SOILveR Webinar series on 'Integration of Soil Health in decision-making processes at various scales'

Recycling Brownfields: Incorporating Soil Health into urban development projects

Destisol: A decision-support tool to assess the ecosystem services provided by urban soils for better urban planning

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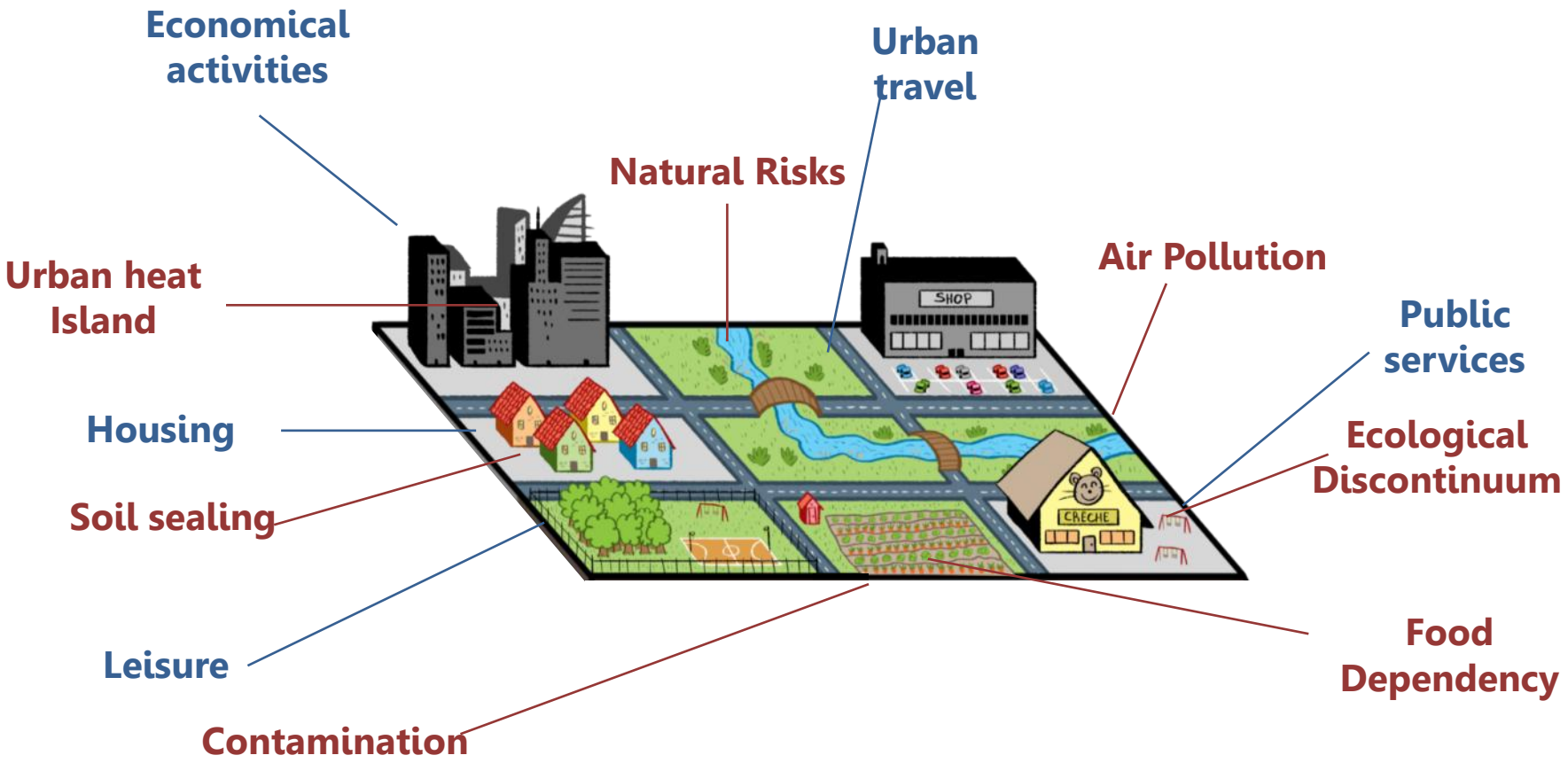
Urban planning to adapt land uses to multiple issues

Urban planning to adapt land uses to multiple issues



Blanchart, 2018

Urban soils are very diverse and heterogeneous

- Large diversity among a gradient of anthropization

Luvisol
Urban forest

Cambisol
Peri-urban agriculture

Anthrosol
Vegetable garden

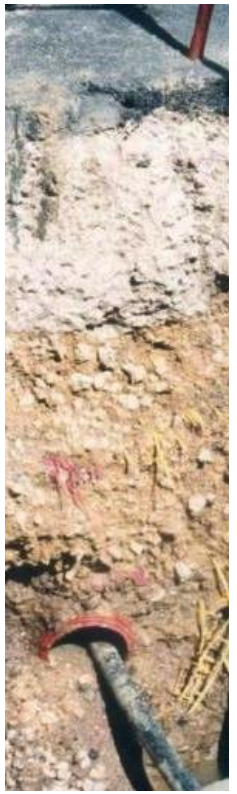
Technosol
Constructed soil

Technosol
Green roof

Technosol
Industrial brownfield

Technosol
Industrial decantation pond

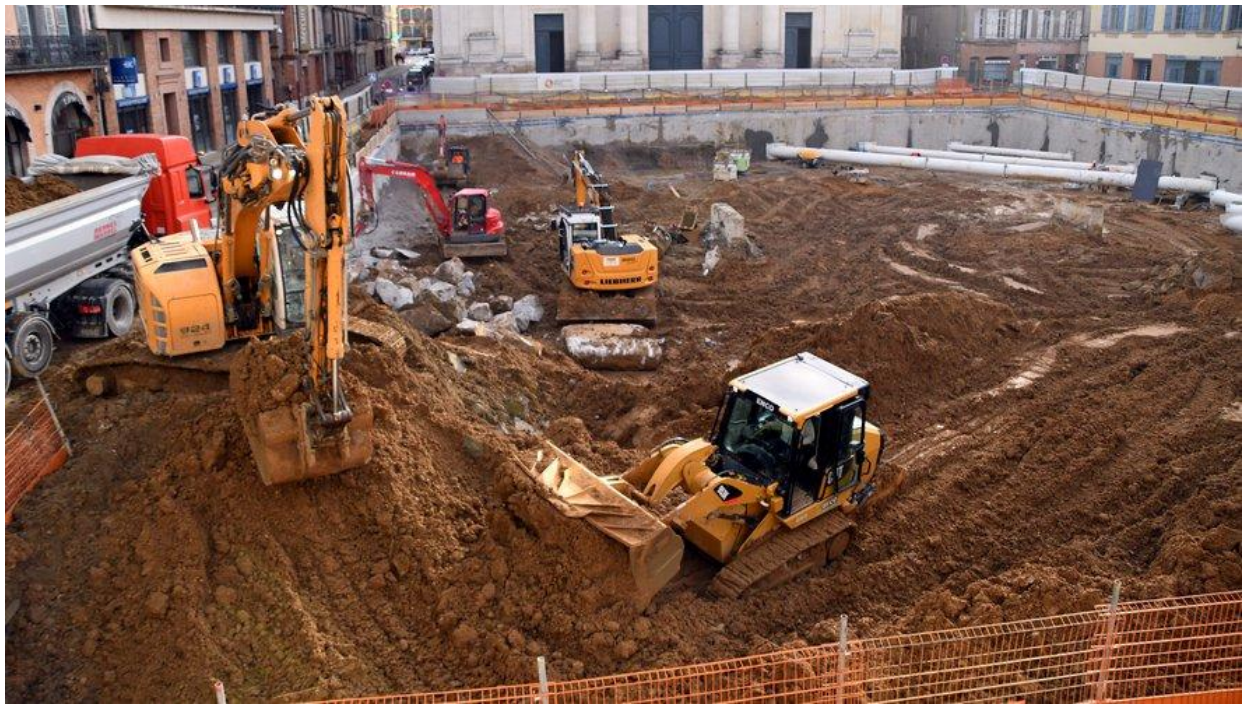
Technosol
Pavement



Technosol
Road

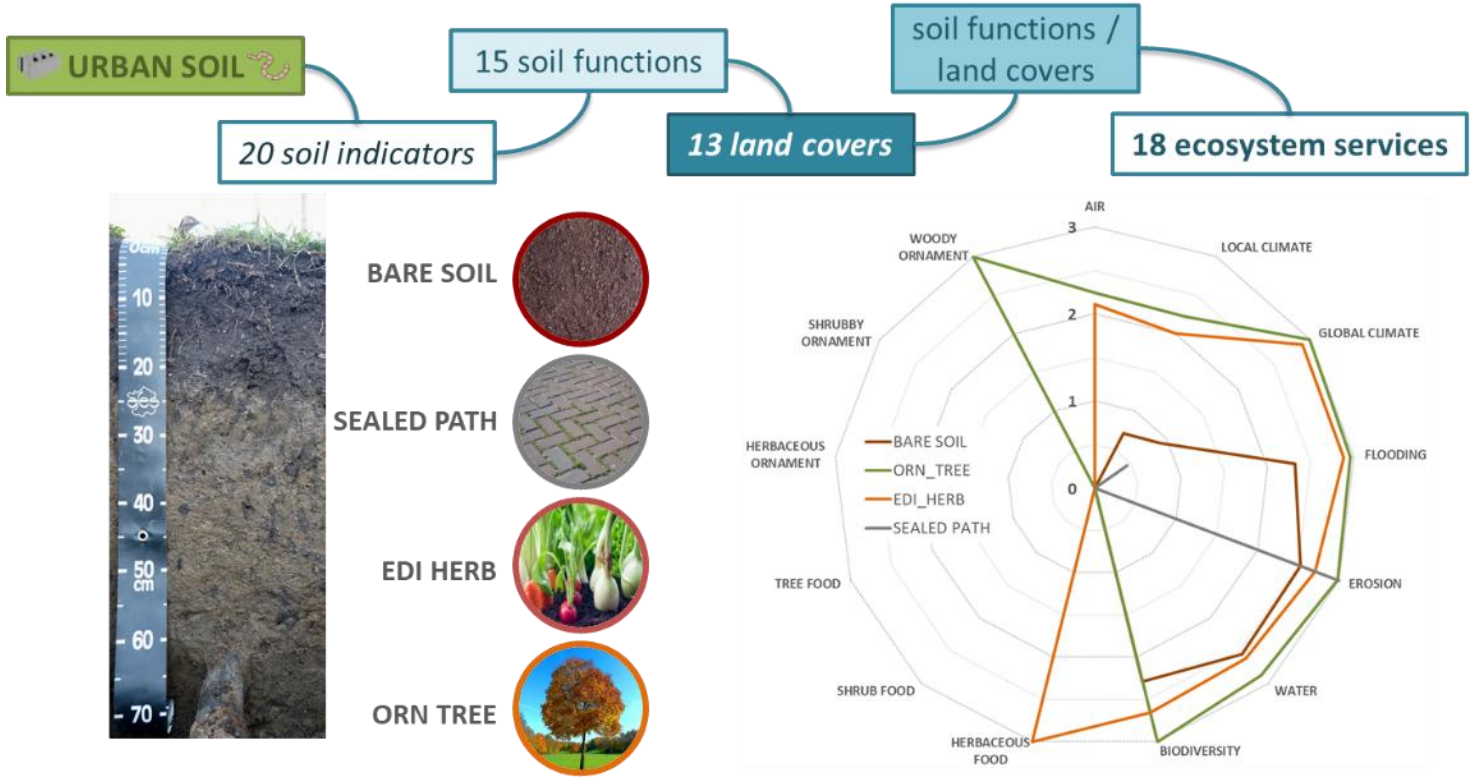
Urban soils rarely consider as a valuable resource

- Urban soils are very frequently excavated and subtituted by agricultural/forest top soil materials



How to take urban soils potential into account?

- By diagnosing the quality of *in situ* urban soils
- By determining compatible urban land covers based on soil properties
- By assessing ecosystem services provided by « soil + land cover »



Séré et al., *2024*

The Destisol decision support tool – step 1

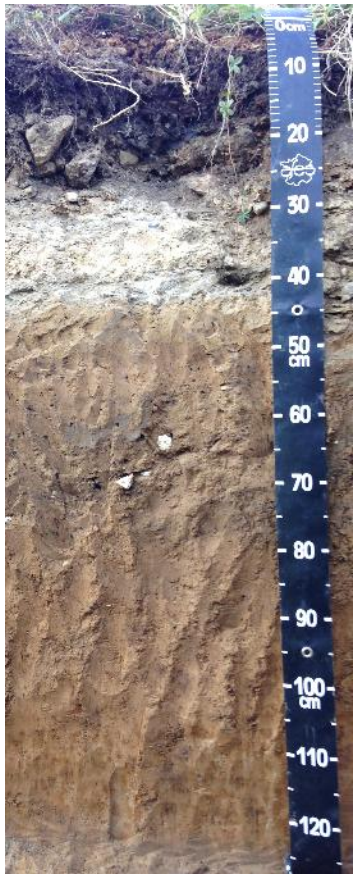
- Initial study of the site (past land uses, geology, hydrology, topography, plant cover)
- Determination of homogenous zones in terms of soil cover

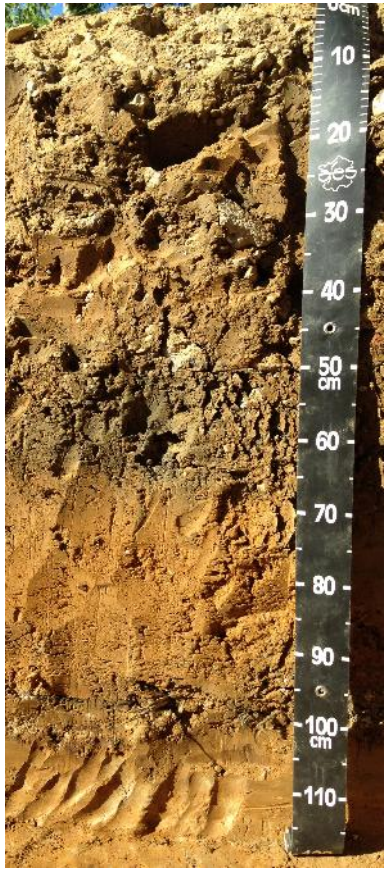
Former military site
to be requalified
into an eco-district

Biancamaria – Nancy (FR)

The Destisol decision support tool – step 2

- Description of the soils of each zone and measurement of various soil indicators





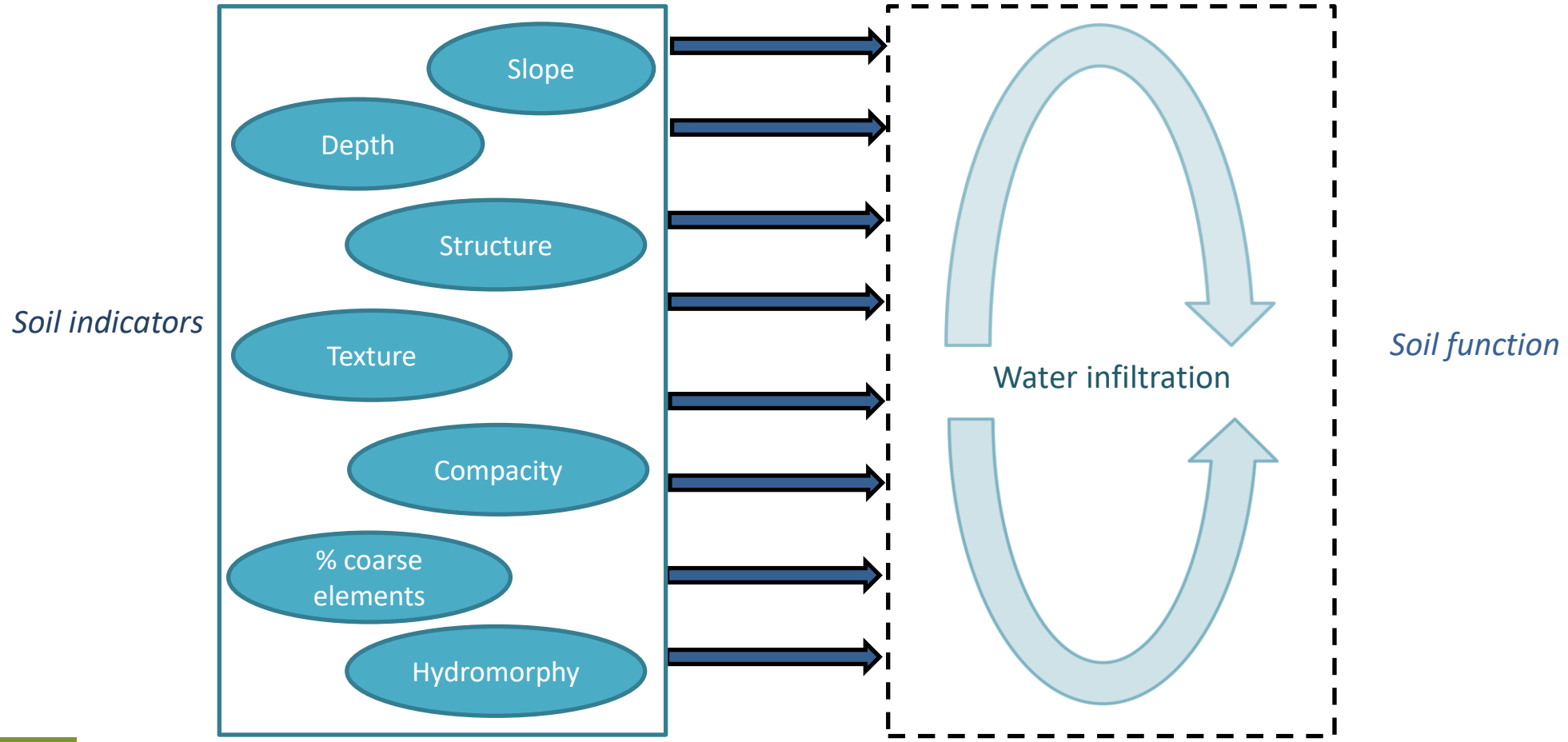
The Destisol decision support tool – step 2

- Description of the soils of each zone and measurement of various soil indicators

Soil profile		Biancamaria - Profile A		
N° horizon		1	2	3
Depth (cm)		25	18	22
Field observation	slope (%)	0		
	soil depth (cm)	75		
	colour	dark brown	light brown	light brown
	roots density (%)	40	1	0
	biological activity	strong	weak	absence
	soil structure	granular	blocky	blocky
	textural classes	silty	silty	silty
	compacity	weak	high	medium
	coarse elements (%)	35,40	13,50	3,70
	artefacts (%)	0,09	1,14	0,19
	hydromorphy	absence	absence	absence
	evidences of pollution	absence	absence	absence
Lab analysis	pH	7,9	8,5	8,3
	P_{Olsen}	0,168	0,049	0,042
	M.O.	169	24,7	18,1
	Ntot	6,08	0,673	0,571
	C:N	16,1	21,2	18,4
	$CaCO_3$	85	62	4

The Destisol decision support tool – step 3

- Rating of soil functions with soil indicators



The Destisol decision support tool – step 3

- Rating of soil functions with soil indicators

Soil functions		Rating
Soil maintenance	OM & nutrients recycling	**2,5**
	Erosion protection	**2,3**
Carbon	Carbon storage	**2,1**
Fertility	Physico-chemical fertility (herbaceous)	**2,3**
	Physico-chemical fertility (food)	**2,3**
	Physico-chemical fertility (shrubs)	**2,5**
	Physico-chemical fertility (trees)	**1,9**
Water	Circulation & infiltration	**2,0**
	Retention	**2,1**
Pollution	Contamination level	**2,2**
	Physical retention	**1,9**
	Degradation	**2,0**
Human activities	Light roadway	**1,5**
	Heavy roadway	**2,1**
	Light building	**1,8**
	Heavy building	**2,5**

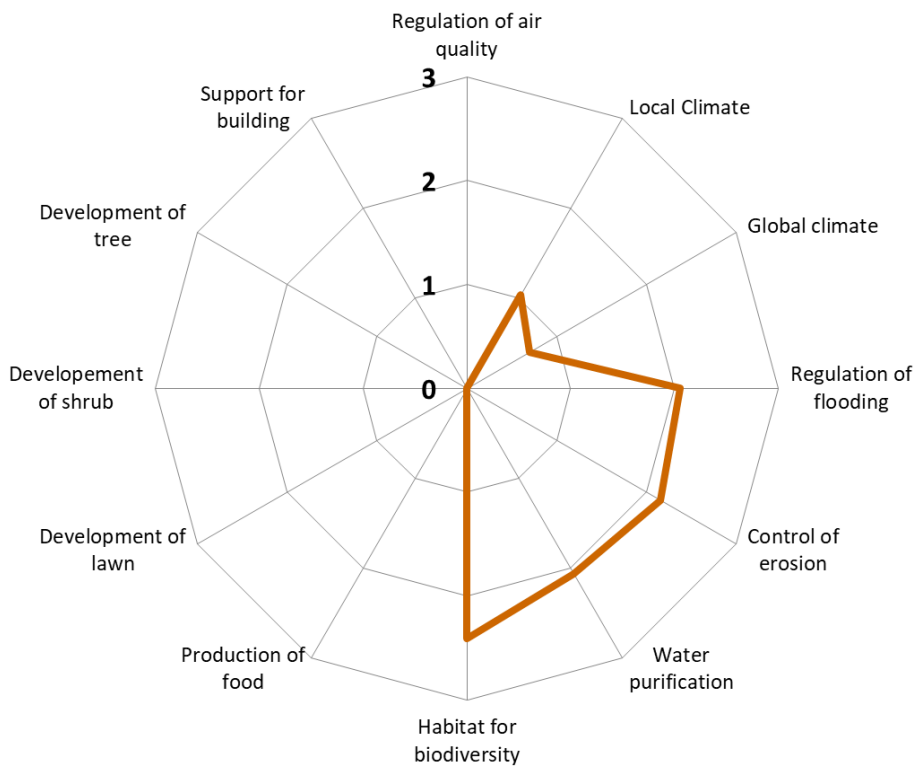
The Destisol decision support tool – step 4

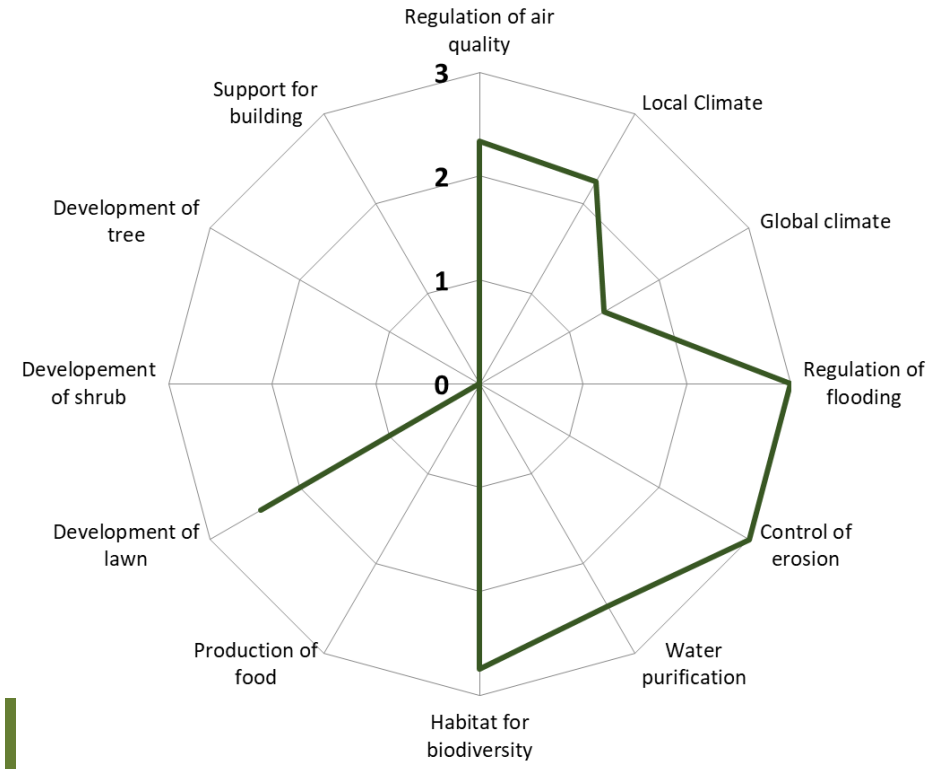
- Adequation between the rates of soil functions and land uses

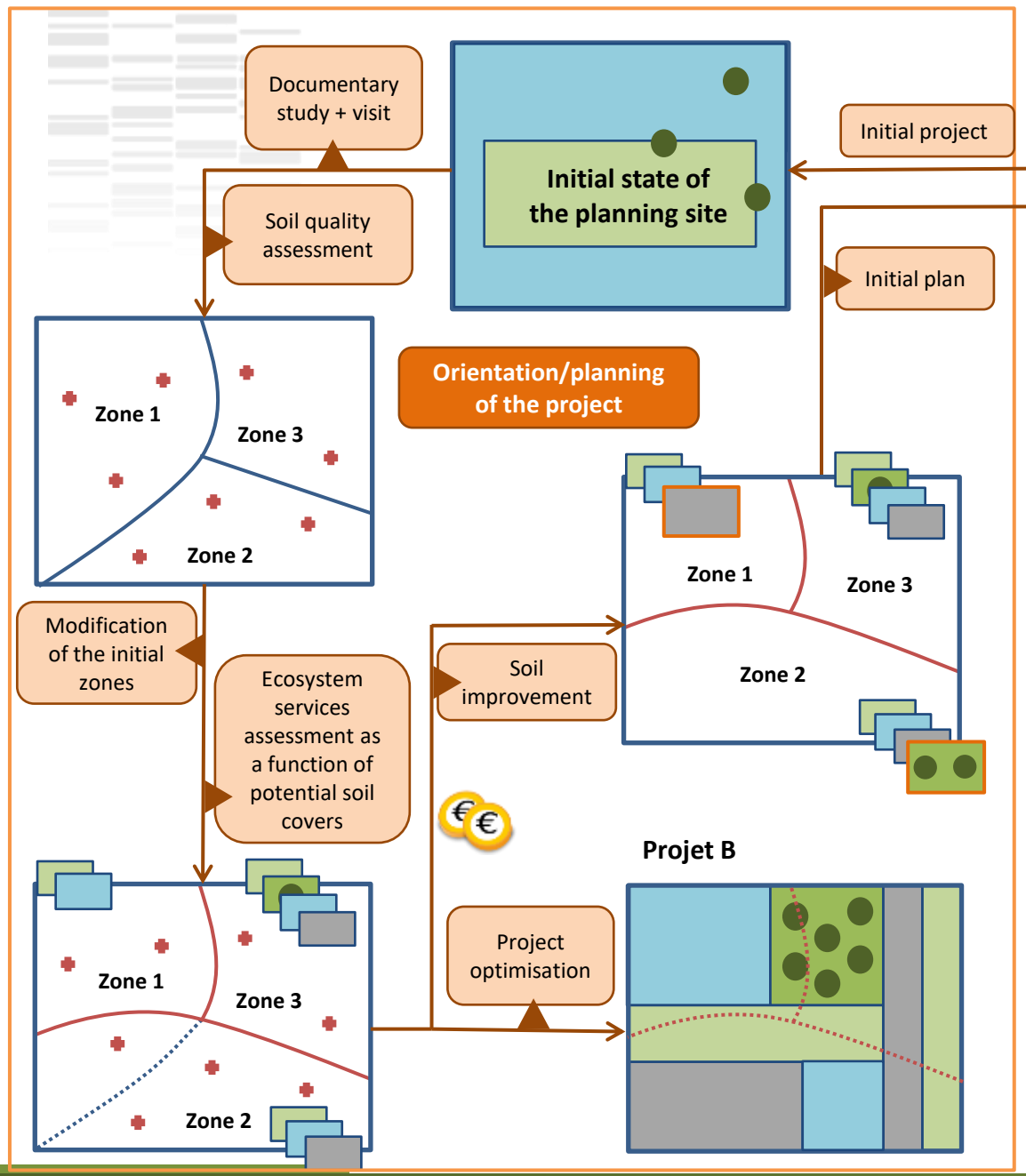
Soil functions		Rating	Building	Sealed path	Paved path	Grassed path	Bare soil	Lawn	Garden	Shrub	Tree
il maintenan	OM & nutrients recycling	2,5	0	0	0	2	0	2	2	2	2
	Erosion protection	2,3	0	0	1	1	1	1	1	1	1
Carbon	Carbon storage	2,1	0	0	0	0	0	0	0	0	0
Fertility	Physico-chemical fertility (herbaceous)	2,3	0	0	0	2	0	2	0	0	0
	Physico-chemical fertility (food)	2,3	0	0	0	0	0	0	2	0	0
	Physico-chemical fertility (shrubs)	2,5	0	0	0	0	0	0	0	2	0
	Physico-chemical fertility (trees)	1,9	0	0	0	0	0	0	0	0	2
Water	Circulation & infiltration	2,0	0	0	2	2	0	1	1	1	1
	Retention	2,1	0	0	0	2	0	1	1	2	2
Pollution	Contamination level	2,2	0	0	0	1	0	1	3	1	1
	Physical retention	1,9	0	0	0	0	0	0	0	0	0
	Degradation	2,0	0	0	0	0	0	0	0	0	0
uman activiti	Light roadway	1,5	0	0	0	0	0	0	0	0	0
	Heavy roadway	2,1	0	3	2	2	0	0	0	0	0
	Light building	1,8	3	0	0	0	0	0	0	0	0
	Heavy building	2,5	0	0	0	0	0	0	0	0	0
		Compatibility	61	71	99	100	100	100	96	100	99

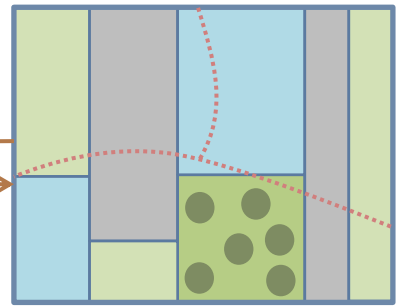
The Destisol decision support tool – step 5

- Evaluation of the ecosystem services provided by urban soils with various land uses

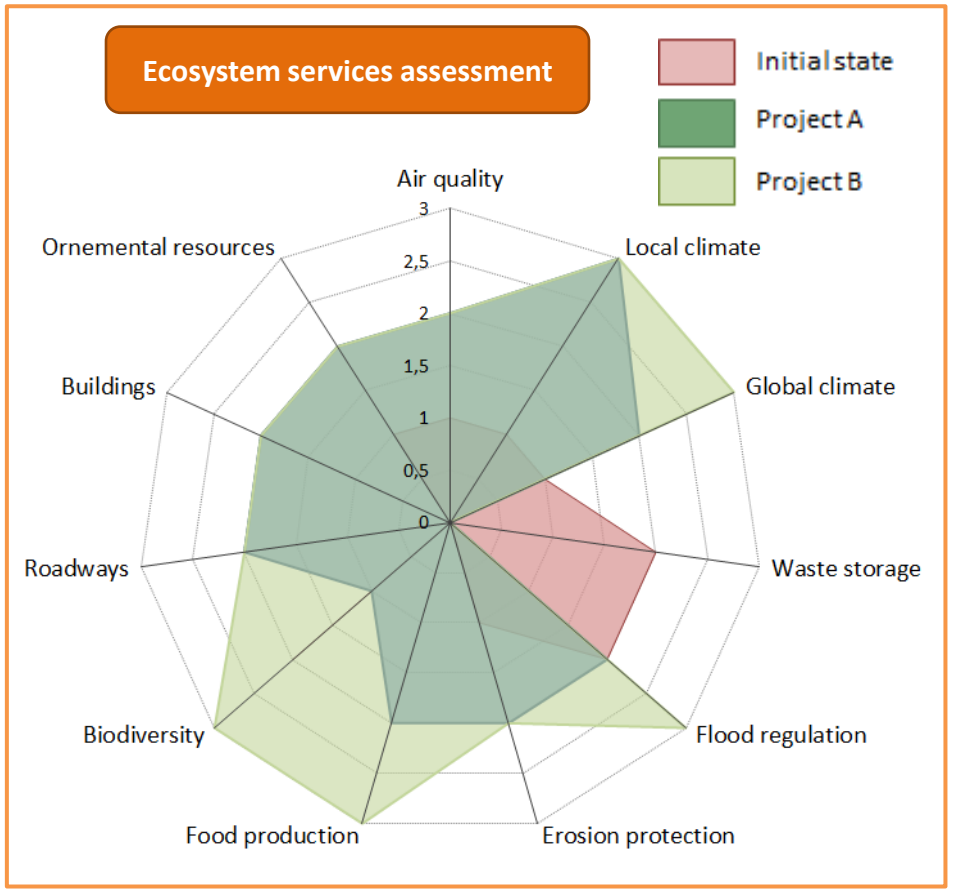





Documentary study + visit
Initial state of the planning site
Initial project
Soil quality assessment
Initial plan
Zone 1
Zone 3
Zone 2
Orientation/planning of the project
Modification of the initial zones
Ecosystem services assessment as a function of potential soil covers
Soil improvement
Zone 1
Zone 3
Zone 2
Projet B
Project optimisation
Zone 1
Zone 3
Zone 2



Project A


Ecosystem services assessment
Initial state
Project A
Project B
Air quality
Local climate
Global climate
Waste storage
Flood regulation
Erosion protection
Food production
Biodiversity
Roadways
Buildings
Ornemental resources
3
2,5
2
1,5
1
0,5
0

Lawn
Tree park
Roadways
Buildings
Pedological pits

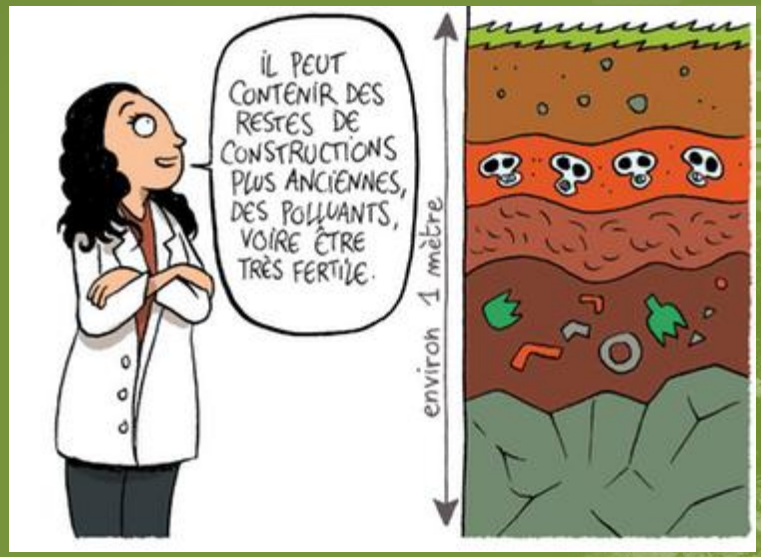
Available Bêta version of the Decision Support Tool

Soil Profile			
N° horizon		1	2
Field observations	slope (%)		
	depth (cm)		
	color	brun foncé	brun
	roots density (%)	30	10
	biological activity	forte	moyenne
	structure	grumeleuse	polyédrique fine
	texture	limoneuse	limoneuse
	compacity	faible	faible
	coarse elements (%)	5	5
	artefacts (%)	0	5
	hydromorphy	absence	rédoxique < 5%

mod 1.2. (2) | Fonctionnement interne | Carbone | Fertilité | Eau | Poll

sce
Aménagement
& environnement

Take Home Messages

- Urban soils are strongly diverse and not systematically strongly anthropized or degraded
- Allocate optimal land-use as a function of urban soils potentials
- Reduce the consumption of natural topsoil
- Optimize the ecosystem services at the scale of urban sites planning in order to tackle to specific issues (*e.g.* regulation of flooding, gardening)

- Anne Blanchart's PhD (2018)
- French Environmental Agency - ADEME
  Destisol & SUPRA projects
- Cities of Nancy, Nantes and Marseille for the provision of urban sites
- IRSTV, Nantes, for the assistance with access to the sampling sites