UNCERTAIN SOILS IN EXPERIMENTATION

architects and scientists representing the plural values of soils

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Soils provide vital ecosystem services in the fight against climate change; they are the subject of economical tensions; they are "returned to nature" when they are exposed to natural risks; they are the subject of citizen mobilization to defend the "commons"; etc. Urban soils, long considered by architects as surfaces to be urbanized, are moving.

A complex project situation as a starting point for research on urban soil values

The "Urban Brière" project proposes different scenarios for adapting an urban sector to the risk of marine submersion by 2040. Commissioned in 2019 by the Agence d'Urbanisme de la Région de Saint-Nazaire (ADDRN), this study is being carried out by the architecture, urbanism and landscape agency ANMA[1] in collaboration with the hydrology consultancy Urbanwater and the programming consultancy Algoé.

In order to understand the origin of the vulnerability to marine submersion of these soils, now occupied by small-scale economic activities and housing, the first step was to study the topography, geology and history of successive urbanization of these soils. Before anthropization of the swamp to adapt it to agriculture and housing, this area was subject to daily hydraulic movements: the ocean extended across it, joining the Brière swamp, before returning to the Loire estuary. Until the 19th century, rural dwellings were built on rocky hills, sheltered from the swamp's daily hydraulic cycles. From 1850 on, the port, naval basins, railroads and industrial development led to the polderization of the swamps and the creation of dykes, severing this hydraulic link.

The project studied by ANMA proposes to recover this "original" hydraulic functioning, to allow the expansion of marine submersion waves and the gravitational regulation of rainwater, through nature-based solutions (NBS). All

1 ANMA was founded in 2001 and is based in Paris, Brussels and Bordeaux. The agency has a team of 70 collaborators and a research platform where various research activities are carried out: exhibition curation, communication, development, etc.

scenarios propose to move urbanization away from the lower parts - traces of the ancient Brière swamp - towards the upper parts - close to the bedrock.
Caught up in the dynamics of the region's attractiveness, these plots of land have the potential to generate real estate value, as they are close to the town center, the train station and the coast. Their economic value is determined by the logic of constructibility. This economic dynamic is now coming up against the recent recognition of the soil's vulnerability. By restoring thickness to the wave of marine submersion, this currently artificial land has the potential to become living, functional soil in the long term, with characteristics similar to those of the Brière swamp. However, such a renaturation operation represents a major investment for the municipality, without generating sufficient income, since it involves a retreat from urbanization! Also, the hypothesis of a wave submerging the area is accepted in different ways by local and regional actors. In fact, this part of the city of Saint Nazaire has never before been submerged by the sea, nor flooded in the event of heavy rain.

The combination of the financial challenges involved and the low level of risk awareness was an obstacle to the implementation of the project, and reveals a structural problem with development in areas at risk of submersion. Against a context of increasing artificialization, falling biodiversity and the financialization of the city, this commission is at the core of a contemporary paradox concerning the way in which value is attributed to land: there are multiple criteria for attributing value, which are

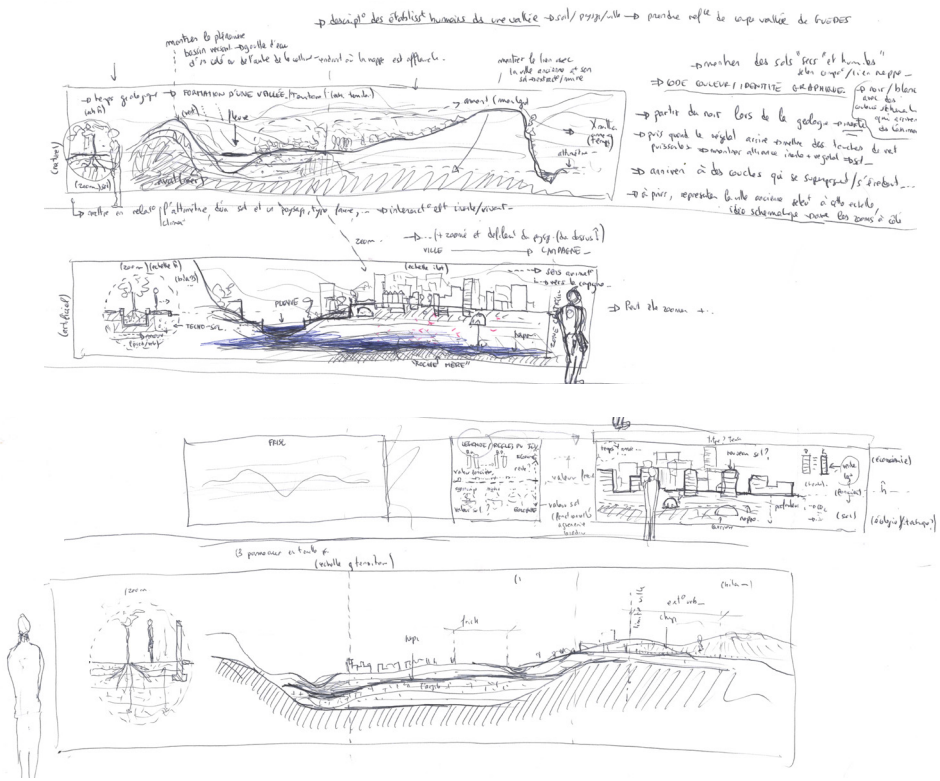
now being disrupted by climate disruption and ecological awareness.
Over the past twenty years, ANMA has carried out several hundred architectural, urbanism and landscape studies and projects in France and abroad. We could cite other mandates in which ANMA's architects are confronted with a complex operationalization of projects linked to competing ways of attributing value to urban soils. This context of changing views on soil reveals major contradictions in contemporary society, which ANMA has to come to terms with in its mandates.

Following a proposal from CAUE Rhône-Métropole to collaborate on an exhibition, ANMA began research into the conditions of urban production through the prism of the value of urban soils. After two years' work in partnership with the CAUE Rhône Métropole, the École Urbaine de Sciences Po and the BRGM national geological service, the *Terre Terrain Territoire* traveling exhibition will first be displayed in Lyon in 2022, then in Toulouse, Strasbourg, Metz, Rouen, Bordeaux and Montpellier in 2023 and 2024.
This article presents the results of the research that led to the *Terre Terrain Territoire* exhibition (TTT), as well as the place of this non-mandated activity within the agency. Firstly, the article will describe the different ways of attributing value to soils, rooted in the practices of the various actors in the urban production process: between land value (land) and ecological value (soil). The article will then focus on the representational work that led to the production of the exhibition documents for a non-expert audience. Those representations are the result of

Moment of work between different participants of the Terre Terrain Territoire exhibition project , ANMA, Paris, 2021

a collaborative process involving architects, hydrologists, soil scientists, ecologists, economists, illustrators and graphic designers. It clarifies two complex processes: the bio-geological process of soil *terraformation* and the process of soil economic value creation.

Finally, the article will look at the place this research activity occupies within the agency's practices: carried out beyond the mandate, it represents an opportunity for collaboration with other disciplines, and an opportunity for collaborators to enhance their skills for future projects.



Working sketch of the sections of three project territories on which ANMA is working, showing the relationships between soils and human installations. Agrippa Leenhardt, 2021

An exhibition to understand the plural values of soils

Tensions (and oppositions) over land values in France

In 1950, a third of the world's population lived in cities. In 2008, for the first time, the majority of the world's population lived in cities, and by 2050 it should be more than two-thirds. This acceleration in urbanization is reflected in the exponential artificialization of land, even in areas experiencing demographic decline. In France, we're talking about the artificialization of the equivalent of 110 soccer fields every day! However, the need for new housing and facilities is still present.

With the Zero Net Artificialization (ZAN)[1] initiative, the French government has set the target of reducing the rate of artificialization of land by half by 2030, in order to achieve zero net artificialization by 2050, at all territorial scales. The aim of this legislation is to strictly control the consumption of agricultural, natural and forest land, and to define the opposite of this : land artificialization. While the law defines artificialization as the durable alteration of the soil's ecological functions[2], what issues are behind the precise application of this definition? Whether to include, for example, the gardens of urban sprawl, intensive agriculture, quarries, energy infrastructures or

1 The goal of Zero Net Artificialization (ZAN) first appeared in July 2018 in the Biodiversity Plan. It leads all local authorities to drastically reduce the rate of land artificialization and has featured since August 2021 in the Climate and Resilience Act, as a consequence of the work of the Citizens' Climate Convention.

2 Article 192 of the Climate and Resilience Act now defines artificialization as "the lasting alteration of all or part of a soil's ecological functions, in particular its biological, hydric and climatic functions, as well as its agronomic potential, through its occupation or use".

monoculture forests on either side of the boundary that the law would determine, is a major issue for many economic sectors. ZAN does not differentiate between the different types of agriculture, and considers any agricultural or forestry parcel to be non-artificialized. However, the impact of intensive agriculture on the soil in France should be included in this legislation on soil, in the same way as urban sprawl, which will only represent around 1% of the territory in the coming decades[3].

And how can we imagine a territorial project in which we could no longer consume agricultural land, which is cheap and easily artificialized, to the detriment of economic competition in increasingly globalized territories? Are alternative models based on resource sharing and bioregional[4] cooperation conceivable?

Soil is more than ever a coveted resource, crystallizing opposition between economic and political players, as well as struggles led by citizens' and environmental movements. These oppositions reveal the widening gap between the conception of their economic value and the recent recognition of their ecological value. Indeed, the acceleration of financial crises since 1971 has transformed real estate into a "safe asset" for diversifying investment portfolios. Neo-liberal urban policies since the 1980s[5] have relied on the financial sector for the urban renewal of post-

3 Jean-Marc Offner, ZAN saison 2 : Un mode d'emploi alternatif du « zéro artificialisation ». *Revue Urbanisme*, 2023

4 Derived from deep ecology, a bioregion corresponds to a territory whose limits are not defined by political boundaries, but by geographical limits that take into account human communities as well as microclimates, soil types and the vitality of flora and fauna in a decentralized perspective. See Mathias Rollot and Marin Schaffner's *Qu'est-ce qu'une bioregion?* published in 2021 by Wildproject.

5 Gilles Pinson, *La ville néolibérale*, Paris, PUF, coll. « La ville en débat », 2020.

industrial Western cities. By transforming real estate into a financial product in these globalized megacities, land value tends to be uncoupled from the real estate market, becoming a speculative investment product.
These tensions over soil in projects influence and question the agency's day-to-day practice, as well as the framework in which it operates. Their land value, associated with constructibility, is central to the operationality of projects, and limits the transition from the current model. This is one of the main reasons why we have decided to make it an object of research, through the *Terre Terrain Territoire* exhibition.

Living soil, an unknown factor in the economic equation of urban development

The production of the exhibition was an excellent opportunity to examine the value that development actors place on soil in their projects, in terms of their economic models and the sector's necessary ecological transition.
In the city's production system, a development project must aim for financial equilibrium. Soil, as a building land capable of generating revenue, plays a key role in this. This leads us to look at it from the angle of land ownership : acquisition costs, building permits and planning regulations. As for its depth, this is approached through the prism of the act of building : the link between soil type and foundation, possible decontamination depending on the expected use, the passage of pipes, etc.The real estate value attributed to a plot of land is defined by an ecosystem of actors. It is the result of negotiations, power struggles, expert debates and sometimes contradictory public policies.

A mechanism structures the creation of value from this resource: the value by anticipation. Whereas market value describes the value of a property in a formal market, value by anticipation refers to the capacity to build according to the maximum capacity defined by urban planning policies. This mechanism enables a real-estate developer to offer a much higher price to the seller of a single-family house, for example, because he will be able to build a building that will multiply the floor area, if the market allows him to sell it. Competition between developers will then generate a bidding competition, which will determine a reference value for similar properties, contributing to the systemic rise in land prices. Value is thus created, but any ecological function of the land is excluded. As a result, the link between soil types and living organisms, the regulation of the water and carbon cycle, its "ecological value", is poorly rooted in the culture of those involved in the urban production process, because its economic value is considered to be negligible.

And yet, in this age of ecological awareness, living soils are recognized as one of the major components in maintaining the habitability of territories[6]. Thanks to scientific advances, the ecological parameters of soils are becoming increasingly legible and communicable. Four soil functions[7] have been characterized to explain their importance in territorial ecosystems:

6 IPCC, "Summary for Policymakers, Climate Change and Emerging Lands: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security and greenhouse gas fluxes in terrestrial ecosystems", 2019. According to the report, climate "is very largely conditioned by what happens on the land."

7 These four soil functions are defined in the Muse project (integrating soil multifunctionality into urban planning documents) coordinated by Cerema and financially supported by ADEME. This project is a tool for local authorities to qualify soil functions using 1:250,000 scale maps, and to help them integrate this subject into supra-territorial urban planning documents (SCOT, SRADDET).

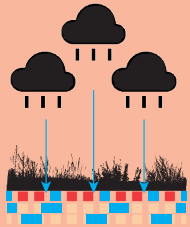
- The hydric function, which is part of the large and small water cycles of a watershed;
- The agronomic function, which depends on the characteristics of a territory's bedrock, the minerals it can transfer to the soil, the silts deposited by a river bed, and its water content;
- The function of carbon capture, involved in a territory's carbon cycle thanks to plant degradation, which could be compared with human activities that consume carbon;
- The function of supporting biodiversity, comprising all life forms whose evolutionary and reproductive cycles take place in the soil.

The ecological value of a soil is understood in terms of the proper functioning of a territorial ecosystem, at the interface between the mineral[8] and living worlds. But we still have a long way to go before we can reconcile the multiple benefits of soil.

To raise collective awareness, the TTT exhibition seeks to unfold these different views of soil, shaped by professional practices and political, economic and cultural acculturation. The terms soil (terre), land (terrain) and territoiry (territoire) illustrate three definitions and interweaving of scales derived from the common ground. They contrast the notion of soil (terre) with that of land (terrain), and highlight the contradictions in the value system of today's city-building model. By linking them to the scale of the territory, the exhibition broadens the gaze towards a notion of common project, which articulates the natural dynamics of soils with their environment, their potential uses, and ways of living.

8 Matthieu Duperrex describes our relationship with the mineral world through the concept of "sedimentation", in his essay *La rivière et le bulldozer*, Premier Parallèle, 2022.

SOIL : THE ECOLOGICAL VALUE OF ITS FUNCIONALITIES

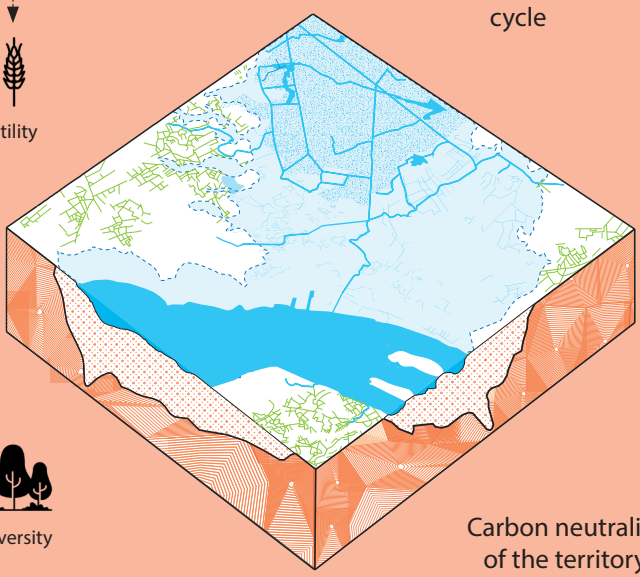


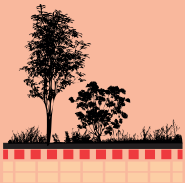
Water

Fertile sediments

Water cycle

Fertility

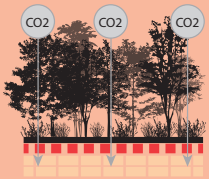




Biodiversity

Carbon neutrality of the territory

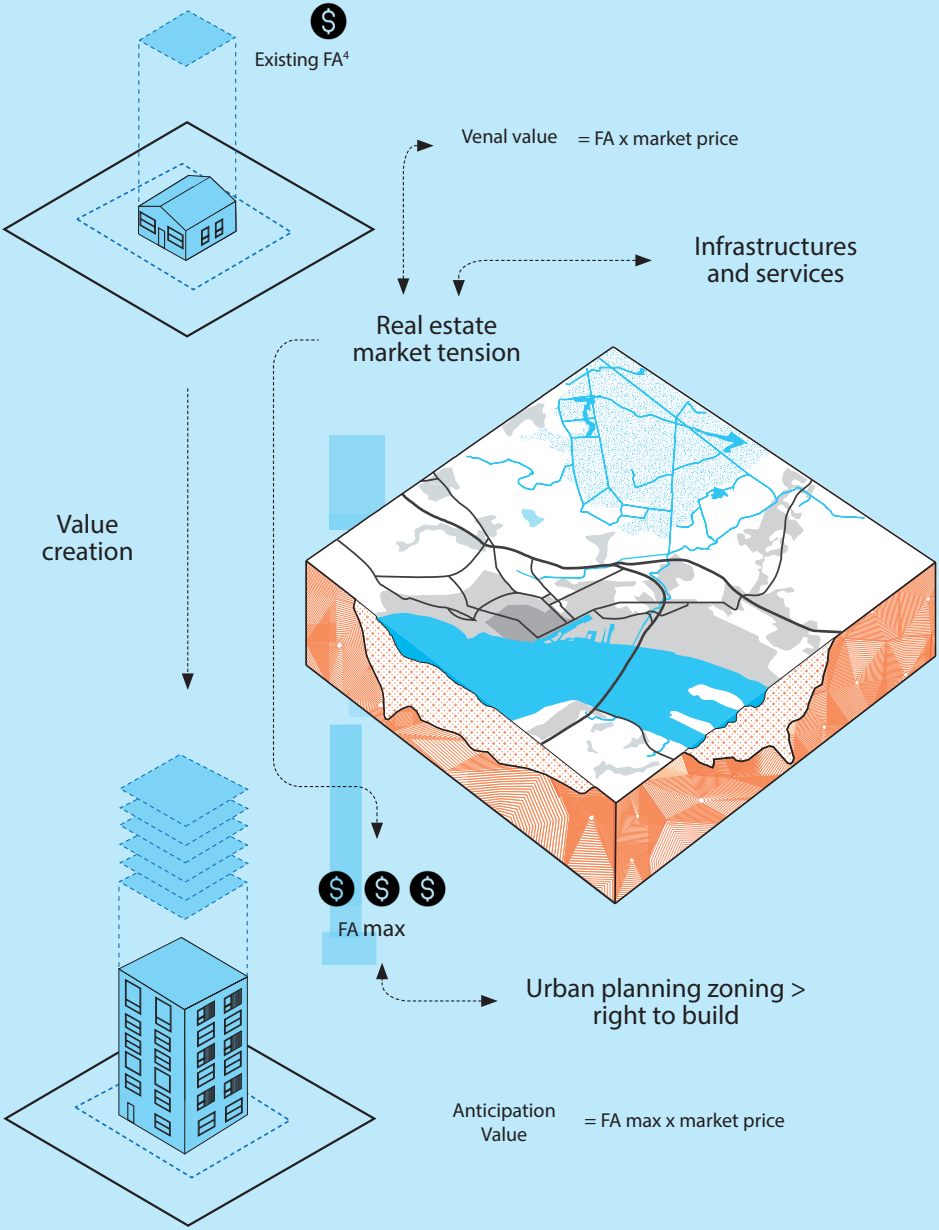
Territorial ecosystems



CO2

These axonometries represent the Saint Nazaire area, the Loire estuary and the Brière marshes.

LAND : THE ECONOMIC VALUE OF ITS CONSTRUCTIBILITY



4 The floor area, or FA, represents the buildable surface area, generally expressed in m^2.

Representing soils: where fields meet

An opportunity for collaboration between architecture and natural sciences

Changing the way we look at urban soils is a matter of representation. And the architectural tools can help to make this shift. In *Terra Forma*, Frédérique Aït-Touati, Alexandra Arènes and Axelle Grégoire explore representations at the crossroads of the natural sciences and art. According to the authors, (cartographic) representations as we know them today "express a relationship to space emptied of its living, an available space that can be conquered and colonized". Yet they have the capacity to unfold worlds, in a context where there is an "urgent need to grasp the crisis of representation of a world in upheaval[1]". As part of this objective, the exhibition explores representations (plans, sections and axonometries) for a non-expert audience, to clarify two complex processes: the bio-geological process of soil terraformation and the process of soil economic value creation. In this section, we will focus on the representation of the soil formation process, which involves biological and geological processes that are still relatively compartmentalized in their respective disciplinary fields[2].

1 Frédérique Aït-Touati, Alexandra Arènes, Axelle Grégoire, *Terra Forma. Manuel de cartographies potentielles*, édition B42, 2019.

2 In *La Terre habitable, ou l'épopée de la zone critique* (La Découverte, 2023), Jérôme Gaillardet describes "the emergence of a new discipline whose aim is to understand the mechanisms by which living beings transform the Earth. A science of "terraformation" in short, which, according to

In fact, representing the complexity of soils challenges the architectural codes of representation. Representing this thickness means taking a step into the world of the natural sciences, each of them having their own language, their own ways of representing and understanding how soils work. This graphic research requires collaboration with other experts in order to transcribe their different languages. It's important to note that, since the 1990s, this knowledge has been shared by a number of landscape architects, who consider the links between plants and soil through landscape design[3].
Ecologists, soil scientists and hydrologists have become the key partners of landscape designers, architects and urban planners in the design process. Faced with an ever-increasing need for expertise, with few knowledge of each of these disciplines, and often with limited soil data available for their projects, commissioning authorities rarely integrate these collaborations into the project process. *Terre Terrain Territoire* was an opportunity to bring these cooperative ventures out of the mandate scope.

In collaboration with pedologists (Sol Paysage), geologists (BRGM) and graphic designers (Les Zinc), we explored a system of graphic representation to explain the ecological functions of soils, and to help us envisage their interaction

traditional Greek roots, would be a "biogeology" having nothing to do with the esoteric definition given by wikipedia, but much closer to the study of Michel Serres' Biogée, of Gaïa by James Lovelock and the philosophers, of Vernadsky's biosphere."

3 For several decades, with the support of ecologists, landscape architects have been changing the approach to soil in landscaping, notably by questioning the contribution of "open soil" traditionally used in green spaces. Landscape architects Marc Rumelhart and Gabriel Chauvel are regarded as pioneers in taking into account the existing soil of urban wastelands. Despite their low agronomic value, the presence of specific, non-standard ecosystems makes them a starting point for a more ecological project where "nothing goes in, nothing comes out", as described in their article "La richesse des sols pauvres", *Pages Paysages*, no. 5, pp. 6-11, 1994.

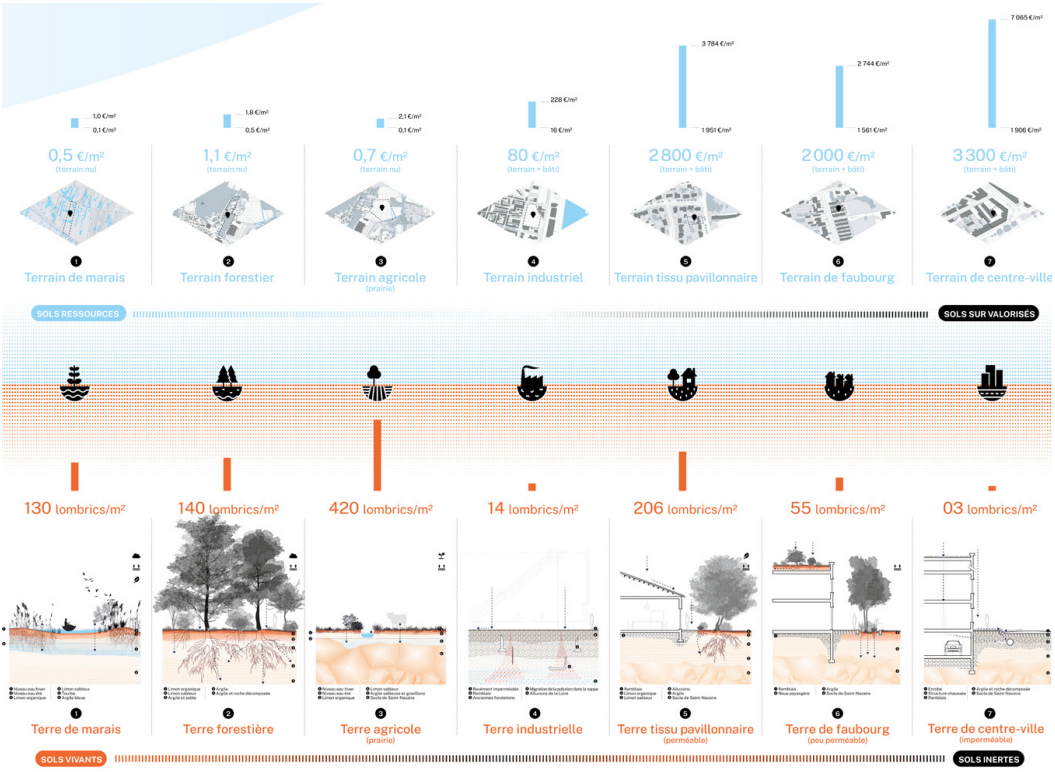
with the project.
This scientific approach led us to retain traditional soil science graphic codes. Thus, the various layers were interpreted according to stratigraphic principles[4], and the soil patterns were derived from the figurations used in geology and pedology.
However, a difference has been made to the classic color codes of these disciplines to highlight the presence of living organisms in soil, and the economic value of land. Orange, a bright color symbolizing life in soil, contrasts with blue, a cold color that characterizes the vision of soil as inert land. In this way, we aimed to transcribe the opposition between living soil and constructible land in project situations.
This duality is also reflected in the way in which soil is represented: cross-section to read the depth of the soil, axonometry to see the soil as a surface on which uses are thought out and carved out. Some soil characteristics have also been integrated into the representation system, such as water content, pollution, inertness, roots and granulometry.

Through these attempts to represent the project, we wish to highlight the disciplinary partitioning we have inherited and its deleterious impact on the functional characteristics of soils. The technical culture of the building industry has inherited a tradition of heavy transformation of the soil to enable the act of building: excavation, channelling of water into networks, waterproofing of the surface, containment of pollution... Conversely, the natural sciences were traditionally focused on the functioning of natural or

4 Stratigraphy is a geological process used to describe soil layers in order to reconstruct the history of the earth's crust.

agricultural areas. Understanding the functioning of urban soils, and building bridges with the world of construction, are therefore relatively recent developments for these so-called natural disciplines.

While the exhibition contrasts soil (ecology) and land (economy), and by extension the natural sciences with construction engineering, it also outlines the fertility of mutual understanding, with a view to ecologizing construction practices.



Extract from a panel in the *terre terrain territoire* exhibition comparing the economic value (monetary) and ecological value of soil (earthworm content).

Designing the city in the age of the Anthropocene: architects working with the ecological humanities

While the creation of the IPCC in 1988 institutionalized the idea of an environmental crisis, the "ecological narrative[5]" did not penetrate the world of architecture in France until late in the 2000s, with a globalizing discourse dominated by scientific and technical considerations. Sustainable development and energy efficiency were developed around the idea of green growth and progress in the service of more responsible architecture. The 2010s marked a new period, during which the Anthropocene thesis, demonstrating the predominant influence of human activities on natural, social and climatic disturbances, spread to the field of architecture, and "shook the way architects took up the

5 This is the hypothesis constructed by Léa Mosconi in her thesis *Emergence du récit écologiste dans le milieu de l'architecture. 1989-2015: de la réglementation à la thèse de l'anthropocène*, under the direction of Jean-Louis Violeau, which she defended at ENSA-Paris Malaquais in 2018.

Greta Thunberg during Donald Trump's speech to the United Nations in New York on September 23, 2019. REUTERS/Andrew Hofstetter.

ecological question[6]", which had until then been very much oriented towards sustainable development, or had been dealt with on the margins by activists.

We are entering an era in which "nature" can no longer be seen as a stable, timeless framework, as the mere "environment" for human activities. The powers of the Earth are reacting to human actions, ever more violently, on every scale. The proliferation of the Anthropocene thesis calls into question the way we conceive of our place in the biosphere, and the relationship between humans and the rest of the living world: we are going through a crisis of sensitivity to the other *earthbound* that make up this environment[7]. Soil is not an inert surface available for urbanization, but "the multi-millennial theater of joint, cobbled-together actions by an infinite number of communities of living beings[8]."

Since 2016, a range of actors in the field of architecture have been refocusing their attention on soil. To cite just a few examples: exhibitions such as "Sols vivants" by the Ter agency (2020), TVK's "La terre est une architecture" (2021), "Elément Terre", theme of the biennale d'architecture et de paysage d'Ile-de-France (2022) or "Reclaim the Earth" at the Palais de Tokyo (2022); new journals such as "Topophile" (2019) or "Terrestres" (2018); or publishers such as "Terres urbaines" (2020). The *Terre Terrain Territoire* exhibition is part of this current trend. By attempting to clarify the dual complexity of bio-geological processes and the processes involved in the production of economic value from urban

6 Ibid. p. 409.

7 Bruno Latour, *Face à Gaïa, Huit conférences sur le Nouveau Régime Climatique*, La découverte, 2015.

8 Léna Balaud, Antoine Chopot, *Nous ne sommes pas seuls, Politique des soulèvements terrestres*, éditions Seuil, 2021.

soils, it hopes to contribute to a better understanding of contemporary conditions for the production of architectural and urban projects.

There is a need for research beyond the mandate, to understand and represent soils in order to transform them with greater care and caution. In this case, the research led to an exhibition as a means of training and collaborating with other disciplines; to better support clients in taking better account of soil and experimenting with other project methods.
More than ever, citizens and authorities expect urban projects to be sustainable, taking care of social situations, resources and landscapes. ANMA believes that the role of architects is to support urban planners in transforming the way they look at urban soil. This role can be played in the context of the mandates, but also beyond.

Getting projects moving towards an ecological transition means taking into account the technical complexities and bio-geological dynamics of soils. Urban planning must engage in a broadening of project disciplines. Rejecting the division between natural and social sciences, the *ecological humanities*[9] represent an emerging interdisciplinary field of research in which designers have their rightful place. Understanding hydraulic dynamics through the expertise of the hydrologist informs us about the capacity of soils to infiltrate water and become the support for ever more

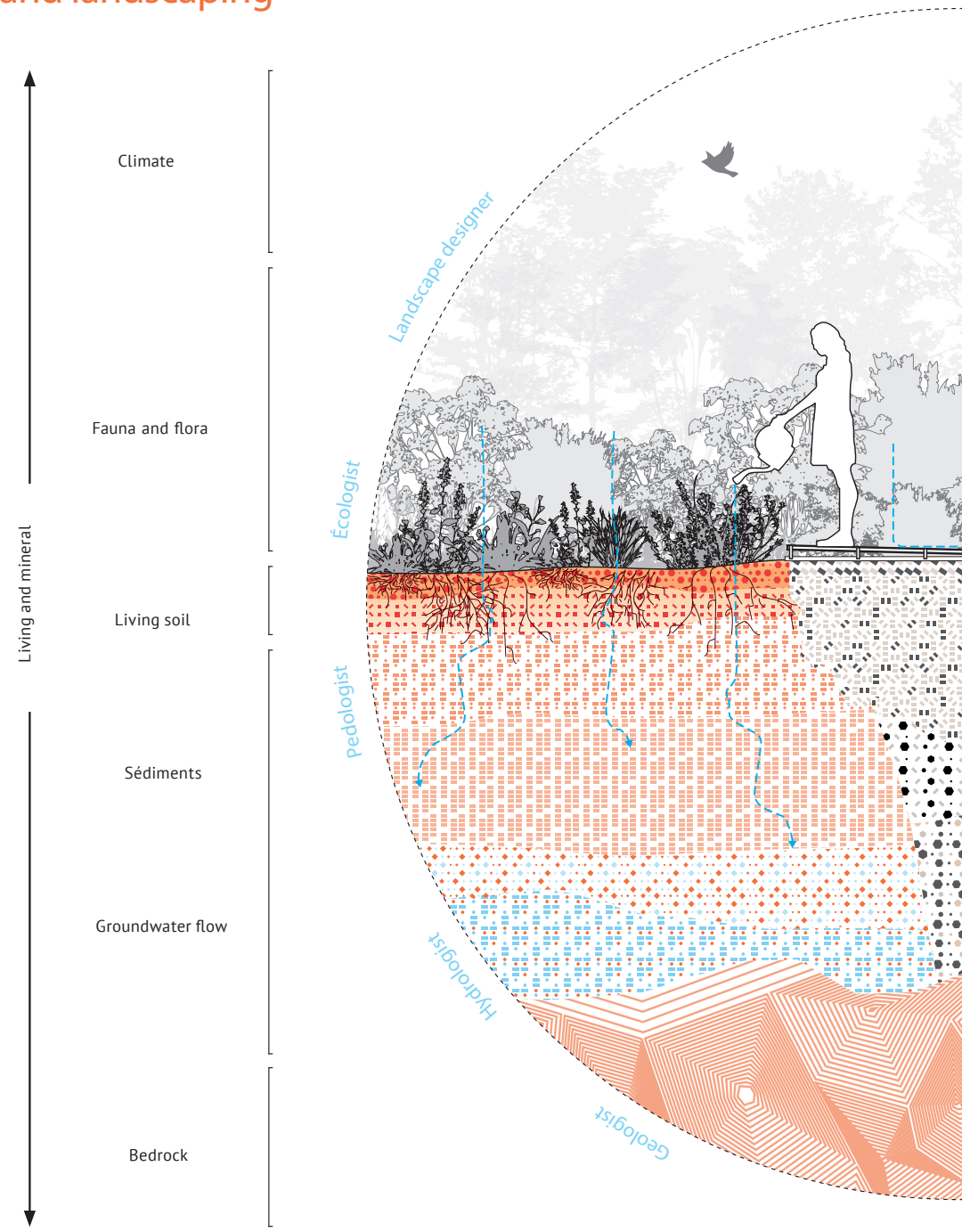
9 *Ecological humanities* propose to abolish the exteriority of nature to the social and cultural to install new acting forces at the heart of the humanities and social sciences. See Deborah Bird Rose, Libby Robin, *Vers des humanités écologiques*, Chapter 11. A new field of research organization, Wild project, 2019.

specific living environments, which the ecologist reveals. The pedologist tells us how the soil functions, the geologist teaches us about the long-term dynamics of the subsoil, which the geographer, sociologist or economist cross-references with the successive dynamics of human settlements. Unavoidable at a time of climate change, these alliances of expertise can be worked out in plan, but also in cross-section. The cross-section becomes a privileged tool for design and experimentation, as it enables us to measure how human and natural actions have shaped the thicknesses of soils over the course of history. The cross-section becomes a powerful tool for representing these interfaces between soil and architecture.

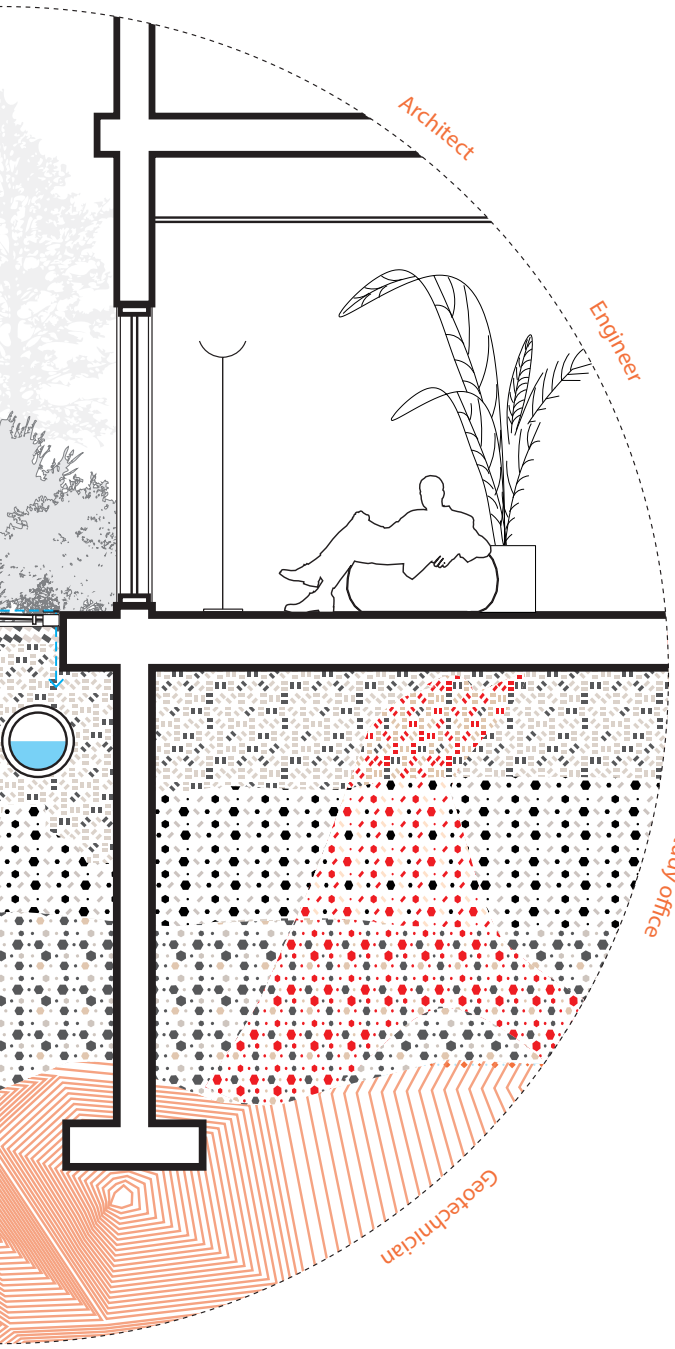
These moments of project making, necessarily trans-disciplinary, are places of learning and breaking down barriers of expertises and particular interests to arrive at a shared understanding of the challenges of soil use and functionality. These moments-workshops are places for the construction of a common culture, debated and negotiated by the actors involved, based on the interaction of projects and soils, specific to each territory.

This research, carried out beyond the mandates, allows us to *take a step aside* to return to our projects in a different way: the collaboration with other experts, the representation of soils and their dynamics, the narration of projects, constitute new fields of research that ANMA wishes to explore in new mandates.

Linking natural sciences and landscaping



to planning techniques and architecture



Bâti

Structure

Network

Backfilling

Pollution

Foundation

Man and artifact

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