensions of extraction, and its consequence. The knowledge gathered through site visits, interviews, observations from the course of the Fifth Year Design Studio[3], and scientific papers are illustrated and laid out in this section to illustrate the geological, natural and anthropological systems in the Tiburtina landscape

1 Ed Wall, ed., The Landscapists: Redefining Landscape Relations, Architectural Design Profile, no 263 (Oxford: John Wiley & Sons, 2020).

2 Tiago Torres-Campos, 'Inwood's Geofollies - And Other Witnesses of Dissonance', in The Landscapists: Redefining Landscape Relations, ed. Ed Wall, Architectural Design Profile, no 263 (Oxford: John Wiley & Sons, 2020).

3 Synthesis Laboratory in Urban and Landscape Design, Prof. Alessandra Capuano, Tutors: Sara Radi Ahmed, Lisbet Ahon Vazquez, Viola Corbari, Valerio Antonio Turbiani, Andrea Valeriani, academic year 2023-24, School of Architecture, Sapienza University of Rome)



1908 Roma e dintorni. Zona: Monterotondo-Palombara-Roma-Zagarolo, Istituto Geografico Militare

1914 carta dell'agro romano in quattro fogli coi confini delle tenute e dei territori comunali limitrofi alla scala di 1:75,000 delineata sulle carte dell'istituto geografico militare dal cav. agr. pompeo spinetti - foglio 3.

1959 Carta pedologica dell'Agro Romano. Luigi Marimpieri

that intersect at extraction.

The spatial of travertine plain of the Acque Albule looks like unimpressive very humble low-grazing semi-natural rocky grasslands. Placing the micro-scales of travertine creatures in the macro-scale realities of territorial extraction within the existing cultural landscape morphologies, entails a very big jump in scale, and therefore requires a reframing on how we can cartographically represent those on a territorial scale. The research experiments these cartographic representations as ways to view the exploitation and resistance (human and non-human) of the landscape through the case study. This would part from analyzing existing cartographic representations of the territory, often depicting the plain as neutral empty space, in the technical maps executed by the state. We use cartography with intentional an political purpose, to dig into what's beneath the surface, revealing maps of potential alliances, depletion, voids, waste, and social aspects. This chapter therefore ends the thesis with a natural description of the complex systems and their resulting dynamics of travertine extraction in the Acque Albule, divides them into four chapters:

- Water
- Waste
- Labour
- Resistant narratives

Void(n.)
opening, gap; empty space : emptiness, vacuum the quality or state of being without something; lack, absence; a feeling of want or hollowness.
Definition by Merriam Webster accessed in 2024

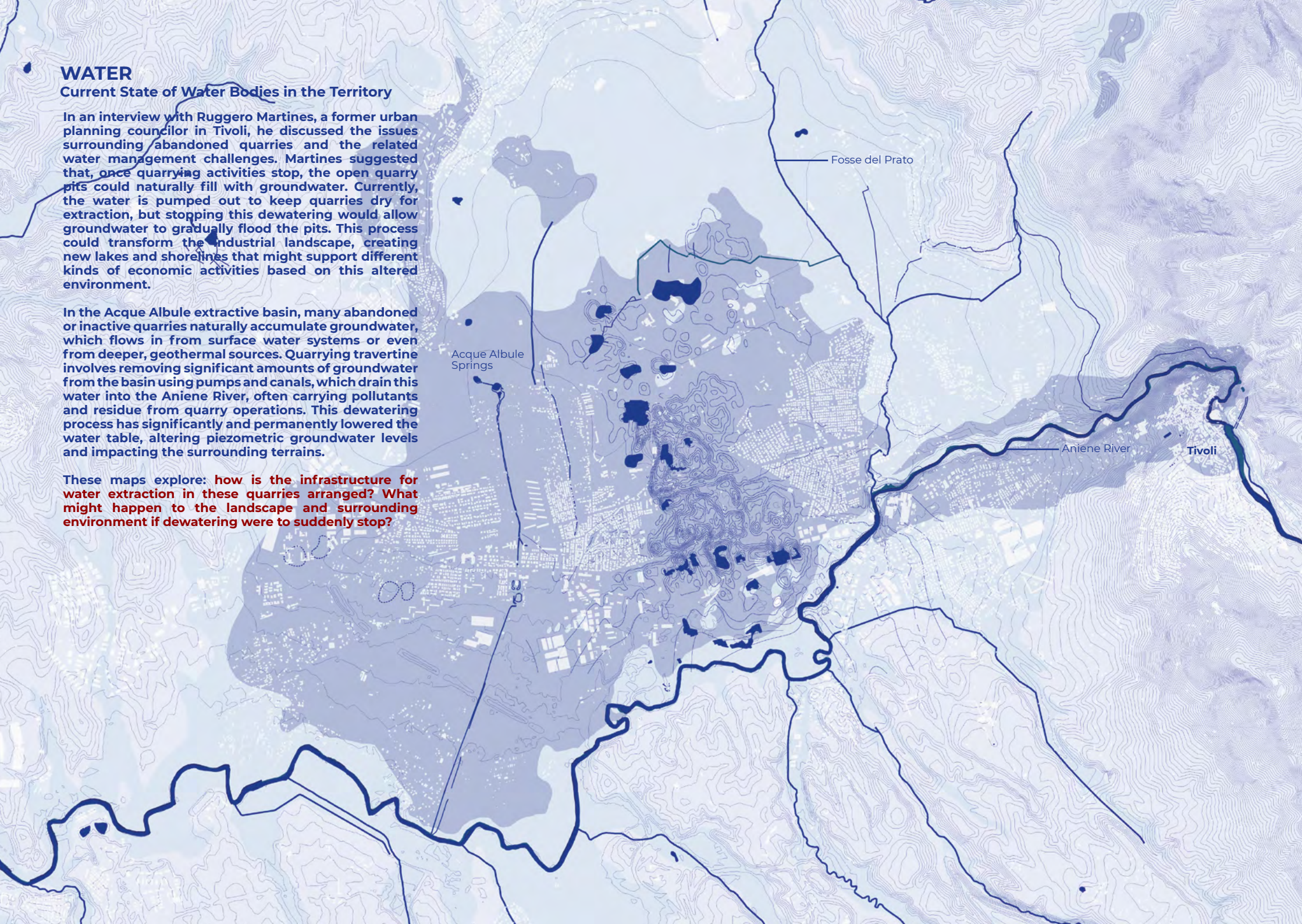
WATER

Current State of Water Bodies in the Territory

In an interview with Ruggero Martines, a former urban planning councilor in Tivoli, he discussed the issues surrounding abandoned quarries and the related water management challenges. Martines suggested that, once quarrying activities stop, the open quarry pits could naturally fill with groundwater. Currently, the water is pumped out to keep quarries dry for extraction, but stopping this dewatering would allow groundwater to gradually flood the pits. This process could transform the industrial landscape, creating new lakes and shorelines that might support different kinds of economic activities based on this altered environment.

In the Acque Albule extractive basin, many abandoned or inactive quarries naturally accumulate groundwater, which flows in from surface water systems or even from deeper, geothermal sources. Quarrying travertine involves removing significant amounts of groundwater from the basin using pumps and canals, which drain this water into the Aniene River, often carrying pollutants and residue from quarry operations. This dewatering process has significantly and permanently lowered the water table, altering piezometric groundwater levels and impacting the surrounding terrains.

These maps explore: how is the infrastructure for water extraction in these quarries arranged? What might happen to the landscape and surrounding environment if dewatering were to suddenly stop?



WATER

If the Landscape is Governed by Abandonement

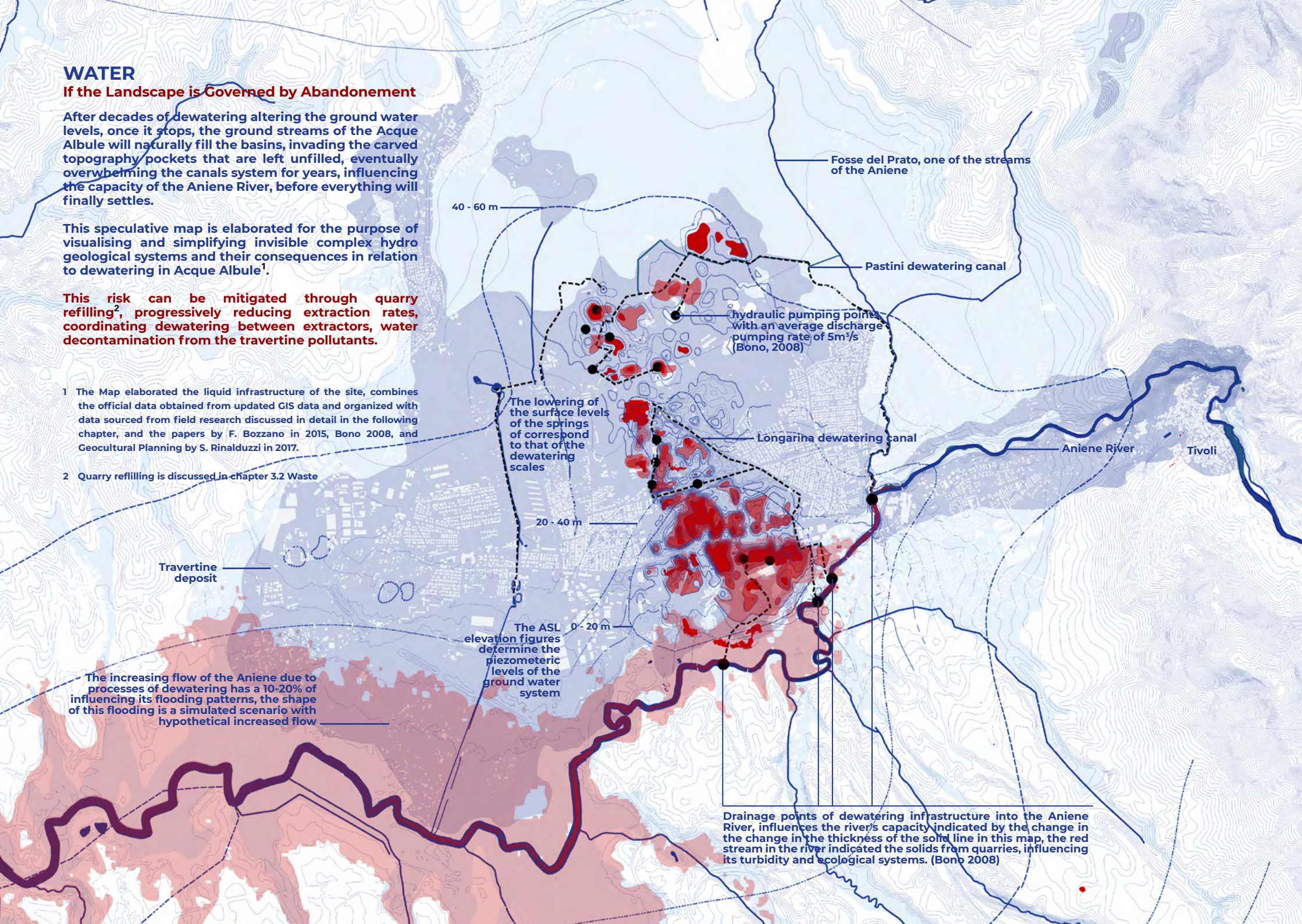
After decades of dewatering altering the ground water levels, once it stops, the ground streams of the Acque Albule will naturally fill the basins, invading the carved topography pockets that are left unfilled, eventually overwhelming the canals system for years, influencing the capacity of the Aniene River, before everything will finally settles.

This speculative map is elaborated for the purpose of visualising and simplifying invisible complex hydro geological systems and their consequences in relation to dewatering in Acque Albule[1].

This risk can be mitigated through quarry refilling[2], progressively reducing extraction rates, coordinating dewatering between extractors, water decontamination from the travertine pollutants.

1 The Map elaborated the liquid infrastructure of the site, combines the official data obtained from updated GIS data and organized with data sourced from field research discussed in detail in the following chapter, and the papers by F. Bozzano in 2015, Bono 2008, and Geocultural Planning by S. Rinalduzzi in 2017.

2 Quarry refilling is discussed in chapter 3.2 Waste



3.1 WATER

The voids that travertine extraction creates are present in different scales, extending beyond the quarry itself. It is unfathomable to estimate the volumes of material removed. Several studies estimate that the total quarried travertine is **103 million m³**, as the surface area of the extractive basin extended from 0.4 km² to 2.8 km², now around four km². Water is also extracted with stone, 5 m³ per second of water were removed from the open pits in 1995[4], often drained, along with travertine powder and heavy metals and pollutants into the Aniene River, and consequently the Tiber River.

Flooding, ecological, chemical pollution, and a series of territorial scale risks way past the extractive basin. However a large portion of subtracted volumes is invisible, existing as cavities in the surrounding terrains underneath the feet of residential urban agglomeration. These cavities manifest in a series of geological risks that include sink holes, low hazard earthquakes, soil depression, ground water pollution[5], and other dangers that take place in the territory slowly, are mapped and revealed in this section[6].

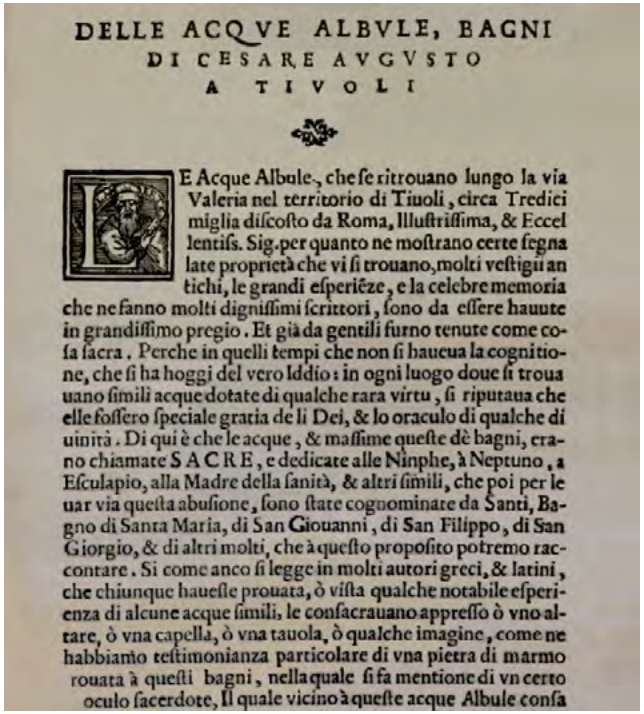
The Liquid Landscapes of the Acque Albule

Water and hydrological resources are remarkably important and sensitive in this context. Arriving close to the site, it is difficult to ignore the dominating atmosphere created by the pungent smell of the

FIGURE 1

Map showing the water bodies of the Lazio region.

1835 - Pietro Ruga - Plan topographique de la campagne de Rome ...
DA PUNICUM (S.MARINELLA) AL CIRCEO
Dettagliata COLORE come quella del 1811 (1)sc409/
source: http://www.luniversoeluomo.org/storia/maps-storiaRM.htm



DELLE ACQVE ALBVLE, BAGNI
DI CESARE AVGVSTO
A TIVOLI

LE Acque Albule, che ſe ritrouano lungo la via Valeria nel territorio di Tiuoli, circa Tredici miglia diſcoſto da Roma, Illuſtriſſima, & Eccellentiſs. Sig. per quanto ne moſtrano certe ſegnalate proprietà che vi ſi trouano, molti veſtigii antichi, le grandi eſperiẽze, e la celebre memoria che ne fanno molti dignifſimi ſcrittori, ſono da eſſere hauute in grandiſſimo pregio. Et già da gentili furno tenute come coſa ſacra. Perche in quelli tempi che non ſi haueua la cognitione, che ſi ha hoggi del vero Iddio: in ogni luogo doue ſi troua uano ſimili acque dotate di qualche rara virtu, ſi riputaua che elle foſſero ſpeciale gratia de li Dei, & lo oraculo di qualche diuinità. Di qui è che le acque, & maſſime queſte dè bagni, erano chiamate SACRE, e dedicate alle Ninphe, à Neptuno, a Eſculapio, alla Madre della ſanità, & altri ſimili, che poi per leuar via queſta abuſione, ſono ſtate cognominate da Santi, Bagno di Santa Maria, di San Giouanni, di San Filippo, di San Giorgio, & di altri molti, che à queſto propoſito potremo raccontare. Si come anco ſi legge in molti autori greci, & latini, che chiunque haueſſe prouata, ò viſta qualche notabile eſperienza di alcune acque ſimili, le conſacrauano appreſſo ò vno altare, ò vna capella, ò vna tauola, ò qualche imagine, come ne habbiamo teſtimonianza particolare di vna pietra di marmo rouata à queſti bagni, nella quale ſi fa mentione di vn certo oculo ſacerdote, Il quale vicino à queſte acque Albule conſa

"And Acque Albule, which make along the Via Valeria in the territory of Tivoli, about thirteen miles distant from Rome, illustrious, and most excellent. Sig-as far as certain sewers show of it made proper, many ancient vestiges are found there, the great experiences, which many most dignified writers make of it, are to be elevated in very great esteem. It, by gentiles, were held as sacred things. For in those times that there was not the cognizance that there is today of the true God in every place where they are found, such waters endowed with some rare virtue, they reputed them to be sacred (special grace of the gods, and the oracle of some deity). Hence the waters, especially those for bathing, were called SACR.E, and dedicated to the Nymphs, to Neptune, to Aesculapius, to the mother of Health, and other such, ... were named by Saints, Bath of St. Mary, of St. John, of St. Philip, of St. George, and of many others, which we may relate in this connection. As also we read in many Greek and Latin authors, that whoever had experienced, or seen some notable experience of some similar waters, consecrated them near an altar, a chapel, or a table, or some image, as we have testimony of a marble stone placed at those baths, in which is mentioned a certain priestly role..."

sulfur released from the grounds as it meets the air. The Romans have called the basin the "Acque Albule" given its whitish-turquoise specific color caused by the presence of sulfur and carbonate of lime, fed by the hot sulfur springs of the still active Lazio Volcano. These subaltern volcanic gases, from underground springs full of sulphuric acid, sulfur dioxide, bicarbonate hydrogen, and carbon nitrate, form the waters that characterize the basin. These thermo-mineral springs were historically known for their healing[7] characteristics and sacredness[8] have witnessed the formation of "a particular kind of marble[9]". The territory's abundance of ground streams resulted in the baths that gave the contemporary name of the territory: Bagni di Tivoli (the baths of Tivoli).

The territory is characterized by the presence of its waters. Travertine itself has formed in this territory due to its waters. A river stone[10], this limestone sedimented on the flood basin of the Aniene River, that was as a major transport infrastructure to carry its blocks to the center of the city[11]. The river once was called "Teverone", corresponds to the ancient "Route of Travertine," an important communication waterway for production and trade from the Imperial

FIGURE 2

Delle Acque Albule – Bagni di Cesare Augusto, script from an original manuscript of 1567, edited by Bacci, which can be read as the waters were considered sacred to the Gods. Ciotoli, Giancarlo & Meloni, Fabio & Nisio, Stefania. (2015)

7 The shepherds crossed these fields with their cattle for the believe that the sulfuric waters also killed parasites

8 Delle Acque Albule – Bagni di Cesare Augusto, script from an original manuscript of 1567, edited by Bacci, which can be read as the waters were considered sacred to the Gods. Ciotoli, Giancarlo & Meloni, Fabio & Nisio, Stefania. (2015). Studi di sintesi e analisi geospaziale applicata alla valutazione della suscettibilità ai sinkholes naturali nella Piana delle Acque Albule (Tivoli, Roma) Study of synthesis and geospatial analysis applied to evaluation of susceptibility to natural sinkholes in the Acque Albule Basin (Tivoli, Roma). Memorie Descrittive della Carta Geologica D'Italia. XCIX. 203-220.

9 Vitruvius Pollio, Pierre Gros, Antonio Corso, and Elisa Romano. De architectura. I millenni. Torino: Giulio Einaudi, 1997.

10 Travertine is born at the flooding shores of the Aniene. A. Pentecost, Travertine (London: Springer, 2005).

11 Mari, 'La Cava del Barco e La Piana delle acque albule nell'antiquità. Il travertino. Aspetti naturalistici e sffrutamento industriale all'inizio del terzo millennio'.

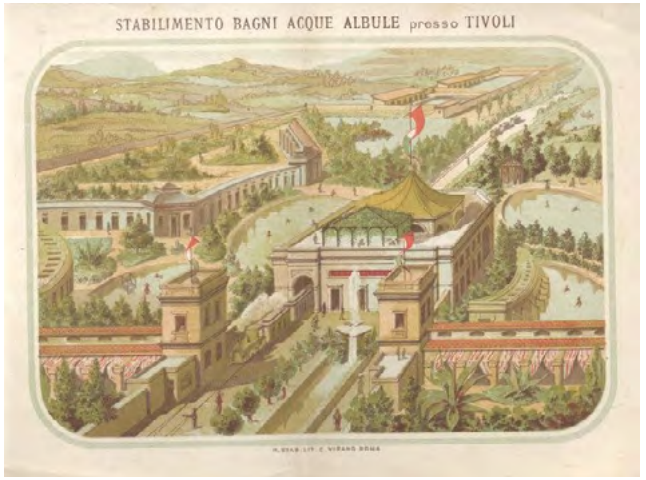


FIGURE 3

An image of the thermal baths establishment of the Acque Albule, built in the late 1800s

From the book of "Leoni Ottavio.GUIDA MEDICA ALLE ACQUE ALBULE." Armanni, 1882 Pg.28. Unita gradevole tavola in cromolitografia in formato cm.14,3x19,3, raffigurante lo "Stabilimento dei Bagni Acque Albule presso Tivoli". Codice libreria 137501.

period to the Baroque one[12]. Its extraction today determines the ways in which thermal, ground and other water sources are depleted in these processes of precarious entanglements of travertine cultivation.

The springs of the Acque Albule were already well known and exploited since ancient Roman times with the construction of a thermal building in the 2nd century AD. The exploitation of the springs began in the 3rd century B.C. and reached its peak in the 2nd century A.D[13]. The Romans extensively used the Albule Waters for healing, drinking them or bathing in them, and even referred to them as "aquae sanctissimae" (most holy waters) due to their healing properties. These waters were considered sacred and were dedicated to deities such as the nymphs, Neptune, Aesculapius, and Hygieia. There was also a popular belief that the Sibyl of Tibur had enchanted the waters, making them capable of curing any illness. Near Tivoli, the Romans built the lavish Baths of Agrippa, commissioned by Emperor Augustus, to systematically exploit these thermal springs. The baths were vast, featuring splendid fountains, pools, shady porticoes, and decorated with statues and columns[14].

The Baths of Agrippa or Zenobia, brought to light in the 16th century, were on the shores of Lake Regina or Solfatara. Archaeological heritage of the Roman baths near the lakes, other than the baths of Agrippa baths, include the remains of a Roman temple Roman temple dedicated to a Chthonic divinity

12 Biancamaria Rizzo, 'Policymaking in Metropolitan Areas: The Aniene River as a Green Infrastructure between Roma and Tivoli', International Studies. Interdisciplinary Political and Cultural Journal 19, no. 1 (15 September 2017): 29–43, https://doi.org/10.1515/ipcj-2017-0003.

13 Vivalda, Paola. "Il Bacino Delle Acque Albule (Lazio): Un Esempio Geologico-Naturalistico Di Grande Rilievo Da Recuperare e Valorizzare," 2017. https://doi.org/10.13140/RG.2.2.20922.90561.

14 Marino, Emanuela. "Sulla Salubrità Delle Acque Albule e Del Fiume Aniene." Il Corpo Malato, no. 2 (2016): 85–93.

FIGURE 4-5
Top:
Kircher's map of 1670:

Lacus Albuneus (1): lake of the Queen or of the Bathing Islands; Albula flumen (2): canal of the Acque Albule that freed the territory from the tyranny of the waters; Confetti di Tivoli (3); Roman baths (4); large lake of sulphurous waters (5) in the locality of le Fosse; Saxifodina tiburtina (6): travertine mine; Via Tiburtina (7); Ponte Lucano (8); Aniene River (9); Barco Area (10); Area characterised by the presence of the testina (11), a deposit derived from the flooding of sulphurous albule waters in the fields. This area, extending between the Tiburtina and the Aniene, would correspond to the area where numerous natural sulphurous springs are still to be found today; Fossa di profondità inscrutabilis (12): presumably Lake San Giovanni; Sources or small lakes of sulphurous waters (13); Arundinetum, reed beds (14)

from: KIRCHER A.(1670)- Latium. Id est, Nova & Parallela Latii tum veteris tum novi Descriptio. Amstelodami.
Kircher's map of 1670 (detail).

Bottom:

Map by Luigi Canina from his:
CANINA L. (1856), Gli edifizi antichi dei contorni di Roma cogniti per alcune reliquie descritti e dimostrati nella loro intera architettura. Tavole dalla VII alla CC. Vol. VI, Roma.

FIGURE 6

Survey of the Thermal Baths of Agrippa, in relation to the lake of the Colonelle, drawing by Luigi Canina, CANINA L. (1856), Gli edifizi antichi dei contorni di Roma cogniti per alcune reliquie descritti e dimostrati nella loro intera architettura. Tavole dalla VII alla CC. Vol. VI, Roma.

of difficult to attribute (Juno Queen or Cybele) but probably dedicated to the Mother Goddess: '... near these waters consecrated a shrine to the mother of the gods Igia'[15].

The constant flooding of the Aniene, that rendered the submerged territory inhabitable for a very long time[16], and its subsequent conditioning transformed this landscape over long time. The 1856 map by Canina provides an eloquent depiction of the vastness of the marshy areas. The Lake of the Tartari, for example, appears more as an extensive area flooded by water than as a lake, similar to other large portions of the plain. The rather irregular shores of the lake may indicate alternating periods when the lake's surface was entirely absent[17].

The way the water systems has shaped landscape morphology is mentioned in detail in various studies, including Erbani's detailed description of the territory's long history of flooding and its relation to the epidemics including Malaria in various points in history[18]. The history of thermal waters and their role in the development of the territory has been studied in detail through historical cartography and bibliography in Geospatial sinkhole analysis done by Ciotoli in 2015[19]. The importance of the hydrographic network is not only related to thermals: already in the past the milling industries, the wool factories and the first paper mills, used the hydraulic power of the Aniene, qualifying above all the functionality of the medieval Tiburtine area; numerous are the testimonies of industrial archaeology on the outskirts of the old town[20].

The Acque Albule has a unique hydrogeological system as shown in Map 01, shaped by the distinct geological features and dynamic history of the surrounding region. Subsidence (the gradual sinking of the Earth's crust) and nearby volcanic activity created ideal conditions for groundwater accumulation, movement, and mineralization. Subsidence allowed for the storage of large water volumes, while volcanic activity introduced fractures, heat, and minerals that

15 Giancarlo Ciotoli, Fabio Meloni, and Stefania Nisio, 'Studi di sintesi e analisi geospaziale applicata alla valutazione della suscettibilità ai sinkholes naturali nella Piana delle Acque Albule (Tivoli, Roma)', in Voragini in Italia: I sinkholes e le cavità sotterranee: ricerca storica, metodi di studio e d'intervento = Sinkholes in Italy. The sinkholes and underground cavities: historical research, study methods and intervention, by A. Argentieri, G. Bagnetti, and M. Baldassarri, ed. Stefania Nisio, Memorie descrittive della carta geologica d'Italia, volume 99 (Rom: ISPRA, Istituto superiore per la protezione e la ricerca ambientale, 2015), 203–20.

16 Erbani, 'Il Territorio Manoscritto, Strumenti per un'indagine territoriale lungo la via tiburtina da Tivoli a Roma'; ZACCARIA MARI and VALENTINA CIPOLLARI, 'La Cava Romana Del Barco e La Piana Dei Travertini Nell' Antichità', in Lapis Tiburtinus: La Lunga Storia Del Travertino (Comune di Tivoli Museo della Città, 2020), 18–35.

17 Nanni, Livia, and Paola Vivalda. "Dalle mappe cinquecentesche all'attuale cartografia un percorso storico nell'analisi del rischio idrogeologico di aree antropizzate" Geologia dell'Ambiente, no. 2 (2018): 18–27.

18 M. Erbani, 'Il Territorio Manoscritto, Strumenti per un'indagine territoriale lungo la via tiburtina da Tivoli a Roma' (Roma, 2023).

19 Ciotoli, Meloni, and Nisio, 'Studi di sintesi e analisi geospaziale applicata alla valutazione della suscettibilità ai sinkholes naturali nella Piana delle Acque Albule (Tivoli, Roma)'.

20 Luca Romagnoli, 'L'area Tiburtina: una millenaria utilizzazione del territorio', Semestrale di studi e ricerche di geografia, 1991, N. 2 (1991), https://doi.org/10.13133/1125-5218.16323.

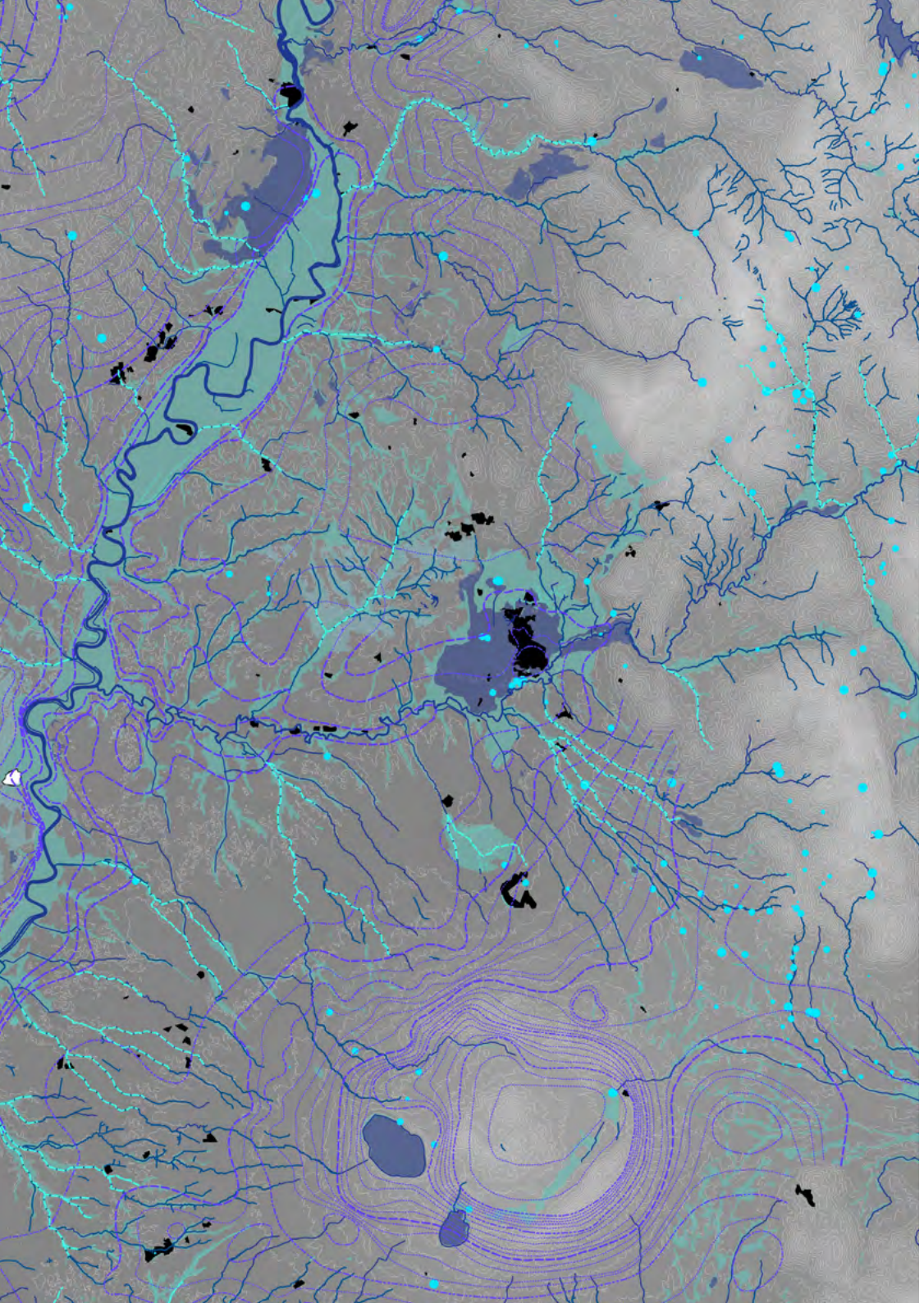


FIGURE 07

Water Systems of the Acque Albule. The peculiar geo-structural arrangement of the basin and the events suffered during the Quaternary, conditioned by subsidence and by the presence in the neighboring area of activity volcanic activity, have created hydrogeological conditions such as to make the Acque Albule a point of delivery of large volumes deep water.

altered groundwater pathways, creating both punctual and linear underground streams. These pathways carry mineral-rich, isotopically diverse waters to the surface, forming thermal springs, that were used as the thermal resources highlighted above. The isotopic curves, representing the thicknesses of isotopic variation across the aquifer, highlight the complex mixing of deep and surface water, influenced by geological layers and volcanic heat. The strength of subterranean streams are ones that, along with other geological travertine bed, could form the sinkholes, such as the lakes of Colonelle and Regina, and other sinkholes found in the vicinity of the extraction site.

Water is delicate issue due to the difficulty in determining and territorializing its governing and management in the Tiburtina landscape. The waters in the territory, as common in contexts such as this one (governed by the unequal dominance of extraction practice), are often subject to inadequate distribution and management of resources and unbalanced decision-making power in its governance. To illustrate the spatial dimension in which the quarrying companies of the territory has dominated and created conflicts in water management and continue to this day to actively threaten the water systems of the territory. One must first determine the theoretical framework under which we identify with the resource under political ecology and landscape paradigms.

We find the definition “hydrosocial territories[21]” specifically useful, referring to a framework of re-po-

21 Rutgerd Boelens et al., ‘Hydrosocial Territories: A Political Ecology Perspective’, Water International 41, no. 1 (2 January 2016): 1–14, https://doi.org/10.1080/02508060.2016.1134898.

liticizing water as an actant[22] in the network of the spatial, social, material and institutional span in which it flows. It refers to the networks that highlights the social relations that connect local human actors and non-human actants to broader political, economic, cultural and ecological scales. Hydrosocial territories—whether imagined, planned, or materialized—carry contested functions, values, and meanings. They shape processes of inclusion and exclusion, development and marginalization, and determine the distribution of benefits and burdens, impacting different groups in diverse ways. These dynamics often lead to the empowerment of some actors while disempowering others, creating arenas for claim-making and contestation[23].

Emphasizing the critical inequalities in water management is essential for understanding and implementing new governance approaches. This involves holding accountable those responsible for the significant ecological costs of intentional pollution and resource waste, which disproportionately burden other actors. This avoids what Boelens in the "hydrosocial" study describe as: "how the dominant ways of conceptualizing these socio-natural configurations and of 'knowing environmental problems and solutions' actively depoliticize forms of socio-economic inequality, mis-recognition, and political exclusion." And argue for a struggle for an alternative territoriality that involve building and engaging in new multi-scalar networks, crucially academic and non-academic, which link local communities to trans-local actors and alliances of monitoring and reporting violations in commons management.

22 Actant, as in Latour's Actor–network theory (ANT) is a theoretical and methodological approach to social theory where everything in the social and natural worlds exists in constantly shifting networks of relationships. Bruno Latour and Catherine Porter, Politics of Nature: How to Bring the Sciences into Democracy (Cambridge, Mass. London: Harvard University Press, 2004).

23 Boelens et al., 'Hydrosocial Territories'.

Voids by Water Depletion

Identifying this intricate relationship starts with outlining the scales of water extraction and its resulting consequences. Since stone extraction is a dry process, and therefore requires water extraction. Now that excavators cannot expand the extraction basin horizontally due to the presence of roads, settlements, and other built infrastructure around the basin, they are forced to extract vertically, in depth, going below the levels of ground waters. As underground and thermal water seep inside the open unfilled pit and need to be drained as extraction begins. Dewatering[24], is the specific term used to describe the process of water removal through massive electric pumps that run 24/7. This process makes up the highest cost of extraction manifesting as energy costs, as massive volumes of water is removed from the basins[25], transferred, often along with all the materials from the extraction site: travertine powder, heavy metals, and other pollutants, to the Aniene River[26]. Quarrymen are required by law to settle the impurities within the waters before its drainage into the river, however, it has been extremely difficult due to the speeds and the scales in which the water is removed.

24 'Dewatering' is usually undertaken to improve conditions in surface excavations and to help construction work at or near the surface., Oxford Reference, accessed 12 August 2024, https://doi.org/10.1093/oi/authority.20110803095714828.

25 Ciriaco Giampaolo and Luca Aldega, 'Il Travertino: La Pietra Di Roma', Rendiconti Online Della Società Geologica Italiana 27 (July 2013): 98–109, https://doi.org/10.3301/ROL.2013.23.

26 Mario Pieracci Galante, Da Castellammare del Golfo a Villaba di Guidonia: don Mario Pieracci Galante racconta cento anni di storia, 1920 - 2020 (s.l: Campo, 2021).

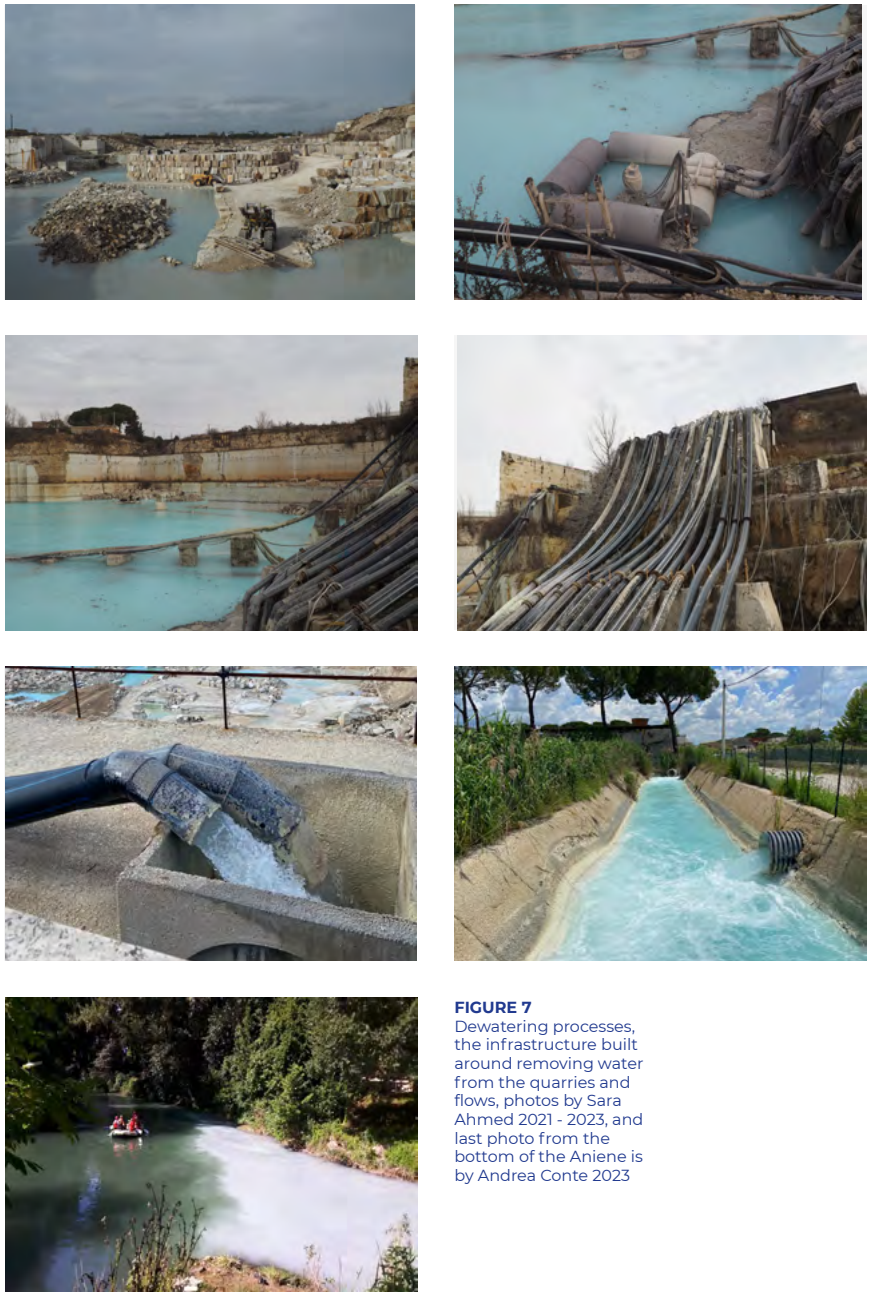


FIGURE 7
Dewatering processes, the infrastructure built around removing water from the quarries and flows, photos by Sara Ahmed 2021 - 2023, and last photo from the bottom of the Aniene is by Andrea Conte 2023

To visualize the volume of the water removed, the studies published by Lombard, estimated a flow rate of one cubic meter per second in the 1970s[27], and data from reports in 1995, estimates the removal rate of five cubic meters per second[28]. The dewatering processes have been increasing progressively with the scale of extraction, incessant day and night including holidays, to ensure a dry quarry bed suitable for stone removal.

An Olympic swimming pool[29] has a capacity of 2,500 m^3; the water taken out of the Acque Albule into the Aniene can fill the size of 1.44 Olympic swimming pools per hour, 35 pools per day, and 1050 pools per month. The described one m^3 per second is 3600 m^3 per hour, and eighty-six thousand m^3 drawn out per day. That is 2.5 million cubic meters per month, 30 million m^3 per year.

If we assume that the rates of the 1970s, to get a hypothetical estimate, one that describes the bare minimum of the waters depleted, we assume that the quarries are only working for six months per year (only for the purpose of avoiding an exaggerated calculation, but extraction is all year round), the unimaginable sum up to this day, only for the past 54 years would be 835 million cubic meters, enough to fill 334 thousand Olympic swimming pools, at least.

The pumping of water by the time this thesis is written is carried by ten main pumping stations, in the active quarries of today. These result in the

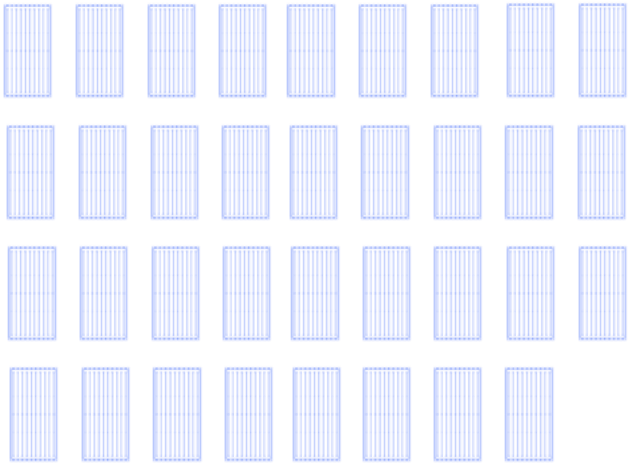
27 A. Annunziatellis et al., 'Studio Dei Parametri Geologici e Geochimici per La Comprensione Dei Meccanismi Genetici Degli Sprofondamente Nella Piana Di s. Vittorino.' (Stato dell'arte sullo studio dei fenomeni di sinkholes e ruolo delle ammistrazioni statali e locali nel governo del territorio, Rome, 2004), 63–82.

28 Ciriaco Giampaolo and Capicotto B.M., 'Il Travertino Romano: Il Bacino Delle Acque Albule.', Marmo Macchine, 27 (January 1997): 72–97.

29 An Olympic swimming pool has a length of 50, width of 25 and depth of 2 meters.

FIGURE 8

The equivalent of 35 olympic swimming pools of ground waters are extracted daily in the dewatering processes



progressive reduction of the flow from two thermal springs, Regina Lake, and Colonnelle Lake, on which the SPA centers in the area depend on. Thermal water tourism is one of the main sources of income in the territory, after extraction[30].

From 1954 to 2008, the impact of water pumping for quarry activities on the underground water levels, or piezometric surface, was carefully tracked. Over time, this pumping created a "cone" or dip in water levels around the quarry site, which gradually became deeper and spread over a larger area. Initially, by 1969, this cone showed a 3-meter drop, reaching 8 meters by 1992. Between 1998 and 2001, the pumping rate increased to 1.5 cubic meters per second, causing the water level to decline sharply to an 18-meter drop. By 2008, as the extraction rate rose to 4 cubic meters per second, the water level was 32 meters below ground. This decline also affected nearby areas,

30 Francesca Bozzano et al., 'Understanding the Subsidence Process of a Quaternary Plain by Combining Geological and Hydrogeological Modelling with Satellite InSAR Data: The Acque Albule Plain Case Study', Remote Sensing of Environment 168 (October 2015): 219–38, https://doi.org/10.1016/j.rse.2015.07.010.

with the water level in the Central sector falling by 4 meters in 1998 and reaching a 10-meter drop by 2008. The quarry's increasing water extraction has, therefore, led to a substantial and expanding drop in groundwater levels over time[31].

Unearthing the Hydrological Crisis

The extraction process is the only productive activity in the Aniene area that necessitates ongoing and consistent "dewatering," or draining of excavation sites. This excessive pumping might also be linked to the drainage of old, flooded quarries that have been reactivated for travertine extraction. Hydrological thermal resources water reserves are reduced[32], jeopardizing the public and private thermal baths in the territory. Paolo Bono reported anthropocentric consequences of extraction in 2008, specifically in relation to, the impoverishment/depletion of sulfurous water springs, the stability of buildings and infrastructure in the surrounding terrain and concerning the ecosystem of the Aniene river[33].

According to measurements and reports by Bono, who carefully measured the water and registered in hydrograms, in the periods between 2005-2008, in the sinkholes and springs of the hydrological reserves in the territory, he reported reductions in the surfac-

31 Bozzano, Francesca, Carlo Esposito, Stefania Franchi, Paolo Mazzanti, Daniele Perissin, Alfredo Rocca, and Emanuele Romano. 'Understanding the Subsidence

32 Paolo Bono, ''Stato Evolutivo Della Falda Acuitina Regionale Nella Piana Di Tivoli - Guidonia' (Roma Tivoli Terme, 12 dicembre 2008 - Acque Albule - Victoria Terme Hotel MONTECELIO, 2008).

33 Bono.

es of the water corresponding to extraction periods[34]. Bono reported alarming "worsening geo-environmental conditions of the Aniene area and the dramatic decline of the groundwater resource-reserves of the regional Lucretile Cornicolan aquifer beyond all foreseeable limits."

The current flow rate from the active quarries into the Longarina and Pastini drainage channels (ranging between 5.0 and 5.5 m^3/s) significantly surpasses the flow that could be sustained by the "naturally renewable" resources of the Lucretile-Cornicolan aquifer (approximately 3 - 4 m^3/s). As a result, this is impacting the "permanent reserves" of the region's rapidly diminishing hydro structure. The lowering is specifically alarming in "Piezometry Treviso" (with an average of 26.7 cm per month, around 4.4 meters lower in 30 months), and the lake of San Giovanni, of an average of 18.0 cm per month, 3.7 meters in the period of 43 months[35]. An updated study in 2020, show a decline in water level of about four m in the period 2005–2008 and of about 5 m in the period 2003–2020 for Regina Lake; S. Giovanni Lake waters decreased by about seven meters in the period 2003–2020[36].

34 From a careful analysis clearly emerges how the complex of operating wells in the travertine quarries cause the greatest impact on the natural hydrological balance of the area. In fact, during periods of interruption (or reduction) of mining activity during the most important religious holidays or -more blatantly- during summer vacations, one observes the systematic raising of the piezometric surface of the aquifer as an unequivocally a response to the reduction of pumping from the quarries.

35 Bono, ''Stato Evolutivo Della Falda Acuitina Regionale Nella Piana Di Tivoli - Guidonia'."event-place":"Roma Tivoli Terme, 12 dicembre 2008 - Acque Albule - Victoria Terme Hotel MONTECELIO","language":"ita","publisher-place":"Roma Tivoli Terme, 12 dicembre 2008 - Acque Albule - Victoria Terme Hotel MONTECELIO","title":"'Stato Evolutivo Della Falda Acuitina Regionale Nella Piana Di Tivoli - Guidonia"

36 Numerous studies carefully confirm the direct correlation between reduction in ground water levels and extracting activity, full state of the art is in: Vincenzo Piscopo et al., 'Sustainability Indicators of Groundwater Withdrawal in a Heavily Stressed System: The Case of the Acque Albule Basin (Rome, Italy)', Sustainability 14, no. 22 (17 November 2022): 15248, https://doi.org/10.3390/su142215248.

Since 2001, the Acque Albule springs reduced their natural outflow at the surface to zero[37]. The thermal water feeding the thermal Spas in the area is since then artificially pulled out.

As mining digs deeper, especially below 35-40 meters, the removal of material from the ground, water, travertine, residuals, soil, and other debris creates void in the surrounding terrains. As a result, the terrain sinks, in a different geological process nominated subsidence, or depression of the territory.

The soil depression of the entire plain is accelerated as consequence of the removal of material from the territory. Studies reported large scale subsidence in the plain of the Acque Albule, as the beds of the quarries lowered from 14 to 18 meters below the original ground level, in the span from 1993 to 2005, hence only 12 years[38]. While the plain is susceptible to depression as a natural phenomenon due to its geological setting, the subsidence is accelerated with the increasing rates of water removal to greater numbers. The lowering of the soil has made vulnerable the terrain around the extraction site, deeming some to be inhabitable. Reports have shown the presence of cracks and structural fractures in over 100 buildings around the area caused by the weakening of their foundational bed in Villa Alba, the area mainly affected. This very invisible and slow damage is catastrophic[39], one that has been manifesting in cracks and crawls in public and private properties reported

37 Piscopo et al.

38 Bozzano et al., 'Understanding the Subsidence Process of a Quaternary Plain by Combining Geological and Hydrogeological Modelling with Satellite InSAR Data'.

39 A. Annunziatellis et al., 'Nuovi Dati Sui Sinkholes Del Bacino Delle Acque Albule (Tivoli, Roma)', Atti Del secondo Workshop Internazionale 'I Sinkholes Gli Sprofondamenti Catastrofici Nell'ambiente Naturale Ed in Quello Antropizzato', January 2010, 395–412.

since 2003[40], with very little done to calibrate the damage.

The voids exasperate the creation of another geological phenomenon called a sinkhole. A sinkhole is a closed natural depression in the ground surface caused by removal of material below the ground and either collapse or gradual subsidence of the surface into the resulting void[41]. In comparison with other regions in Italy, Lazio region has the highest number of sinkholes (due to its geological morphology)[42]. A recent census[43] was done more systematically by identifying even the smallest ones, resulted in around 393 in all the region. The lake of San Giovanni south of Guidonia is a sinkhole. The largest and most significant concentration in the area east of Rome is in the Acque Albule basin[44], which contains around 20. These boreholes have been studied in various geomorphological surveys, where it has been highlighted the role of travertine extraction in accelerating these "natural" processes in the area in alarming rates[45]. The risks identified through the monitoring of the Guidonia-Tivoli Plain's hydrological, hydrogeological, and environmental conditions demand urgent and decisive action to gradually restore the natural balance of the Aniene area. The environmental and hydrogeological disaster unfolding before us is a clear warning of more severe calamities to come—issues that are well-known in the region and that the state attempts to mitigate without addressing the root cause[46].

40 'Tivoli e Villalba sprofondano dal 2003: mille famiglie a rischio, fondi per 25', Il Fatto Quotidiano, 3 June 2012, http://www.ilfattoquotidiano.it/2012/06/03/tivoli-villalba-guidonia-sprofondano-dal-2003-mille-famiglie-a-rischio-fondi-per-25/245839/.

41 Definition provided by USGS, United States Geological Survey.

42 Giancarlo Ciotoli, Fabio Meloni, and Stefania Nisio, 'Studi Di Sintesi e Analisi Geospaziale Applicata Alla Valutazione Della Suscettibilità Ai Sinkholes Naturali Nella Piana Delle Acque Albule (Tivoli, Roma) Study of Synthesis and Geospatial Analysis Applied to Evaluation of Susceptibility to Natural Sinkholes in the Acque Albule Basin (Tivoli, Roma)', Memorie Descrittive Della Carta Geologica D'Italia XCIX (January 2015): 203–20.

43 Represented by the "map" published in 2012 by the Lazio Region, after the studies carried out by ISPRA (Higher Institute for Environmental Protection and Research).

44 Silvia Bianchini et al., 'Machine Learning for Sinkhole Risk Mapping in Guidonia-Bagni Di Tivoli Plain (Rome), Italy', Geocarto International 37, no. 27 (20 February 2024): 16687–715, https://doi.org/10.1080/10106049.2022.2113455.

45 R. De Ritis et al., 'Multidisciplinary Study of Subsidence and Sinkhole Occurrences in the Acque Albule Basin (Roma, Italy)', Earth and Space Science 7, no. 7 (July 2020): e2019EA000870, https://doi.org/10.1029/2019EA000870.no. 7 (July 2020

Milky Waters

The extraction process has created a network of channels and pumps in the quarrying basin, with the main drainage canals running along Longarina and Pastini. These two canals converge and feed into the Fosse del Prato, which drains water from the basins into the river, just a few hundred meters from the archaeological site of Ponte Lucano and the Plauzi Mausoleum. This point, known as the waterfalls of the Fosse del Prato, marks a significant feature of the river's geography: here, the Aniene River's water turns white, laden with travertine powder and industrial metals. This whitish color persists all the way to where the Aniene meets the Tiber River in northern Rome. From there, the liquid the stone residues will "sail" to the Tiber, with the final stop in the Tyrrhenian Sea. The milky trail in the Aniene River, visible even from Google Earth satellite images, in figures 9-10, results from debris spillage from quarrying activities, impacting the river's ecosystems.

The turbidity of the river has been reported in several studies, including the report of Bono mentioned above, and in a much more recent study car-

46 Bono, ''Stato Evolutivo Della Falda Acuitina Regionale Nella Piana Di Tivoli - Guidonia'.

FIGURE 9-10

Fosse del Prato Draining point, and the changes in the water color as seen from Google Earth 2024.

ried out by the collective CaveAquam[47] researching reporting the solids present in the water system. The collective along with other environmental associations active in the territory[48], compared samples taken from the river around extraction periods to examine the presence of the white residual of the travertine, in locations before and after the Prato drain.

Other studies detected the mixing phenomena between deep and shallow groundwater, and hydrothermal water mixing with superficial fresh water[49], one that is induced by anthropic pressure on groundwater resources, and significantly affects the natural conditions. Along with its rising tides due to the enormous water added to it daily due to the dewatering processes mentioned before. Further ecological studies would still be required to address the ecological impacts of the different complex water systems drained into the ecosystem of the Aniene.

The Aniene constitutes the backbone of the relevant area hosts some 500,000 people living in a low-density conurbation along the Aniene and Via Tiburtina. The river also represents an important ecological corridor for animal and plant species along the northeast direction of the city of Rome. From the naturalistic point of view, it not only presents within it a vast ecological network consisting of species animals and plants typical of the river environment, but also several elements of historical-cultural interest little known to the public. It is a potential blue-green infrastructure that connects and develops the landscapes between Rome and Tivoli[50].

Different development projects for the territory have included the Aniene as a main axis of develop-

47 In their installation exhibition in Parco delle Energie, Ex SNIA in february 2024, CAVE AQUAM is a collaborative project that was created at the conclusion of the 2023 edition of the Master's program in "Environmental Humanities - Environmental and Territorial Studies" (Università Roma Tre), a research project composed of: Cristina Martone, Paola Pietronave, Anastasia Solazzo, Arianna Cianetti, Davide De Lillis, Cecilia Blanco, Laura Landi, Lucia Tedesco.

48 Aniene Rafters society that continue to monitor the ecological condition of the Aniene inside the GRA (the Gran Raccordo Annullare)

49 Francesco La Vigna, Roberto Mazza, and Giuseppe Capelli, 'Detecting the Flow Relationships between Deep and Shallow Aquifers in an Exploited Groundwater System, Using Long-term Monitoring Data and Quantitative Hydrogeology: The Acque Albule Basin Case (Rome, Italy)', Hydrological Processes 27, no. 22 (30 October 2013): 3159–73, https://doi.org/10.1002/hyp.9494.

50 Romina D'Ascanio and Anna Laura Palazzo, 'Unfolding the Aniene River in Peri-Urban Rome. From Conflicts to Opportunities for a Sustainable Strategy', in Green Infrastructure, ed. Benedetta Giudice, Gilles Novarina, and Angioletta Voghera, The Urban Book Series (Cham: Springer International Publishing, 2023), 43–53, https://doi.org/10.1007/978-3-031-28772-5_4.

ment and recovery, these projects in different ways compromise the size and scales of extraction. These projects include the “il Piano Stralcio dell’area romana da Castel Giubileo alla foce” PS5[51], PTPR[52] as the Lazio Region proceeds to approve the PTPR as the only regional landscape territorial plan”, The PTPG[53] “Piano Territoriale Provinciale Generale” (the only one that potentially expands the extractive territories) and the PRUSST[54]. In most of these models and projects: is projected to expand by approximately an additional 1300 hectares into Natural Reserve of the Aniene River, stretching the reserve into the municipalities of Guidonia Montecelio and Tivoli, even when it includes the decommissioning of some of the travertine quarries[55].

The Italian environmental regulations outlined in Articles 104, 105, and 106 govern the discharge of wastewater into various environmental zones. Article 104 prohibits direct discharge into groundwater and the subsoil, with specific exceptions for geothermal, mining, and certain civil engineering activities, sub-

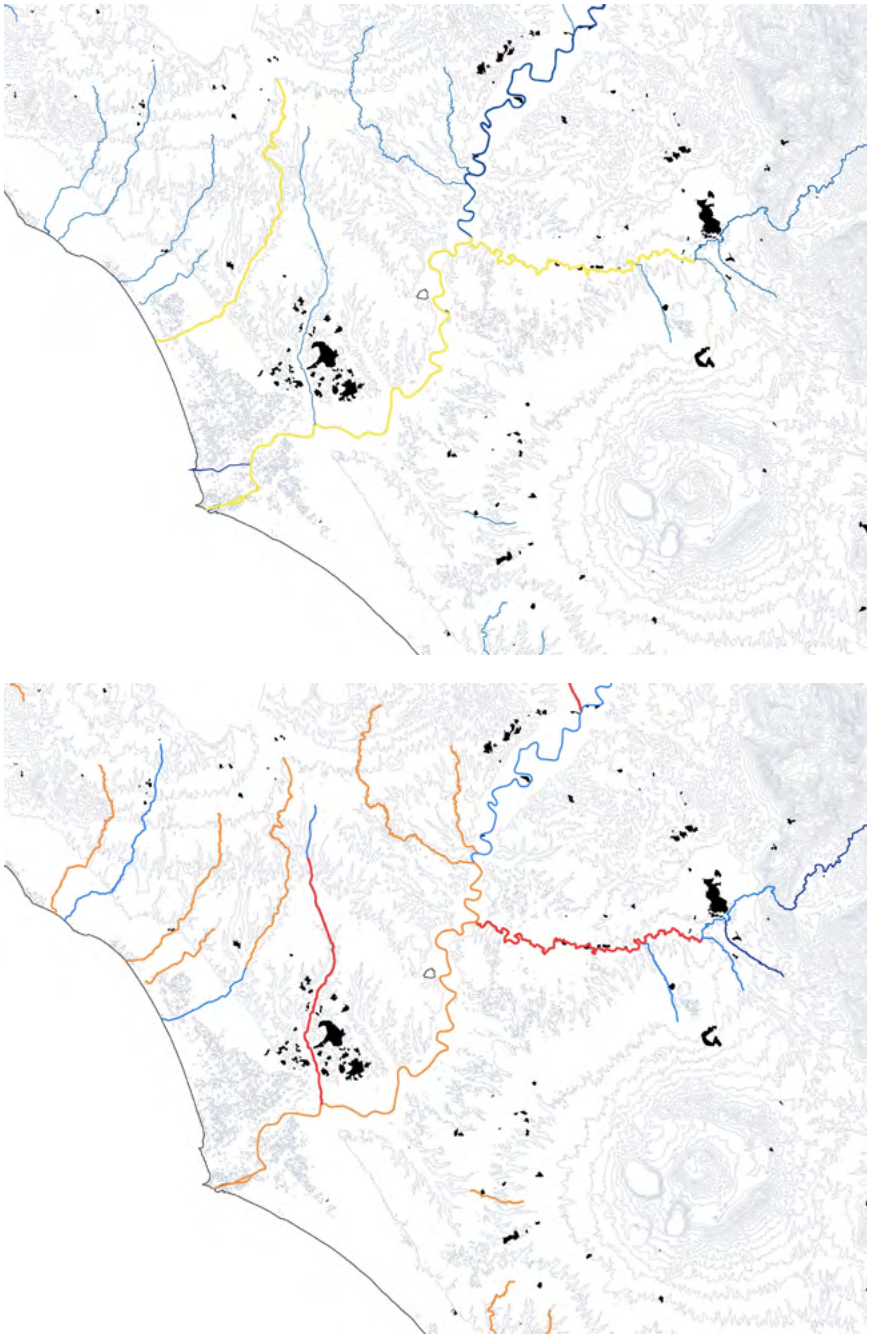
51 PS5: The Basin Plan, introduced by Law no. 183/89, takes on the value of a superordinate Plan and represents a cognitive, regulatory and plan and represents the cognitive, regulatory and technical-operative instrument through which actions for the correct use of water are planned and programmed with reference to the physical water with reference to the physical-environmental characteristics of the hydrographic basin.

52 PTPR: The Regional Landscape Territorial Plan aims to regulate the protection and enhancement of the landscape, its natural environment, and the sociocultural assets that characterize the territory. On July 6, 1998, with Regional Law No. 24, the 29 landscape territorial plans drafted and adopted by the Regional Council between 1985 and 1993, in accordance with Law 431/85, were definitively approved.

53 PTPG: Set within a programmatic perspective, consisting of medium- and long-term timelines, it aims to integrate the city of Rome with its surrounding provincial territory. The General Urban Plan of the Municipality of Tivoli and the General Urban Plan of the Municipality of Guidonia Montecelio, both developed in the 1970s, are characterized by the expansion of residential settlements and the development of local industry, which essentially include the expansion of the extraction territories.

54 PRUSST: The Urban Recovery and Sustainable Territorial Development Program of the Tiburtina axis.

55 D’Ascanio and Palazzo, ‘Unfolding the Aniene River in Peri-Urban Rome. From Conflicts to Opportunities for a Sustainable Strategy’.



MAP 03 (top)

MAP 04 (bottom)

ject to strict conditions. Article 105 mandates that industrial and urban wastewater discharges meet specific treatment standards, especially in sensitive areas or regions with small populations. Article 106 requires enhanced treatment for discharges into ecologically sensitive areas, ensuring the protection of water quality and ecosystems[56].

We're still quite unsure about the quantities, or processes of treatment of the ground and thermal water drained into the Aniene, but we know it's a depleting resource[57]. The ways in which the river has been conditioned, dominated, and determined by the quarrying industries of travertine in the territory needs to be addressed. However, the presented studies of the urban planning tools managing the extractive basin reveals contradictions, underscoring the need for planning that is modern and responsive to environmental concerns. The area, endangered by unchecked development, is inadequately protected by outdated urban plans and a weak landscape plan, which prioritize economic interests over environmental protection[58].

Maps 3 and 4 show the chemical and ecological state of the Aniene, obtained through GIS data published open source through the Lazio region, overlapping with flooding maps of the Aniene. It is evident the structural changes quarrying creates on the rivers' ecosystem, as evident water quality degradation happens in correspondence with extraction, as evident on the Tiber as well, next to the ex-quarries of Malagrotta, that is now a massive landfill.

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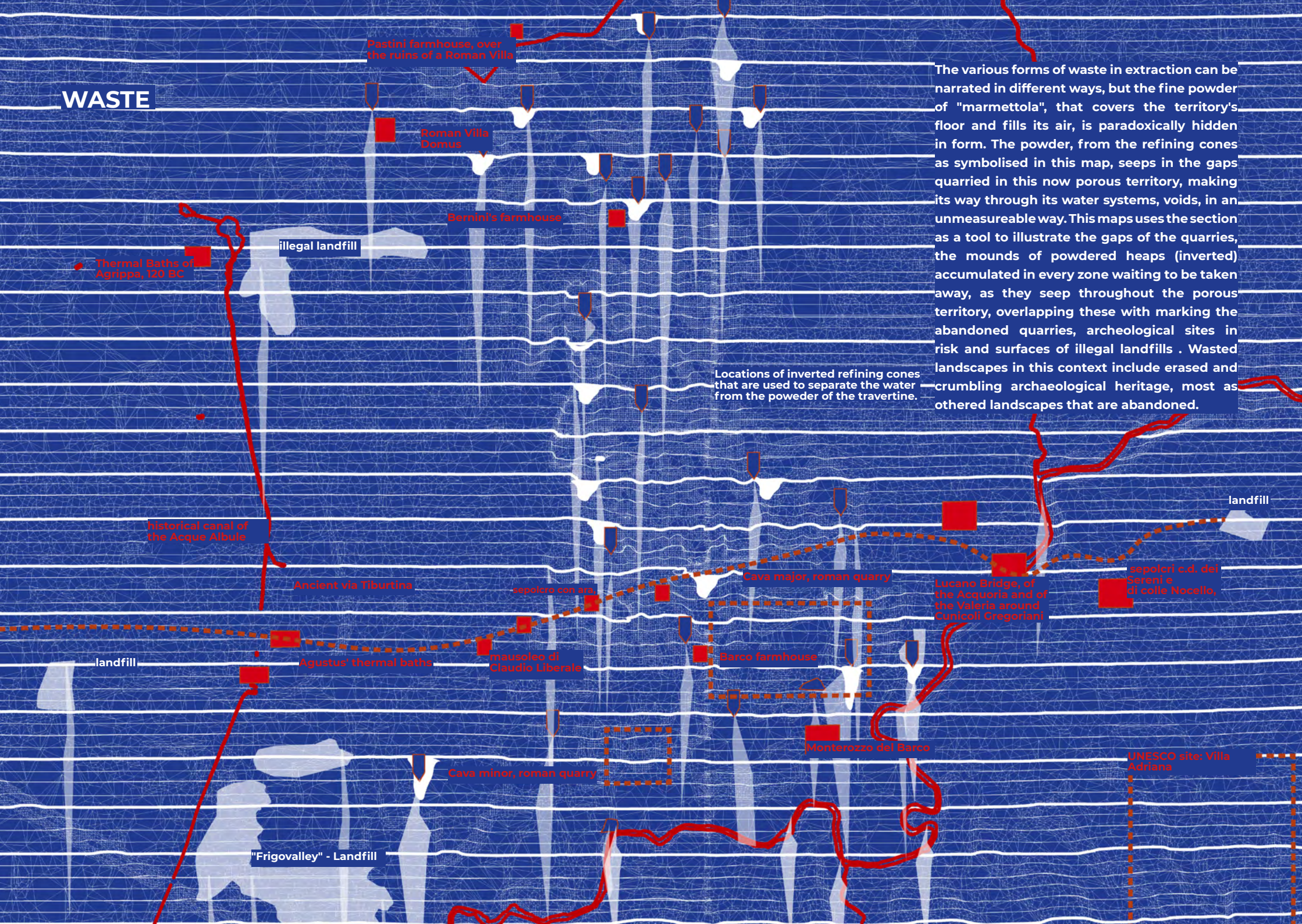
Waste (n.)

Waste material is no longer needed and can be got rid of; to fail to use (something) fully or in the correct or most useful way; things that are not wanted. Definition by Cambridge dictionary accessed in 2024


WASTE
Pastini farmhouse, over the ruins of a Roman Villa
Roman Villa Domus
Bernini's farmhouse
illegal landfill
Thermal Baths of Agrippa, 120 BC
historical canal of the Acque Albule
Ancient via Tiburtina
landfill
Agustus' thermal baths
sepolcro con ara
mausoleo di Claudio Liberale
Cava major, roman quarry
Barco farmhouse
Monterozzo del Barco
Cava minor, roman quarry
"Frigovalley" - Landfill
Lucano Bridge, of the Acquoria and of the Valeria around Cunicoli Gregoriani
sepolcri c.d. dei Sereni e di colle Nocello,
landfill
UNESCO site: Villa Adriana
Locations of inverted refining cones that are used to separate the water from the poweder of the travertine.
The various forms of waste in extraction can be narrated in different ways, but the fine powder of "marmettola", that covers the territory's floor and fills its air, is paradoxically hidden in form. The powder, from the refining cones as symbolised in this map, seeps in the gaps quarried in this now porous territory, making its way through its water systems, voids, in an unmeasureable way. This maps uses the section as a tool to illustrate the gaps of the quarries, the mounds of powdered heaps (inverted) accumulated in every zone waiting to be taken away, as they seep throughout the porous territory, overlapping these with marking the abandoned quarries, archeological sites in risk and surfaces of illegal landfills . Wasted landscapes in this context include erased and crumbling archaeological heritage, most as othered landscapes that are abandoned.

3.2 WASTE

Quarry or Dump

Growth, decay, production and waste are bound up with all landscapes[59]. Extraction has waste in its essence, it is based on created economic value of a small percentage of the extracted resource, discards everything else. This encompasses the quintessential residual architecture of extractive landscapes, characterized by spoil heaps, waste ponds, slag piles, tank farms, tramways, stacks, and flues gathered around the excavation site—a landscape shaped by the processes of sorting, transportation, and abandonment, embodying the abstract calculations of value[60]. Extractivism[61], has substantial waste embedded in its material flows: it discards large quantities "sterile" material, creates more waste in the refining and processing of the extracted material while its occurring.

Once it's done, *Extractivism* discards entire buildings, machinery, labour, and entire waste landscapes. In some areas of the country, the illegality rate in yard waste disposal exceeds 50 percent of the total produced. This is millions of tons of waste abandoned on the territory to the detriment of the community, both in terms of costs and damage to the environment and health[62]. It is based on waste relationships, manifesting what Marco Armiero describes as Wasteocene, a term that defines waste as an ecology. The Wasteocene is not about waste as an object, it is rather, a socio-ecological relations creating wasted people and wasted places[63]. "Waste as a relation (wasting) produces the targeted community

FIGURE 01

The Barco historical farmhouse, from the 1600s of the family d'Est, also known as Casale Vecchio (old farmhouse), with its foundations crumbling from the ongoing extractions, , Photo by Sara Ahmed 2024

63 M. Armiero, Wasteocene: Stories from the Global Dump (Cambridge University Press, 2021).

rather than solely selecting it as the ideal place for an unwanted facility.

Trash has always been regarded as a dystopic symptom of consumer societies, architectural practice comprised, for which rather than treating the symptom, the response however was to further remove trash from site. This involves the erasure of waste systems and their displacement to an externality, to territories that are out-of-sight-beyond-accountability.[64] In this sense, we might adapt what Dipesh Chakrabarty once wrote on the issue of waste[65]: "For whether we are talking about radioactive waste from the industrialized countries or of the waste of a household or village in India, the "dirt" can only go to a place that is designated as the "outside."[66] The "outside" is a cultural construct that sacrifices, outsides, and expels landscapes and territories. These waste landscapes were never found per se, they are created.

Most waste in the world is industrial solid waste, in terms of weight, volume, and toxicity. Critical theorizations of waste and the process of wasting, drawing from studies on environmental justice, e-waste, recycling, food waste, and more-than-human interactions, have played a key role in revealing the complex network of actors involved in the creation, management, movement, valuation, and consumption of waste across different levels[67]. Studies that illustrate the correlation between waste, its landscapes and extraction in systematic way are worth revisiting.

64 El Hadi Jazairy, Geographies of Trash (New York City: Actar D, 2016). Pg. 12

65 Armiero, Wasteocene: Stories from the Global Dump. 2021, pag: 2

66 Dipesh Chakrabarty, 'Of Garbage, Modernity and the Citizen's Gaze', Economic and Political Weekly 27, no. 10/11 (1992): 541–47. Pg: 542

67 Nathan McClintock and Georgina Morris, 'Urban Geographies of Waste', Urban Geography 45, no. 4 (20 April 2024): 518–27, https://doi.org/10.1080/02723638.2024.2319437.

The issue with extraction and waste are related to wasting process in its making, and the brownfields it leaves. Brownfields, one that defines the de-industrialised post-extraction contaminated land. It describes the mixture of terrain vague and drosscapes often result from what Allen Berger describes as the enormous new territories adjacent to the city's development and in its making that end up forming waste landscapes. Berger sees these landscapes as landscapes-in-transition, an opportunity to measure from the wasted-scapes the scales of material removal and industrialization. As he puts it: ""It attempts to burn the conscience of this process into the public's awareness, highlighting the magnitude of the post-mining landscape. The goal is to redesign these landscapes creatively, finding ways to make waste produced from mining (from haul roads to waste-rock piles, pits to polluted waterways, and altered ecologies) functionally, safely, and opportunistically reclaimed, redesigned, and aesthetically reused.[68]" Berger's theoretical framework of drosscapes goes hand-in-hand with "Reclaiming American West[69]", one that focuses on the scales of the altered landscapes that result from natural resource extraction. The discourse about reclamation as defined by Berger, will become as the biggest challenge for landscape architects with the increasing scales of mining and their resulting landscapes.

In this section, we dissect the dynamics of waste generated by extraction processes and the resulting waste landscapes. Investigating in the case of Roman Travertine, we argue that the dumpsters of travertine

68 Alan Berger, Drosscape: Wasting Land in Urban America, 1. ed (New York, NY: Princeton Architectural Press, 2006). Pg. 13

69 Alan Berger, Reclaiming the American West, 1st ed (New York: Princeton Architectural Press, 2002).

occur in three forms. Starting from the different scales of waste in the stone extraction itself, highlighting the significant waste margins compared to the "useful" material that is sold. We extend the notion to the aftermath of these sites as wasted-scapes occurring in two stages: first by "landscape-othering": the deliberate contamination and sabotage of the natural and archaeological heritage of the Acque Albule. And finally, how they risk turning into eventual landfills, a case common in landfills in the Italian context.

With the dominant extraction narrative of the site, even when miners don't plan to stay in the territory forever, they contribute to practice that determine its long-term afterlife. These practices seem to be preparing this landscape for its eventual future as a dumpster.

Artificial Natures of Debris

Extraction of natural resources is often associated with large margins of waste. Sterile material is the term used to define the material that has no commercial value, noneconomic portion of the mined rock. In the case of coal, sterile is often estimated to be around 50%, while precious metals like gold, it is mined in part by the thousands in rocks. Extraction landscapes are therefore also coupled with the formation of "slag heaps", hills that are formed with the accumulation of mining waste material, which can be in many cases significant in size. They often pose a financial dilemma for their removal or reuse, and with time become environmental and safety hazards

FIGURE 02

Refill material of another form, probably taken from another construction site, used as refilling material. Photo by Sara Ahmed 2024

for soil contamination, erosion, and landslides[70].

The scraps of travertine extracted in Roman times has been accumulating in the small artificial hill of the Montarozzo del Barco, one that is very similar in its essence to the artificial hill of scraps and debris in the centre of Rome, Monte Testaccio. The accumulation of waste from travertine processing has, over the centuries, been colonized by a large number of plant species. Currently, 268 floristic species have been recorded, including some very rare ones[71]. The hill is located within the SAC area known as 'Travertini Acque Albule (Bagni di Tivoli)[72]' and it

70 One of the most famous catastrophic stories was the Aberfan disaster in Wales, in the UK in 1966. When a coal mine colliery spoil tip collapsed due to a rainfall, turning into an avalanche that hit an elementary school, killing 116 children and 24 adults. Residents and activists have for years preceding the incident called for the removal of the slag heaps. Iain McLean, 'Lessons from the Aberfan Disaster and Its Aftermath' (British Academy Review, issue 12 (January 2009). © The British Academy, 2009),

71 Romeo Di Pietro et al., 'Floristic and Coenological Data from the Travertine Substrates of the SAC "Travertini Acque Albule (Bagni Di Tivoli)" (Lazio Region – Central Italy)', Plant Sociology 59, no. 2 (30 December 2022): 51–70, https://doi.org/10.3897/pls2022592/05.

72 SCI code IT6030033, see chapter 2

FIGURE 3-6

Waste travertine in its different forms, some used as a refill material while others are waiting to be taken away. The first image, left, depicts blocks with faults, with the series of the three images aligned vertically depicts the "pezzame" or travertine scarts, either used for refill, or sold to make cement, or is total waste, as in the image at the bottom.
Photos by Sara Ahmed

bears witness to the now extremely rare vegetation of the travertine formations in the Acque Albule region[73].

In the Acque Albule today, only 25% of the travertine that is extracted is sold[74]. The typical yield in "valuable" material is estimated at 10% in other reports[75]. While the rest could be used for the refilling of the quarries once the quarrying is done, this is not usually the case, it is often sold as construction aggregates. The aggregate conveyor belt systems and large machines of construction companies who buy and process these aggregates are a feature of the extraction site, making up a substantial part of its spatial land use. The remaining aggregates and debris are used to refill the quarries once extraction

73 the Montarozzo del Barco is discussed in detail in the 2.1 travertine, the living stone

74 Percentage of sold travertino ranges from 25-30% as testified by different cave owners in interviews with: Estraba SRL 2023, Medi Stone 2022, and STR in 2024.

75 Published in a report of estimated value by arch: arch. Luisa Cannavacciuolo in 2021 "Relating to the travertine extraction quarry, with annexed sheds and service rooms, located in the municipality of Guidonia Montecelio (RM), locality "Le Fosse", identified in the Land Registry at fgl 7 p.lla 32 Qual. Ente Urbano correlated to Catasto Fabbricati fgl 7 p.lla 32 sub 501 cat. D/1 and p.lla 33 sub 501 cat. A/4." Link: https://astetribunali24.ilsole24ore.com/wp-content/uploads/2022/10/3_Perizia_di_stima_Arch_Luisa_Cannavacciuolo.pdf

is ceased. Another sizable portion of the travertine debris exists in the form of fine white powder, also otherwise known as "*Marmettola*[76]" too thin to be used for refill as it could contaminate the soil and groundwater reserves. This powder accumulates in small dunes on-site, becoming a burden that occupies space until specialized companies are called to remove it—an expense that falls on the extractor. These dunes of white travertine powder often remain on the site for months or even years, exposed to erosion and mixing with the environment during rain or floods. The fate of these mounds becomes uncertain if the extracting company goes bankrupt. This white powder constitutes one of the most costly and problematic residual material of extraction, since it can be barely sold (often to chemical and pharmaceutical companies), and is costly to remove. Most extractors end up burying it in the site between other materials, which is highly prohibited[77]. The risk lies in the high permeability of the soil may allow for rapid infiltration and reach of groundwater by a this fine contaminant.

This is the other reason for which the Regional quarrying activities over the over the opening of new quarries to limit the withdrawal of non-renewable resources and favors renewable resources and privileges the environmental recovery of disused quarrying areas. It also encourages research and testing of alternative materials for the reprocessing and reuse of materials from demolition, restoration renovations, earthworks and drainage"[78].

76 This specifically refers to the residual of Carrara marble powder, in Tuscany

77 Testimony from Estraba on 10-10-2024.

78 'Consiglio Regionale Del Lazio - Leggi Regionali (Testo Coordinato) - Legge Num. 17 Del 6 Dicembre 2004', accessed 20 August 2024, https://www.consiglio.regione.lazio.it/consiglio-regionale/?vw=leggiregionalidettaglio&id=8984&sv=vigente.

Systematic Othering of the landscape.

There is a direct relationship between processes of estrangement and the designation of a specific place into a waste land. The heavy transformation of the natures of the place beyond recognition yields landscape into ruins. As these landscapes transform in quick paces and speeds, it is difficult to create a sense of belonging to them, resulting in sensations of estrangements, in a process of "othering[79]". The vastness of the site, aggressive anthropic transformation due to extraction, along with the lack of accessibility results in difficulty of orientation; all of which lead to perceptual estrangement, and scarce belonging. The territory therefore is left to necropolitical[80] dynamics.

Mining activities have wiped out the Roman quarries' archaeological remains, and risks of the loss of more heritage as well. Rodolfo Lanciani mapped forms of the ancient quarries of the Barco, Roman Barco Quarry[81] (Cava Lapidicina maior) one of which stretches for almost 2 kms, its traces are completely erased by the ongoing extraction activities[82]. Other historical monuments are heavily jeopardized: Casale del Barco (15th century hunting reserve) of the Est family, of which its roofs have already collapsed and now precariously suspended on a rocky outcrop,

79 Armiero, Wasteocene: Stories from the Global Dump.

80 Achille Mbembe, Necropolitics, trans. Steven Corcoran, Theory in Forms (Durham London: Duke University Press, 2019).

81 Mari, 'La Cava del Barco e La Piana delle acque albule nell'antiquità. Il travertino. Aspetti naturalistici e sffrutamento industriale all'inizio del terzo millennio'.

82 Rodolfo Amedeo Lanciani, Ruins and Excavations of Ancient Rome: A Companion Book for Students and Travelers (Classic Reprint) (S.l.: Forgotten Books, 2018).

FIGURE 7

Archeological Map of Via Tiburtina from the Lake of Tartari to the Lucano Bridge (photo by Lanciani, 1885).

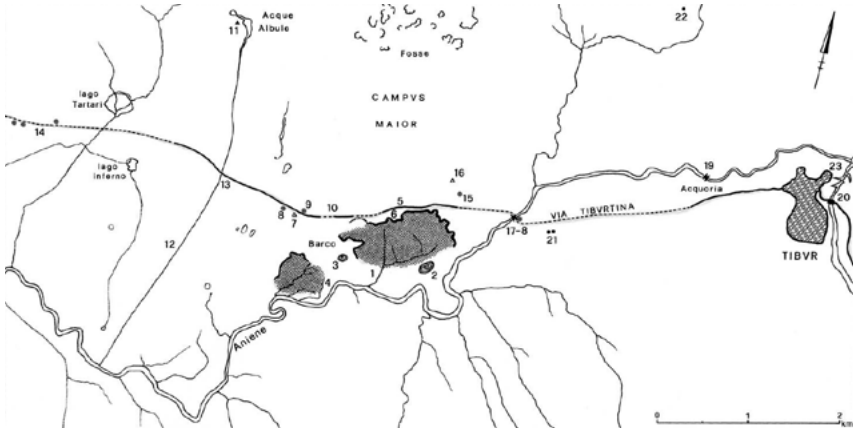


FIGURE 8

The Ager Tiburtinus west of Tivoli, (Photo from Z. Mari, 1983).
detail of the Barco Quarry and archaeological pre-existences
1. Quarry,
2-3. "Montarozzo del Barco" e "Montarozzo piccolo",
4. banchina (?),
5. Ramp of via Tiburtina,
6. casale del Barco,
7. villa (?),
8. sepolcro con ara,
9. mausoleo di Claudio Liberale,
10. Modern acqueduct,
11. Thermal Bathsof Agrippa,
12. Canal of the Acque Albule,
13. via Tirburtina a Bagni di Tivoli,
14-15, sepolcro dell'Albuccione e c.d. "Truglio",
16. villa di valle Pilella,
17. sepolcro dei Plauzi,
18-20. Lucano Bridge, of the Acquoria and of the Valeria around Cunicoli Gregoriani,
21-22. sepolcri c.d. dei Sereni e di colle Nocello,
23. Temples of the acropolis of Tivoli.

FIGURE 9

Casal di Bernini as quarrying eats around its foundations as seen on October 2023, photo by Sara Ahmed

waiting to topple[83]. The Casale di Bernini, figure 10, is the 16th century artists' residency and farmhouse, built in the first half of the sixteenth century to supply the best travertine to the factory of San Pietro and in which Gian Lorenzo Bernini stayed, is now under the risk of crawling as quarriers continue to remove earth from beneath its foundations. The ancient route of the Via Tiburtina has completely disappeared due to the intense urbanization of the economic boom. The Ponte Lucano and Plauzi Mausoleum in a state of total abandonment, if not for academic intellectual projects. The main archaeological elements along the territory has been the subject of study by Lanciani, and were elaborated in the maps in Figure 7, and restudied by Zaccaria Mari, elaborated in the map figure 8.

Along with extraction, heavy duty industrial transport produces problematics due to its vicinity to two important UNESCO sites, (Villa d'Este and Villa Adriana), and other various archaeological remains

83 testimony through the marketing agent of ESTRABA SR. L, the quarrying company currently operating in the location of the Barco Quarry in October 2023, same phrase repeated a year later, as the conditions of the monument deteriorate.

still present on the site.

The same fate has befallen the other sites in the Acque Albule area, with its significant natural monuments are currently in a state of complete abandonment. Of the two large lakes that once characterized this, the Inferno Lake is now filled with waste, and its basin is barely recognizable. The Tartari Lake has been destroyed by the construction of the new "L. Pisano" Technical Institute.

The largest dumpsite for refrigerators and appliances in Rome, known locally as "frigo-valley," is situated within the margins of the above-mentioned SAC, on the borders of the travertine quarries on the shores of the Aniene. The environmental catastrophe has been unfolding for nearly a decade, following the bankruptcy of Stacchini's powdery (polvericcio) in 2000, the former owner of the site, the area was first abandoned and later occupied by a community of nomads, who were evicted.

The so called "frigo-valley" appears to be several accumulations of orange substance that makes up the insides of our electro domestics, is visible from google images, and it suddenly appears abruptly on a massive scale between 2012-2013. The disposed bulky waste has fuelled an illegal money-making cycle of urban mining, through extracting valuable materials like copper, steel, and iron from appliances, which were then sold at low prices. This inevitably leads to an increased the likelihood of releasing toxic substances into the soil. Fortunately, in April 2024, it has been approved the environmental recovery plan of the area.

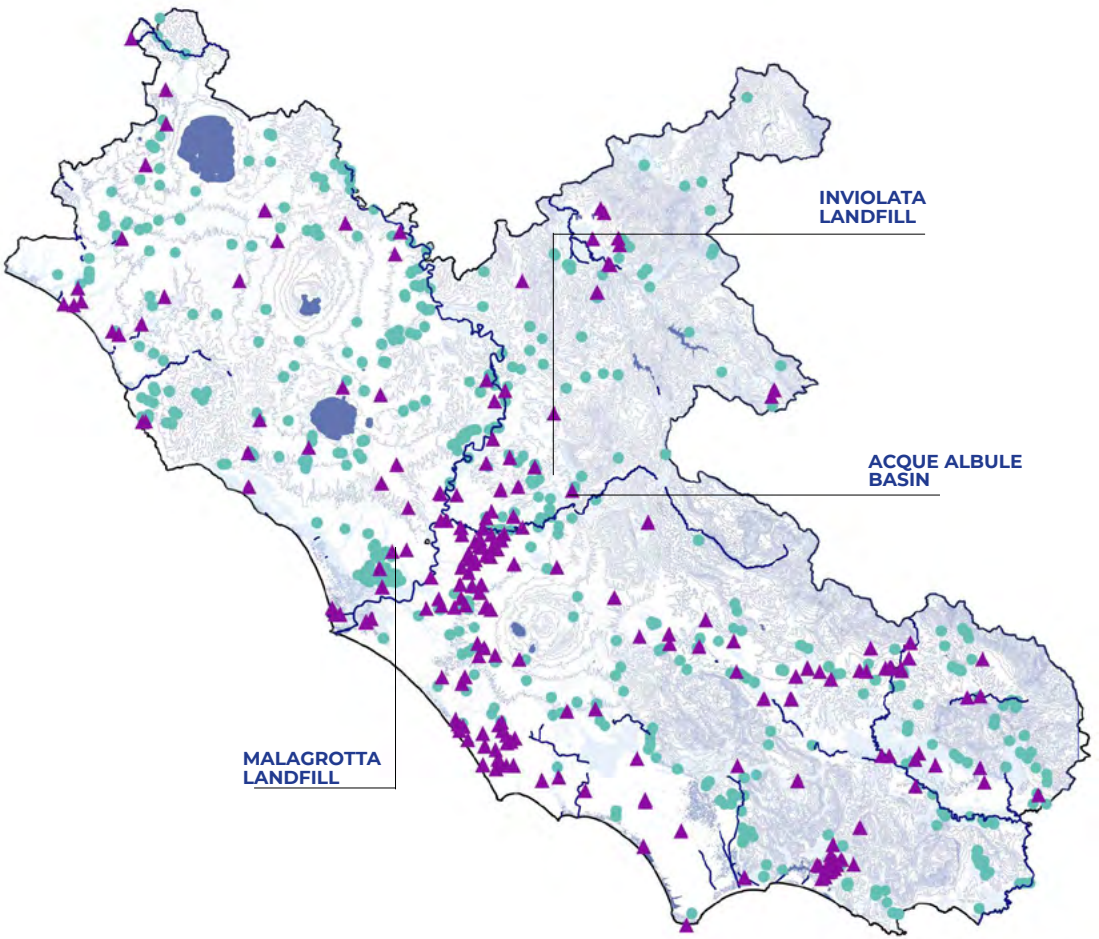
From Quarry to Dump as Environmental Recovery

The environmental recovery of dismissed quarries from a legal point of view is still a topic of major debate. The legal framing of quarries upon their dismissal is extensively covered by Elena Paudice, as she highlights the case of quarry recovery in the plain of the Acque Albule[84]. Paudice highlights that the environmental recovery often does not occur because financial guarantees are inadequate to support recovery efforts, and there is a lack of oversight. In addition, recovery frequently does not involve morphological restoration but instead results in the creation of landfills at disused quarry sites, sometimes allowed by regional regulations and national legislation. Extraction sites and landfill are categorised in the same cartography in maps published by the official open data sources of the Lazio region[85]. Why do discarded quarries often end up being converted into landfills?

In this discouraging picture, the combination of quarries and landfills has increasingly become more and more a constant favoured by the rise of the practice of allocating the void created by cultivation for the creation of a landfill (once the exploitation of the site is done). If we think that quarrying activity results in the creation of a space that is, of a volume, we must also consider that a landfilling activity is substantiates the filling of the void or volume resulting from extraction.

84 Paudice, Paesaggi Interrotti, La rigenerazione delle cave dismesse.

85 In its updated open-access GIS cartographies, source: https://geoportale.regione.lazio.it/layers/geodbgt:geonode:web_050303_sc_dis_a



MAP 01

Map of extraction and landfills in Lazio, highlighting the correlation between landfill and quarries.

- **Landfills and scrap yards**
- **Main rivers**
- **Quarries**

Quarry owners are required by law[86] to environmentally recover, also through refilling, their quarries after its exhaustion. Under Legislative Decree No. 117 of May 30, 2008, Article 10, the use of extraction waste to fill voids and volumes created by mining activities is allowed only if specific conditions are met. These include ensuring the stability of the waste, preventing soil and water pollution, and monitoring both the waste and the mining voids. Compliance with these conditions must be documented in a waste management plan approved by the relevant authority. Additionally, the filling of these voids with waste other than extraction waste must follow the regulations set out in Legislative Decree No. 36 of January 13, 2003, concerning landfill operations.

That nonetheless provides very little restriction and does not guarantee the recovery of the quarries into something that is not a landfill. Near the travertine extraction basin, we witness the cases of Inviolata landfill, an ex-quarry, which was once an illegal dumpster, now is an enormous problematic landfill the second largest in Lazio after Malagrotta. Malagrotta[87] landfill was an ex-concrete quarry and is now main landfill of the municipality of Rome, one of the biggest in Europe. Map 01, overlaps 130 landfills existing in Lazio region existing with quarries, most of the time, the two either overlap or are geographically very close. Armiero explains this dynamic, as he puts it: frequently, new landfills and other waste facilities are proposed to be constructed near existing dumps or in areas already impacted by contamination[88]. Areas affected by illegal dumping

86 The effective law in this moment is the: Legge Regionale n. 17 del 6 dicembre 2004, 'Consiglio Regionale Del Lazio - Leggi Regionali (Testo Coordinato) - Legge Num. 17 Del 6 Dicembre 2004'.

87 Size of the Malagrotta landfill is 240 hectares

88 Armiero, Wasteocene: Stories from the Global Dump., pg.: 40

become ideal locations for new waste facilities, it makes sense to reinforce the existing socio-ecological inequalities, implementing new industrial scale contamination occurs where it conveniently already exists, where it is financially beyond recovery.

This is a recurring case in different open quarry sites, especially in Campania region, as reported by Paudice[89], Armiero[90], and De Rosa[91], as they report on how the "waste entrepreneurs" have the capacity to bend laws and turn enclaves in the landscape into potential renting spaces to fill with waste for profit. These operations seldom respect safety distances between these landfills and residential clusters, often with devastating health consequences that are extremely difficult to proof through scientific knowledge, that is uncertain about the direct correlation between the newly introduced toxicities and health issues[92].

Another controversial "recovery" project in one of the dismissed travertine quarries, was the bio-digestor facility, a biogas plant, one that converts organic waste and produces biofuel. Around 2011, the project submitted by "F.lli Pacifici spa[93]", one of the main quarry extractors in the territory, to the Lazio

89 A decree was used to convert abandoned quarries into open-air landfills. This occurred in Campania in 2009 when the region faced another waste management crisis. In response, Legislative Decree No. 90 from May 23, 2008, authorized the creation of a new landfill within an open-air tuff quarry on the northern outskirts of Naples. The landfill site, located near a block of public housing built a few decades earlier, is part of the tuff quarry system within the Metropolitan Park of the Hills of Naples.

90 Armiero, Wasteocene: Stories from the Global Dump.

91 Salvatore Paolo De Rosa, 'A Political Geography of "Waste Wars" in Campania (Italy): Competing Territorialisations and Socio-Environmental Conflicts', Political Geography 67 (2018): 46–55, https://doi.org/10.1016/j.polgeo.2018.09.009.I propose a novel analytical framework to inquire into the spatial and socioecological antagonisms of socio-environmental conflicts based on the integration of Urban Political Ecology (UPE

92 Armiero, Wasteocene: Stories from the Global Dump.

93 Fratelli PACIFICI Ing. Cesare e Lorenzo S.p.A., operating in the area of travertine extraction since 1938.

Region to be evaluated, including its compatibility with the "Barco" area. The small road leading to the proposed biodigester currently ends at a large travertine deposit, which seems to have been abandoned for several years. If the plan is approved, this outdoor storage area would be replaced by a biogas plant capable of processing 38,000 tons of organic waste annually. The project aims to achieve "environmental recovery" of an old, unused travertine quarry located on Via Della Bullica, across from a farmhouse-restaurant Inside the boundaries of the protected SAC. It is also 500 meters away from an elementary school, of Alberto Manzi in Villalba.

The project involves the construction of a biogas purification plant to produce biomethane, a renewable biofuel. The facility processes waste using anaerobic digestion, a method of decomposing organic material without oxygen. This process results in a gas mixture consisting of methane (CH_4) and carbon dioxide (CO_2). Despite the outcries of local environmentalists, scientists, politicians, and associations, the building biogas purification plant has been authorized by the Lazio region in June of 2023[94], and has gained the approval from the Tivoli municipality in April 2024[95]. The need for green energy sources does not justify placing such a facility within the borders of an area of community interest, rich in hydrologic resources, where it would only further marginalize and degrade an already burdened indus-

94 Lazio Region, 'Provvedimento Autorizzatorio Unico Regionale Ai Sensi Dell'art. 27-Bis Del D.Lgs. 152/2006 e s.m.i. Sul Progetto Di "Impianto Di Digestione Anaerobica Della FORSU Con Produzione Di Biometano", Comune Di Tivoli (RM), Località Barco – Via Della Bullica Società Proponente: Fratelli PACIFICI Ing. Cesare e Lorenzo SpA Registro Elenco Progetti n. 109/2020', June 2023, https://www.regione.lazio.it/sites/default/files/documentazione/AMB-DD-G08979-28-06-2023.pdf.

95 'Consiglio Comunale lunedì 22 aprile ore 09:30', Comune di Tivoli (blog), accessed 22 August 2024, https://www.comune.tivoli.rm.it/notizia/consiglio-comunale-lunedi-22-aprile-ore-0930/.

trial zone. This raises serious questions about why such a proposal is considered a valid environmental recovery plan for an area already facing significant ecological challenges.

Capitalism does not tolerate the formation of unused voids in the territory without profiting from them[96]. It sees opportunity in the voided terrains to be filled, and very often the solution is found in the refilling with waste, in literal conversion from extraction to wastelands. Since mining regulations are in part left to local authorities and works filling of quarry voids can be influenced by the needs of economic development[97]. Extraction creates dynamics of socio-economic waste, where not only material is wasted, but also social and environmental injustices. This creates entanglements of precariousness, where economic dependence leads to degradation of ecosystems and communities, in this context it has left no alternative to stone extraction. The interconnectedness of economic practices and environmental harm in a closed loop of marginalizing populations to bear the outcomes of pollution, depletion and its resulting wastelands.

We typically address the issue of waste as an urgent crisis rather than through thoughtful planning. However, planning is essential for developing new habits and systems that can drastically cut down on waste, while also creating strategies for waste disposal and re-imagining and restoring the landscapes of landfills[98]. It is therefore not an environmental recovery operation if a disused quarry is used as a container for waste, even if it the contents of the landfill are classified as non-hazardous.

96 Armiero, Wasteocene: Stories from the Global Dump.

97 Michela Passalacqua e Nicoletta Rangone, Recupero delle cave dismesse e tutela dell'ambiente:fallimento della regolazione e prospettive di riforma, in Rivista quadrimestrale di Diritto dell'Ambiente, n.3,2011, pag.60.

98 Alessandra Capuano and Orazio Carpenzano, eds., Ripensare Le Discariche (Quodlibet, 2016).

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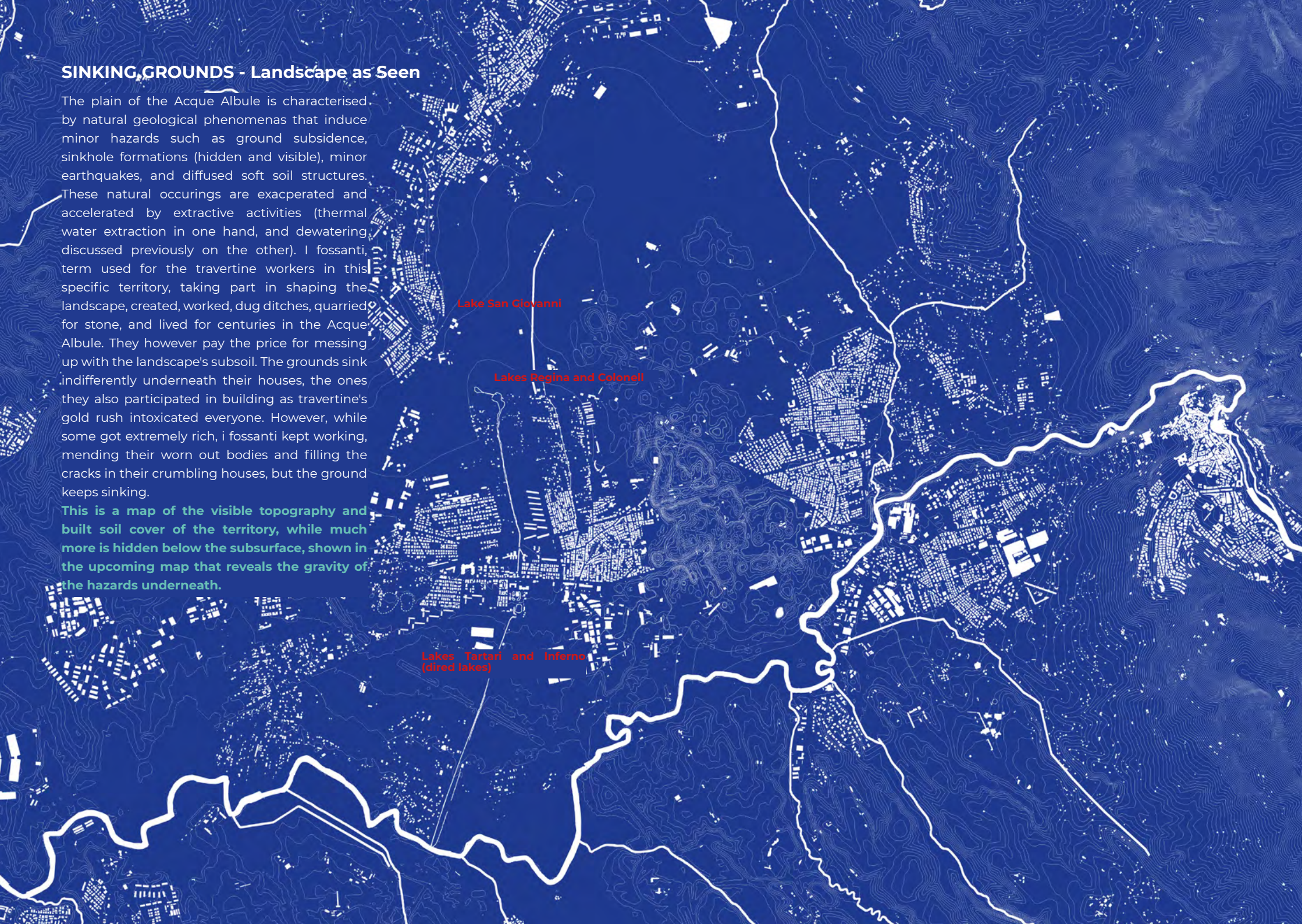
Fossante (ita-adj.)
is based on historical and linguistic understanding of Italian terminology related to manual labor in specific historical contexts, referring to workers responsible for digging or maintaining fossati (ditches or trenches) or graves (hence connected to foss from Latin, meaning "ditch" or "pit").

SINKING GROUNDS - Landscape as Seen

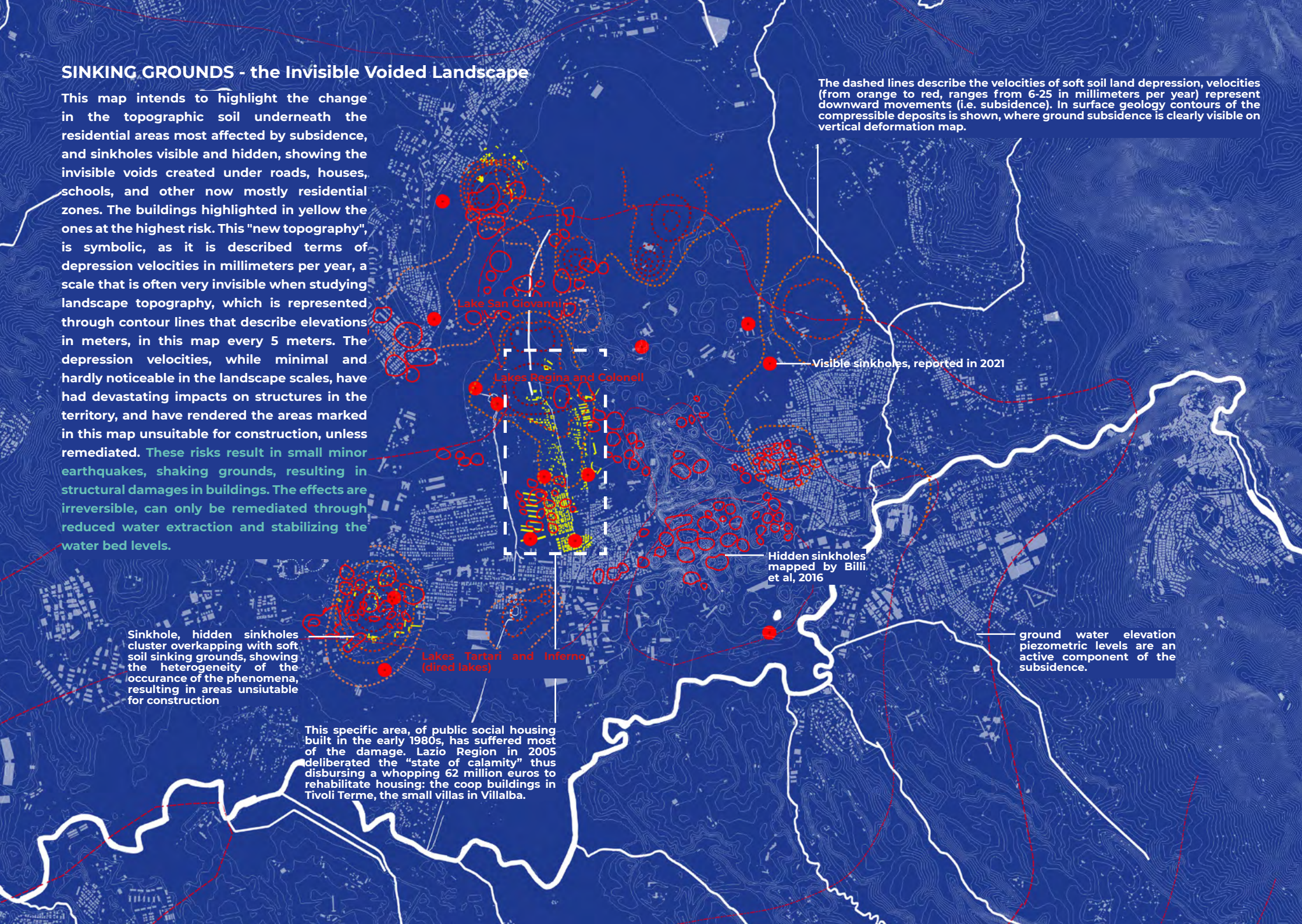
The plain of the Acque Albule is characterised by natural geological phenomenas that induce minor hazards such as ground subsidence, sinkhole formations (hidden and visible), minor earthquakes, and diffused soft soil structures. These natural occurings are exacperated and accelerated by extractive activities (thermal water extraction in one hand, and dewatering discussed previously on the other). I fossanti, term used for the travertine workers in this specific territory, taking part in shaping the landscape, created, worked, dug ditches, quarried for stone, and lived for centuries in the Acque Albule. They however pay the price for messing up with the landscape's subsoil. The grounds sink indifferently underneath their houses, the ones they also participated in building as travertine's gold rush intoxicated everyone. However, while some got extremely rich, i fossanti kept working, mending their worn out bodies and filling the cracks in their crumbling houses, but the ground keeps sinking.

This is a map of the visible topography and built soil cover of the territory, while much more is hidden below the subsurface, shown in the upcoming map that reveals the gravity of the hazards underneath.



SINKING GROUNDS - the Invisible Voided Landscape

This map intends to highlight the change in the topographic soil underneath the residential areas most affected by subsidence, and sinkholes visible and hidden, showing the invisible voids created under roads, houses, schools, and other now mostly residential zones. The buildings highlighted in yellow the ones at the highest risk. This "new topography", is symbolic, as it is described terms of depression velocities in millimeters per year, a scale that is often very invisible when studying landscape topography, which is represented through contour lines that describe elevations in meters, in this map every 5 meters. The depression velocities, while minimal and hardly noticeable in the landscape scales, have had devastating impacts on structures in the territory, and have rendered the areas marked in this map unsuitable for construction, unless remediated. These risks result in small minor earthquakes, shaking grounds, resulting in structural damages in buildings. The effects are irreversible, can only be remediated through reduced water extraction and stabilizing the water bed levels.



The dashed lines describe the velocities of soft soil land depression, velocities (from orange to red, ranges from 6-25 in millimeters per year) represent downward movements (i.e. subsidence). In surface geology contours of the compressible deposits is shown, where ground subsidence is clearly visible on vertical deformation map.

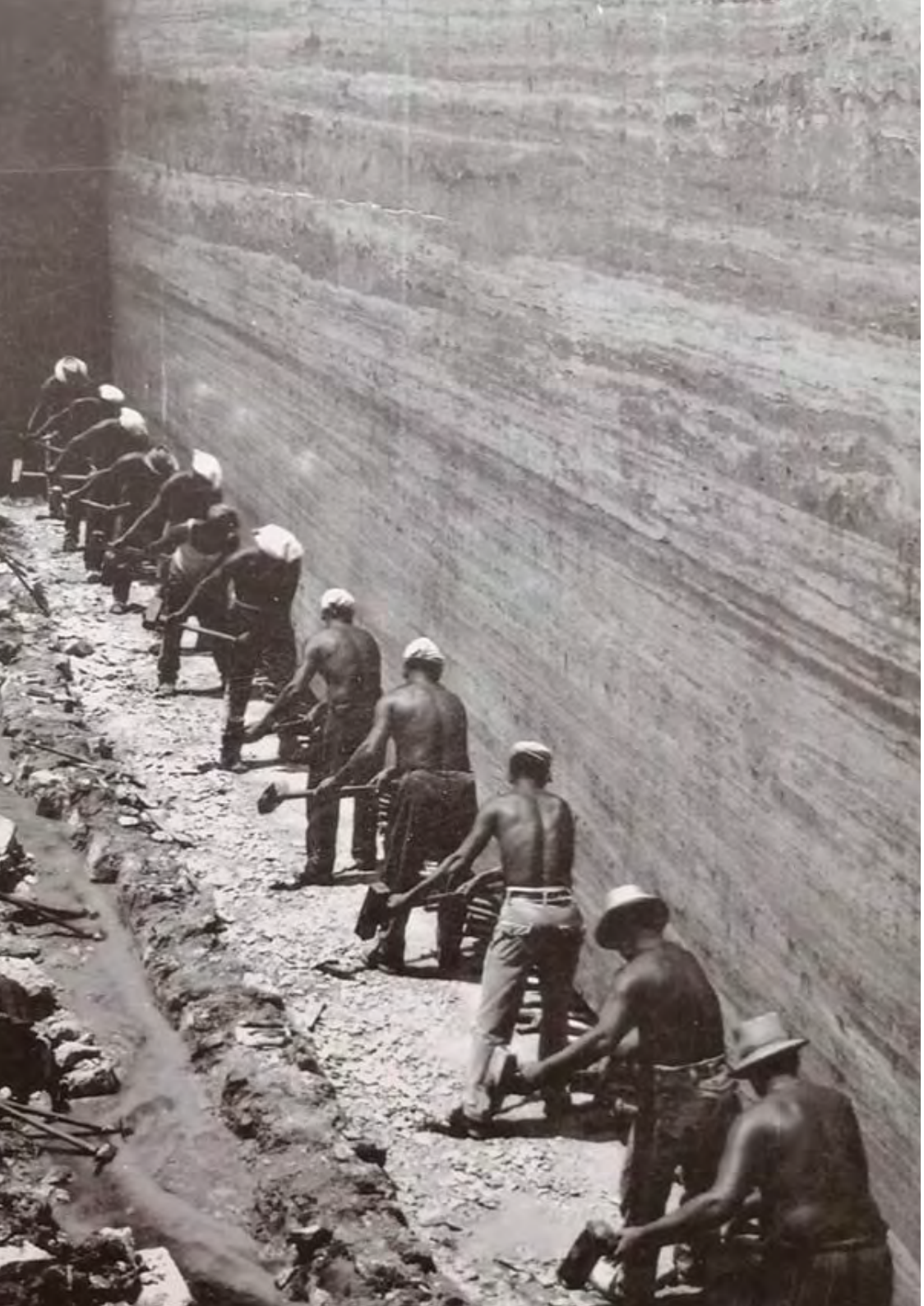
Visible sinkholes, reported in 2021

Hidden sinkholes mapped by Billi et al, 2016

Sinkhole, hidden sinkholes cluster overkapping with soft soil sinking grounds, showing the heterogeneity of the occurance of the phenomena, resulting in areas unsiutable for construction

ground water elevation piezometric levels are an active component of the subsidence.

This specific area, of public social housing built in the early 1980s, has suffered most of the damage. Lazio Region in 2005 deliberated the “state of calamity” thus disbursing a whopping 62 million euros to rehabilitate housing: the coop buildings in Tivoli Terme, the small villas in Villalba.



3.4 LABOUR

The cities surrounding the Roman Travertine quarries manifest in formal and informal urban agglomerations. These cities of labour, can be described as a resulting and an accompanying urban landscape of extraction, enlarging along with the extraction's rapid growth. After the recent edification of the area surrounding travertine quarries, structural damage to buildings has been recorded since the mid-1980s, with a strong intensification at the beginning of the 2000s, sometimes leading to the evacuation of houses and public buildings. The damages were mainly caused by a generalized subsidence characterized by differential settlements of the buildings. Ground subsidence is a common process occurring on the ground surface. Subsidence can be controlled by natural processes, in this case accelerated dramatically due to human activities, mainly through water extraction for the thermal uses, and dewatering for travertine extraction. Subsidence can be on the order of some metres with velocities of some decimetres per year, thus quite often causing damage to buildings and infrastructures.

Sinkholes, while a common in travertine deposits, are also present in the plain of the Acque Albule

FIGURE 01

Workers of Roman Tr avertine , from the Exhbition of the Long Story of Roman Travertine, Archive of Mariotti

in hidden forms, also known as dolines[99], present in clusters or groups, and have been studied and recorded as early as the 1950s in maps constructed by Maxia in figure 02. These clusters overlap with visible sinkholes, ones where land depression occurred, most known in the territory as lakes: Lago della Regina, Colonel, San Giovanni are actually sinkholes.

Another contributing feature to subsidence is caused by "soft soil" thickness, one that settles as the gases and water underneath is drawn out. The research done in 2015 illustrates this correlation: it revealed that ground sinking is influenced by the thickness of soft soils and the drop in groundwater levels. Ground sinking remains under 4 cm when the soil layer is less than 6 m thick and the groundwater drop is under 4 m; exceeding these thresholds causes greater sinking. Therefore, key factors include groundwater level changes, which trigger sinking, and soil thickness above the travertine, which controls its magnitude. Variations in sinking may also result from differences in the timing of groundwater drops and soil consolidation[100].

The presence of widespread karst processes such as soft soils, and sinkholes, aligned in a N-S direction,

99 These types of sinkholes are common in the travertine substratum of the Acque Albule Basin and visible along the travertine quarry walls. Buried (hidden) cave-collapse sinkhole filled by soil and regolith after (and partly before) the collapse of the carbonate vault. Buried (hidden) solution sinkhole (also commonly known as doline) filled by soil and regolith after the chemical (and partly physical) erosion of the carbonate substratum. Both sinkholes are drawn as apparently inactive (i.e., no surface depression). Billi, Andrea, Luigi De Filippis, Pier Paolo Poncia, Pio Sella, and Claudio Faccenna. 2016. 'Hidden Sinkholes and Karst Cavities in the Travertine Plateau of a Highly-Populated Geothermal Seismic Territory (Tivoli, Central Italy)'. Geomorphology 255 (February):63–80. https://doi.org/10.1016/j.geomorph.2015.12.011.

100 Bozzano, Francesca, Carlo Esposito, Stefania Franchi, Paolo Mazzanti, Daniele Perissin, Alfredo Rocca, and Emanuele Romano. 'Understanding the Subsidence Process of a Quaternary Plain by Combining Geological and Hydrogeological Modelling with Satellite InSAR Data: The Acque Albule Plain Case Study'. Remote Sensing of Environment 168 (October 2015): 219–38. https://doi.org/10.1016/j.rse.2015.07.010.

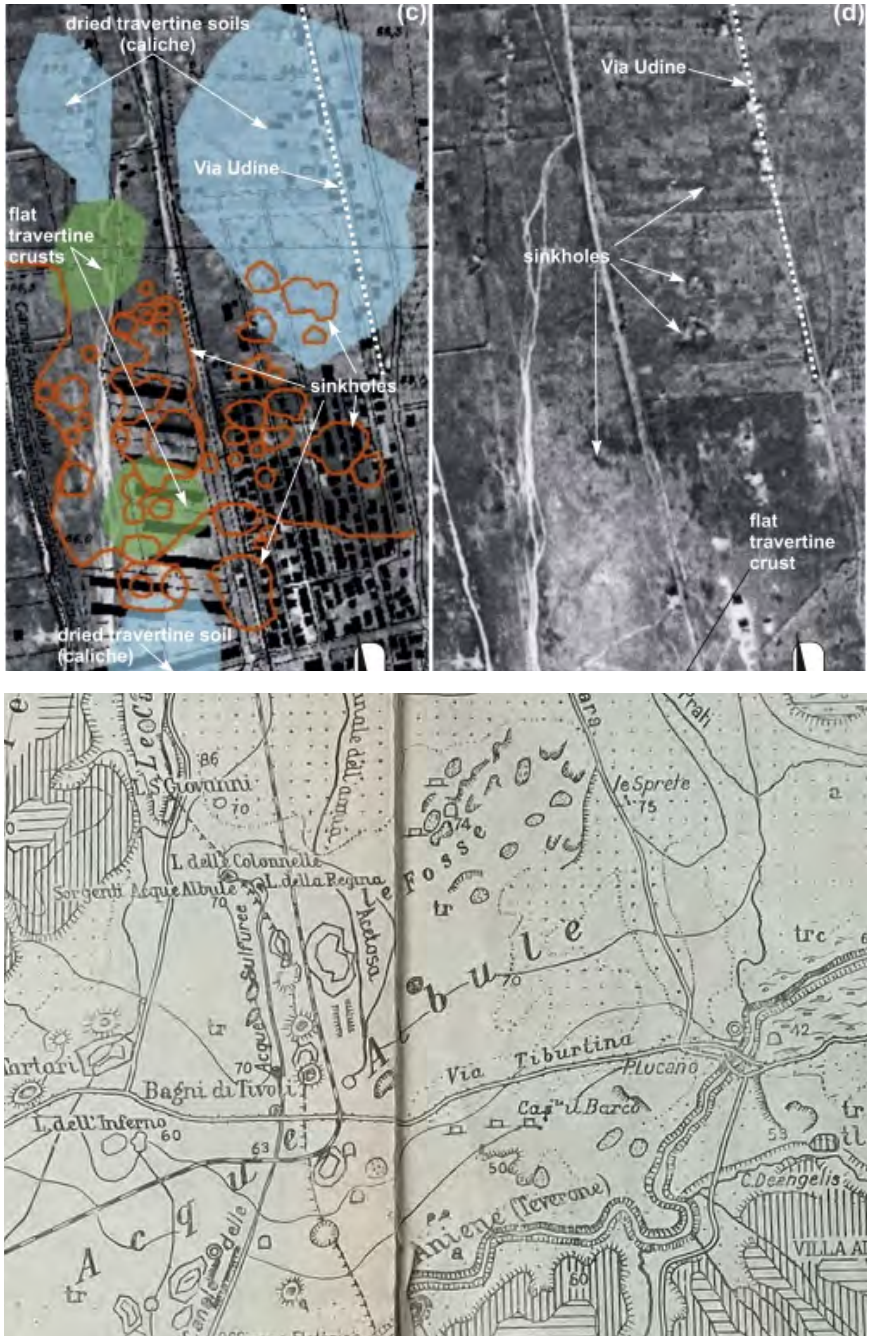


FIGURE 02

Diagrams from the works of Billi et al, where they trace hidden sinkholes in the territory, in comparision with historical aerial photos from the 1950s, where such depressions were visible. These dolines were traced as well by C. Maxia, 1950 in a paper titled: "Il Bacino delle Acque Albule (Lazio) Contributi di Scienze Geologiche" updated and analysed in: Billi, Andrea, Luigi De Filippis, Pier Paolo Poncia, Pio Sella, and Claudio Faccenna. 'Hidden Sinkholes and Karst Cavities in the Travertine Plateau of a Highly-Populated Geothermal Seismic Territory (Tivoli, Central Italy)'. Geomorphology 255 (February 2016)

subsequently masked or buried by the built development of Tivoli Terme and Villalba di Guidonia. The most damaged buildings were found toto be built at these depressions.[101] This issue has been the cause of turmoil in the territory as extraction accelerated and jeopardized an already geologically fragile territory, one in which local authorities have been complicit either through desregulated building in surfaces where building is unsuitable, or conducting the residential project itself, as in the social public housing in figure 02, the part that has suffered most of the damage.

Urban research today increasingly grapples with urbanization processes that extend far beyond traditional boundaries, encompassing not just agglomerations, urban regions, and mega-city areas, but reaching across the entire planet. Urbanization now exhibits a global scope, manifesting in diverse environments—including agricultural lands, extraction spaces, remote wilderness areas, and even oceans—challenging the conventional view of the urban as a confined, densely populated space. This expansive urbanization involves the development of complex, multiscalar center-periphery relationships, one like Rome's and its peripheries, the blurring and reconfiguration of urban fabrics, the creation of functional logistical/operational spaces, and the systematic sacrifice of some landscapes to sustain the accelerated growth of other metropolitan areas102.

101 De Filippis, Luigi, Claudio Rossetti, Andrea Billi, and Claudio Faccenna. 'Uomo, Georisorse e Faglie Nel Bacino Delle Acque Albule, Italia Centrale'. Rendiconti Online Della Società Geologica Italiana 27 (July 2013): 86–97. https://doi.org/10.3301/ROL.2013.22.

102 Extended urbanization as defined by Christian Schmid, in: Christian Schmid, 'Analysing Extended Urbanisation', in Future Cities Laboratory - Indicia. 02, by Future Cities Laboratory, ed. Stephen Cairns and Devisari Tunas (Zürich: Lars Müller Publishers, 2019), 157–80.

FIGURE 03

VIRGINIA TOMESCU SCROCCO (1886-1950), Travertine sculptors, oil on canvas, cm 71x91, 1928, Villa d'Este

The operationalisation of the landscapes of extraction in the Acque Albule is accompanied by extreme forms of rationalisation and automation reduces the necessity of labour force, and results in processes of peripheralization. Key aspects of peripheralization includes economic disadvantages, social marginalization, political neglect, and spatial segregation, representing one of the most unstable forms of urbanization. As this form of extended urbanization leads to land enclosure (into distinct industrial zones) for further extraction and investment, particularly by massive scale capital investments: biotech, mining, bioenergy and waste processing. This commodification of land devalues local activities (agriculture and common pool resources) which results in the increasing depopulation in the other sectors[103]. The industrialization of entire zones results in depletion of cultural and natural resources.

Tivoli's hinterlands have always been subject to these processes for its long history of industrialization of various forms. In this section the urban

103 Christian Schmid and Milica Topalović, Extended Urbanisation: Tracing Planetary Struggles (Basel: Birkhäuser, 2023).

ecologies in the towns that are fragmented by the extraction are investigated. First, we start from the people that carry out the extraction and self-built and inhabited its surrounding cities. These territories are also the setting of social and environmental tensions that represent forms of plurality narratives to the future of the territory different from the dominant one of extraction. Then investigate the present reality of these small cities, that now display unexpected forms of diverse economic activities that are not based on extraction, and its potential post-industrial transitional urban landscape.

I fossanti

The reliance on international markets for travertine exports offsets Italy's high extraction costs but has created precarious conditions for today's travertine workers. Since the 1990s, increased supply from Acque Albule and high mechanization have reduced the local workforce from 2,500 in the 1980s to around 236 in 2021, including administrative staff, while many remaining workers are employed daily without fixed contracts.

"The people who build and maintain landscapes are rarely seen" landscape architect Jane Hutton emphasized in her Material as Method[104] book, one that traces landscapes and the stories of construction material production. Intrinsic to the flow of construction materials are the people who work, extract, assemble, interact with and maintain them. Putting forward the uneven social realities of landscape and architecture making, does more than simply acknowledge them. It contributes to the process of how we imagine modern landscape architecture and the processing of its production, including what otherwise is invisible trivialized and often erased. To apply an ethical approach to the design process with attention to social, economic and environmental impact that the project has in all stages of design, pushes to include labor narratives in landscape narratives, ones that incorporate the conditions in which materials are processed, ones that have been successfully effaced and distanced from the imagination of the architectural production.

It is hypothetically impossible to visualize extraction processes and scales without taking into consideration the labor that carries processes of extraction. Labor-power is a capitalist commodity, a resource vital to capital accumulation, and another territory where extraction and exploitation manifests. The history of labor and labor movements is a history of extraction itself.

In the travertine context, term "*fossanti*" is commonly used to describe the workers of the quarries, In the 15th to the 17th centuries, the communities of Montecelio, Marcellina, and San Polo dei Cavalieri. Etymologically derived from Latin, it refers to those who dug ditches, stemming from the verb "fodĕre," meaning "to dig.", but it corresponds to name given to the early areas of quarrying "Le Fosse".

It can't be more appropriate to call the workers "I *fossanti*", for which they were the first to inhabit and build drastically transforming the vast semi-abandoned wet meadows of the Acque Albule. This massive flux of immigrants, already from the 15th hundred with the rise of Roman Travertine industry, started populating the surrounding villages of the urban centres Tivoli and Montecelio.

104 J. Hutton, 'Material as Method', in Landscripts 5: Material Culture, Assembling and Disassembling Landscapes, ed. J. Hutton (Berlin: Jovis Verlag GmbH, 2017), 13–21.

FIGURE 04-05

photo of Mario Caucci, owner of Estraba, Caucci, and Pacifici, another defining name of the owners of travertine,

The growth the Papal Rome project in the 15th century constituted the deepening of the widening of the basin, in a direct material accumulation and subtraction relationship. The area was at that time, a territory bustling with movement and one of the most dynamic sectors in the Roman countryside[105].

The region's rich resources have attracted migrations from across the country. This placed enormous expectations on the landscape to sustain the rapidly growing population working. This is reflected mainly in the municipality of Guidonia Montecelio, where the city of Guidonia has passed in a relatively brief period from a small city to the third largest municipality in Lazio regio, of a population of around 90,000 in 2023[106].

Before public transportation became widely motorized, the "*fossanti*," who hailed from nearby villages, would travel to the travertine extraction site on foot, on mules, or by bicycle to work as paid

105 The evolution of the organizational structure of work has been described in detail in the medieval by Manuel Vaquero Piñeiro, Manuel Vaquero Pinero, 'Lavoro e Lavoratori Nelle Cave Romane Di Travertino in Età Moderna', n.d.

106 demo.istat.it

labourers[107]. The evolution of production systems in the Acque Albule, has been an evolutive process with a distinction between artisans and wage labourers. Initially, artisans owned their tools, materials, and products, typical of medieval cities. The introduction of merchants created hybrid systems where artisans lost control over materials and sales, becoming more dependent on merchant capital. Eventually, merchants transformed into entrepreneurs, organizing and financing entire production cycles with wage labourers.

These stages—artisan, mercantile, and entrepreneurial—can coexist in time and space, as seen in the travertine quarries of Tivoli, which evolved through these phases from the 15th to the 17th century, that transitioned in the territory from "artisan – merchant – entrepreneur". The latter as current system indicates that travertine is extracted through paid laborers, an indication of the precariousness and temporality of contracts that depended on the amount of stone production. This also indicates the moving in and out of temporary immigrants in the territory, depending on the market demand, which resulted in an unstable form of habitation and disconnection from forming a social collective identity related to the territory.

Today these entrepreneurs represent some form of monarchy of travertine production: the five names of five families, most of which within three generations dominate the Roman Travertine industry. Unlike cases like the infamous marble of Carrara, where stone producers have temporary commissions of territories for periods of time, the terrains basin of

107 Vaquero Pinero, 'Lavoro e Lavoratori Nelle Cave Romane Di Travertino in Età Moderna'.

FIGURE 06

DOCUMENTARY
La Rimozione
Aamod -Archivi aggregati - Altre produzioni
Centro di cultura popolare Tufello (1977 - 1999)

https://youtu.be/rQZgjseMvZg

Acqua Albule are owned. The first to start excavating were the Filippini family; from the 17th century, they were followed by other families who currently dominated the sector, such as the Conversi, Cecchetti, Pascucci, Poggi and Mariotti families, and determined the development of the activity. Today the terrain is divided into owned slots, making the cultivation of travertine a hereditary generation-based business monopoly. Mariotti, Lipiello, Caucci, Pacifici, Poggi, are some of the names that have now become international brands the dominate the territory for three generations. With the resumption of extraction activities after the second world war, consider that in the Guidonia and Tivoli area from 1951 to 1971 there was an increase in employment from 1,383 employees to 2,472, the boom of this rise being between the years 1970-1990s.

Whereas the dependence of travertine exports on international markets compensates for the high economic cost of extraction in Italy, it has created serious precarious conditions for the contemporary fossanti of travertine. The increase of travertine supply from Acque Albule was accompanied with high mechanization since the 1990s[108], yielding to the decline local workforce has from 2500 in the 1980s to around 236 in 2021, including the personnel employed in administrative positions: sales, communications and marketing, the rest are employed on daily bases and are not registered as fixed workers.

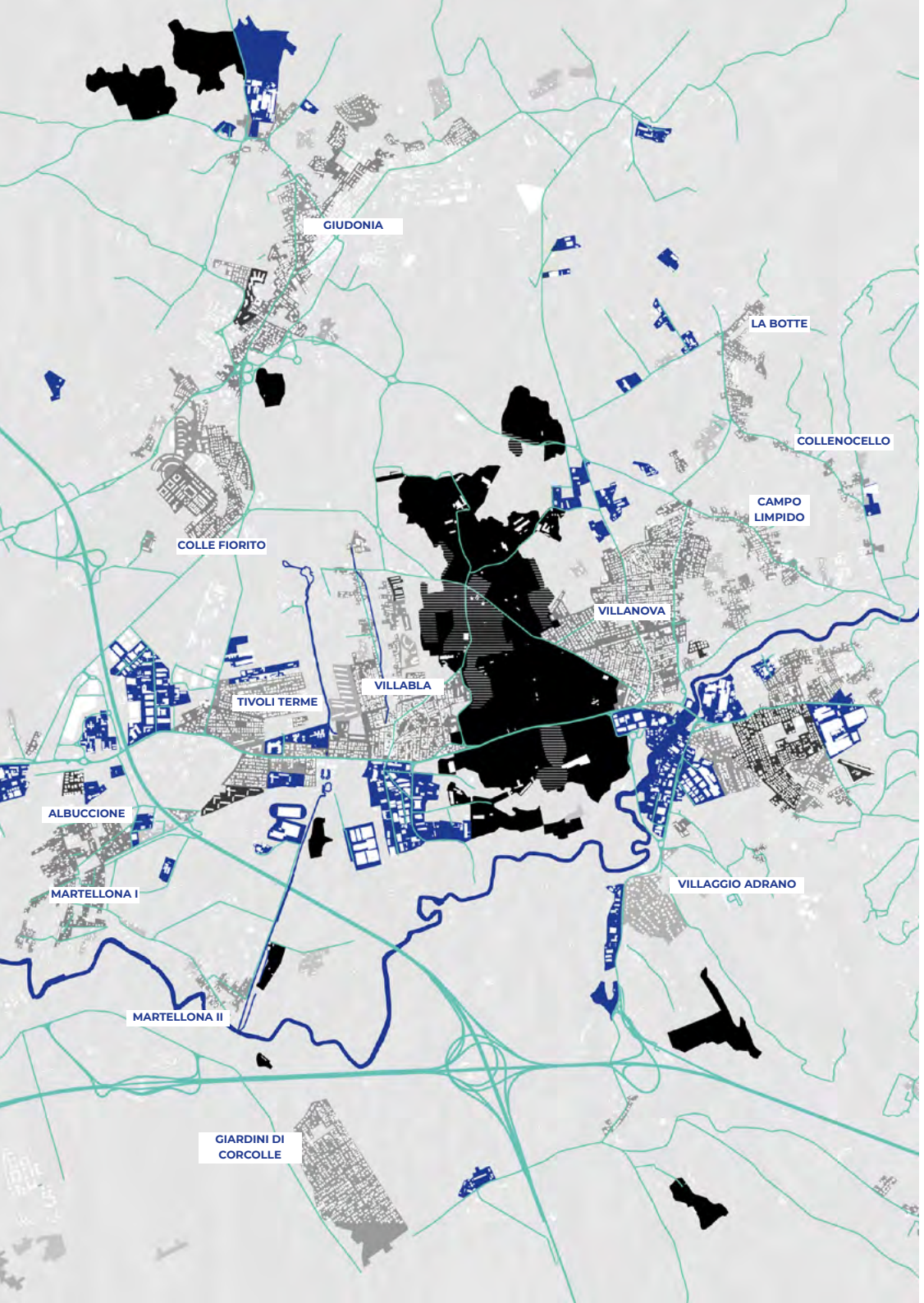
The intangible heritage invaluable artistic Italian handwork constitutes a unique local knowledge of centuries long accumulated experience working with this stone. However, to reduce costs, artisan processing of the travertine is often now outsourced to cheaper processing locations[109]. All of this has resulted in a drop in the labor employed in the basin by around 85%-90% in the span of 20 years, despite the increase in travertine production in the same time span.

Workers absorb the biggest hits of economic and health risks in extraction's embedded dependence on precarious economies. The position on the quarry is never stable, the hired workers in the quarry "are never the same persons[110]", which indicates a job market full of uncertainty. In addition, fatalities and accidents in quarries have historically been a result

108 These years were described as the golden years of roman travertine by the main quarry manager of STR during an interview in February 2024.

109 Italy in 2021 is the largest producer of raw stone material (Grezzo), with its biggest buyers are China, Egypt and India, countries where artistic labour is believed to be employed.

110 "Non sono mai gli stessi", as testimonied by Estraba's marketing agent on the site in October 2024.



of the challenging work environment faced by workers. In a film titled "*La Rimozione*" (the removal), figure 06, produced in the 1990 following the urban construction works for the 1990 World Cup in Italy, seen from the perspective of workers, with an investigation into working conditions on construction sites and "white-collar murders"[111]. Various forms of occupational disease are associated with travertine extraction, reports document what is commonly known as hand-arm vibration syndrome, an irreversible condition associated with partial paralysis[112]. It is worth noting that generally that one year of working in mines and quarries is worth two working years, which essentially means quarry workers go to retirement earlier than other professions[113]. Even if advancements in extraction technology initially led to better working conditions, this eventually translated into increased productivity, work restructuring, and eventually downsizing of the workforce[114].

Roman Peripheries of Extended Urbanization

The history of Tivoli's urbanization is one directly related to its industrialization. The Acque Albule's topography was favored as the only easy path of "transhumance," which refers to the seasonal move-

MAP 01

The scales of urbanization and industrialization In the surrounding areas of the extraction basin. Population density of the inhabited citites are shown in degrees of grey, the darker the more dense.

Extractive basin

Abandoned Quarries

Industrial encalves

111 'La Rimozione - Film - Archivio Aamod', accessed 30 August 2024, https://patrimonio.aamod.it/aamod-web/film/detail/IL8180002791/22/la-rimozione.html?startPage=0&idFondo=.

112 M Bovenzi et al., 'Hand-Arm Vibration Syndrome among Travertine Workers: A Follow up Study.', Occupational and Environmental Medicine 51, no. 6 (June 1994): 361–65, https://doi.org/10.1136/oem.51.6.361.62

113 'Gestione speciale dei lavoratori delle miniere, cave e torbiere', Sito ufficiale di INPS (Istituto Nazionale Previdenza Sociale), accessed 30 August 2024, https://www.inps.it/content/inps-site/it/it/dettaglio-approfondimento.schede-informative.49946.gestione-speciale-dei-lavoratori-delle-miniere-cave-e-torbiere.html.

114 Chiara Braucher, 'L'estrattivismo uccide', Jacobin Italia (blog), 2 October 2023, https://jacobinitalia.it/lestrattivismo-uccide/.

ment of livestock between pastures at different elevations, typically from lowlands in Rome to highlands in Abruzzo, passing through Tivoli and through the waters of the Acque Albule, that was believed to disinfect potential parasites in the beasts. But unlike the other Roman countryside plains, known for their mainly agricultural activities and vacation residence of rich Romans, Tivoli's plain has always been industrialized. Its abundant resources created the solid basis for industries like paper mills, textiles, hydrological electrical plants, and stone extraction. The paper mills, with over twenty plants, formed the biggest economic force in the territory until 1950-60s, forming the mechanic base and expertise allowing other industries to develop. Following the second World War, Tivoli's industrial power declines gradually due to different legislative developments that excluded Tivoli, forcing its entrepreneurs to move their businesses where public funding can be found[115].

Once industrial activities diminished or disappeared, as in the rest of Italy, the role of the economic motor was taken over by construction. Travertine extraction in this period has had its economic boom and expansion along with the construction boom in Rome, one that climaxes in the 1950s-1960s, as can be seen in the images of the extraction basin as it rapidly carves up the surrounding territories in unprecedented velocities in the figure 1. In the years before and immediately after World War II, urban concentration was primarily focused on the area of expansion above the medieval settlement. The area

115 This point refers to the "Cassa di mezzogiorno" (Southern Development Fund). Aprilia and Pomezia, more than the others, became industrial hubs, absorbing many activities that had previously been located in Rome's Valco San Paolo and Ostiense areas. (from an interview with prof. Ruggero Martines, in September 2024)

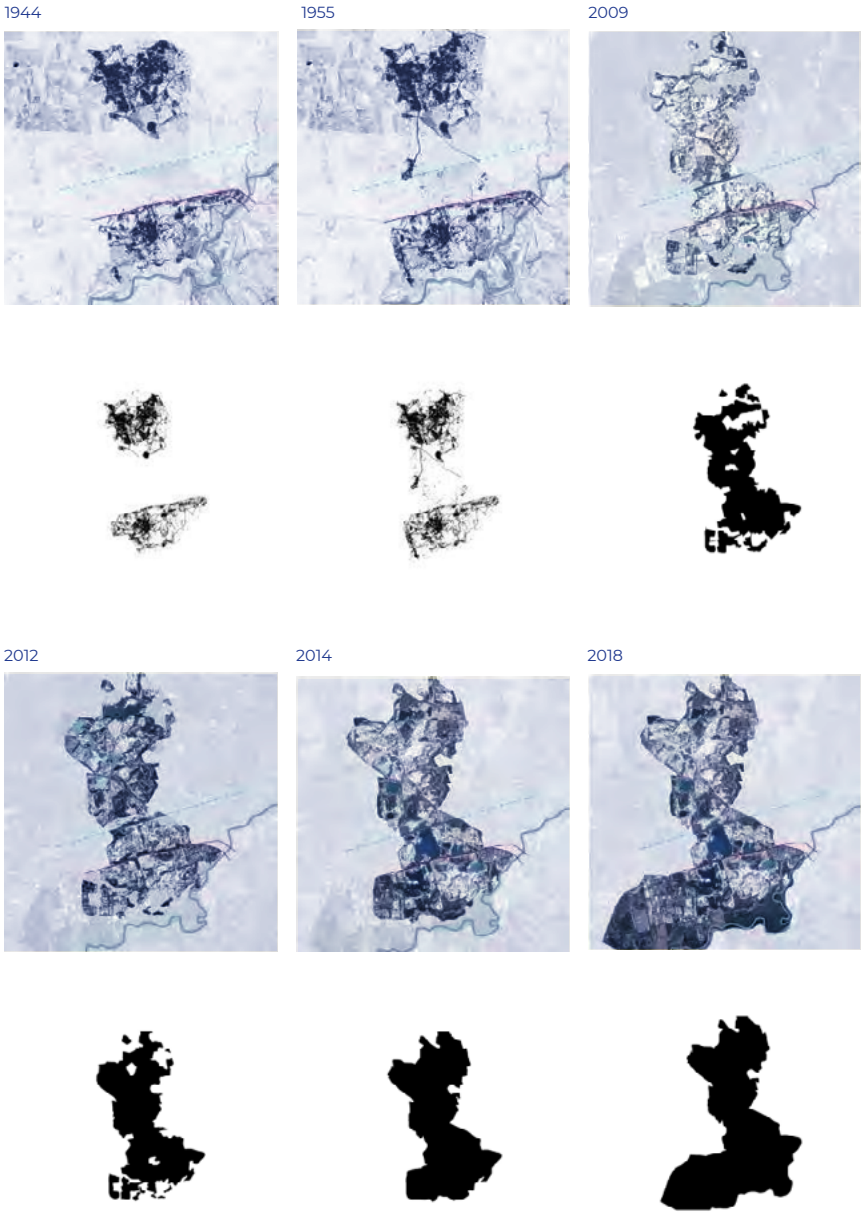


FIGURE 07

The expansion of the extraction site from 1954 - 2018, data obtained from IGM maps of 1944-1954 and google earth timeline cartography

around Villa Braschi was divided into "villas", (like Villalba, Villanova, etc...) which later became apartment buildings in the 1950s and 1960s.

These villas would eventually become "external" and densely populated neighborhoods as Rome externalised relocated its industrial operations and associated housing sectors towards the Aniene valley, where they overlapped with pre-existing industrial, extractive, and agricultural activities. In other ways, the rapid urban growth in Rome, driven by the construction boom and attracting populations from Lazio's peripheral areas, led to a consistent demand for housing. This demand initially bypassed the costly Roman offering available housing convenient for its to distance and expense, eventually spreading sporadically across the plain of Tivoli. It initially favoured areas like Bagni di Tivoli and Villaggio Adriano, and only later did this pattern extend to Guidonia[116].

These regions, which have evolved from small agricultural villages into urban clusters, are deficient in essential and secondary services, devoid of communal spaces, and present an incoherent and low-quality urban landscape. They essentially form the outskirts of both Tivoli and Rome[117]. These low-density self-constructed agglomerations resulted from the internal migratory forces employed in the increasing extraction activities post the second world war. Their houses were auto-constructed, some in already defined urban lots, others growing from a single shed to an entire unit, in a process that urban-

116 Ruggero Martines, 'La Recente Storia Urbana Di Tivoli. Un Caso Emblematico', in Tivoli, Un Laboratorio Urbano. Ieri, Oggi, Domani, by Francesco Martines and Elisabetta Pallottino ([object Object], 2019), http://romatrepress.uniroma3.it/wp-content/uploads/2019/03/Tivoli-un-laboratorio-urbano.-Ieri-oggi-domani.pdf.

117 Martines.

FIGURE 08

Villalba in the 1930s, source unknown

FIGURE 09

Urban evolution as the aggolomeration expands drastically between the years 1980s, and the 2002. Information was extracted from the works of Nanni and Vivalda, (Nanni, L., & Vivalda, P. (2018). Dalle mappe cinquecentesche all'attuale cartografia un percorso storico nell'analisi del rischio idrogeologico di aree antropizzate. Geologia dell'Ambiente(2), 18–27.) and the IGM Images of the 1954, modified and elaborated by Sara Ahmed.

ist M.B. Simone describes as Labour-urbanization in action. These are often considered "improper inhabitation" unsuitable for habitation due to the industrialization of its surroundings[118]. Simone emphasizes how in these contexts residents themselves shape urban environments through their daily activities and decisions. He argues that this extended urbanization, suggests more than just the gradual expansion of cities; it implies an act of actively contributing to the building, functionality of spaces, bodies, and systems[119].

This process does manifest in Villalba and the surrounding post agricultural cities, as it fell on the margins of urban law (specifically the law of 1942[120]), one that has excluded the most of Roman suburbs, contributing to the expanding irregular and informal building. The inhabitants of Guidonia and Tivoli's hinterlands built on privately owned small huts, then expanded to become a small housing unit, then gradually grew to become an independent unit, all of which was mostly (and still is[121]) informal.

Guidonia's foundation has been the exception to this form of urban expansion[122]. The city was planned to supplement agricultural activities in Tivoli's plain. It was Mussolini himself who inaugurated this

118 AbdouMaliq Simone et al., 'Inhabiting the Extensions', Dialogues in Human Geography, 8 May 2023, "Dialogues in Human Geography","language":"en","page":"204382062311688","source":"DOI.org (Crossref

119 AbdouMaliq Simone, 'When Extended Ubranisation Becomes Extensive Urbanisation', in Extended Urbanisation: Tracing Planetary Struggles, by Christian Schmid and Milica Topalović (Basel: Birkhäuser, 2023), 379–403.

120 "LEGGE 17 Agosto 1942, n. 1150 - Normattiva." Accessed September 22, 2024. https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:1942-08-17;1150~art28-com5.

121 The expansion of these aggolomeration is still one of the fastest growing in the territory,

122 The population went from the 6597 people who made up the population in 1936, it reached 50,990 in 1981. On 1/1/2005, the population rose to 75,692


VILLALBA


VILLANOVA


BAGNI DI TIVOLI


VILLANOVA


VILLALBA


VILLAGGIO ADRIANO


BAGNI DI TIVOLI

FIGURE 10

Variegated independent housing typologies from Bagni di Tivoli, Villalba and Villanova from site visit in 2024, photos by Sara Ahmed.

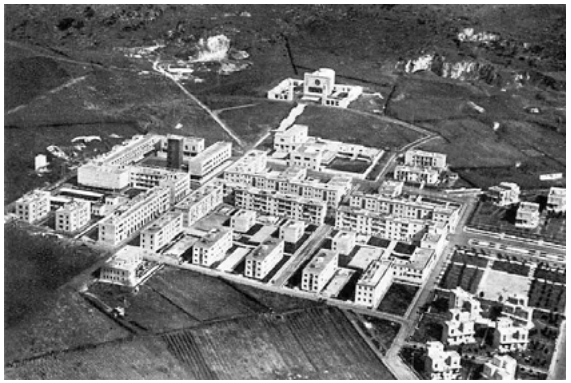


FIGURE 11

Aereal photo of Guidonia after 1938, inauguration of Guidonia by Mussolini in 1940.

Source: Official website of the City of Guidonia

newly founded town: Guidonia in 1935, named after Alessandro Guidoni, who died during a parachute jump there. Guidonia's primitive core, on the other hand, remained tied to the architecture in vogue during the Fascist period: wide roads with right-angle intersections, square and uniform buildings with linear and schematic architecture like that found in other towns of this period such as Latina.

The rapid urbanization that took place primarily starting in the 1970s has profoundly transformed the territory of the Acque Albule. This change has made it not only difficult to recognize the ancient and original natural environments, as previously mentioned, but also, and especially, to understand the nature of the deposits on

FIGURE 12

Buzzi Unicem and its surrounding pozzolana quarries.

CC Google image 2024

which current human settlements are built[123]. Today, Guidonia and Tivoli are urbanistically very heterogeneous. The new neighbourhoods, dormitory suburbs, feature six-story and lower buildings: they were built hastily under the pressure of the pressing demand for houses. In the meantime, from the initial bipolar structure (formed by Montecelio and Guidonia) today we find this polycentric urban archipelago floating between agricultural land and vast territories of travertine extraction and its processing facilities. The new low density urban clusters are: Albuccione, Setteville, Villanova, Villalba, Castell'Arcione, Bivio di Guidonia, La Botte, Colle Fiorito, which were added to already existing ones: Villaggio Adriano, Tivoli Terme, Campo Lipido Favale, and Collencello.

The ease with which Rome could be reached by railway determined the rapid growth of the settlement linked to the increase in population, given the large number of jobs available both at the airport

123 Nanni, Livia, and Paola Vivalda. "Dalle mappe cinquecentesche all'attuale cartografia un percorso storico nell'analisi del rischio idrogeologico di aree antropizzate" Geologia dell'Ambiente, no. 2 (2018): 18–27.

and at Unicem, a cement factory, shown in figure 12, and at the travertine and pozzolan quarries, active since 1941[124], supplied by the clay quarries nearby. This structure produces 4500 tons of cement daily, consuming 1.5 tons of raw material for each ton produced, making their extracted materials for production to equal 6750 tons of extracted material per day.

The region's resources that are extracted are various, from aggregates and construction materials extraction from pozzolana, to tuff and inert materials for construction. The municipality of Guidonia hosts major production companies, including the Buzzi Unicem cement factory and the large pharmaceutical company Merck Serono, as well as three industrial zones where significant businesses are located. Additionally, it is adjacent to the Tecnopolo Tiburtino in the municipality of Rome, which is home to hundreds of high-tech and service companies. Now, this is a territory of a large labour force in working class, 40% of the population are employed in the second sector. Other entrepreneurial third sector activities include: waste collection, the paper industry, livestock farming, the construction industry, the tourism sector, and thermal facilities.

Today, the residents of these urban agglomerations, gravitate increasingly towards Rome, from in the 1990s. This gradually converted them over time to one of Roman peripheries, due to the ease and diversity of connections (Via Tiburtina, and the A24), and the railway[125]. The passenger Rome-Tivoli railway line partly follows the old route of the tramway that connected the town of Tivoli, that was used to transport

124 Giorgio Moscatelli, 'Archeologia industriale a Guidonia Montecelio', Sito degli Italiani Monarchici, un Patto per la Corona, 31 May 2021, https://www.italianimonarchici.it/blog/archeologia-industriale-a-guidonia-montecelio.

125 Romagnoli, 'L'area Tiburtina'.

travertine, with Rome during the late 19th century[126].

Travertine extraction basin is an urban quarry[127], therefore, the cities of Guidonia and Tivoli that surround the extractive basin, are heavily influenced by its impact in forms of tiny dust particles, and noise pollution. Near travertine extraction sites, warehouses with ancillary facilities like parking and storage support the production and sale of travertine slabs. Surrounding these grim industrial atmospheres, industrial zones alternate in an interestingly and unexpectedly with commercial wholesale and retail outlets, elementary schools, thermal parks, hospital facilities, and sports complexes[128].

A transitional territory

While the communities in the Aniene valley do not possess the typical features of a district or a city, they lack adequate parks and green spaces, urban pedestrian and bike infrastructure. Nonetheless, they don't represent typical mining cities either, ones that become ghost towns once extraction is ceased. These agglomerations unlike other mine cities, they are not economically "stuck" in the mono-economic model of extraction and mining, that require a socio-economic transition model to the post extractive reality, nor face a challenge into re-habitation.

Since Tivoli's hinterlands have always been industrialized[129], its current reality is the result of informal housing with legal loopholes common in Roman agricultural hinterlands, and errors from the public administration (referring specifically to the

126 Paudice, Paesaggi Interrotti, La rigenerazione delle cave dismesse.

127 One that exists in the proximity of cities and transport infrastructure.

128 Rinalduzzi et al., 'Geocultural Landscaping'.

129 Interview with prof Ruggero Martines, councillor for the municipal general urban plan conducted in Rome, the 12th of september 2024.

FIGURE 13

Commercial services activities of larger scales in the agglomerations of Villa Alba

FIGURE 14

Housing on the margins of Villalba, as the countryside begins, in a sudden way as the density of housing deminishes.

social housing units erected on grounds in risk of depression, and on one of many unbuildable grounds of the Acque Albule plain). They however represent an interesting urban lab of resilience, with expanding other second and third sector commercial services that busy the territory today. This economic transitioning from extraction already manifests in the densification of its road networks, an expansion in the areas of residential demand, tourist services and increasing services and recreational structures.

Some of the major advantages of the area is related to its high accessibility from the metropolitan city of Rome. While developed initially for industrial purposes, the roads serving these hinterlands play a dual role, connecting industrial settlements while also easing the connection between the urban islands and essential services. The fragmented border area, featuring scattered buildings amidst gardens and open land, creates an interesting gradual shift from urbanized zones to rural countryside. The urban agglomerations of the Guidonia and Tivoli are somehow backed with an economic resilience and

versatility, urban and landscape diversity, qualities that typical mining cities are usually deprived from.

Official development landscape plans and urban planning are abundant indeed, they predict a development in third sectors, while not providing detailed plans about the future of extraction (neither implying its growth or decline), it remains untouchable topic due of fears of local lobbying against it. The trend of planning and urban development in the area instead pushes for the expansion towards touristic sectors, enhancing the touristic infrastructure of thermal waters, Villa Adriana, and a potential Travertines of the Acque Albule public park, all of which would automatically increase investment in services and enhance transport infrastructures.

Landscapes of tensions and resistance

Extraction leaves a territory of conflict. Local resource conflicts extend beyond the physical territory of a mining concession to include the attitudes and behaviors of the people who interact with it. The formation of subjects in these conflicts is not solely imposed by powerful extractive operations through top-down governance, but emerges through multi-directional, overlapping, and interconnected processes[130].

On this basis, we argue that the extraction model creates contested territories. Its impacts and consequences exceed spatial and temporal dimensions of the territory it was intended to exploit. It creates conflicts in common resources that are laterally depleted as consequence of economic progress. The

130 Matthew Libassi, "Gold Conflict and Contested Conduct: Large- and Small-Scale Mining Subjectivities in Indonesia," Geoforum 148 (January 2024): 103648, https://doi.org/10.1016/j.geoforum.2022.10.005.

FIGURE 15

Activists of the park involving residents in public activities related to the territory, photos by Sara Ahmed, last photo is the logo of the resistance movement of the Apli Apuan against Carrara estraction sprayed on a piace of travertine from the exhibition of the collective Cave Aquam in February 2024

motivation behind reading the landscape as a territory, and then as a contested territory, is the key to insert political ecology of extraction production into this equation. To understand the complex and often contradictory nature of the people living and working in extraction zones, they manifest in intersecting and unbalanced dynamics of power.

The environmental impacts of open pit quarrying such as the use of explosives, soil removal, and chemicals, often render the land unsuitable for other economic activities like agriculture, livestock farming, or real estate. However, it has been argued that mining concessions exaggerate the extent of extraction's impact because only a small fraction of the area granted for extraction is actually mined, while the rest is dedicated to processing, transportation and other logistics spaces.

While the terrain is privately owned, what's underneath is state owned extraction in the Italian context is permitted through temporary concessions that allow the exploitation of the subsoil strata. The companies that hold these concessions gain significant control over the territories, creating economic enclaves. These enclaves are highly integrated into the global economy but remain disconnected from the national economy. Although concessions grant rights to the subsoil, companies must still acquire surface rights through market transactions, negotiations, or forced purchases, leading to processes of "accumulation by dispossession," where corporations effectively establish autonomous control over these territories. The state ultimately plays a key role in facilitating this spatial fragmentation and hierarchy through its legal frameworks governing mining concessions[131].

The resulting relationships between political, economic, and social factors in the extraction industry have shifted significantly. The traditional mining model has transformed into a more complex modern extractive business model, involving global mining companies, international outsourcing firms, and national service providers. As the extraction industry has grown, it has deepened the uneven geographical

131 Martín Arboleda, "Spaces of Extraction, Metropolitan Explosions: Planetary Urbanization and the Commodity Boom in Latin America," International Journal of Urban and Regional Research 40, no. 1 (January 2016): 96–112, https://doi.org/10.1111/1468-2427.12290.

development in resource-rich areas. This unevenness often overlooks the actual needs of local communities, leading to social conflicts. These conflicts are driven by unequal distribution of benefits, with some areas suffering from limited access to public services and infrastructure[132].

In this conflictual context, very familiar to the extractive model created everywhere, however the details and dynamics in which it occurs are different. It creates a dominance over the entire territories by extracting companies, while depletion, pollution of the other resources in the region, and how these resources are managed are held hostage, since their activities are legalised through the concessions and permits allowed by the state.

In this Changes Everything, one of Naomi Klein's definitions of Extractivism is the turning of complex ecosystems into either "natural resources" or "overburdens". It is also the reduction of human beings either into labour to be brutally exploited, or into social burdens, problems to be resolved somehow or closed off in peripheral sacrifice zones. However, the illusion of the lack of sustainable economic ways to manage resources manifest in these conflicts, where extractors are off the hook from various violations for the "greater good of economic progress". For whom, we ask, is this progress allocated for, the progress that forces us to "accept that we have only bad choices available to us, austerity over extraction, poisoning over poverty."[133] Stefania Barca describes this as "environmental violence", one that occurs also in progressed and developed contexts, does not adhere

132 L. Valenzuela, "Conflicting Spaces in New Territories of Extraction," in The Camp and the City: Territories of Extraction, by J. Sordi and F. Vera (Rovereto (TN: LISt Lab, 2017), 210–21.

133 Klein, This Changes Everything. Pg 23

to traditional distinctions between North and South, 'developed' and 'developing' nations, or capitalist and socialist ideologies. Its impact varies across social groups, intricately tied to how societies allocate benefits and burdens. Environmental degradation and social inequity share historical origins, stemming from corporate or governmental policies that create sacrifice areas and marginalized populations. Therefore, environmental violence operates within frameworks of environmental injustice[134], one that creates conflicts between various actors on opposing and imbalanced ends of spectrum of benefit and destruction.

The tension occurring between workers in the travertine industry, the quarry owners, politicians, residents and local activists who have different interest of in the management of the resources and those who do not necessarily benefit from the continuation of extraction. Industrialists aim for an extension of mining to the northeastern side, the only portion of the territory not yet affected by urbanization[135]. Associations and activists from see a total "re-naturalization" of the landscape foreseeing the gradual increase in limitations of the travertine quarrying, to its eventual cessation.

In Depoliticized Environments, Erik Swyngedouw argues that in the era of the Anthropocene, Nature has become de-politicized, with decisions about land management falling largely "outside the field of public dispute, contestation, and disagreement". The conflict often though involves "radically differentiated and often opposing social, political, or ecological desires, that calls the proper democratic political into

134 Stefania Barca, 'Telling the Right Story: Environmental Violence and Liberation Narratives', Environment and History 20, no. 4 (2014): 535–46.

135 Paudice, Paesaggi Interrotti, La rigenerazione delle cave dismesse.

being.[136]" In this work, Swyngedouw calls instead for a re-politiciozation of nature that allows for complex conversations about contemporary ecological threats[137]. Politicizing nature elevates the discourse into the struggle of conflicts between the different actors in the landscape, rather than the protection of an abstract nature. It poses the challenge on the way in which extraction risks and depletes various common resources.

One of the episodes of these conflicts reached their climax in September 2018, following the cessation of the release new permits for quarrying as a response for the series of environmental of violations[138], and the failure to pay taxes to the municipality of Guidonia Montecelio. This unpaid amount, owed by the companies holding the licenses to extract travertine, totals around 27 million euros[139]. The immediate reaction was the dismissal of forty seven quarry workers overnight, resulting in a wave of protests and boycotts by their peers, in solidarity with their laid-off colleagues. Michele Barbet, Guidonia's Mayor back then, insisted that the issue was initiated by the quarry owners' consistent environmental violations, and tax evasion. The licenses were then issued again after pressures from the various parties involved, without necessarily resolving the violation related issues.

Villalba's residents have suffered the consequences from the subsidence of the terrain aggravated by extraction. The northern part of Villalba, along the canals of the Acque Albue, is considered the most affected and susceptible to geological depression and sinkholes. To date, extraction-related damage has been identified in 140 homes. As a result, in 2005, the Lazio region declared a state of emergency, allocating 62 million euros for safety measures. However, many of these interventions have not been carried out, and subsidence continues to erode the foundations of buildings.

The landscape discipline in some way participate actively in these dynamics. The awareness of such dynamics presses the importance of positioning practitioners of architecture and landscape in a political role, rather than a neutral position. In the Drosscapes manifesto, Alan Berger proposed a new paradigm is proposed for the role of landscape designer in the conflictual settings of extraction. Drosscapes, which depend on the creation of waste landscapes from other forms of development, challenge the designer to shift from being a sole expert (for a certain client) to becoming a collaborator and negotiator. In this context, designers no longer rely solely on their tacit and explicit knowledge but engage in complex, interactive, and responsive processes. They work from the ground up, conducting fieldwork, analysing large-scale trends, and identifying underutilized urban spaces. Analysing the landscape's actors, stakeholders or advocates, designers must find and educate potential local actors who recognize the need for change. The future of these drosscapes lies in human agency and the sharing of knowledge, requiring designers to create adaptable plans that balance flexibility with resilience against exploitation of common resources. Ultimately, this approach broadens the scope of landscape design,

136 Erik Swyngedouw, 'Depoliticized Environments: The End of Nature, Climate Change and the Post-Political Condition', Royal Institute of Philosophy Supplement 69 (October 2011): 253–74, https://doi.org/10.1017/S1358246111000

137 Elizabeth Yarina, 'Contested Landscapes: Staking Claims in Michigan's Copper Country',

138 Environment of the municipality of Guidonia Montecelio, Paolo Piseddu and Maria Tina Bergamo, as well as some exponents of the Lazio Region Environment Commission including Daniele Ronci.

139 Edoardo Zanchini and Gabriele Nanni, Rapporto Cave 2021 -

moving beyond traditional practices and embracing a politically charged, dynamic, collaborative field that reinterprets and generates new landscapes[140].

140 Berger, Drosscape.

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Resistance (n.)
a situation in which people or organizations fight against something or refuse to accept or be changed by something; a force that acts to stop the progress of something or make it slower, definition from the Cambridge dictionary accessed in 2024

3.4 RESISTING EXTRACTION

Maps have been the primary tool for spatial representation, as they are “statements that affirm or deny the existence of something”[141]. It is necessary to acknowledge how practitioners are agents and complicit in territorial transformation entailed by extraction processes, through the architecture and landscape construction practices. Maps are revelatory devices with the ability to uncover aspects of reality that were previously unknown (documentary vector) or imagined (mythical vector) and through transformation action through representation (projective vector). The individual or organization producing a map is responsible for selecting objects and events, as well as deciding how they are visually represented. Their work demands imagination and creativity, but there is also scope for lies and manipulation.

Maps are also historically instruments of territorialization and are complicit in processes of colonization. As James Scott brilliantly argued, maps embody “state simplifications” shaping and not only representing reality.[142] We've elaborated on the role on cartography contributes to establishing and enforcing the landscape to territories shift in earlier chapters, and therefore their historical use in objectifying resources, such as the map of 1882, "the Sketch of King Solomon's Mines" (Fig.01) that accentuates this perception in a treasure hunt map for mines as mythical resources in colonial context.

141 Roger Paez, Operative Mapping: Maps as Design Tools (New York [Barcelona]: Actar Publishers ELISAVA, 2019).

142 James Scott, Seeing Like a State. How Certain Schemes to Improve the Human Condition Have Failed (New Haven and London: Yale University Press, 1998), 3.

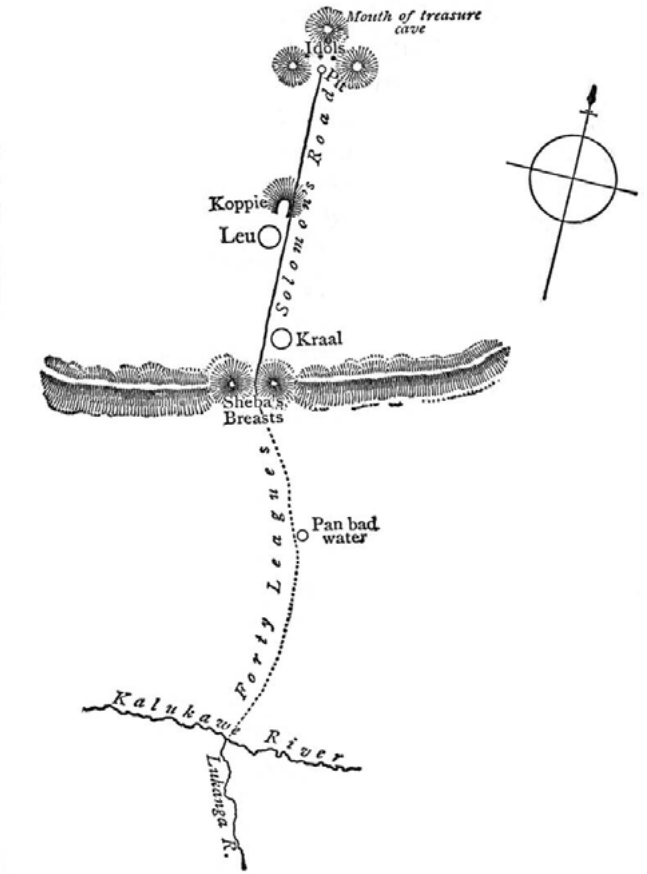


FIGURE 01

“Sketch Map of the Route to King Solomon's Mines,” in H. Rider Haggard, King Solomon's Mines (London: Cassell, 1886), 30.

The Maps as Systems of Resistance

There are landscape practices that has been using maps to valorize and highlight the hidden aspects, diminished and erased by dominant narratives such as extraction, and unjust colonization. Planning - in the landscape practice- “is a visualization exercise

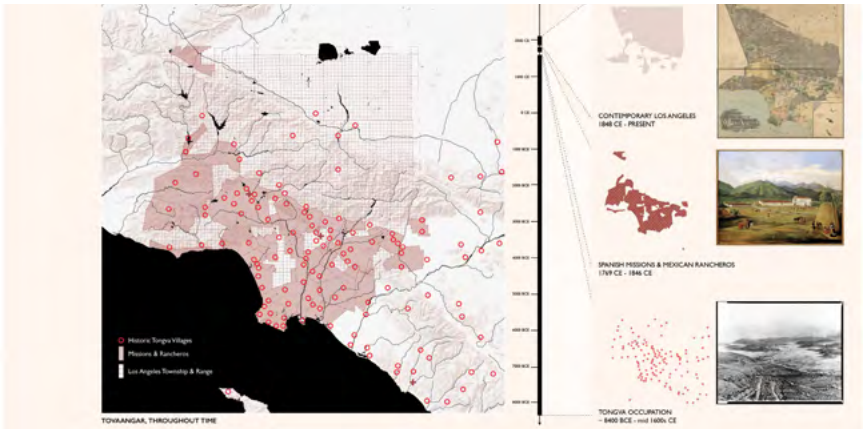


FIGURE 2

Highlighting the Indigenous people's villages colonialized, in Mapping Reparative Futures CC Danika Cooper and Jaclyn Tobia, Mapping Land Ownership in Zuni Territory, Then and Now, 2022.

with rigor and strong environmental commitment"[143] In this sense, these Resistant Maps are used to highlight the findings of other scientists and activists, in addition to revealing the invisibility of the living agents present in landscapes of extraction, foreground them, and resist their further exploitation. The Resistant Maps use the same territorialization instruments as a tool of pushing back further environmental loss. They function on a dichotomic sense, first as an instrument of research as they reveal the underground extraction structures and their invisible devastating consequences, such as the gaps and voids created under the terrains that would only appear once their effects are beyond repair, in people's housing and public infrastructure.

Secondly, the Resistant Maps sustain an alternative narrative of the territory. In the process of making a territory legible for the state many things are erased from the map, therefore from the narratives that construct that place. These counter cartographies are then defined as maps that use the same instruments of territorialization, to reclaim and resist extractive processes. They make visible what maps of oppression have invisibilized; they restore the interconnected complexity that state - and this thesis argues capitalist - simplifications have erased.

143 Filippo De Dominicis, 'From Humboldt's Chimborazo to Geddes' Valley Section and Beyond: How a Cross-Section Oriented World Scale Ecologies', in The Landscape as Union between Art and Science: The Legacy of Alexander von Humboldt and Ernst Haeckel = Il Paesaggio Come Unione Tra Arte e Scienza: L'eredità Di Alexander von Humboldt e Ernst Haeckel, ed. Alessandra Capuano et al., 1. Auflage (Marcerata: Quodlibet, 2023), 79–97.

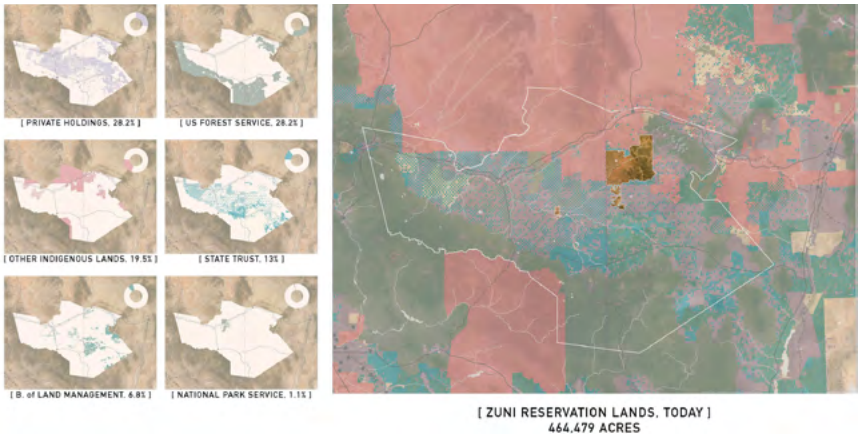


FIGURE 3

Mapping Reparative Futures, Cartography that uses instrments of territorialization to highlight the scales of land confescated by colonialization.
CC Danika Cooper and Jaclyn Tobia, Mapping Land Ownership in Zuni Territory, Then and Now, 2022.

These cartographies were used by Danika Cooper in "Spatializing Reparations, Mapping Reparative Futures", in which normative cartography is used as a tool to mobilize support and advocacy efforts of land rematriation and reclamation to indigenous people, and highlighting environmental risks. The maps dialogue with the cultural assets and artefacts created by the communities that once based their livelihoods on the territory and they were then expropriated from their lands through the same cartographic territorial tools. Instead, here these cartographies are ways to interact with these rather small and invisible realities, overlapping with territories of environmental and cultural resistance, in ways that might invoke a sense of belonging that is otherwise estranged and distanced through extraction.

These resistant cartographies describe the mapping tools used as resistance to colonization, and processes of getting back the landscapes, examples range from alternative Counter Atlases[144], Guerilla Cartographies[145], Mapping-Back Projects[146], and Atlases Of Environmental Justice[147]. Those cartographies of a participatory and pluralistic nature often include non-human species, engaging in new connections, new alternative narratives and new interpretations of the landscape. Among others, we can mention Benöhr, et al Ecopolitical Mapping: A Multispecies Research Methodology for Environmental Communication[148].

Another interesting study is explored in the project by Burke, and Fichel in "Across Species and Borders: Political Representation, Ecological Democracy and the Non-Human", where the researchers conducted a series of workshops under the title "Multispecies Resistance" in different case studies in Chile and Berlin[149]. Narration of multi-species oppression and dynamics of resistance are central in a 2023 article by Armiero and Pellow, in which they discuss the possibility of multi-species

144 Severin Halder and Kollektiv Orangotango, eds., This Is Not an Atlas: A Global Collection of Counter-Cartographies, First edition, Social and Cultural Geography, Volume 26 (Bielefeld: transcript, 2018).

145 Guerrilla Cartography identify as: mapmakers, researchers, and designers intent on widely promoting the cartographic arts and facilitating an expansion of the art, methods, and thematic scope of cartography, through collaborative projects and disruptive publishing. - https://www.guerrillacartography.org/

146 Greg Lowan-Trudeau, 'Mapping (as) Resistance: Decolonizing↫Indigenizing Journalistic Cartography', Media+Environment 3, no. 1 (4 March 2021), https://doi.org/10.1525/001c.19057.

147 EJAtlas - Global Atlas of Environmental Justice - https://ejatlas.org/

148 Jens Benöhr et al., 'Mapeo Ecopolítico: Una Metodología de Investigación Multiespecie Para La Comunicación Ambiental', Revista CS, no. 36 (30 March 2022): 317–43, https://doi.org/10.18046/recs.i36.5275.

149 Anthony Burke and Stefanie Fishel, 'Across Species and Borders: Political R1epresentation, Ecological Democracy and the Non-Human', in Non-Human Nature in World Politics, ed. Joana Castro Pereira and André Saramago, Frontiers in International Relations (Cham: Springer International Publishing, 2020), 33–52, https://doi.org/10.1007/978-3-030-49496-4_3.

alliances against the "Wasteocene[150]", meaning with this expression the transformation of human and non-human communities in socio-ecological dumps through the imposition of wasting relationships producing profits for a few and toxicity for the majority[151].

The Resistant Maps of th Acque Albule

In our case, we can consider these practical ontologies in a context of conflict and tensions such as the ones created by extraction, social struggles and injustices. Invoking a resistant narrative of non-living actants without including social voices of resistance can be perceived as incoherent and limited for the inclusive thesis is advocating for. Environmental violence, caused by the rigidity of extractive processes and the consequent waste and disposal dynamics, generates "sacrificed" areas, and forms of coercion and abuse of human and non-human beings, in deeply complex and often hidden ways[152].

The habitats in figure 5 mapped by the team employed to study the natural habitat of the area, Marco Giardini, Romeo di Pietro and others[153], were translated in the proposal of four natural reserves/ environmental monuments hightighted in figure 04, that include quarries of ongoing extraction undergo-

150 M. Armiero, Wasteocene: Stories from the Global Dump (Cambridge University Press, 2021).

151 Marco Armiero and David N. Pellow, 'Multispecies Alliances Against the Wasteocene: Counter-Narratives and Commoning Practices', Topoi (Rio de Janeiro) 24, no. 54 (September 2023): 685–702, https://doi.org/10.1590/2237-101x02405403.{\\i{}Topoi (Rio de Janeiro

152 Stefania Barca, "Telling the Right Story: Environmental Violence and Liberation Narratives," Environment and History 20, no. 4 (2014): 535–46

153 Agreement between the Monti Lucretili Park Authority and the Sapienza PDTA Department University of Rome for the drafting of scientific floristic and vegetation and mapping relating to the territory of the SCI (IT6030033) 'Travertini Acque Albule', aimed at mapping the priority habitats relevant to the Habitats' Directive 92</43/EU

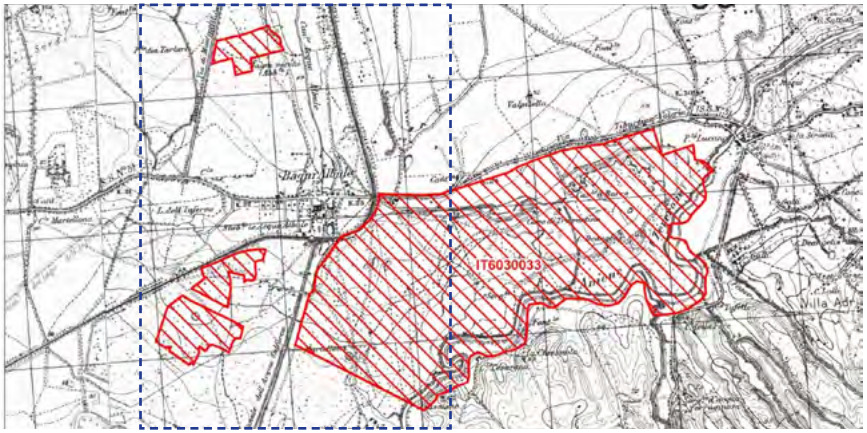
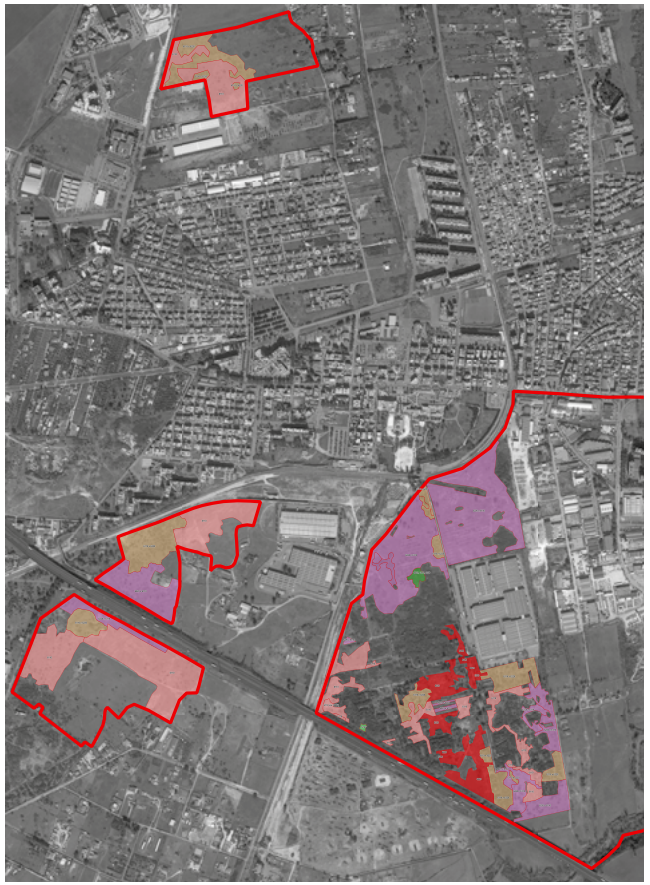


FIGURE 04

The SAC borders, as indicated in the Natural Reserve of Monti Lucretelli

Scardelletti, Giorgina. "Firma della convenzione per la ZSC Acque Albule." Parco dei Monti Lucretili (blog). Accessed July 16, 2024. https://parcolucretili.it/firma-della-convenzione-per-la-zsc-acque-albule/.



HABITAT IDs:

- **3140**
- **5330**
- **6110**
- **6220**
- **7210**
- **6110 e 6220**
- **6110 e 6220**

ing transformation, under different legal instruments of attempts of resistance and protection such as SCI (Site of Community Importance[154]). The 430 hectares[155] outlined by the activists were converted into a SAC (Special Area of Conservation)[156]. These areas take their starting point from the Habitats Directive, which is the European Union's main instrument for the protection of biodiversity and concerns the conservation of habitats and wildlife. Each country must identify areas with the environmental values specified in the Directive; these areas are first defined as SCIs (Sites of Community Importance) and are then designated as SACs. SACs, together with Special Protection Areas (SPAs)-established specifically for the protection of birds-constitute Natura 2000, the ecological network for the conservation of European biodiversity, which in Italy covers an area equal to 21 percent of the national territory[157].

The legal instruments of territorializing and mapping these specific zones did not necessarily result in an increase in the degree of their conservation, nor hindered the expansion of travertine quarrying. Quarries and landfills take part of the bordered

154 SCI code IT6030033 - During 2006, a number of local environmental associations submitted to the Lazio Region four different proposals for the establishment of a natural monument for the best-preserved, and therefore most naturalistically interesting, areas of the Acque Albule. These four proposals were collected in a richly illustrated publication funded by the provincial Laboratory of Environmental Education (LEA) in Tivoli Although with enormous difficulties, due in part to the lack of sensitivity to the matter from local governments, the process of establishing natural has been finally accepted in 2019 - Giardini, Le 'Conversazioni Di Ecologia' Di Giuliano Montelucci.

155 Legally inserted in the jurisdiction of the Regional Natural Park of Monti Lucretili, one of the biggest in Lazio, https://parcolucretili.it/firma-della-convenzione-per-la-zsc-acque-albule/

156 SAC – Special Area of Conservation, translates from Italian ZSC (Zona di Speciale Conservazione)

157 Definition of the SAC– sourced from https://www.mase.gov.it/ - accessed in 20-06-2024, https://www.parchilazio.it/travertini_acque_albule_bagni_di_tivoli

FIGURE 05

Snippet of the Carta della Habitat ZSC Travertini Acque Albule, from the project: botanical material Convention Department PDTA and Park Authority Regional Park of Monti Lucretili, from the project supervised by Prof. Romeo di Pietro, and University of Sapienza. (modified)

HABITAT ELEMENTS:

3140: Calcareous oligomesotrophic waters with benthic vegetation of Chara spp.
5330: Thermo-Mediterranean and pre-desert shrublands
6110*: Calcicolous or basophilous rupicolous grassland formations of the Alysso-Sedion albi
6220*: Sub-steppe courses of grasses and annuals of the Thero-Brachypodietea
7210*: Calcareous marshes with Cladium mariscus and species of the Caricion davallianae
6110 - 6220 Mosaic of Illyrian scrubland
6110 - 6220 Mosaic of habitats

SAC, as big part of the area is an illegal landfill[158], while ESTRABA owns one of the largest active quarries inside the protected marked borders[159].These described cartographies are the spatial dimension of resistance to wasting dynamics of extraction. The specific case of the travertine basin of *Acque Albule*, describes the legal efforts of territorial protection, manifesting through the SAC, and processes of environmental monitoring. As we hypothesize the use of mapping and cartography as an instrument to give a spatial dimension to the biodiversity composing travertine has. Challenging complications rendered by the severe industrialization of the territory in general, on the SAC specifically, even in a very controlled hypothetical context, arise.

Representation can play an important role in highlighting the small and fragile realities of the quarrying landscape, the protection of which has been neglected by travertine production processes. The basis of constructing an alternative narrative to the dominant one as a form of resistance, as "stories make things real, perhaps since there's nothing more real than a story"[160]. Resistant cartographies, such as the map in figure 06, also unveil conflicts embedded within a geography of private ownership and collective commons. This map is titled Archaeological and Environmental Park of the Area of the Barco, elaborated by the Barco Park Promoter Committee[161] in 2008, and published Association of the Travertines of the Acque Albule. The map highlights a vision of the SAC area as a park where archaeological remains, some disappeared, others under the risks of collapse, as the main attractors of the area. The project uses of archaeological linear remains such as the few stretches of the Tiburtina Valeria, still present inside the borders of the Thermal Baths of Tivoli, to lead to the different archaeological and natural monuments of the territory. The natural monuments proposed include the aforementioned Montarozzo del Barco, along with other goals that include: the recovery of Ancient Roman quarries of Lapis Tiburtinus, a vision of a navigable Aniene river , the reopening of the hunting estate of Ippolito II d'Este and, the search for sustainable extraction.

While the fields of extraction are privately owned by quarrymen, other resources, like water, are depleted through extraction, and cultural heritage, jeopardized by deliberate sabotage, are not owned. These maps highlights the commons that are protected under various laws[162], the SACs (and other Special protection zones present on the territorial scale). Commons in this sense include: the Natural Protected Areas, Natural monuments, natural reserves, including the Aniene River littoral, as natural commons, and its potential connection with the Natural Reserve of the Valley of Aniene[163]. These ecological connections highlight different forms of human and non-human alliances that reveal the

158 Di Pietro et al., 'Floristic and Coenological Data from the Travertine Substrates of the SAC "Travertini Acque Albule (Bagni Di Tivoli)" (Lazio Region – Central Italy)'.

159 Legal boundaries of the site: https://parcolucretili.it/firma-della-convenzione-per-la-zsc-acque-albule/

160 Marco Armiero and David N. Pellow, 'Multispecies Alliances Against the Wasteocene: Counter-Narratives and Commoning Practices', Topoi (Rio de Janeiro) 24, no. 54 (September 2023): 685–702, https://doi.org/10.1590/2237-101x02405403.{\\i{}Topoi (Rio de Janeiro

161 Whose president is prof. Brunella Testi, landscape architect and activist in the area.

162 Protection of archaeological heritage on private property is established in the italian constitution, Code of Cultural Heritage and Landscape (Codice dei Beni Culturali e del Paesaggio), and are specifically nominated in the Lazio region's Regional Landscape Plan or PTPR (Piano Territoriale Paesistico Regionale) for this specific case study. Sources: 'PTPR Regione Lazio (Tav. A - Tav. B)', geoportale.regione.lazio.it, accessed 1 July 2024, https://geoportale.regione.lazio.it/maps/43.

163 https://www.parchilazio.it/valledellaniene

FIGURE 06

Project elaborated by the committee of the Area del Barco, where highlighted are the natural and historical elements in the landscape. Activists elaborate this map as an alternative future of the territory as an archaeological and environmental park.

landscape's performativity and potential remediation against the dominant macro-extractive narrative.

These described cartographies are the spatial dimension of resistance to wasting dynamics of extraction. The specific case of the travertine basin of Acque Albule, describes the legal efforts of territorial protection, manifesting through the SAC, and processes of environmental monitoring. Challenging complications rendered by the severe industrialization of the territory in general, on the SAC specifically, even in a very controlled hypothetical context, arise.The Resistant Cartographies of Acque Albule make visible what generally remains invisible and marginalized. Instead, the narrative of the landscape is centred on natural systems and invisible entities, including legislative framework, commoning practices, and archaeological remains. Those maps do not

only represent what is in front or around us but they have a prospective reach, imagining what it might imply to connect the diversified regimes of protection in a coherent territorial system. Overlapping the two previous maps of the seemingly separate entities reveals a territory with potential projective human and non-human alliances. Foregrounds stories and new concepts to intervene with the space, as Christan Jacobs in his Cultural history of Cartography talks "cartography transforms the earth from a shapeless concept into a visible and describable space[164]".

These maps lead to pluralistic reading of the landscape, engaging in new connections, alternative narratives and innovative interpretations. We do not want to overcharge the power of the map. Scott clearly wrote that the performative nature of maps is charged when they are allied with state power; similarly, insurgent or counter-maps need the alliance of rebel communities. Researchers can represent a territory beyond its mainstream narratives but without an insurgent community this will remain an intellectual project. Furthermore, counter-maps are always thick; they include layers of stories that need to be narrated/remembered or sometimes envisioned. In this sense, an insurgent map is a visionary exercise even when it describes the past or the present because it refuses to remain trapped within the limits of mainstream narratives. For this reason, we categorize counter-mapping within the wider family of guerrilla narrative practices, that is, the ensemble of insurgent practices aiming at sabotaging mainstream narratives by counter-hegemonic storytelling.[165]

164 Jacob, Christian. "Toward a Cultural History of Cartography." Imago Mundi 48 (1996): 191–98.

165 Sergio Ruiz Cayuela & Marco Armiero, Cooking commoning Subjectivities: Guerrilla Narrative

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CONCLUSIONS

common(n.)
what belongs to nobody and therefore to everybody, or, what belongs to everybody and therefore to nonody.

CONCLUSIONS

"The relationship between resources, land, and the people is a violent affair; even though the violent relation can sometimes look like a peaceful landscape[1]". The entanglements between the resource, social context, economic dependency, and environmental aspects illustrated in this thesis has proven the complexity of approaching the site in a top-down territorial project. Nontheless, the closeness of the case study to two important UNESCO sites (Villa d'Este and Villa Adriana), the various archaeological remains still present on the site, along with the lunar landscape forms created by man-made excavations for travertine, call for further research addressing of the future of the territory. As Roman travertine exhaustion becomes a near reality, this part concludes with some of the reflections and debates that have occurred during the phases of conducting this research.

1 Ursula Biemann, the necropolitics of extraction, 2016

Architecture and landscape practices are complicit

In comparison with other construction and architectural materials, the use of natural stone in construction has one of the lowest ecological impacts, even when accounting for its entire carbon footprint. Building with natural stone is more sustainable, compared to synthetic construction materials, as it requires minimal maintenance, involves less processing, can last a lifetime, and needs fewer chemicals. Nonetheless, the Roman travertine quarrying has profoundly shaped the socio-economic landscape and ecological fabric of the Tiburtina territory. This thesis delves into how the unique geological properties and specific formation processes of travertine, stemming from its biodiverse, more-than-human and micro ecologies, have influenced its global architectural and economic success. By representing the intricate, microscopic life forms embedded within the travertine, this study advocates for a paradigm shift: viewing the material as a vibrant and regenerative entity. There could be the risk of fetishizing the material through turning its livelihood into an aesthetic, and end up to be used like Meier did in the Getty project and others.

This reflection is made to address the difficult architectural and landscape practices' complicit relationship with extraction. This direct connection is made by revealing the necropolitical vicious cycles and complications associated with the irreversible geomorphological, social, and environmental aftermaths of capitalist extraction. However, travertine remains one of the most ecological architectural materials in general, as extracting travertine does not have the same carbon footprint as synthetic building

materials. It remains a durable, low-maintenance material that can essentially last forever untouched; one could simply look at the Roman monuments. Nevertheless, the main objective is to bring to the imagination the voided sacrifice territories that are deliberately carved out to bring materials to our catalogues and shelves, and the range of dynamics that are involved in the production of such materials, to then have a much more conscious, deliberate choice of architectural material that goes beyond its aesthetic and price.

Herscher and Leon argued in their article about Urgent Pedagogies, and unlearning architecture: "... architecture was directly involved in the seizure, settlement, and exploitation of Indigenous land, along with the enforced and enslaved labour that cultivated and built on that land. And today, architecture remains indebted to colonial legacies through the property it occupies, the capital it is financed by, the materials it is constructed from, the underpaid migrant labour that continues to construct it, and the expertise that benefits from it through accumulations of social and financial capital.[2]" It is perhaps an incredibly difficult discourse to be an architect and enter in a cycle of blame and guilt towards landscapes of extraction through our practice. It is rather more difficult to convince a group of practitioners whose practice relies on extraction to think of other ways to build. Indeed, learning to build without extraction is equivalent to unlearning and relearning architecture.

It is also of a scarcity of imagination and openness to consider that non-extractive or post-extractive

2 Anna Maria León and Andrew Herscher, 'Learning Decolonization, Unlearning Architecture - URGENT PEDAGOGIES', ed. Magnus Ericson and Roberta Burchardt, Urgent Pedagogies Temporality, no. 2 (2021), https://urgentpedagogies.iaspis.se/learning-decolonization-unlearning-architecture-2/.

architecture equal not building new constructions at all. It naturally occurs that the way we have been instructed in schools, and practicing architecture relies on virgin materials, and it is also natural given that they are simply cheaper. The global market has not – yet invented ways to produce in the same scales, "ecological" architecture and construction materials, but the supply will exist once the demand is there, isn't this how innovative capitalism is supposed to work? Our academic institutions, nonetheless, must not rely on the capitalist market to find newer ways to interact with the environment to build.

But this discourse is, unfortunately, long overdue. It is absolutely too late for the practice responsible for 37% of carbon emissions globally[3] to revolutionise the ways on which it is based. The ways in which this might occur might be suggested as follows, by first acknowledging the complicity of the architecture practice to extraction, recognize that it has an active role, rather than a consequential one that depends on the presence of materials on the market. This would also require a deeper reflection on the arbitrariness of material selection based on availability, aesthetics, and cost, to include the far more hidden dynamics of the material production, and that material selection in this sense, is one of the ways we, builders, can take responsibility.

Second, taking responsibility rather than guilt and shame, for architecture is entangled not only with the ecological conditions in which extraction occurs, but also with precarious conditions of labour,

3 Architecture and construction are responsible for 37% of carbon emissions globally, for the immense carbon footprint used in the production of steel, cement and aluminum, in U. N. Environment, 'Building Materials And The Climate: Constructing A New Future', UNEP - UN Environment Programme, 9 December 2023, http://www.unep.org/resources/report/building-materials-and-climate-constructing-new-future.

the layers of socio-economic injustices, and the resulting consequential operational territories of extraction. The incorporation of this responsibility in architectural pedagogical institutions, academies and universities is an urgency in current realm of climate, and socio-economic injustices.

Representing Wasted Landscapes

The maps presented in this thesis are an ongoing process of visualization, rendering visible extraction and its conseuquences, rather than a conclusive project. The maps are simplistic, reductionist and abstract depictions of the territory and its inhabitants, and do not take into consideration various other inputs/parameters, such as a lack of social engagement and economic analysis, necessary for a comprehensible representation of the territory. They also risk to treat the landscape as a passive entity waiting for human intervention. They however, aim to bring forward other scenarios that reclaim, in Allen Berger's sense to "call out" and "represent" the landscape, if the ongoing processes proceed and dominate, rather than try to restore it to its "original state", had this assumed original state ever been analyzed or documented given the antiquity of extraction in this specific case.

The mapping project provides an innovative perspective on an alternative narration of the landscape, challenging traditional restoration notions and emphasizing the dynamic interplay between natural systems and human activities. By prioritizing ecological and environmental considerations, the mapping project reveals hidden landscapes shaped by legislative and anthropocentric systems, underscoring the resilience of existing natural systems, as they react to the ongoing forms of landscape exploitation. Forms of human and non-human alliance are suggested through the instrumentalization of these cartographies, as they present the scenarios in case the present state of the site persists, and in the eventual "Abandonment" as a form of landscape reclamation. Abandonment (explored under new lexicon and connotations) thus, provokes a way to foreground the processes that the natural systems carry out on territorial scales in the extraction is were to cease. The maps presents a speculation of an ongoing situation as a starting point for reflections on transitional scenarios of reduced, mitigated or abandoned extraction practices.

An ode to Abandonment, Re-naturalization is a myth

In the 1800s, Henry David Thoreau wrote:

"The earth I tread on is not dead, inert mass. It is a body, it has a spirit, is organic, and fluid to the influence of its spirit, and to whatever particle of this spirit is in me.[4]" As humans reshape the landscape, we forget what was there before. Ecologists call this forgetting the "shifting baseline syndrome." Our newly shaped and ruined landscapes become the new reality."[5] Slavoj Zizek, puts it: "the ultimate obstacle to protecting nature is the very notion of nature we rely on." He suggests that the concept of "nature" as something separate from human influence is outdated and even dangerous. Instead, it advocates for an "ecology without nature," where the focus shifts from trying to

4 Railton, Stephen. "Thoreau's 'Resurrection of Virtue!'" American Quarterly 24, no. 2 (May 1972): 210. https://doi.org/10.2307/2712071.

5 Anna Lowenhaupt Tsing, ed., Arts of Living on a Damaged Planet (Minneapolis: University of Minnesota Press, 2017).

protect an idealized version of nature to recognizing and managing the complex, intertwined reality of human and natural systems. This perspective implies that the ultimate barrier to effective environmental protection is the very notion of nature that we often cling to. By acknowledging that nature as we know it is deeply enmeshed with human activity, we can move towards more realistic and effective strategies for ecological sustainability that don't rely on the illusion of returning to a pre-human, balanced state[6].

Indeed, disturbed sites[7], such as the one discussed in this research, result from economic strategies that treat nature as a mere resource and accept environmental damage as an unavoidable outcome of technological advancement. Extraction Landscapes are usually invisible, contaminated, hidden and rarely addressed until their resources are exhausted, abandoned, or became an environmental/health hazard. The task of the landscape practice in such contexts is not restoration of an assumed ecological make-up of the site prior to extraction process. The interest lies in the currently existing natural systems that resist the harsh alterations induced by anthropogenic transformation. The restoration of the site to original conditions, prior to extraction, can be deemed difficult, above all economically, given the lack of earth material, since the law deems only material from the site is suitable[8], and since the economic model of extraction relies on selling the material, to refill the quarries and scarcity of ecological data about the native species of the site prior extraction given the

6 'Slavoj Zizek - Censorship Today: Violence, or Ecology, a New Opium for the Masses II', accessed 21 August 2024, https://www.lacan.com/zizecology2.htm.

7 E. Meyer, "Uncertain Parks: Distrubed Sites, Citizens and Risk Soceity," in Large Parks, ed. J.C. Hargreaves (Princeton Architectural Pr, 2007), 59–85.

8 This law has changed recently to allow the refilling of quarries with other earth materials that are ecologically suitable, more on the chapter of waste.

FIGURE 01

An abandoned quarry as seen from the northern part, photo by Sara Ahmed, July 2023

antiquity of quarrying. The task is neither converting industrial ruins to green hills suitable for human use, Elizabeth Meyer's essay on "disturbed" landscapes critics camouflaging these sites as: "Large pastoral parks are a form of amnesia, a practice of forgetting site histories[9]". She calls for design strategies that recognize the landscapes as both for consumption and production, making visible the connection between individuals and the distant industrial processes. The scope is then, to observe the landscape's ecological setting that thrived through extraction as potential for its reclamati. And to highlight Abandonment while the landscape itself reacts, while we practitioners observe, rather than top down restoration.

As of 2021, there are 4,168 authorized quarries in Italy, while there are 14,141 quarries that have been

9 Ibidem

decommissioned and abandoned[10], 475 of which are in Lazio. In the Acque Albule, in 2024, twenty are abandoned[11] and open (unrefilled) travertine quarries. These abandoned quarries present laboratories of high botanical interest[12], as they host varieties of life that immediately form the minute pollutants and human disturbances are seized. The study by biologists and botanists reported for the rare fly, highlights the potential of renaturing through flooding the quarries as a conservation strategy to restore ecosystems[13]. Flooding the quarries essentially occurs automatically, as the depths of the basins reaches levels below the groundwater springs, for which the water seeps and fills the travertine basins simultaneously as the water pumps that remove them are disabled.

Imagining a new reality for this site involves steps of conscious awareness, responsibility cooperative design and reclamation. The first step would be to perceive the current realities of extractive landscapes of travertine as spatial manifestations of waste-dynamics[14], where unjust socio-ecological relationships strongly manifest. This step is essential before the process of untying these narratives is necessary - and untying is meant as detaching from the processes that lead to the production of the left-over landscapes, but not as erasure, refilling, elimination

10 Edoardo Zanchini and Gabriele Nanni, Rapporto Cave 2021 - La Transizione Dell'economia Circolare Nel Settore Delle Costruzioni (Ufficio clima di Legambiente, 2021).

11 Abandoned quarries as of the time the conclusions was written, and are legally identified by them reaching the limit of 40 meters of the depth of excavation, in relation to the ground water levels, as dictated by the law L.R. 27/1993; L.R. 17/2004; Delibera Consiglio Regionale del 20/04/2011

12 Giardini, 'Aspetti Floristici e Vegetazionali Dei Travertini Delle Acqua Albule (Tivoli, Roma)'.

13 E Edoardo Pulvirenti et al., "Rediscovery of Paracoenia Beckeri (Kuntze, 1897) in the Acque Albule Plain, Italy."

14 M. Armiero, Wasteocene: Stories from the Global Dump (Cambridge University Press, 2021).

and curing. For which it is essential to consider the dark present (current state) of the landscape as a starting point.

Annalisa Metta emphasizes how perceiving remained or leftover landscapes as laboratories of corporations with many other agents, where transformative processes operate by multispecies subjects, ones that continuously adapt to their changing environment[15]. "In Italian, another way of saying *scarto* is *avanzato* which at the same time literally means leftover and exceeding, so it is a translation for waste." But, based on Metta's speculation and research of lexicon and different connotation, avanzato also means advanced, evolved, innovative, cutting-edge and avant garde. Territori avanzati - "advanced territories" left-over landscapes of precocious design the proceed and go forward[16].

Alan Berger defines the term reclamation, expanding its connotation in landscape disciplines in the context of post-mining to include: to recall from wrong or improper conduct (reform), to rescue from an undesirable state or to make available for human use by changing natural conditions (rescue), to obtain from a waste product, or by-product (recover), to demand the return of or regain and finally, possession of (return). He then distinguishes the term from restoration / and protection to an independent evolving aspect: as "reclamation (especially at large scales) attempts to set up a (new or modified) framework from which nature adapts new natural processes that reflect conditions of the new place. Understanding

15 Annalisa Metta, "Adaptive Reuse for Leftover Urban Landscape: Ruins, Remains, Waste and Monsters for an Approaching Genealogy of Future," Journal of Cultural Heritage Management and Sustainable Development 14, no. 1 (February 15, 2024): 98–109, https://doi.org/10.1108/JCHMSD-07-2022-0118.

16 Annalisa Metta, Il paesaggio è un mostro: città selvatiche e nature ibride, I edizione, Habitus 32 (Roma: DeriveApprodi, 2022).

potential ecological processes therefore is vital to strategies for reclamation, as the framework and trajectory for the site's future evolution"[17].

These disturbed sites are not merely remnants of past extraction activities but have the potential to be living laboratories that reveal the intricate dynamics of waste and ecological resilience. Viewing these landscapes through the lens of "advanced territories" encourages a shift from traditional notions of restoration to innovative reclamation strategies.

The void described in this thesis as highlighted in its title: Mapping the Void, intends to focus on the obvious and hidden voids of the sacrificed landscapes, one that is vastly visible through Google Earth, and that describes the major laceration in the highly inhabited landscape of today. One that can be explored for its infinite architectural and landscape capacity to view the resultant landscape of today as a spatial architectural and landscape project of great unexplored interest. I would like here to shed light to the starting questions in this thesis, This research asks the question, if we'd imagine a hole in the territory for each structure we erect, how would that shift the way we perceive our extraction based discipline? Once the temporary mode of production is discontinued, what happens to the permanent traces of material production in the earth? Also, how does territorial representation, beyond a sort of nostalgia of their past forms, define new futures in the case the present condition persists?

By recognizing the inherent value and potential of these spaces, as a starting point, we can foster new ecological processes and socio-environmental relationships that reflect contemporary conditions and future possibilities. This approach underscores the importance of integrating ecological understanding with landscape design, not undermining socio-economic settings, and positions that advocate for post-extraction, and an alternative narrative that advocates alliances between human activities and natural systems.

17 A. Berger, "Representation and Reclaiming: Cartographies, Mappings, and Images of Altered American Western Landscapes," Landscape Journal 21, no. 1 (January 1, 2002): 1–22, https://doi.org/10.3368/lj.21.1.1.

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