SOILveR
Webinar series ‘Integration of Soil Health in decision-making processes at various scales’
Soil management and Land planning, 24th of January

Soil-based urban design for climate-resilient and inclusive cities

Prof Dr Antoine Vialle

Chair for Transitioning Urban Ecosystems
Technische Universität Berlin

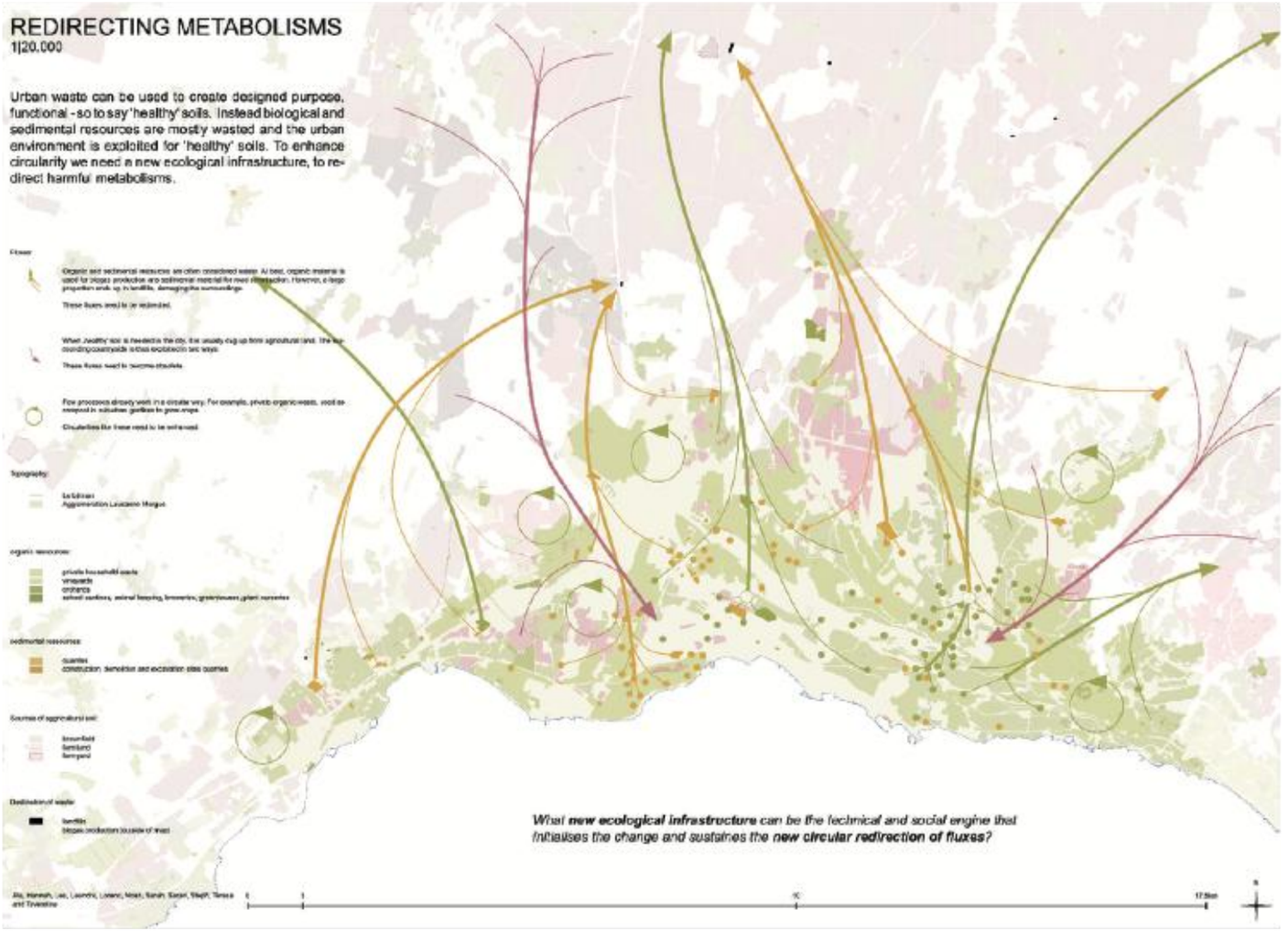
FG „KLIMAORIENTIERTER STÄDTEBAU UND URBANE (ÖKO)SYSTEME“

cue*

CHAIR OF TRANSITIONING URBAN ECOSYSTEMS

cue (noun) /kjuː/ : *a thing said or done that serves as a signal to an actor or other performer to enter or to begin their speech or performance.

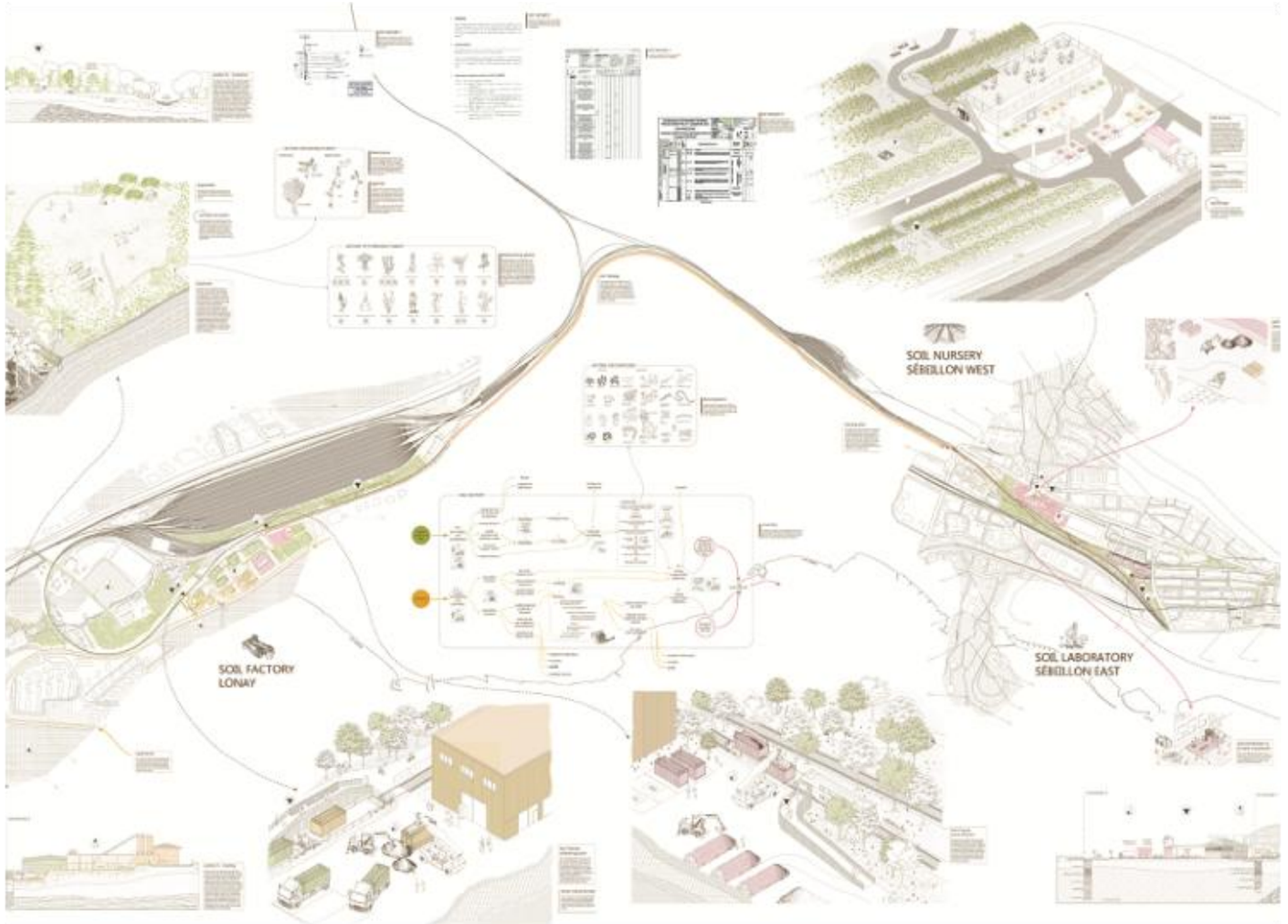
Oxford languages: https://languages.oup.com/google-dictionary-en/



WiSe 23-24 Design Studio, Studio Climate-Resilient Urban Soils-Case Lausanne, Chair for Transitioning Urban Ecosystems (CUE),TU Berlin

CUE is therefore committed to develop design strategies for URBAN SOIL preservation and regeneration through the ecological transition and sustainable requalification of metropolitan areas - on a territorial scale...

Climate-Resilient Urban Soils as core topic for teaching, research and design over the next five years



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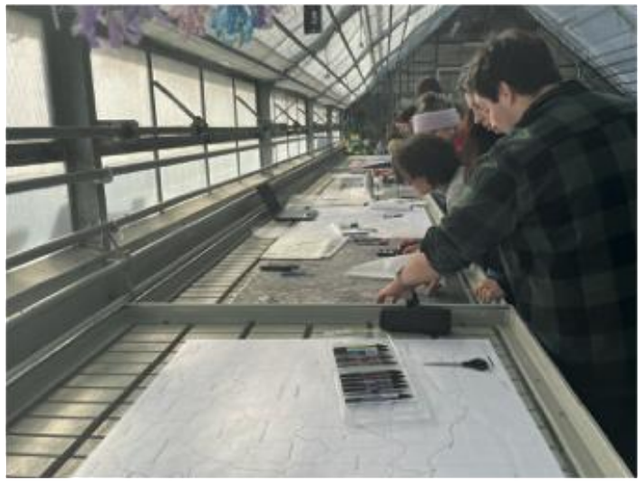
CUE is therefore committed to develop design strategies for URBAN SOIL preservation and regeneration through the ecological transition and sustainable requalification of metropolitan areas - in societal engagement.

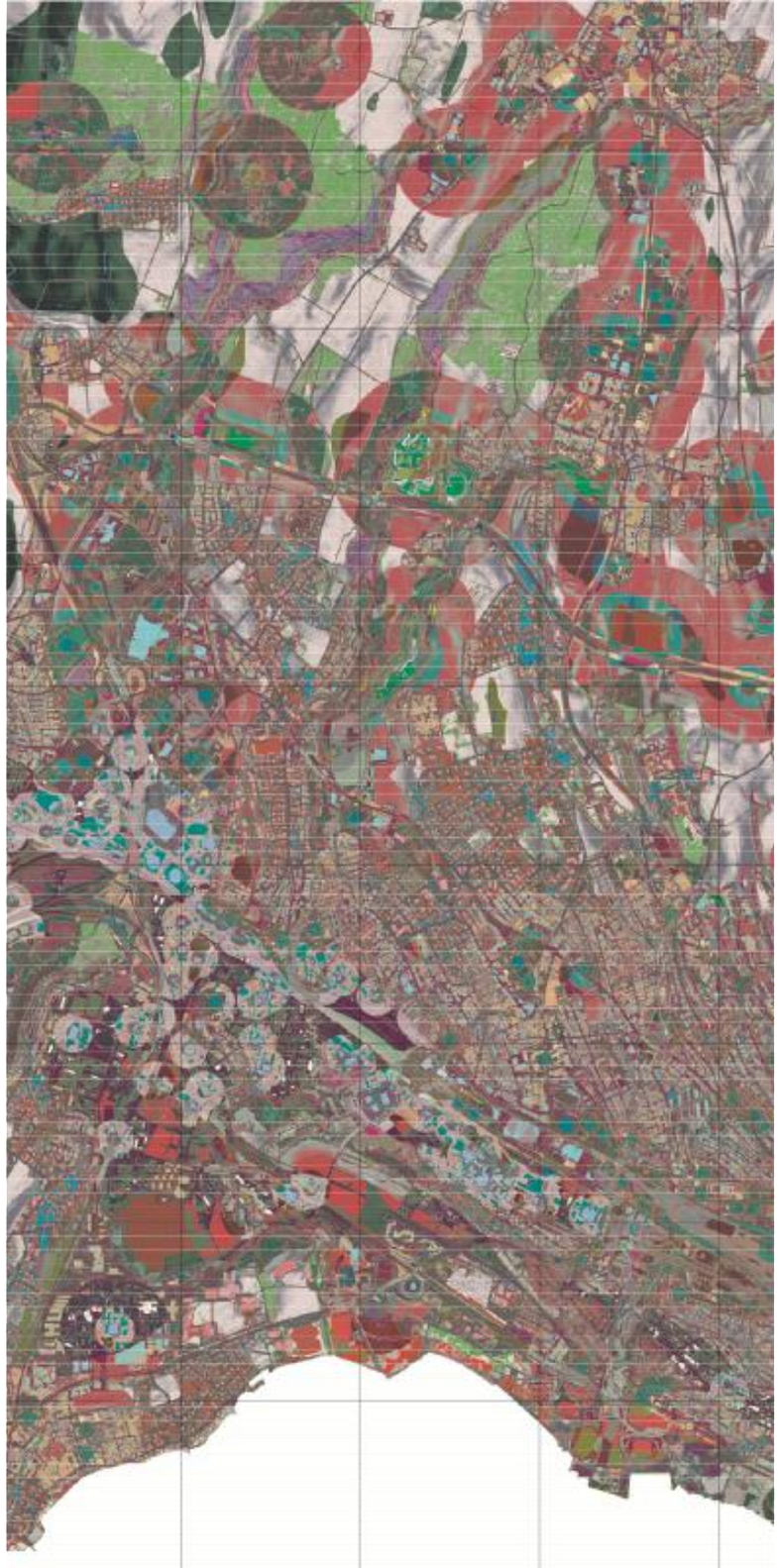
CUE design method starts on and from the field, through transdisciplinary exchanges and interactions with scientists.

WiSe 23-24 , PiV (co-taught w. Dr. Thomas Nehls), Chair for Transitioning Urban Ecosystems (CUE),TU Berlin



CUE design method starts on and from the field, through transdisciplinary exchanges and interactions with local actors and stakeholders.

WiSe 23-24 Lausanne Workshop, Chair for Transitioning Urban Ecosystems (CUE), TU Berlin

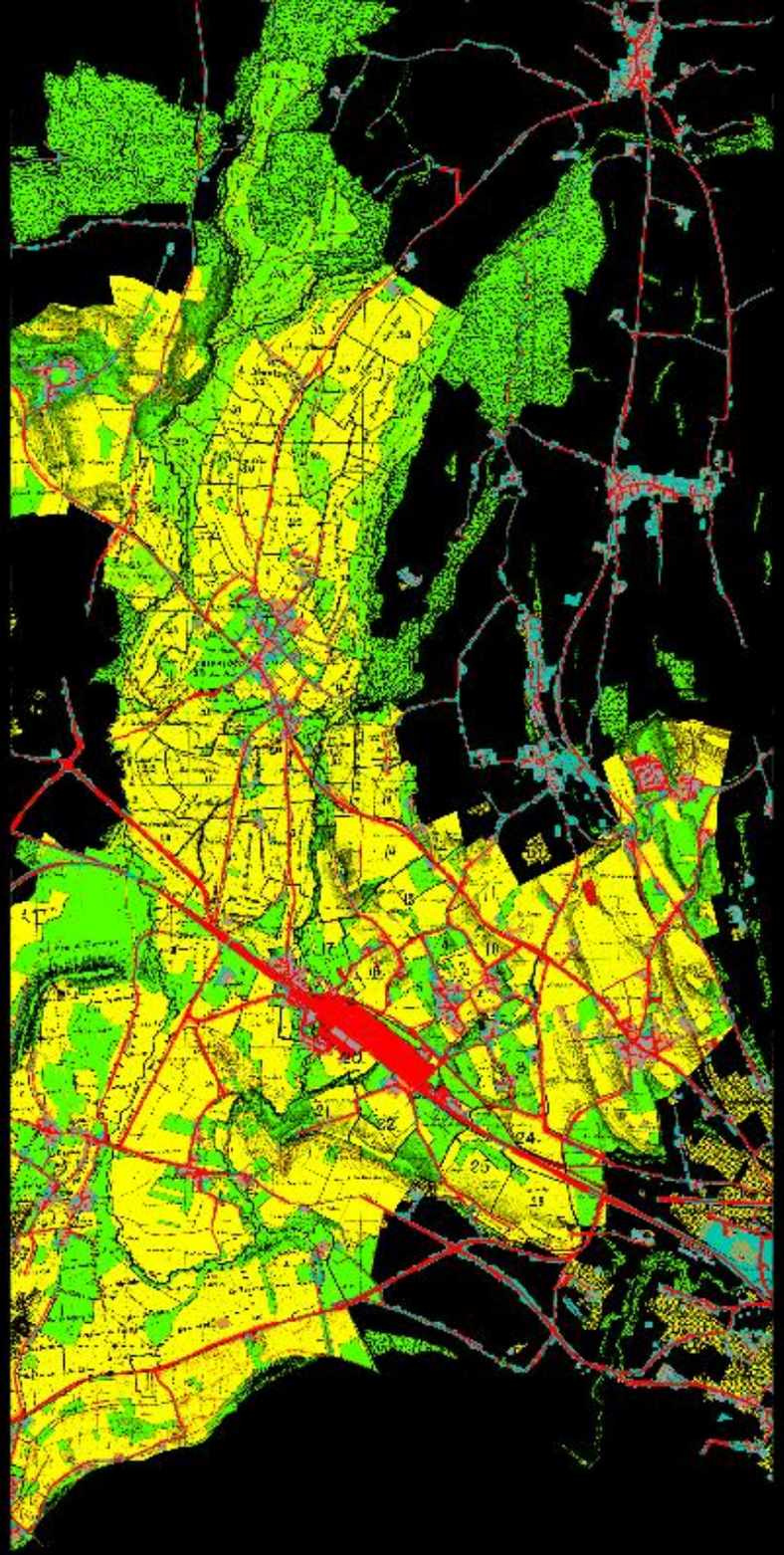


OUR COMMON SOILS:

West Lausanne Urbanization as Anthropedogenesis,

A Section through the Spaces and Times of Urban Soils

An original representation and spatialization of the natural and anthro-pedogenetic dynamics in process on a territory: Soil historical trajectories ca. 1900



no data and water
trajectory A
trajectory B
trajectory C, D
trajectory E
trajectory F
trajectory G

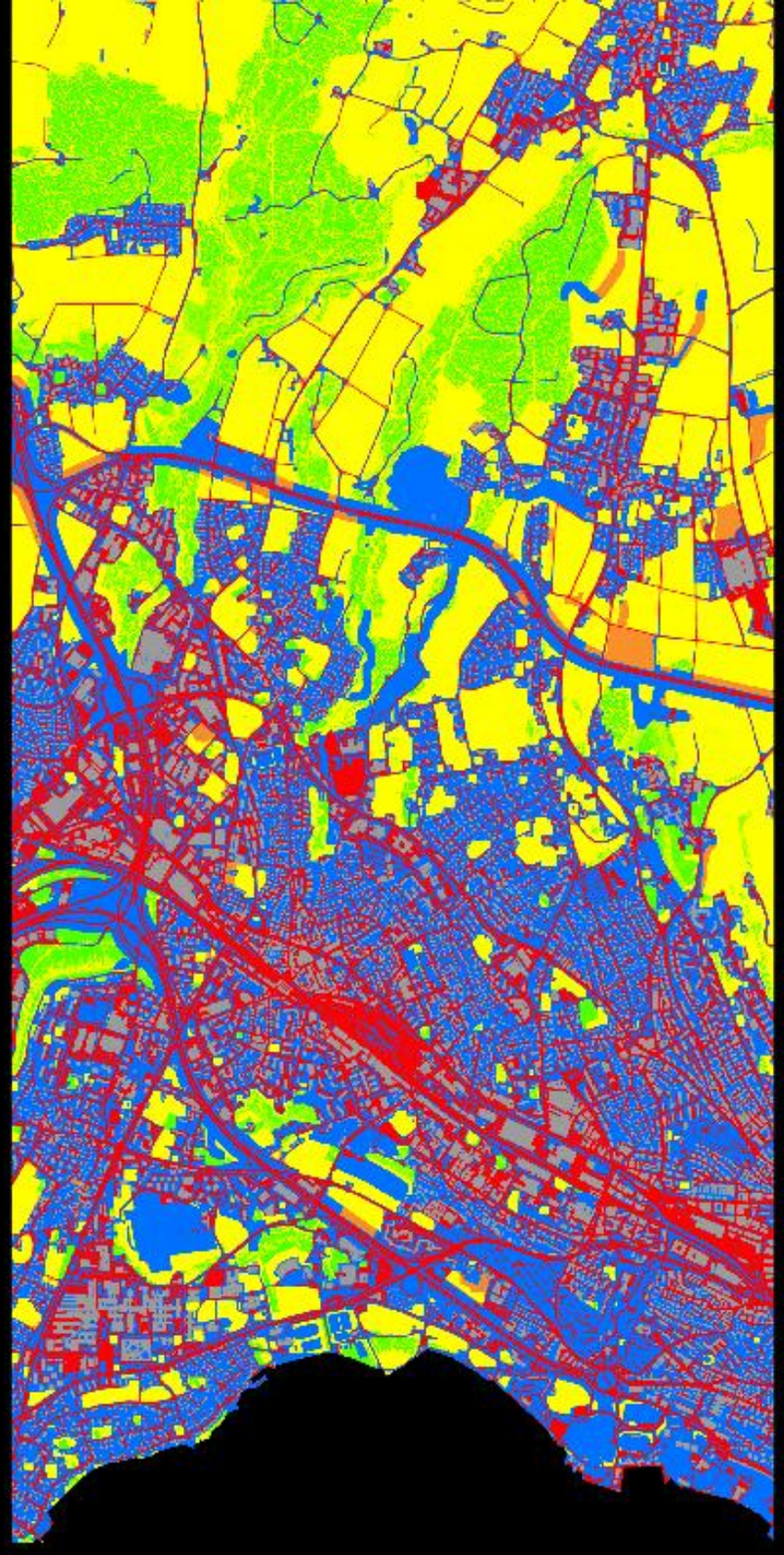
1 km
500 m
0

N

Soil historical trajectories ca. 2018

ca. 10 %
ca. 17 %
ca. 1,5%
ca. 27,5 %
ca 28 %
ca. 8 %
ca. 8 %

Total extant of the case study



water
trajectory A
trajectory B
trajectory C, D
trajectory E
trajectory F
trajectory G

Carbon in Urban Soils, Towards Ecological Transition and Urban Requalification

Research Consortium:

Antoine Vialle (project leader), UNIL Competence center in Sustainability (CCD)

Stephanie Grand, UNIL Institute of Earth Surface Dynamics (IDYST)

Yannick Poyat, Planisol Lausanne

Kevin Vega, ETHZ Department of Environmental Systems Science (USYS)

Funding Stakeholders:

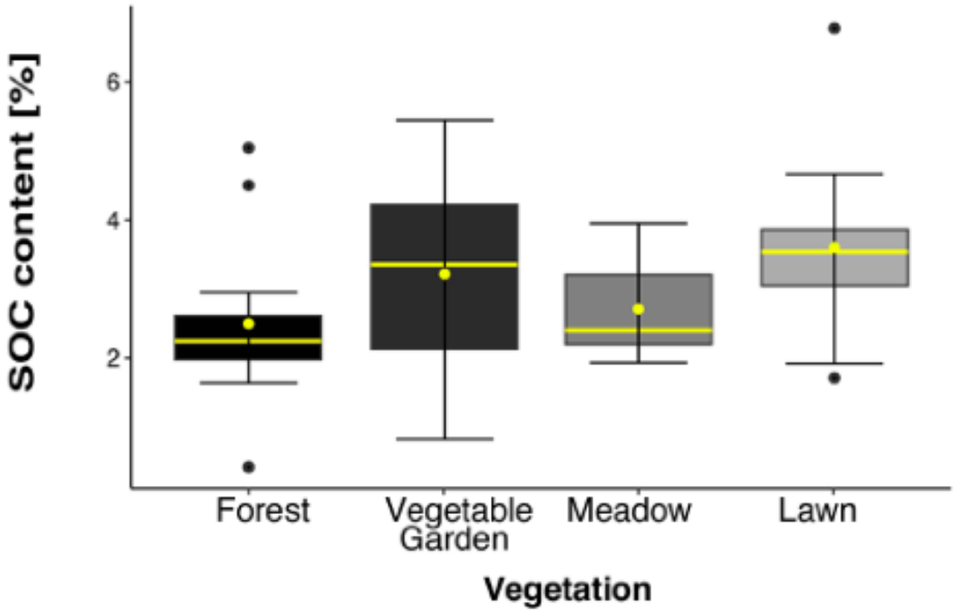
Federal Office for the Environment (FOEN), Soil Section

Canton de Vaud, Direction Générale du Territoire et du Logement (DGTL)

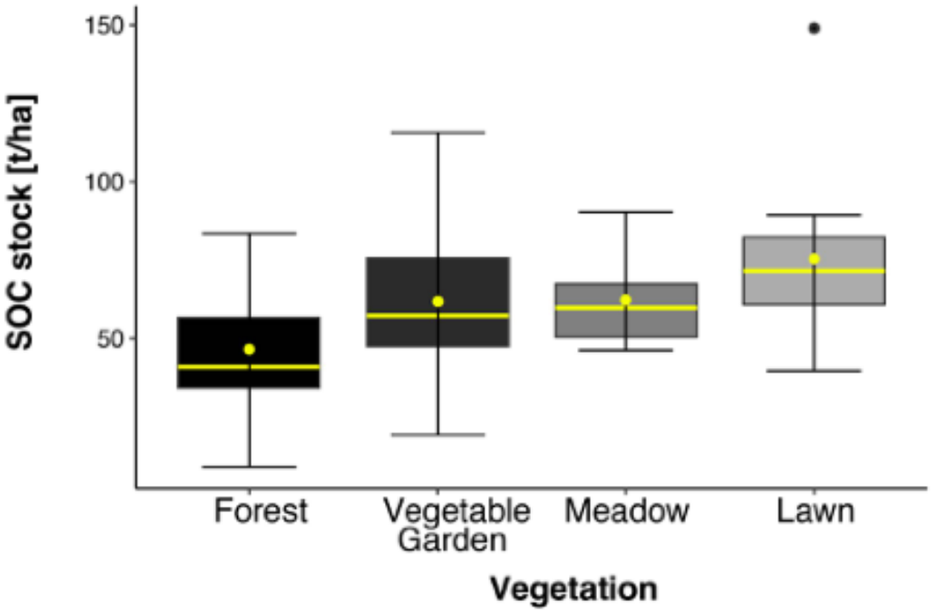

Forest
Vegetable Garden
Meadow
Lawn

a) Lausanne

I) SOC content [%]

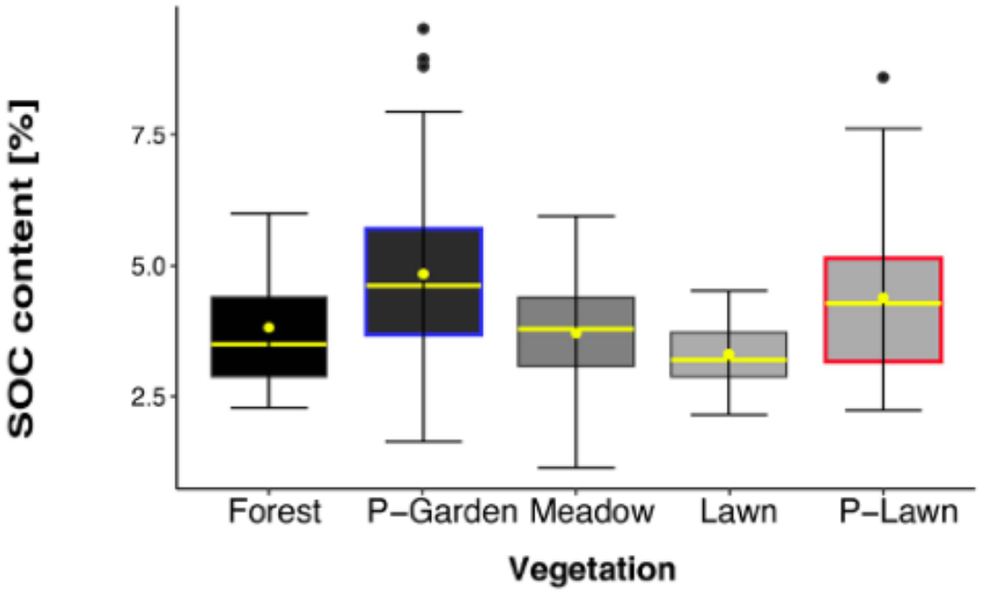


II) SOC stock [t/ha]

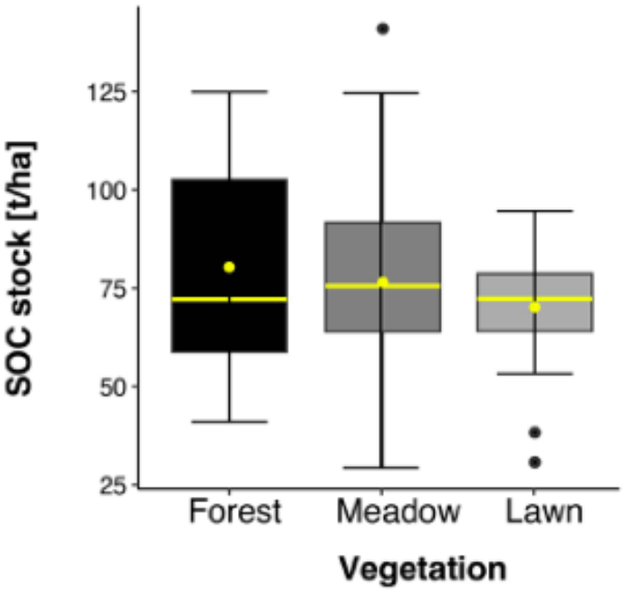


b) Zurich

I) SOC content [%]



II) SOC stock [t/ha]



Stadtentwicklungsplan Klima

Urbane Lebensqualität im Klimawandel sichern

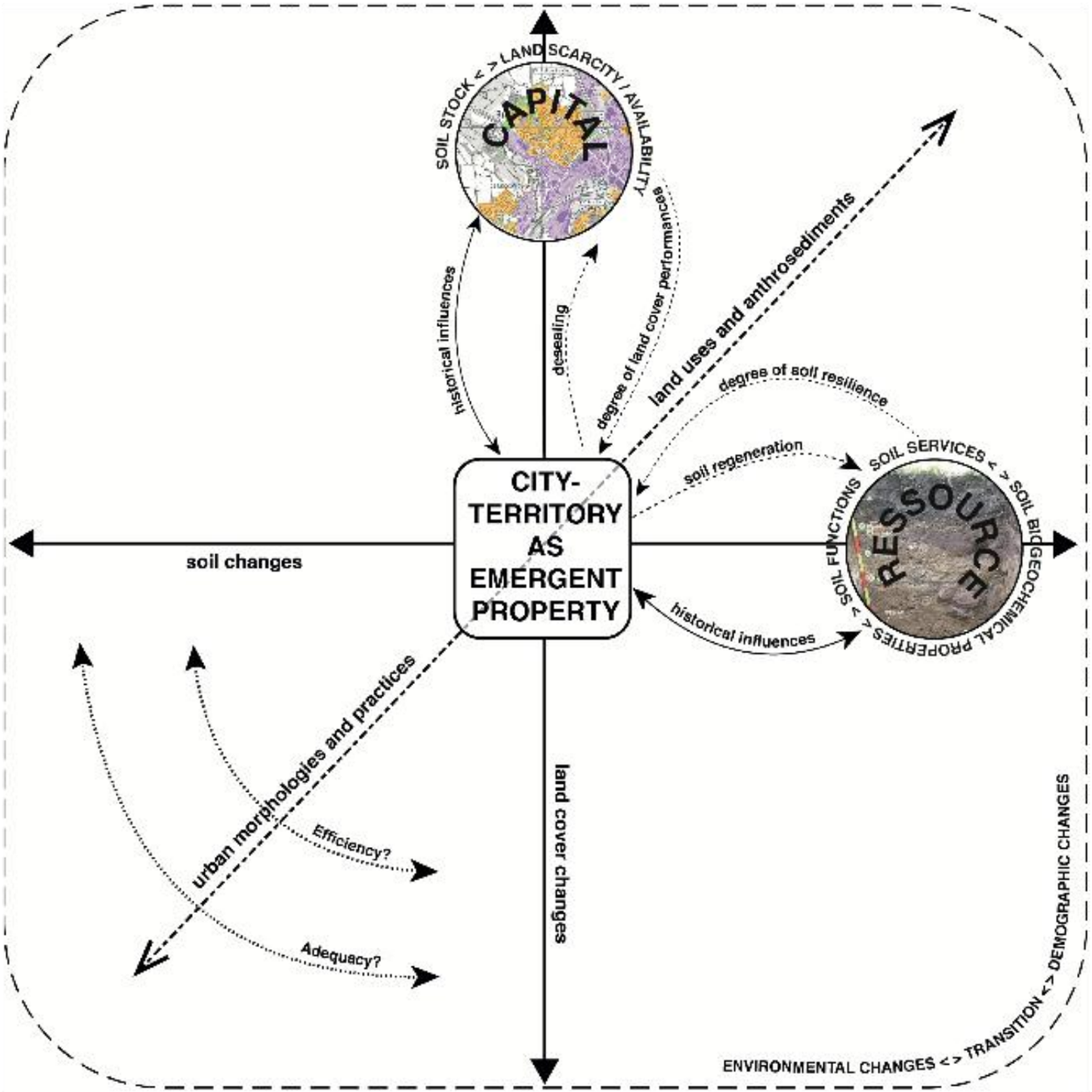
spatial and territorial planning policies …
soil protection policy …
neither sprawl …

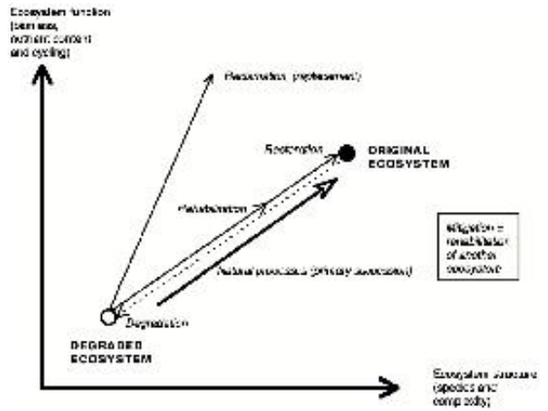
… climate plans
… quality of life
… nor over-densification

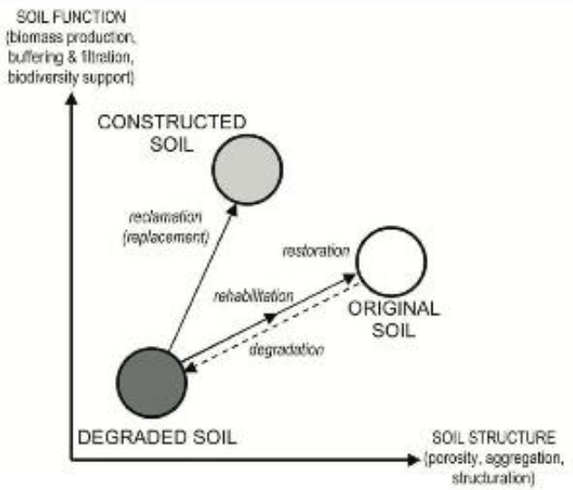
Science for Environment Policy. 2016. "No Net Land Take by 2050?" 14. Future Brief. Bristol: Produced for the European Commission DG Environment by the Science Communication Unit, UWE

Louis Back. 2011. "Stadtentwicklungsplan Klima. Urbane Lebens-qualität im Klimawandel sichern". Berlin: Senatsverwaltung für Stadtentwicklung

preservation of resources + densification vs. environmental performance within cities:
a potential paradox and conflict of interest regarding land use in the city



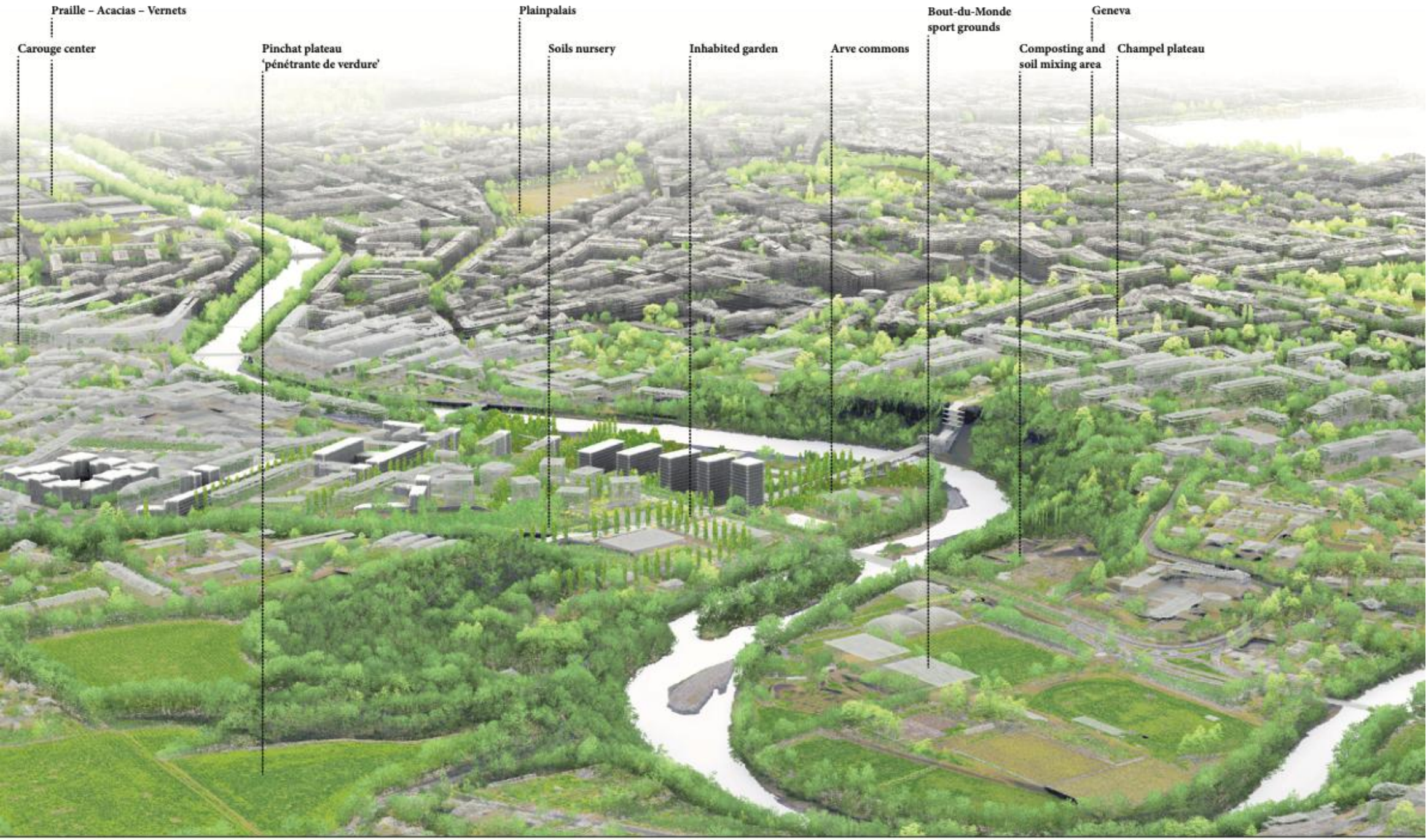


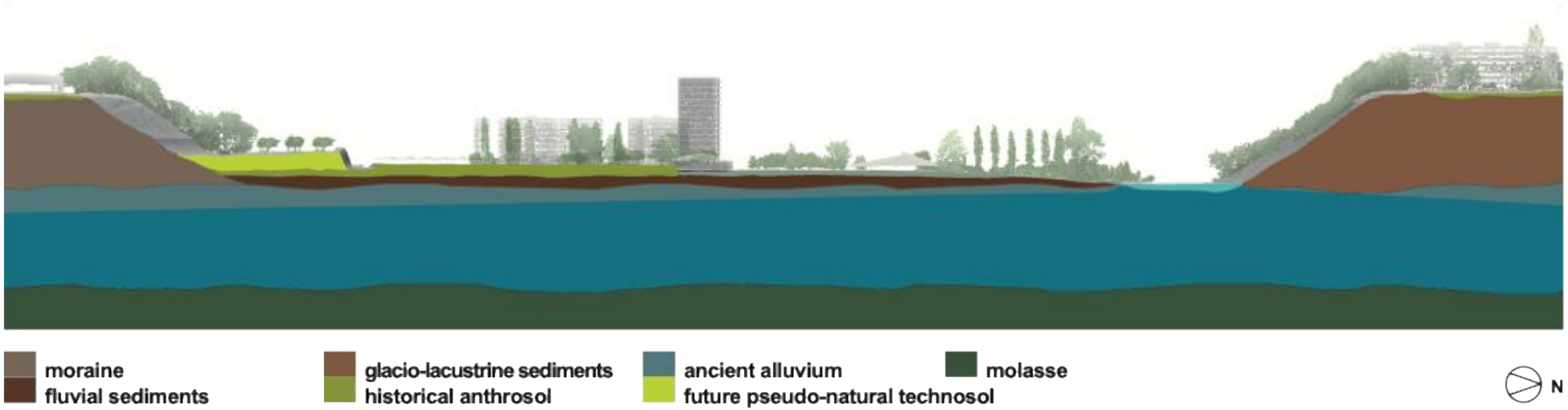


Anthony Bradshaw's diagram of options (primary successions, rehabilitation, restoration, reclamation, mitigation) for the improvement of degraded ecosystem in terms ecosystem function and structure; Geoffroy Séré's diagram of 'the contrasting approaches to the restoration of soils on derelict lands, including soil construction'

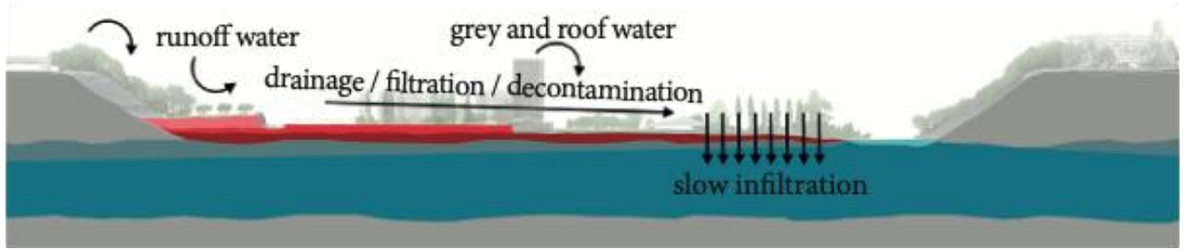
A toolbox and compass to guide and activate a set of soil management strategies: the bearings are established by a wide range of tools and contrasting means of action in order to orient urbanization and choose efficient and adequate trajectories in the framework of the forthcoming social and ecological transition

In relation to the water table and the river, the future of the site must be re-imagined and re-modeled as a large inhabited landscape and ecological infrastructure.

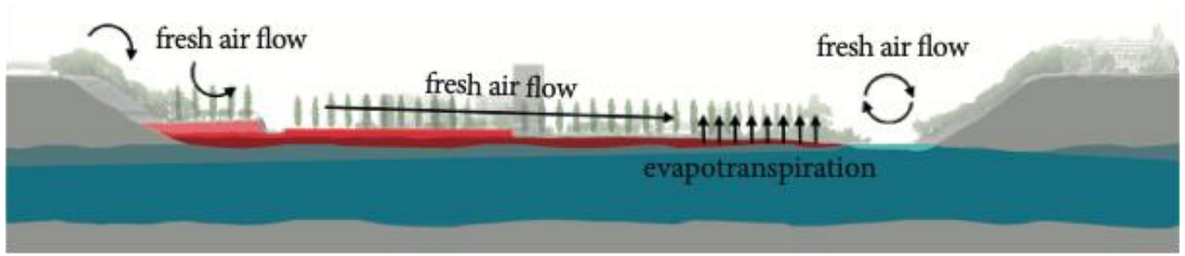




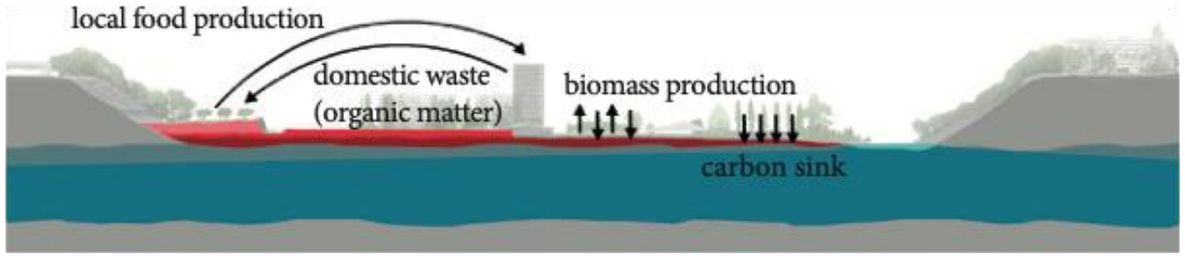
The Valley Section:
Reactivating the Urban Metabolic Fluxes



A/ (IN)FILTERING WATERS



B/ COOLING THE URBAN ATMOSPHERE



C/ TOWARDS CARBON NEUTRALITY

draining and fertile soils
filtering, decontaminating soils

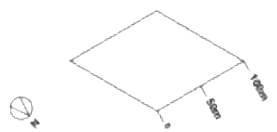
poorly draining soils for filtration
and slow infiltration

Three main objectives are targeted for sustainable urban design and climate adaptation/ mitigation

Axonometric model of the projected topography, with water runoff simulation

The systematic demineralization, reopening and regeneration of mineral surfaces generates a new topography shaped by three soil levels (terraces) and a series of ecological corridors ensuring transversal metabolic exchanges throughout the site.

Cutting and filling of the existing terrain



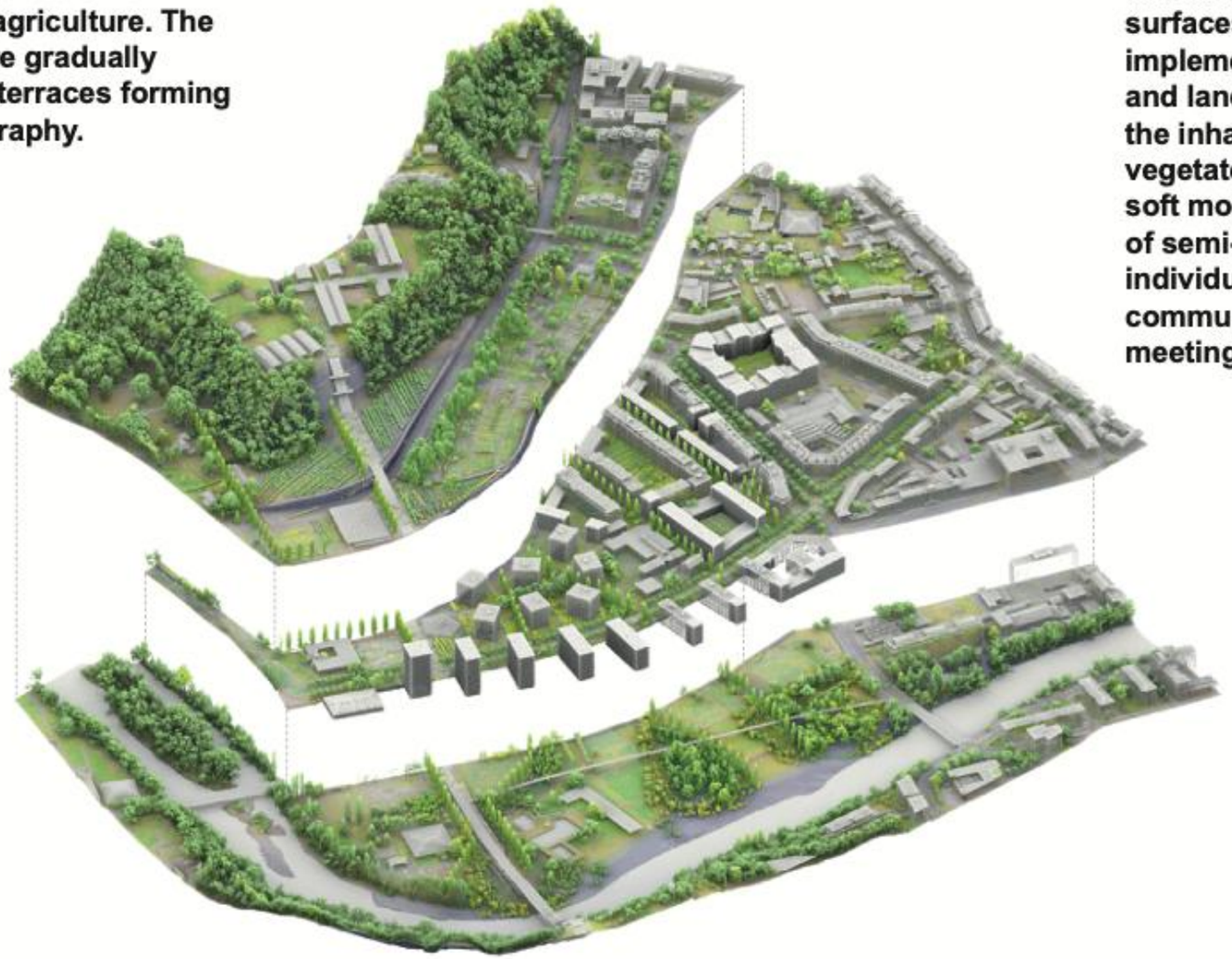
Remodeling the topography, materiality, ecological functions and social uses of the grounds

SOILS NURSERY

Historically dedicated to logistical functions, the higher part of the site is meant to meet future challenges of urban ecology: the creation of new soils, in particular for urban agriculture. The anthropic soils of the cemetery are gradually extended by a series of orchards terraces forming an ephemeral and evolving topography.

INHABITED GARDEN

The reopening of asphalt surfaces allows for the implementation of two functional and landscape devices on the inhabited garden terrace: vegetated ditches bordered by a soft mobility network, and a grid of semi-public spaces including individual vegetable gardens, community gardens and small meeting places.



ARVE COMMONS

Terrain excavations progressively shape an alternating sequence of transversal commons: lower, wild and cool wetlands expanding toward the Arve banks, and higher, drier and less densely vegetated grasslands favoring multiple informal leisure uses.

Remodeling the topography, materiality, ecological functions and social uses of the grounds

Cultivated soils to be diversified | Sealed soils to be regenerated | Built-up soils to be densified

Stage 1/ preservation of functional soils / de-sealing / densification

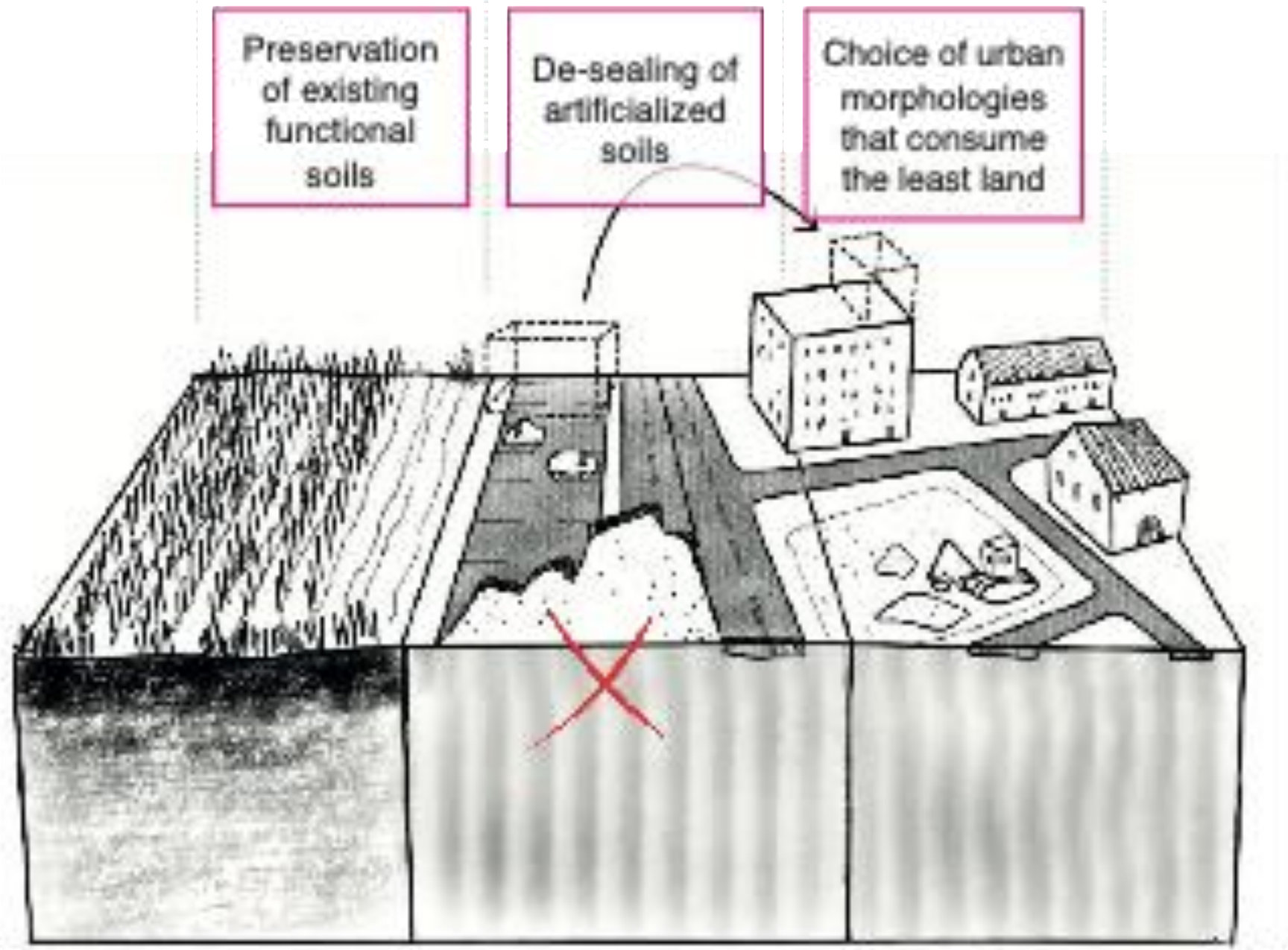
Integrating soil diagnostics into planning and projects

Densification and urban redevelopment as a lever for soil management

Planning environmental soil functions

Preserved existing soil organic carbon stocks

- 10,000 to - 5,000 y

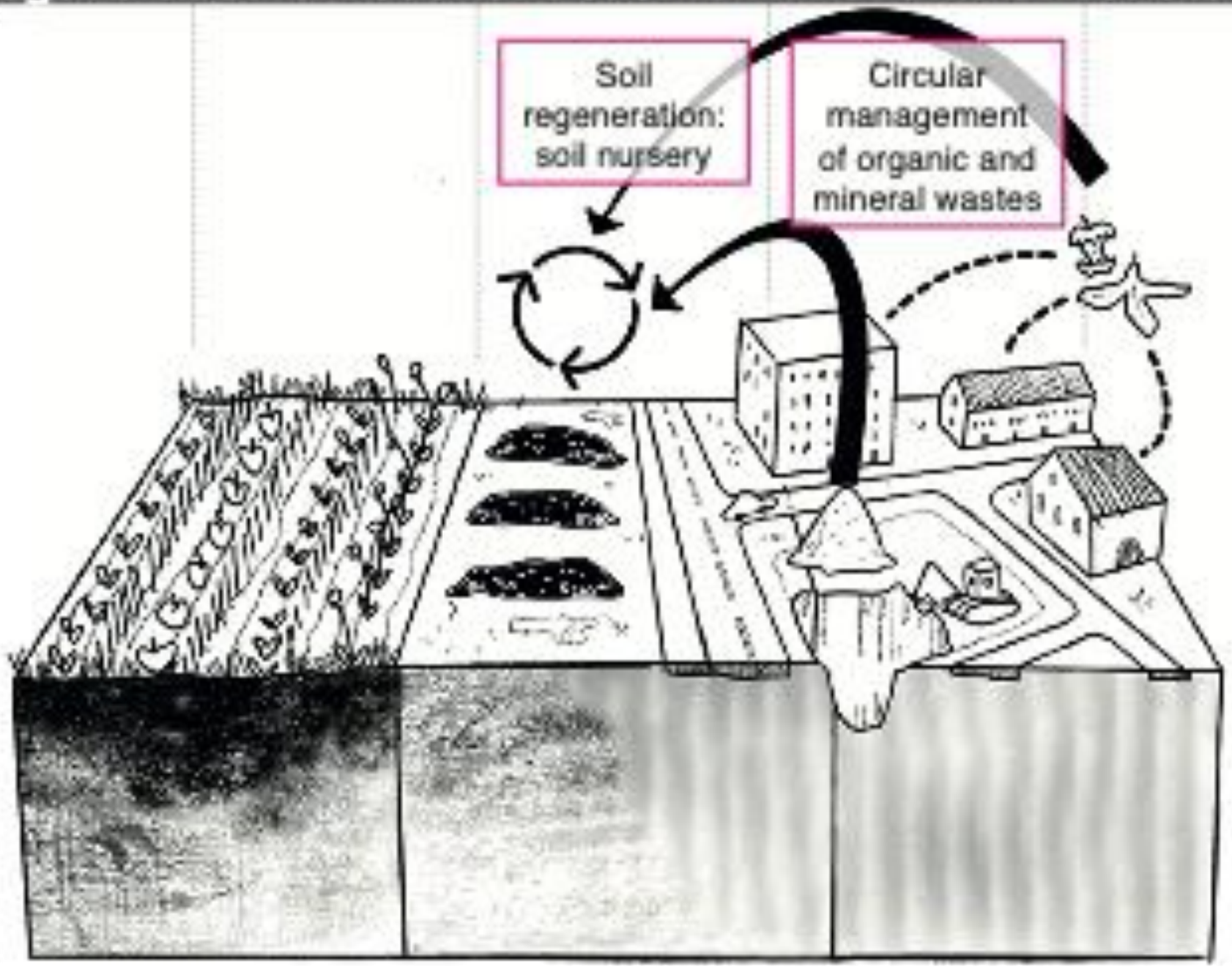


Stage 2/ circular regeneration or reconstruction of functional substrates

Planning with a soil bank: match excavation and green waste resources with needs for new substrates

Organic carbon from urban metabolism sequestrated in regenerated soils

0 to +20 years



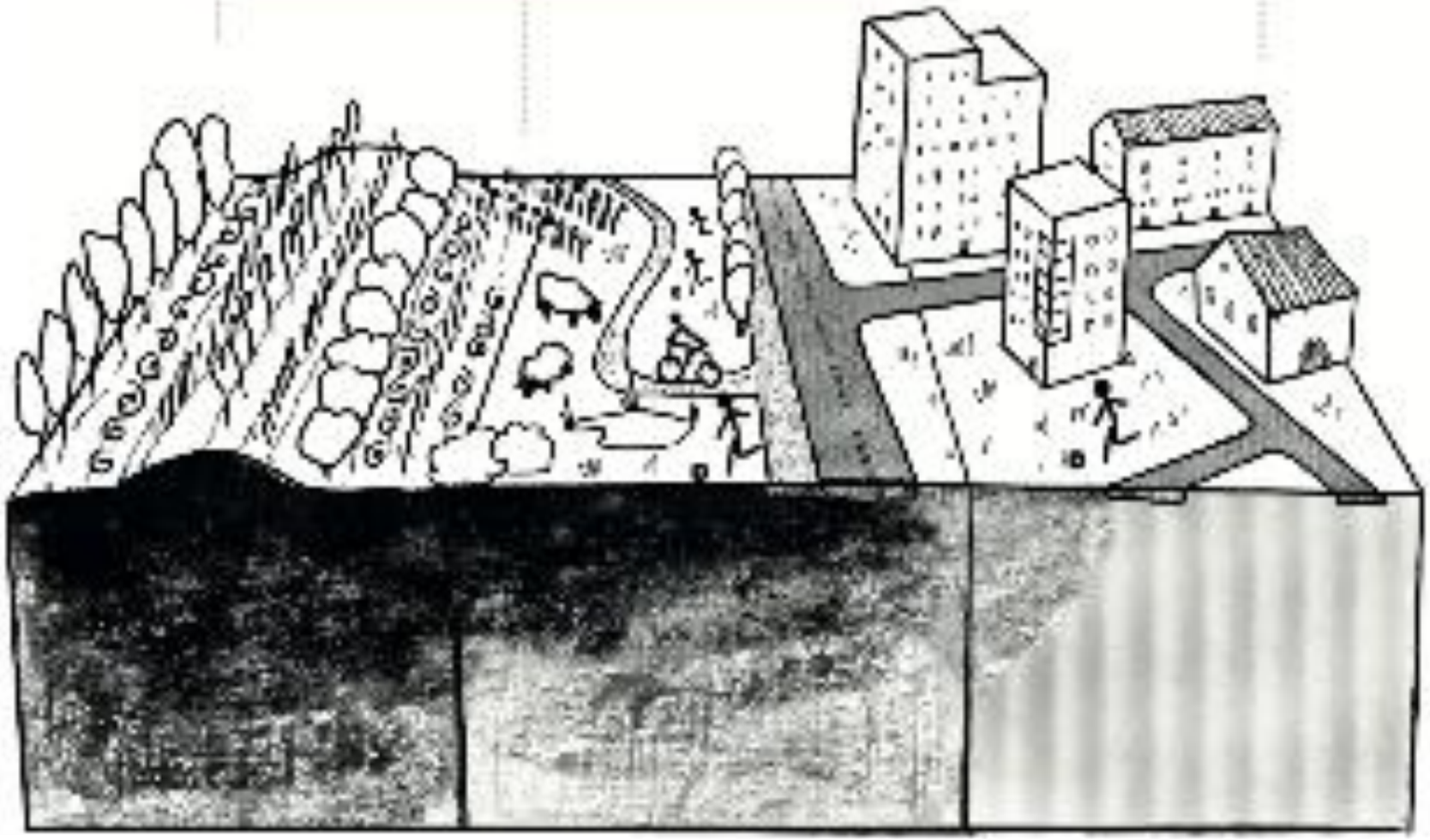
Stage 3/ diversification of vegetation covers and maintenance practices

Diversification of vegetation covers and improved maintenance practices

Promoting the multifunctionality of cultivated land in urban areas

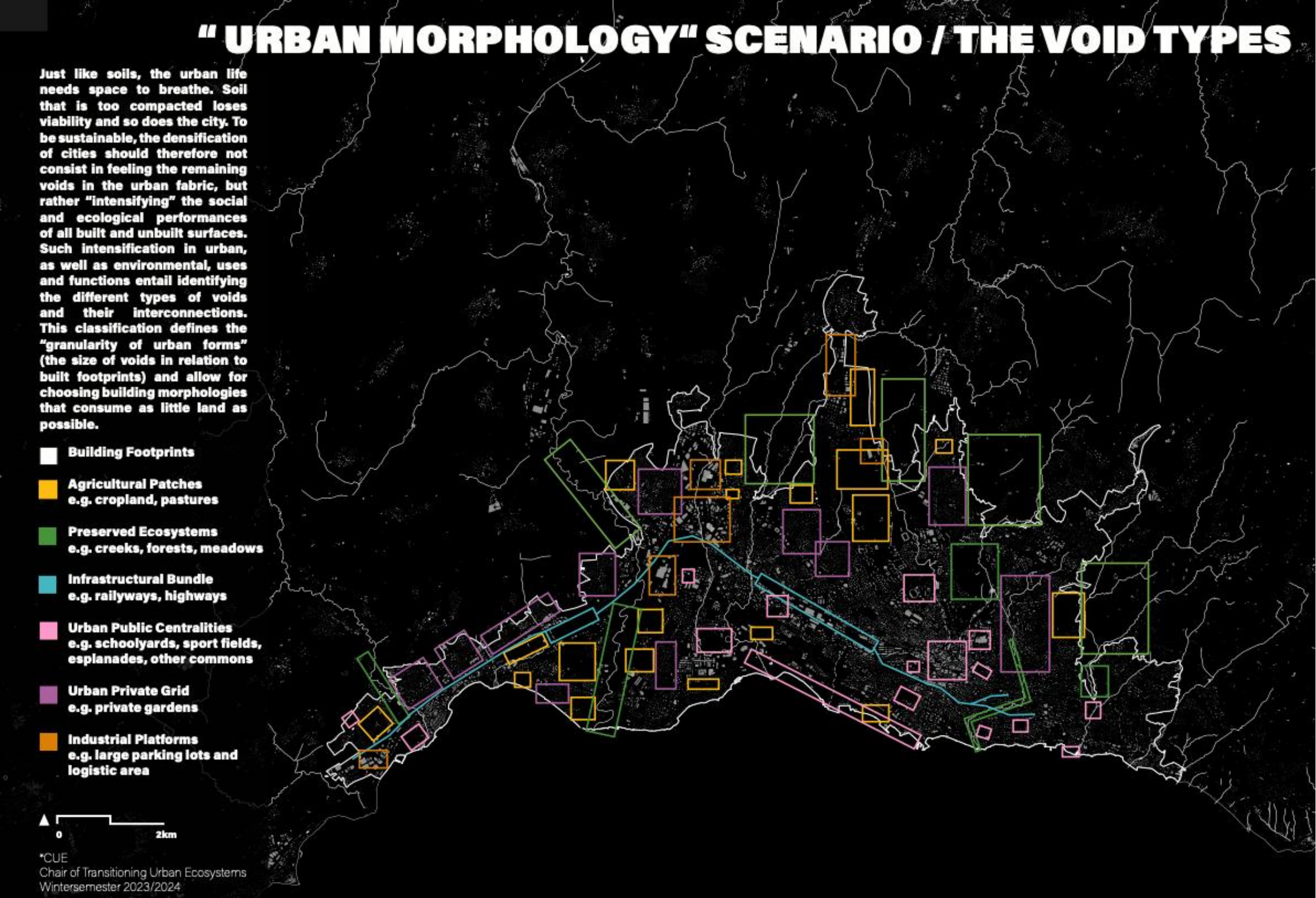
Gradually increased sequestration in preserved and regenerated soils

0 to +100 years ...



" URBAN MORPHOLOGY" SCENARIO / THE VOID TYPES

Just like soils, the urban life needs space to breathe. Soil that is too compacted loses viability and so does the city. To be sustainable, the densification of cities should therefore not consist in feeling the remaining voids in the urban fabric, but rather "intensifying" the social and ecological performances of all built and unbuilt surfaces. Such intensification in urban, as well as environmental, uses and functions entail identifying the different types of voids and their interconnections. This classification defines the "granularity of urban forms" (the size of voids in relation to built footprints) and allow for choosing building morphologies that consume as little land as possible.



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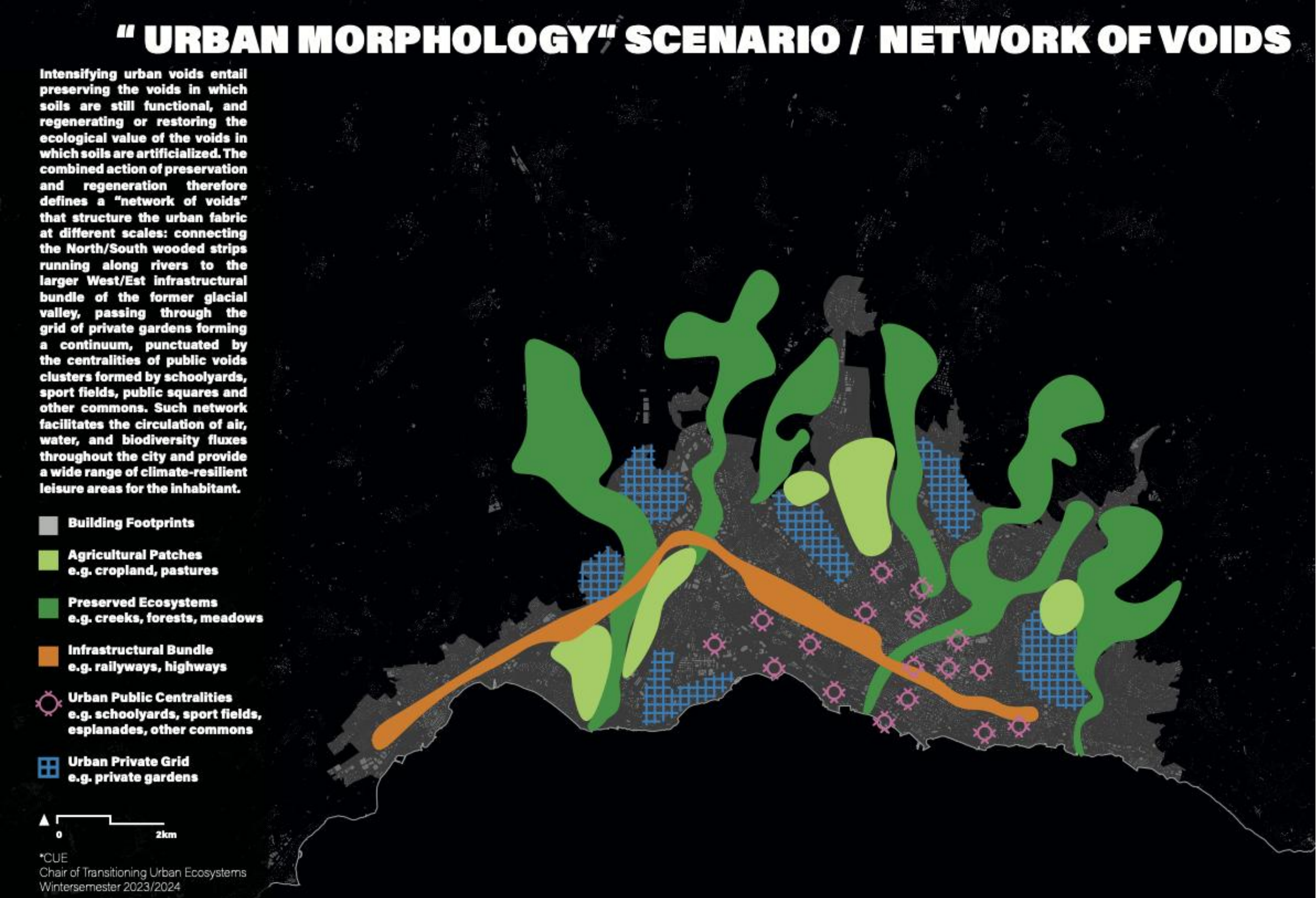
" URBAN MORPHOLOGY" SCENARIO / NETWORK OF VOIDS

Intensifying urban voids entail preserving the voids in which soils are still functional, and regenerating or restoring the ecological value of the voids in which soils are artificialized. The combined action of preservation and regeneration therefore defines a "network of voids" that structure the urban fabric at different scales: connecting the North/South wooded strips running along rivers to the larger West/Est infrastructural bundle of the former glacial valley, passing through the grid of private gardens forming a continuum, punctuated by the centralities of public voids clusters formed by schoolyards, sport fields, public squares and other commons. Such network facilitates the circulation of air, water, and biodiversity fluxes throughout the city and provide a wide range of climate-resilient leisure areas for the inhabitant.



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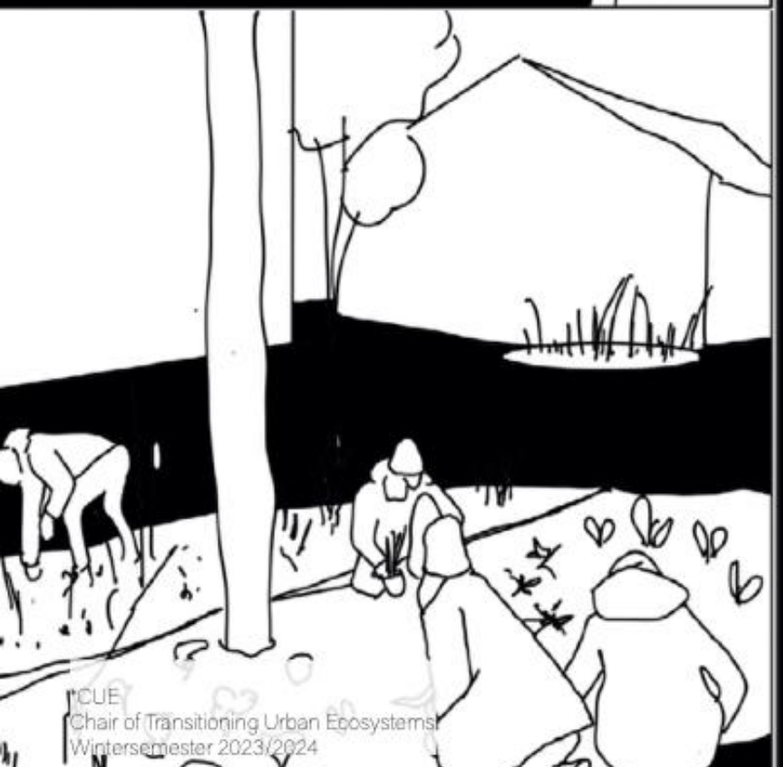
“ URBAN MORPHOLOGY“ SCENARIO / REDEFINING PUBLIC SPACE TYPOLOGIES



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“ URBAN METABOLISM“ SCENARIO / TOWARDS THE CIRCULARITY OF GREEN AND MINERAL RESOURCES

Urban green and construction wastes can be used to create purpose-designed and functional soils. Instead biological and sedimental resources are mostly exported outside the urban environment, which, in turn, consume ‘healthy‘ soils to create green spaces. We need to enhance circularity by processing urban green and mineral waste into new soils.

Fluxes

Organic and sedimental resources are often considered waste. At best, organic material is used for biogas production and sedimental material for road construction. However, a large proportion ends up in landfills, damaging the surroundings. These fluxes need to be redirected.

When ‚healthy' soil is needed in the city, it is usually dug up from agricultural land. The surrounding countryside is thus exploited in two ways. These fluxes need to become obsolete.

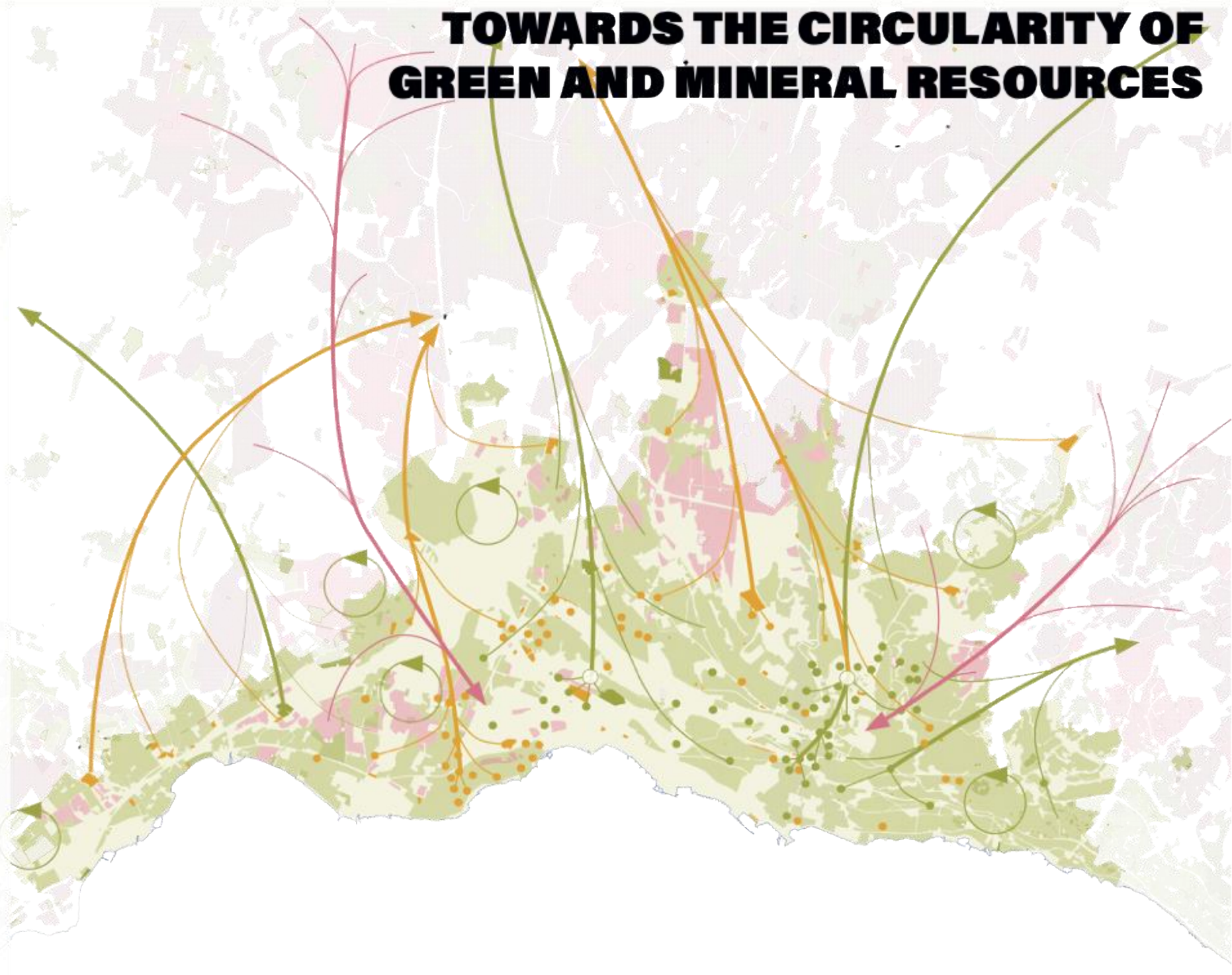
Few processes already work in a circular way. For example, private organic waste, used as compost in suburban gardens to grow crops. Circularities like these need to be enhanced.

Organic Ressources

Sedimental Ressources

Landfills

0 1 2 3km



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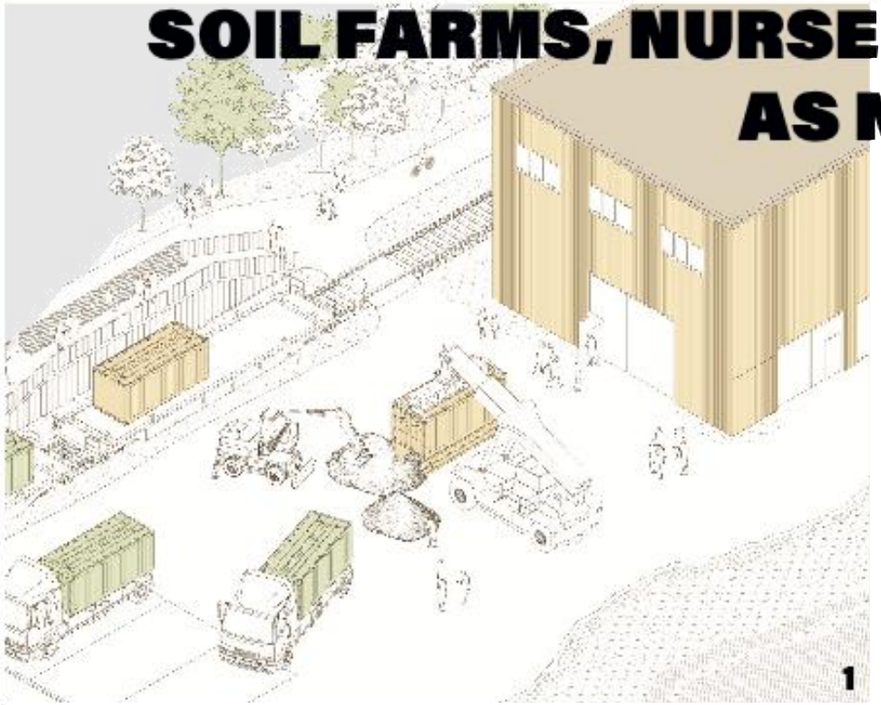
“ URBAN METABOLISM“ SCENARIO /
SOIL FARMS, NURSERIES AND LABORATORIES AS NEW URBAN LANDSCAPES

The Soil Factory in Lonay SSD processes waste into soil substrate by composting organic resources and crushing, washing, and sorting sediments. This base material can become living soil when mixed correctly. Located on a former industrial site in Lonay, the factory uses nearby railway infrastructure to send non-matured soil to Sebeillon. In the Soil Nursery, this base material matures into living soil in the city center, enhancing urban awareness of soil and material cycles. The soil from Lonay is piled, planted, and left to mature for a year, transforming into functional soil through plant growth and microbial activity. The nursery offers public engagement through guided tours, information boards, workshops, and a terrace. The Soil Laboratory evaluates and creates knowledge about soil production. Soil scientists conduct research on urban soil development and functions. Connected with the educational center, the laboratory aims to expand soil farming across the region and beyond, requiring immediate funding through research contracts. This laboratory, part of the Sebeillon complex, will be a leading center of soil science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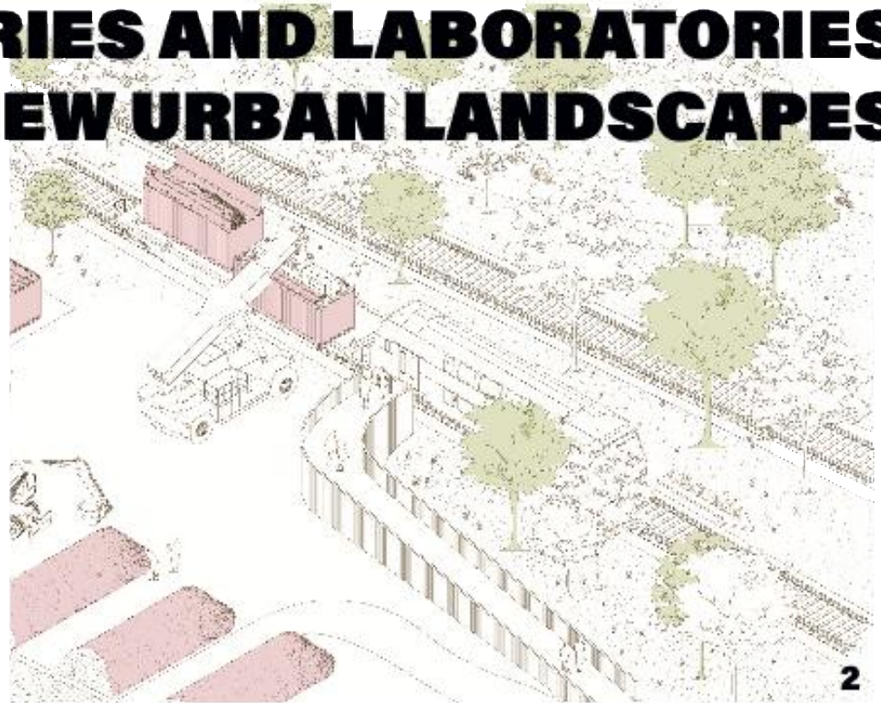
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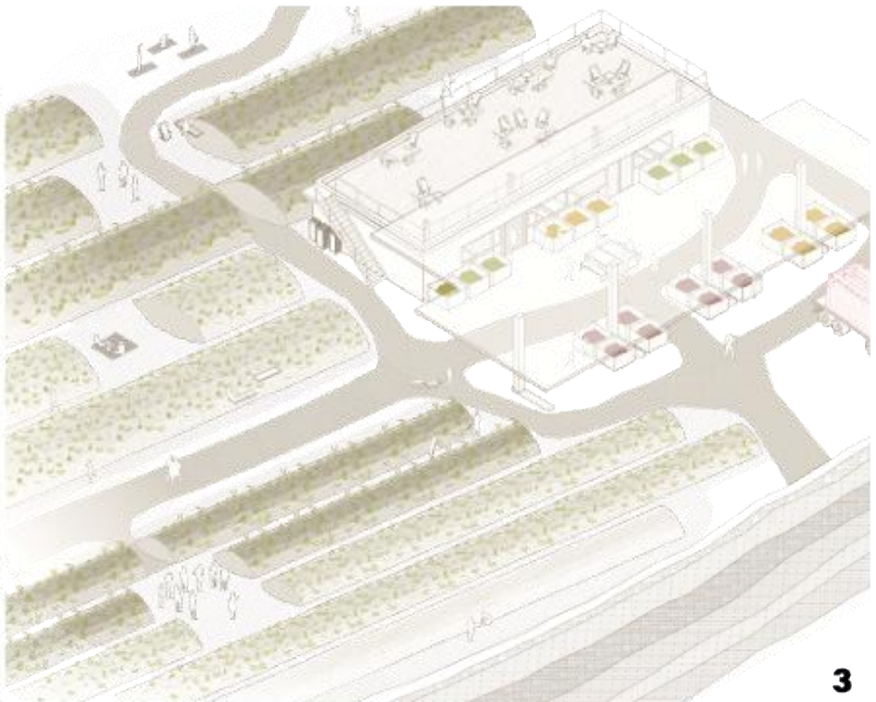
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4

1 Soil Factory collecting point

2 Soil Factory send off point

3 Soil Nursery Sébeillon West

4 Soil Laboratory Sébeillon Est

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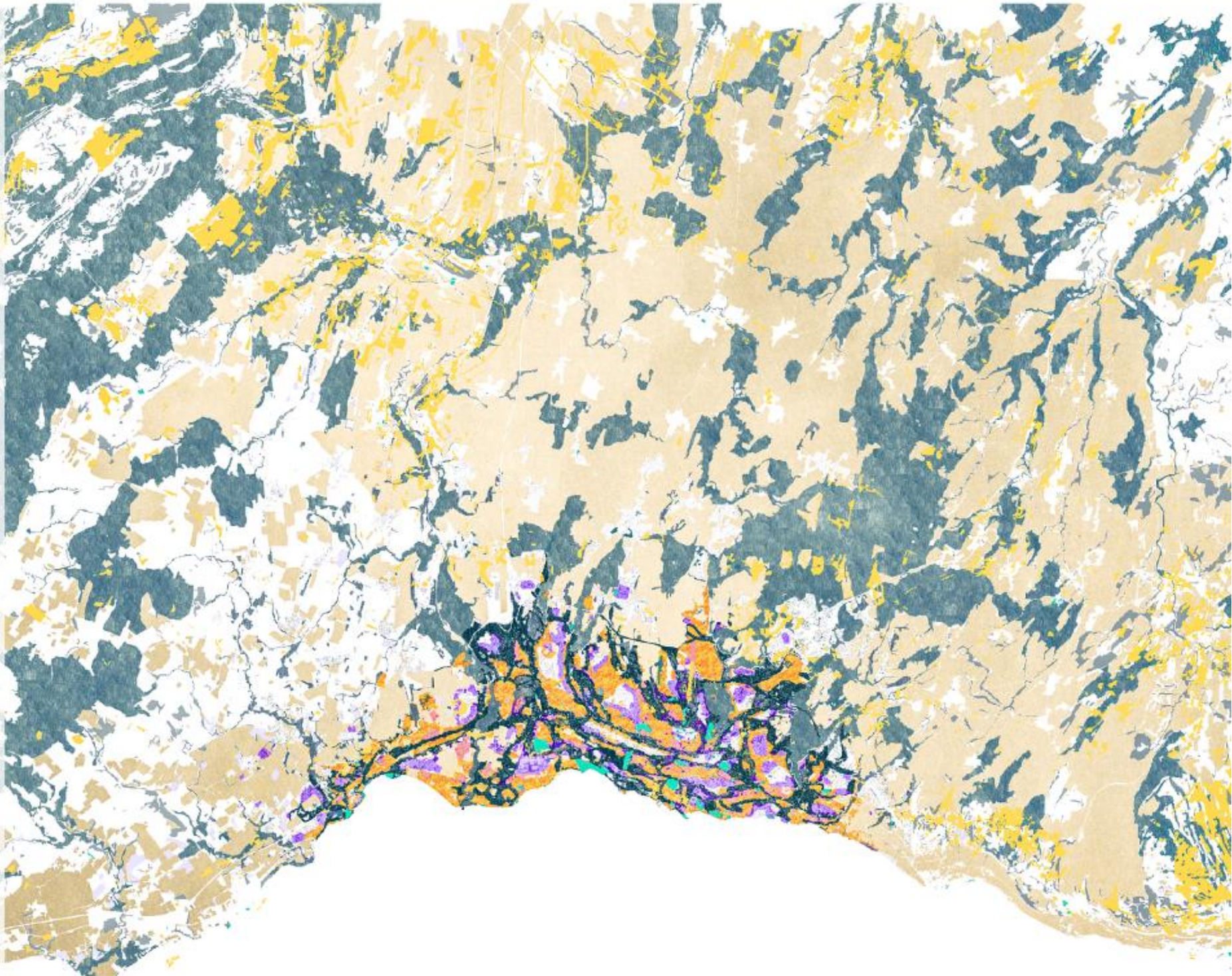
“ URBAN NATURE“ SCENARIO / THE GREEN NETWORK

Vegetation cover and land management practices have an impact on soil health and carbon sequestration capacity. Strategies to increase soil organic matter input include transforming existing meadows, parks and lawns into perennial pastures which introduce long-lived and deep-rooted plants into the urban fabric, that maintain consistent soil cover and enhance soil structure and carbon retention. Agricultural practices such as crop rotation, cover cropping, polycultures, agroforestry and organic farming using integrated pest management as well as conservation tillage and composting ensure sustainable nutrient cycling and benefit soil fertility. Interconnecting private urban gardens into a network increases biodiversity and promotes a variety of plant species with diverse root systems. Together, these practices create a “Green Network“ as sustainable urban landscape that regenerates damaged soils, enhances urban resilience and serves as a potent carbon sink.



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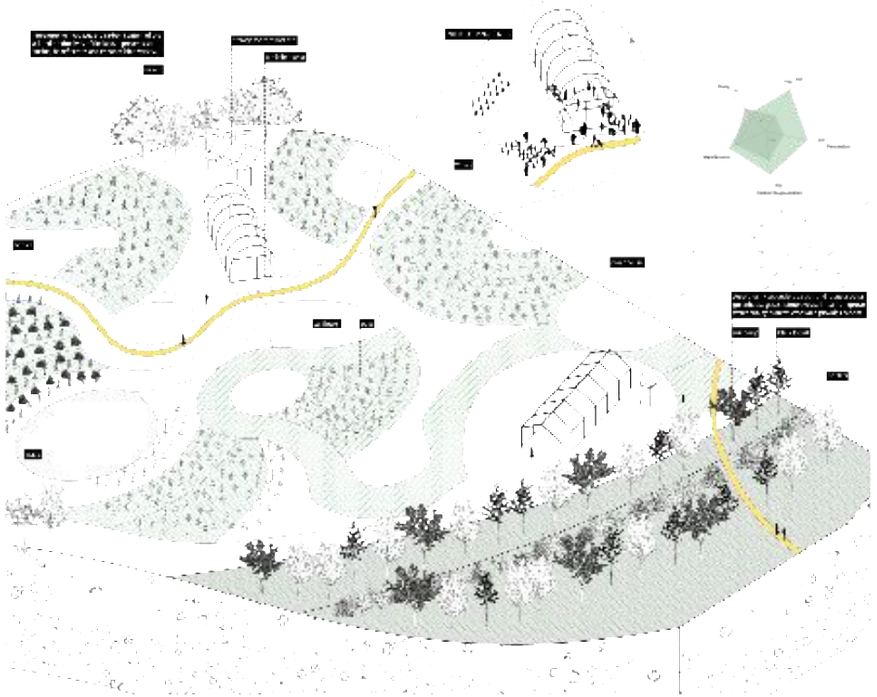
" URBAN NATURE" SCENARIO / 4 ECOLOGICAL HABITATS

Ecotones, or transitional areas between ecosystems, support rich biodiversity and deep-rooted plants, which increase soil organic matter and carbon storage. Preservation of existing vegetation ensures continuous organic matter input and protects soil from erosion, maintaining and enhancing soil carbon levels. Agroparks integrate agriculture with natural landscapes, fostering diverse plant species and sustainable practices like crop rotation and reduced tillage, boosting soil carbon. Silvopastures combine trees with livestock grazing, enhancing biomass and root depth while animals distribute organic matter, improving soil structure and carbon retention. Intercropping, or growing multiple crops together, increases plant diversity and organic residues, enriching the soil and promoting microbial activity, further enhancing carbon sequestration.

Collectively, these land management practices create a resilient and productive soil ecosystem. By integrating biodiversity and sustainable agricultural techniques, they significantly boost soil carbon sequestration, helping mitigate climate change while improving soil health and productivity.



1Ecotone Lonay SSD

2Preservation Lonay Villa-Est

3Agropark & Silvopasture

4Intercropping Center

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