

Integrated management of soil and subsurface

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Programme

- Introduction
- Soil and subsurface: challenges
- Sustainable development
- Integrated management: ecosystem services
- Cases: IBC locations, Amersfoort / Amsterdam
- Discussion – remaining questions

Introduction

- Who am I?
- Link with soil and subsurface – KOBO network
- Who are you?
- Knowledge and images of soil and subsurface

Who am I?

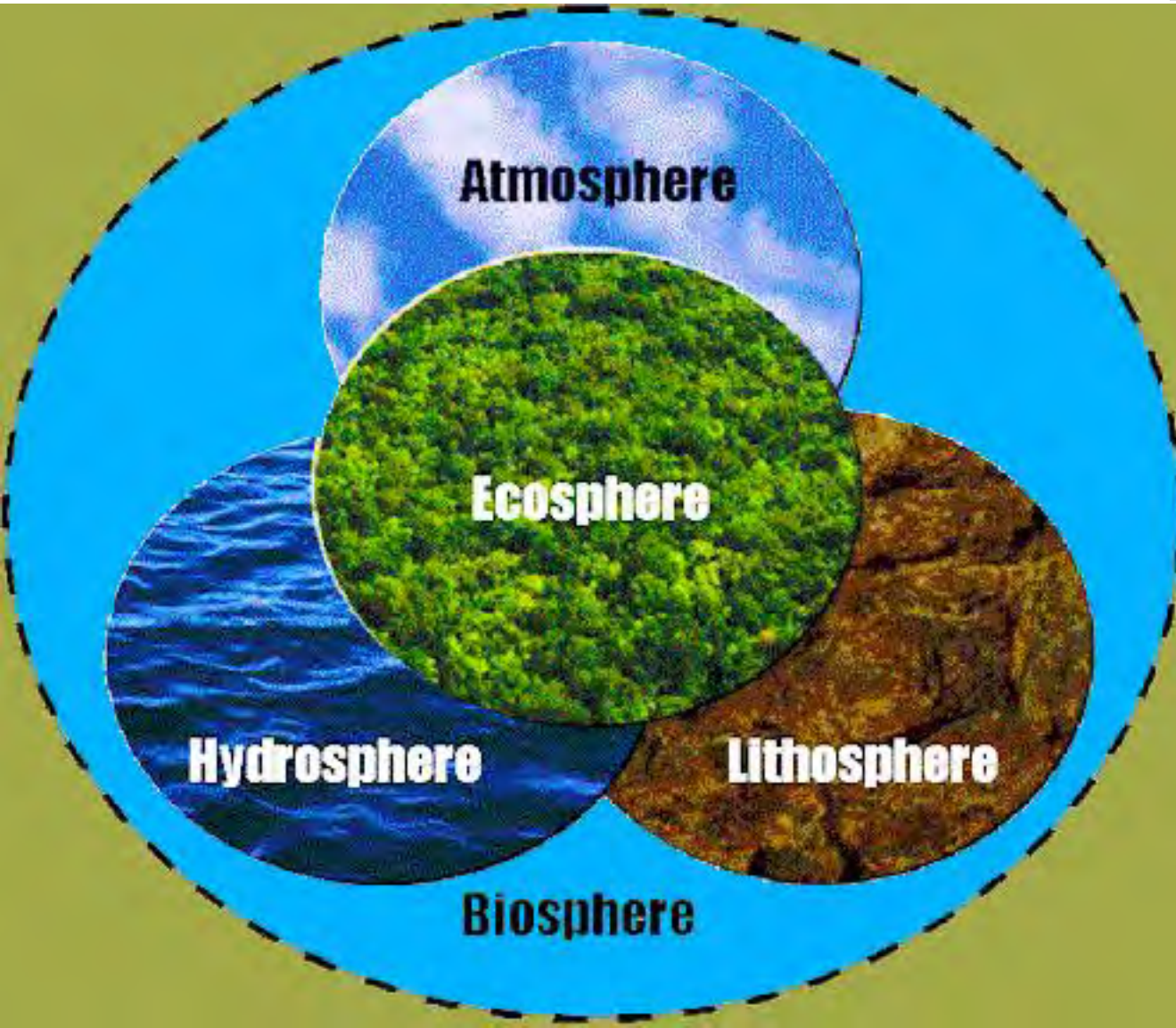
- Senior lecturer Sustainable Development, Saxion University of Applied Sciences
- Member of [KOBO](#) network (Dutch Higher Education Network on Soil and Subsurface)

Soil and subsurface

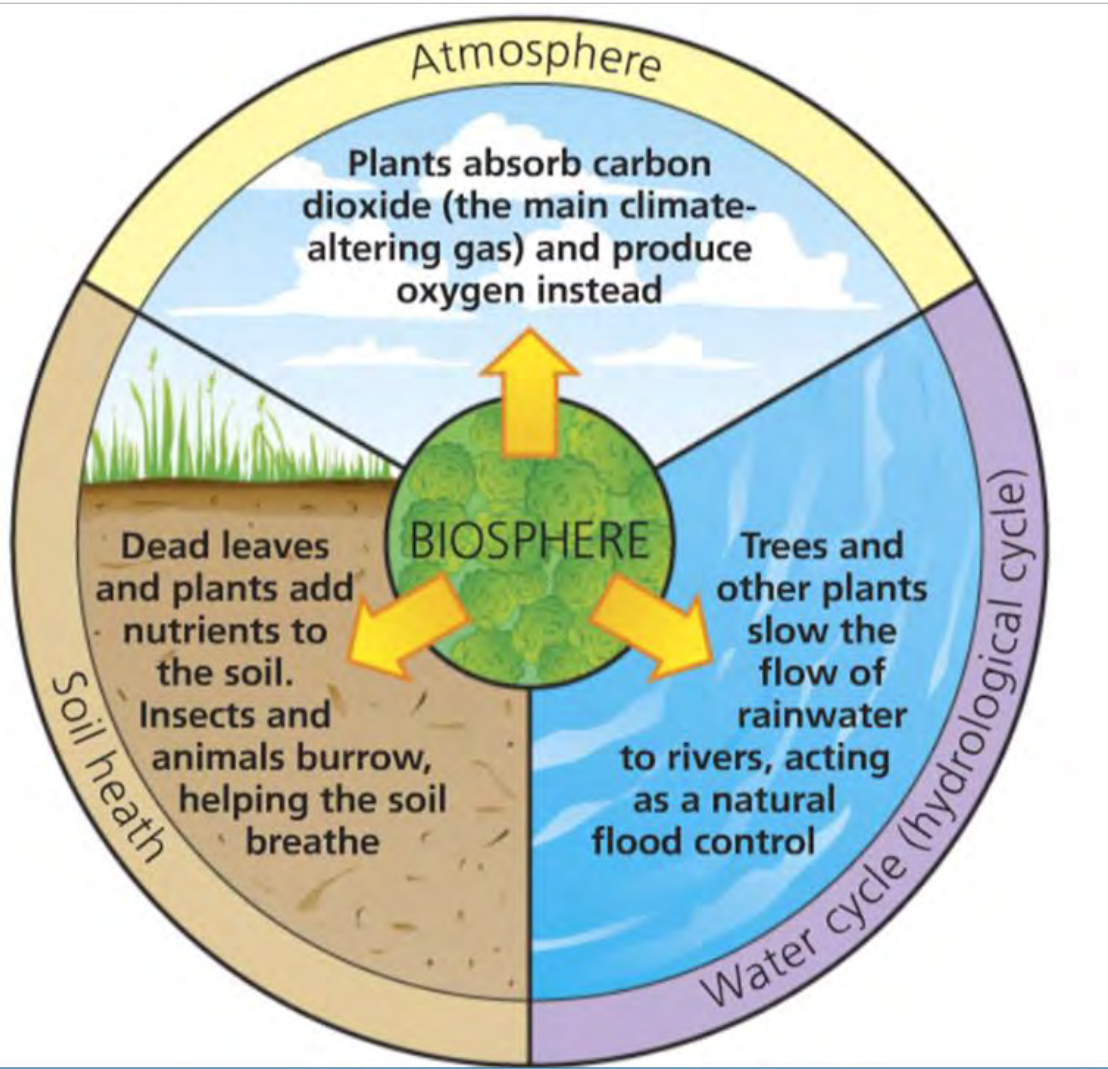
- Definition
- Functions
- Challenges
- Policy

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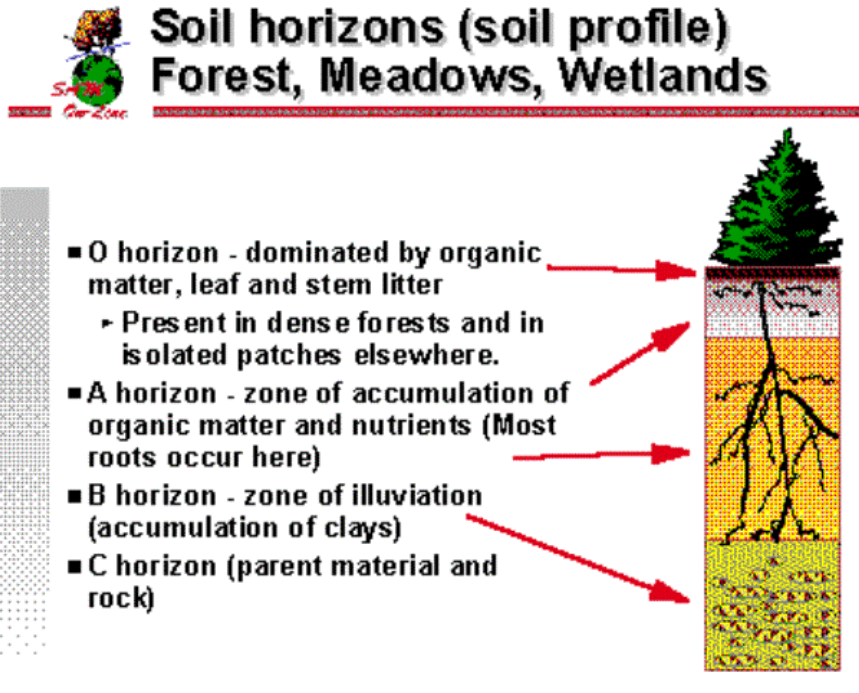
Interaction between spheres



Interaction between spheres (2)

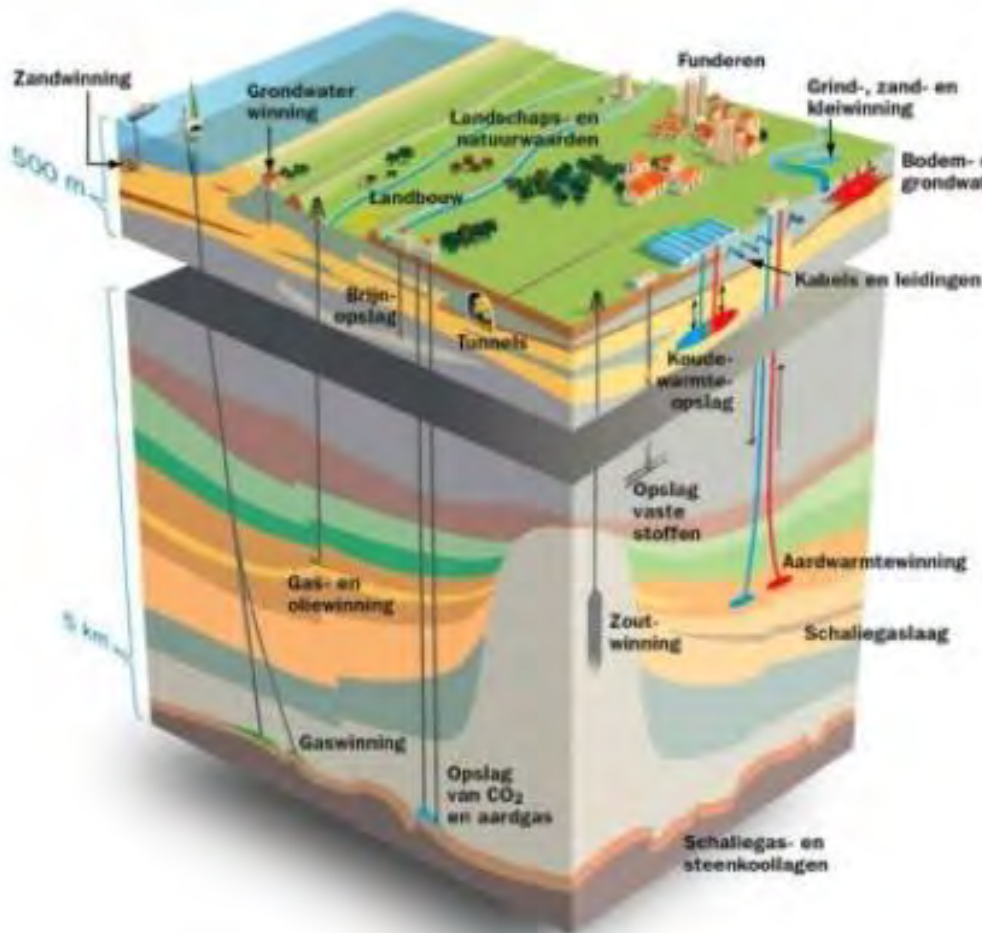


Soil



- Interaction with biosphere (vegetation, bacteria, fungi, micro- and macrofauna)
- Up to 10 meters.

Subsurface: part of the lithosphere interacting with human activities



- Energy provision and transport
- Supporting food production
- Resources extraction
- Storage / dumping of 'waste'
- Subsurface infrastructure
- Up to 5 km

Challenges

- Scarcity of space, especially in urbanised areas
- Interaction between functions (known or unknown; positive or negative)
- Conflicts of interest between stakeholders
- Unknown or unwanted long term effects (local or elsewhere)

Problems / dilemmas in subsurface

- Gas extraction / earth quakes
- Impact of heat / cold exchange and Geothermy (deep extraction of heat)
- Impact of CO₂ storage, oil storage, storage of polluted water
- Impact of shale gas extraction

Problems / dilemmas in soil

- Loss of organic matter / soil fertility
- Over-fertilisation (N, P)
- Soil pollution and land use
- Soil subsidence / peat oxidation / salinisation

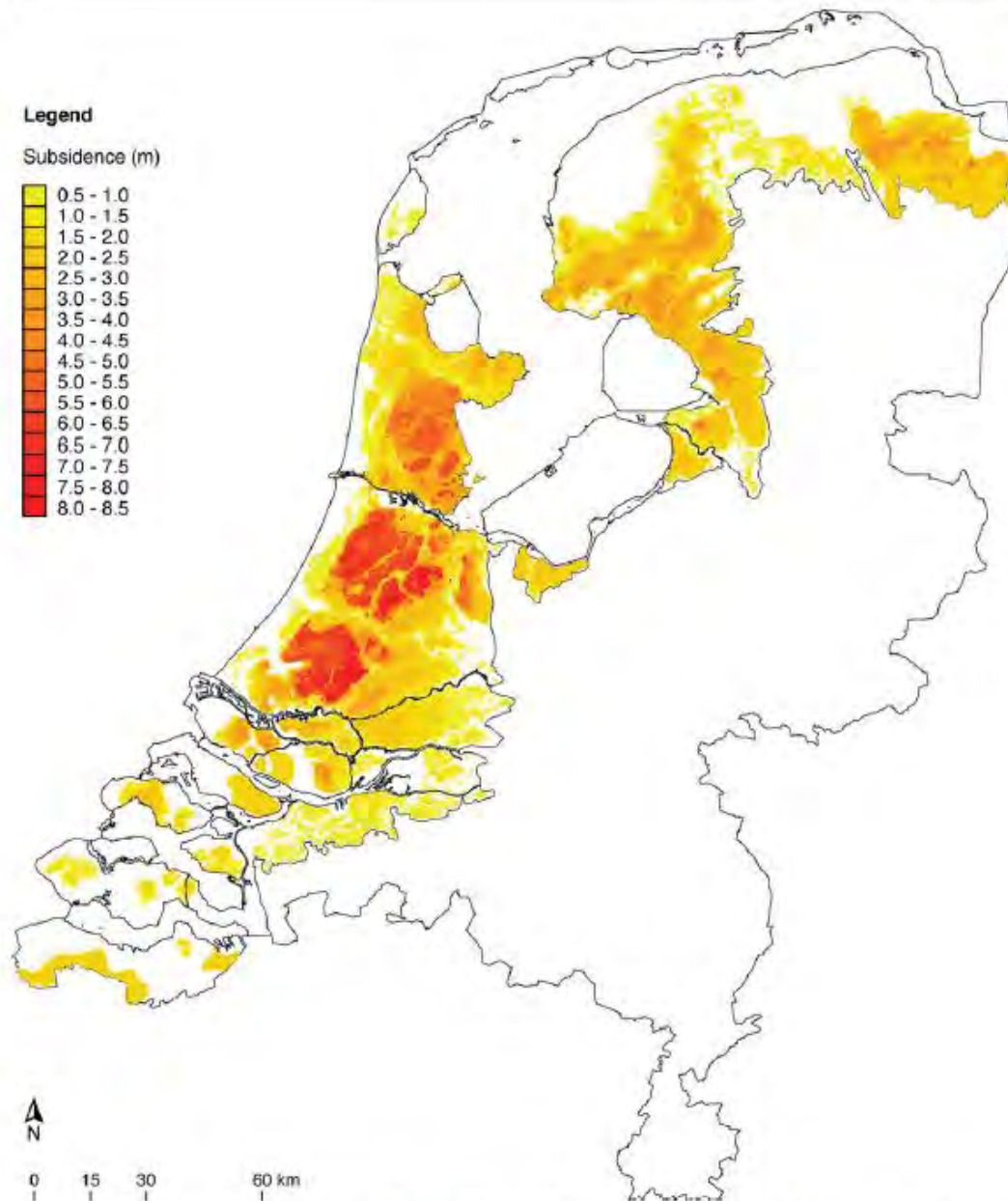


Fig. 9 Subsidence of the peat landscape since AD 1000, obtained by subtracting the current elevation (DEM2005) from the reconstructed paleo-elevation (DEM1000). Depicted are the results for best estimates

of bog and fen height. A comparison with Figure 6 reveals that the highest values are found in former peat mining areas. In the legend, a subsidence range of 'a–b' denotes the interval 'a–<b'

Soil subsidence in peat areas in the Netherlands

Erkens et al (2016)

Peat digging and draining (Erkens, 2016)

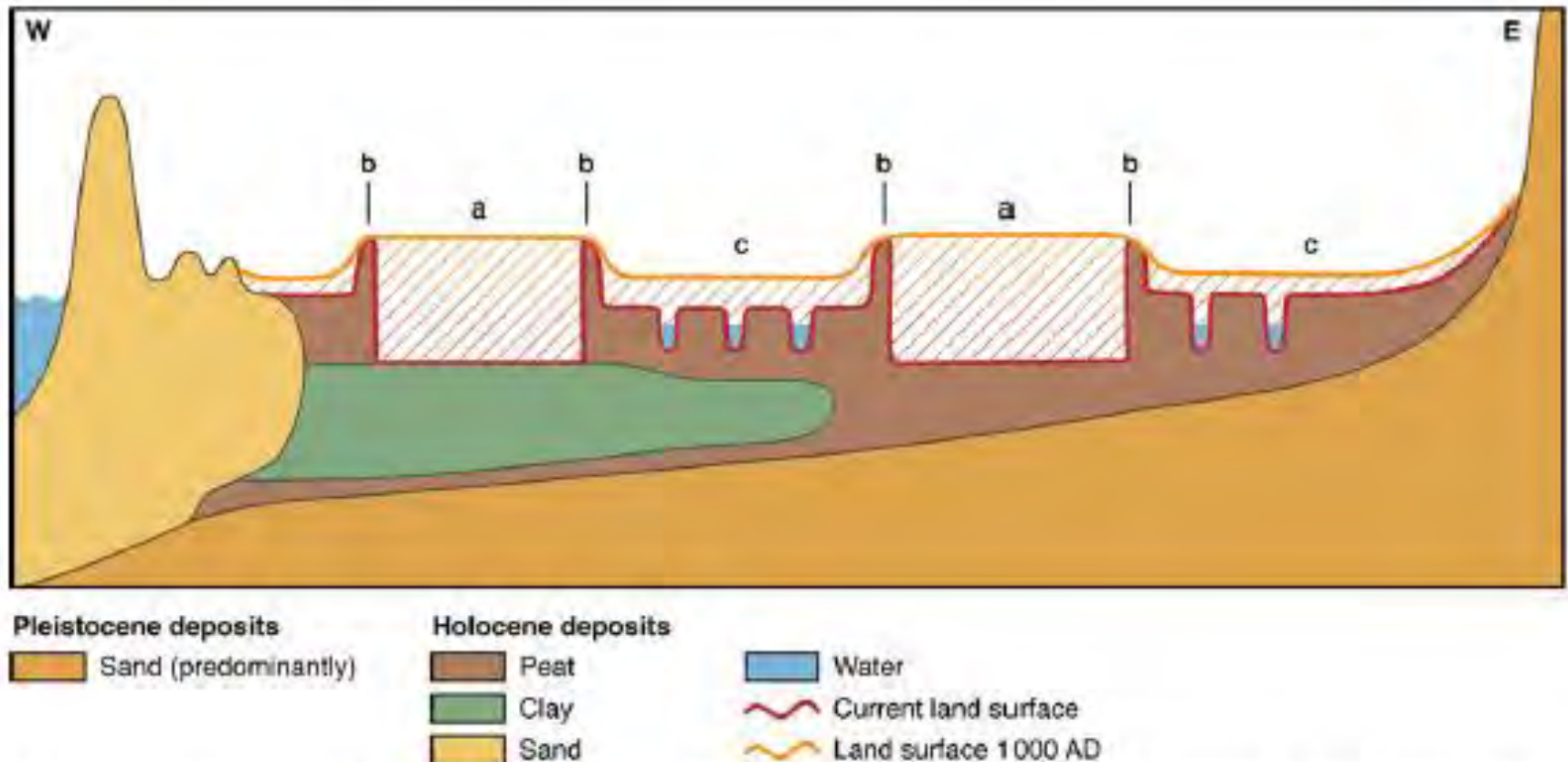


Fig. 2 Schematic cross-section across the Dutch coastal plain in its most peaty development. A sandy coastal barrier is present in the west. On the landward side, a wedge of fine-grained clastic back-barrier deposits is enveloped in organic deposits. The land surface of AD 1000 represents a more or less pristine bog and fen landscape; the current land surface reflects the effects of a thousand years of cultivation. The current lowest

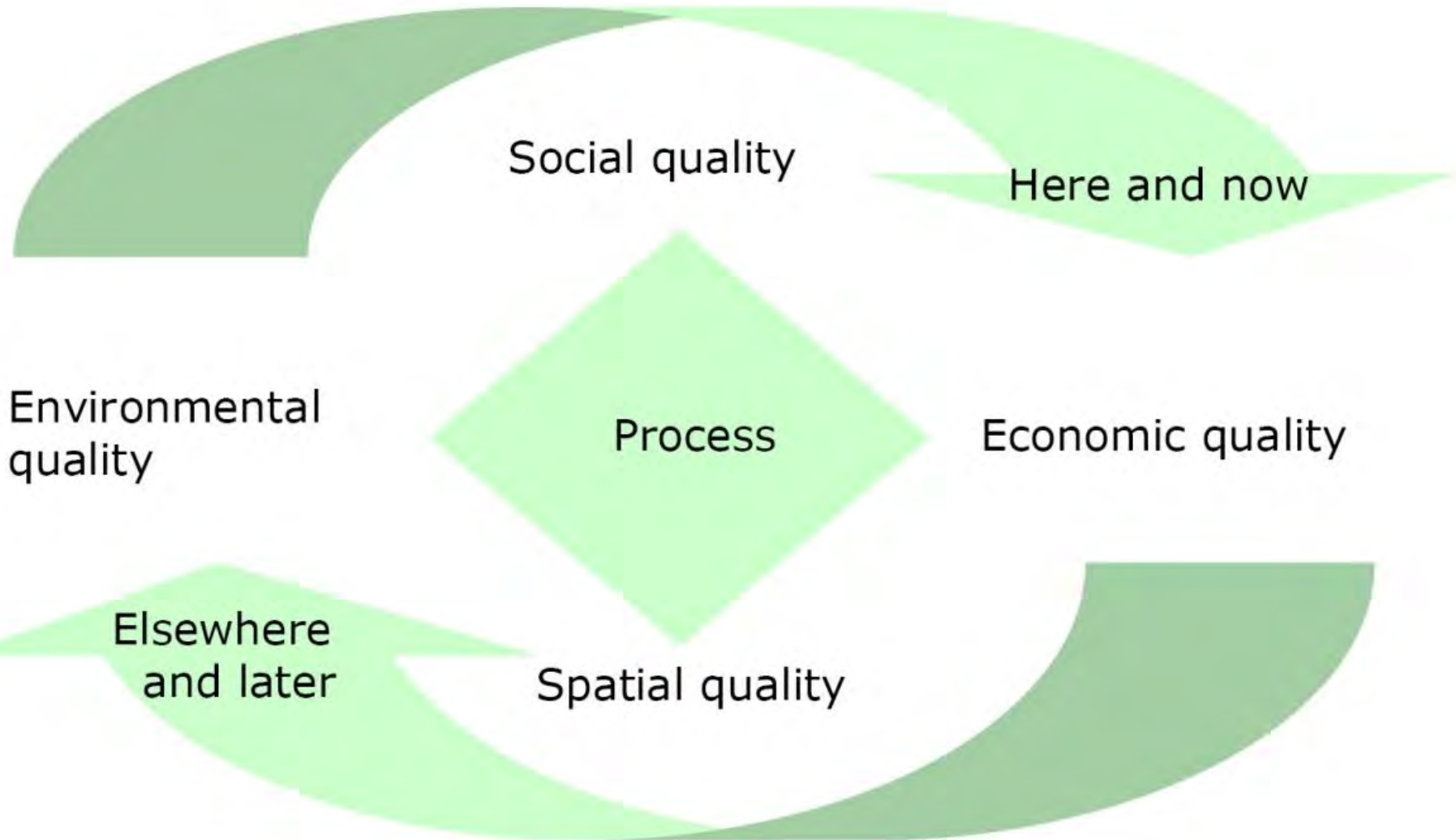
areas are mined peat bogs (a), the remnants of which function as dykes (b). Fen areas (c) are primarily lowered by subsidence attributed to water table drainage, as indicated schematically by ditches. *Hatching* between the historic and present land surface indicates the volume loss of peat, the reconstruction of which is the first objective of the study



To deal with these issues, we need to...

- Understand the systems and their interactions, including complex long term processes
- Create awareness among experts and stakeholders about the role and importance of soil and subsurface
- Develop decision making tools, to deal with conflicting interests and long term impacts.

Sustainable Development



Combine qualities here/now and elsewhere/later

Elsewhere	<i>Attention for effects outside area</i>	Elsewhere / later <i>Sustainable</i>
Here	<i>Here / now</i> <i>Quality of life</i>	<i>Future proof</i>
Quality	Now	Later

UN Sustainable Development Goals

- [UN Sustainable Development Goals](#)

Tools for sustainable planning with respect to soil and subsurface

- Make use of the qualities and (ecological) services
- Understand the systems and interactions on different scale levels
- No transfer of problems to the future and to other areas / stakeholders
- Combining interests of different stakeholders

3-D planning: Dutch Layer approach

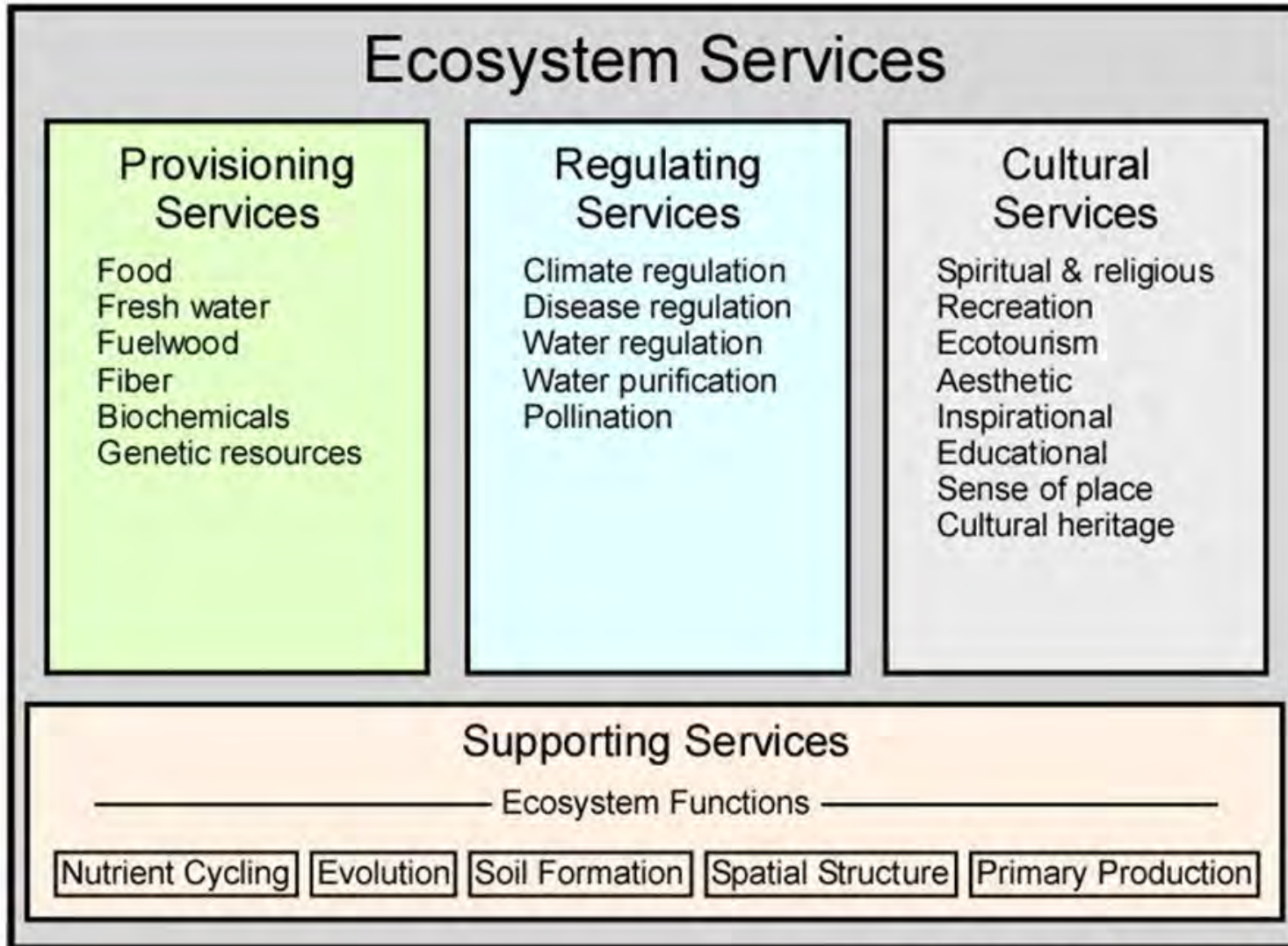


- Occupation layer
- Infrastructure / networks
- Subsurface / soil and geology

Ecosystem / Geosystem services

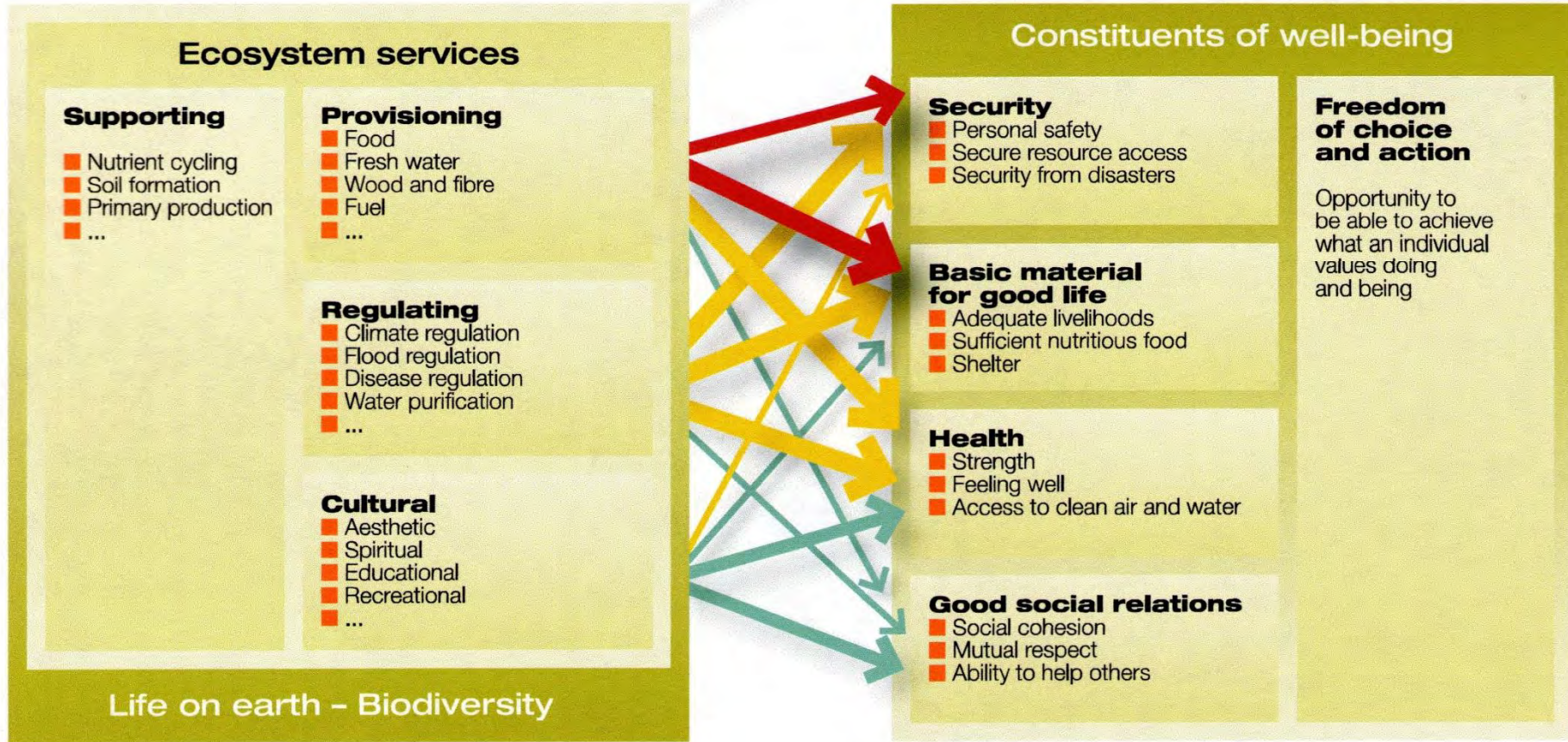
- Framework for decision making on subsurface issue
- Natural capital approach: we receive products and services *for free*, from ecosystems and the subsurface – but this can only continue if we do not deplete or disturb the resources

Ecosystem services



- Services create conditions for well-being of humans
- But this can only continue if the natural capital is managed in a sustainable way

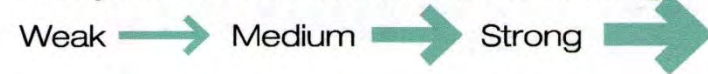
Biodiversity and Ecosystem Services (BES)



Arrow colour: Potential for mediation by socioeconomic factors



Arrow width: Intensity of linkages between ecosystem services and human well-being



From ecosystem services to geosystem services

- Not only biosphere and soil, but also (abiotic) deeper subsurface
- Adds issues like energy transition, deep water extraction and resource extraction
- Helps to develop an integrated perspective on the system

From ecosystem services to geosystem services

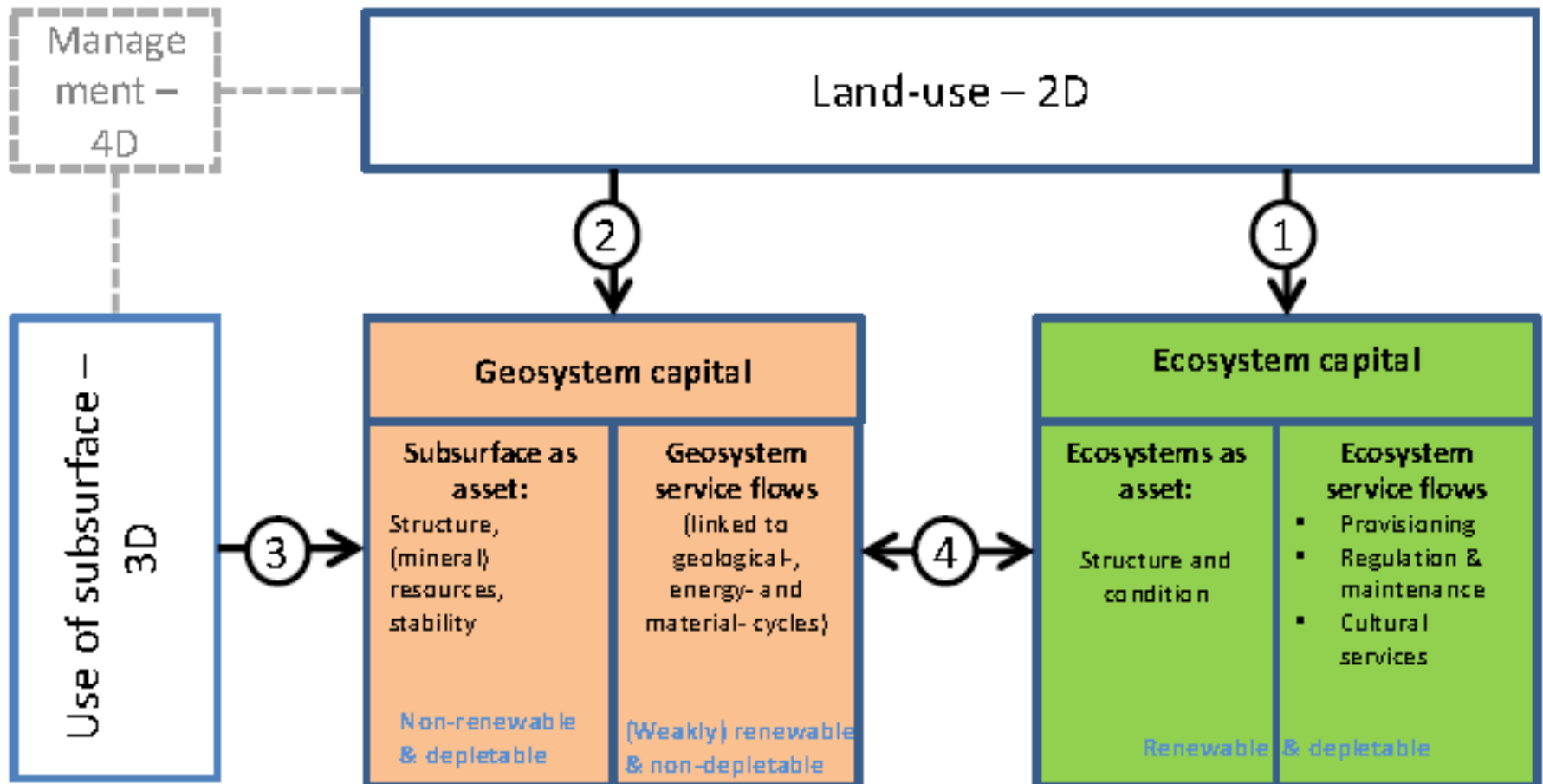


Figure 1. Natural capital overview diagram. Adapted after EU (2013)

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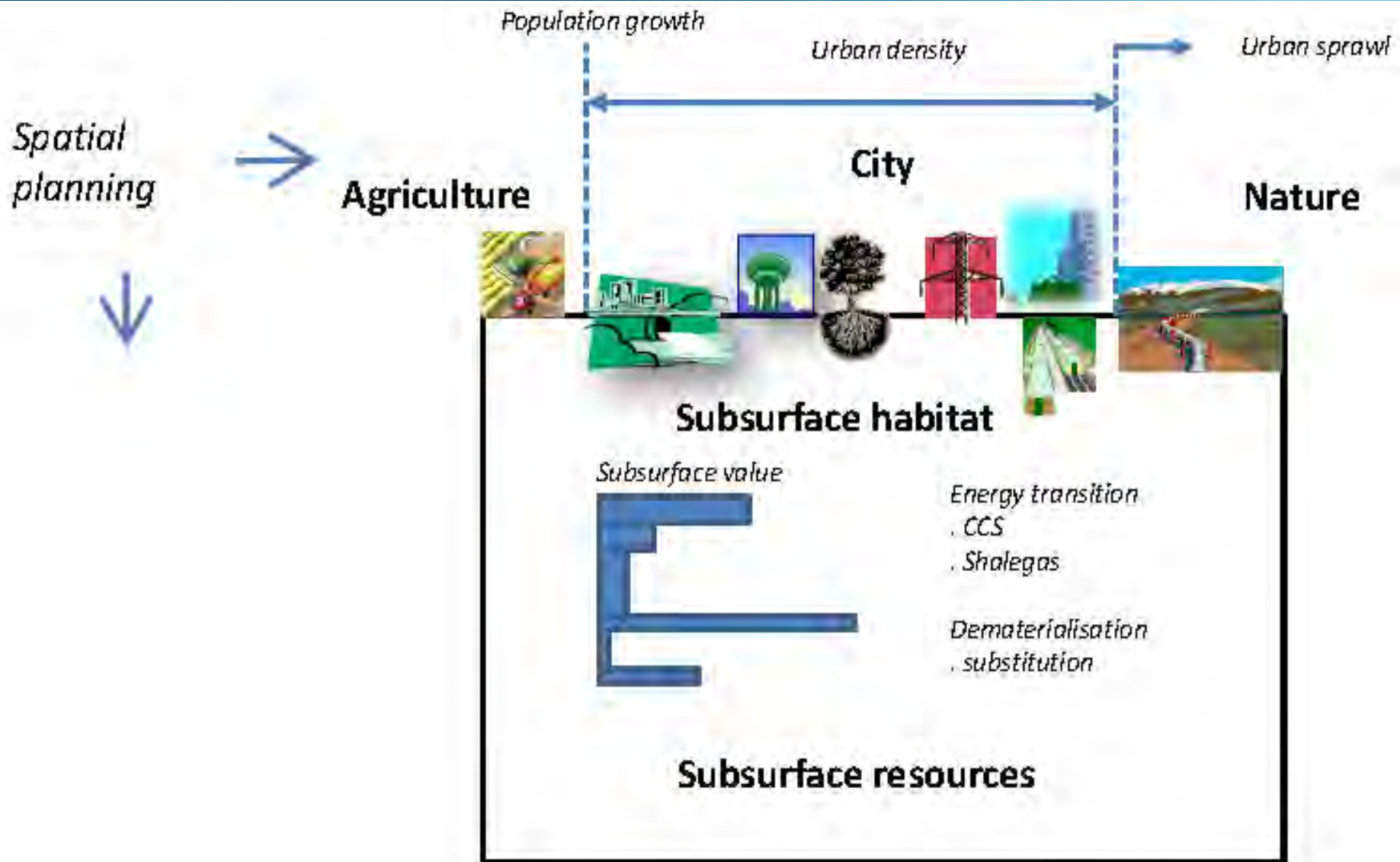
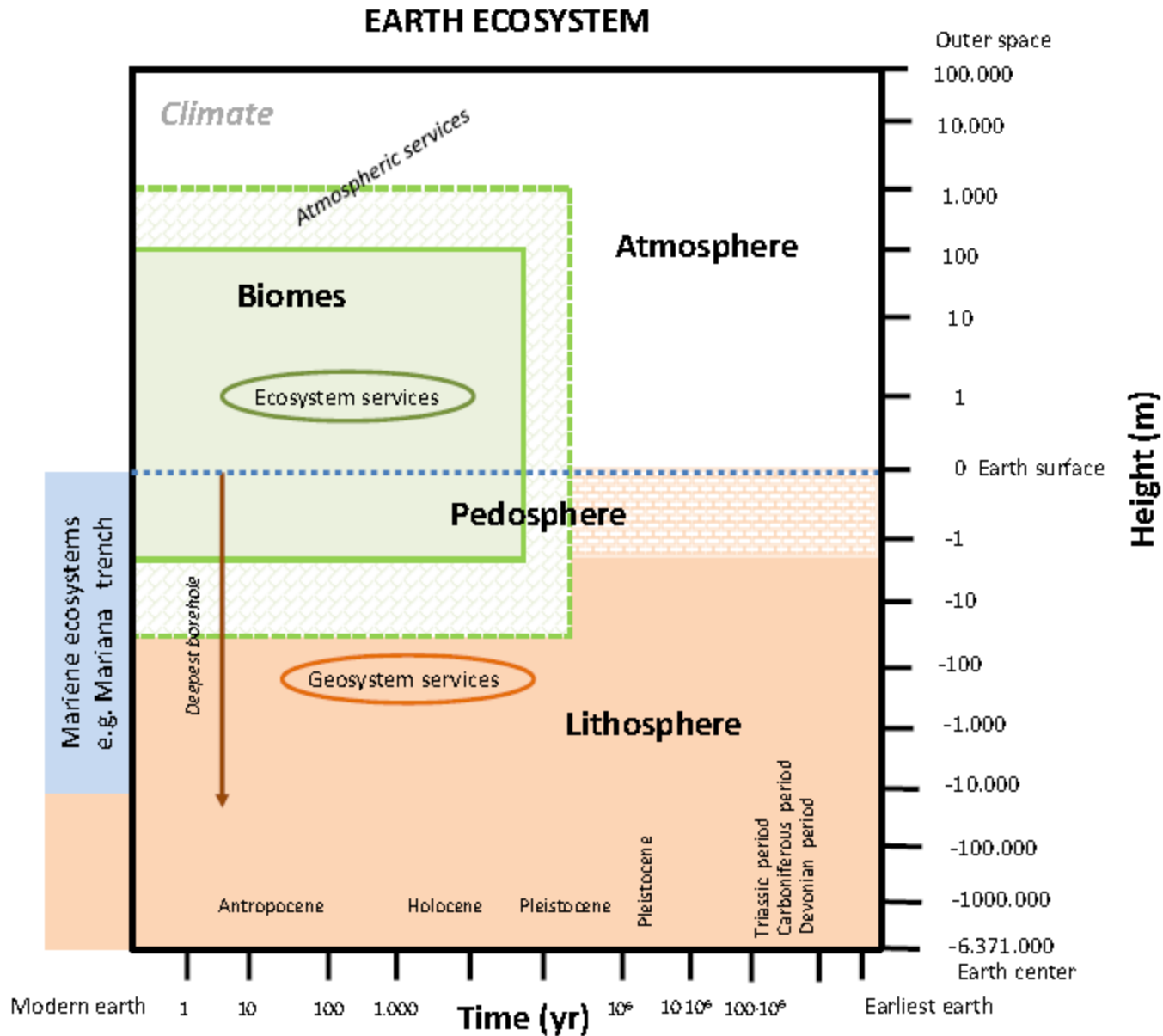


Figure 2. Framework linking land use and the subsurface.

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From services to benefits and value

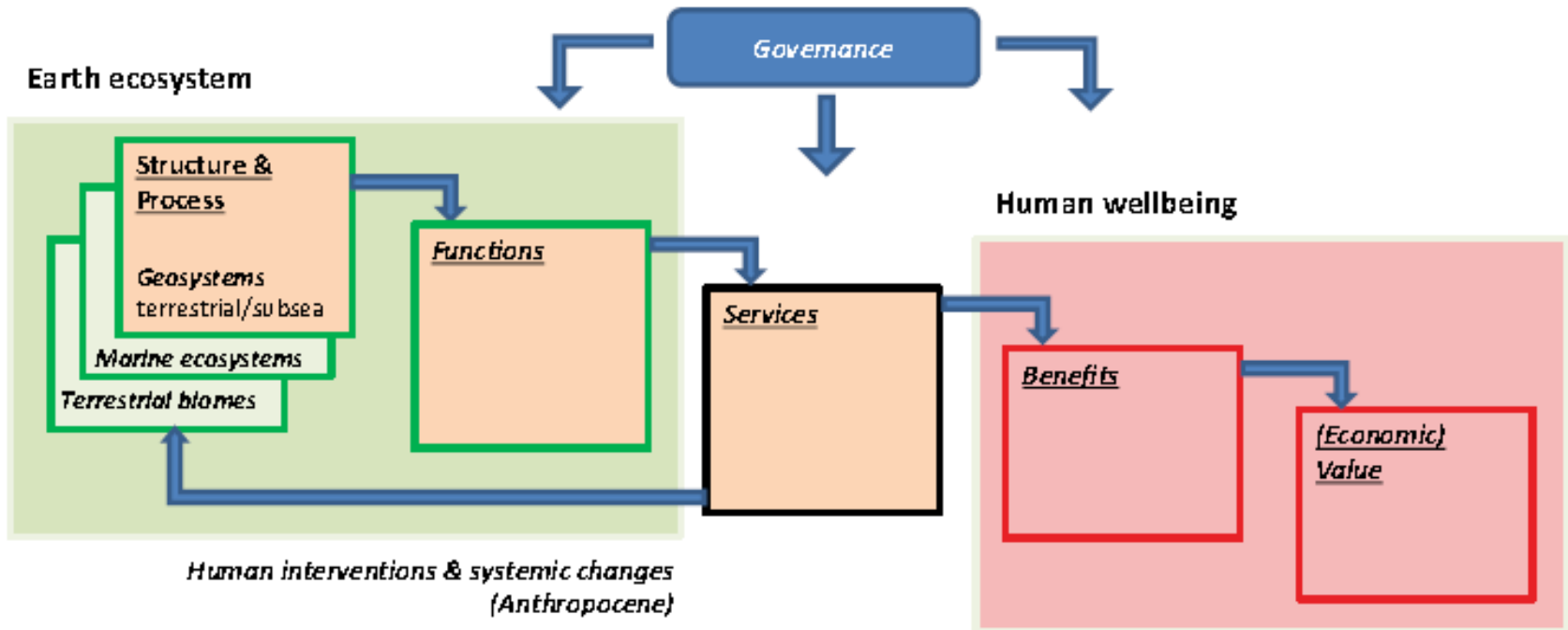


Figure 4. The Geosystem Services Cascade (adapted Braat & de Groot, 2012).

APELDOORN DOOR-GROND

EEN INSPIRATIE- EN HANDELINGSKADER VOOR EEN
DUURZAME OMGANG MET DE ONDERGROND



- Sub-surface vision Apeldoorn
- Towards a sustainable use of soil and subsurface in spatial planning

From services to qualities: subsurface vision Apeldoorn

DRAAG KWALITEITEN



Draagkracht
om te
bouwen



Ondergronds
bouwen



Onder-
grondse
Buisleidingen



Kabels en
Leidingen

Carrier qualities

Carrying capacity (strength) for constructions on the surface

Subsurface construction (tunnels, parking garages etc)

Subsurface pipelines (oil, gas, water, wastewater, others)

Cables and other small infrastructure (electricity, data, etc)

PRODUCTIE KWALITEITEN



Gewas-
productie



Voorraad
grondwater



Warmte
Koude
Opslag

Production qualities

Crop production

Ground water resources

Heat and cold storage

INFORMATIE KWALITEITEN



Aardkundige
waarden



Archeo-
logische
waarden



Diversiteit
in landschaps-
beeld



Niet
geexplodeerde
explosieven

Information qualities

Geological values

Archaeological values

Landscape and cultural history
values

Unexploded bombs (2nd World
War)

REGULATIE
KWALITEITEN



Schone
bodem



Levende
bodem



Water-
bergende
bodem



Water-
filterende
bodem



Gebieds-
gericht
grondwater
beheer

Regulation qualities

Clean and healthy soil

Living soil (organic matter,
bacteria, funghi, microfauna)

Water storage capacity in the
soil

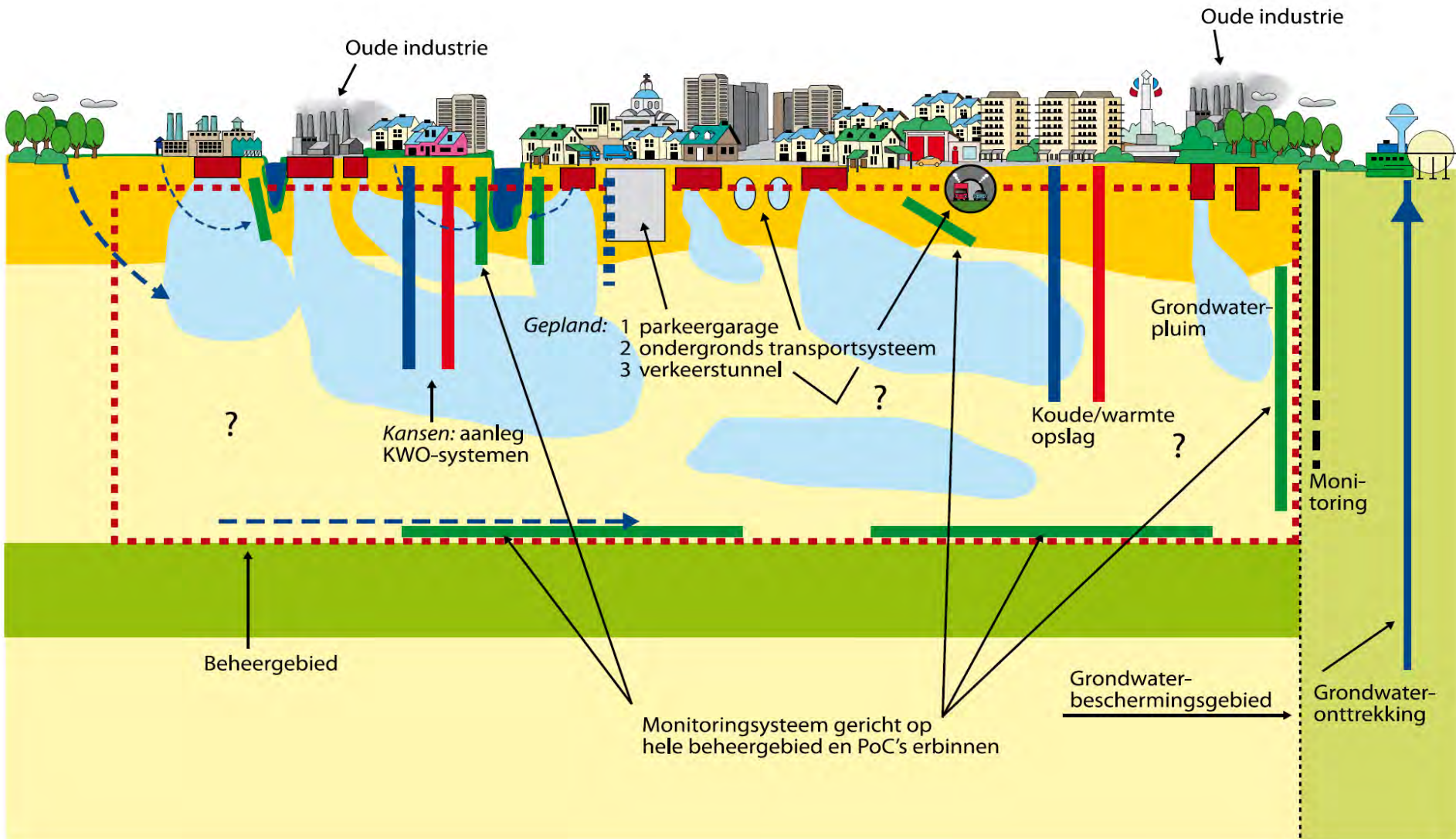
Water filtering and cleaning
capacity in the soil

Area-specific groundwater
management

Impact on decision making

- Ecosystem services will be available for ever and for free ...
- If used in a sustainable way (no pollution, no over-exploitation)
- Knowledge of sub-surface processes is used for on-surface planning decisions

Area specific groundwater management



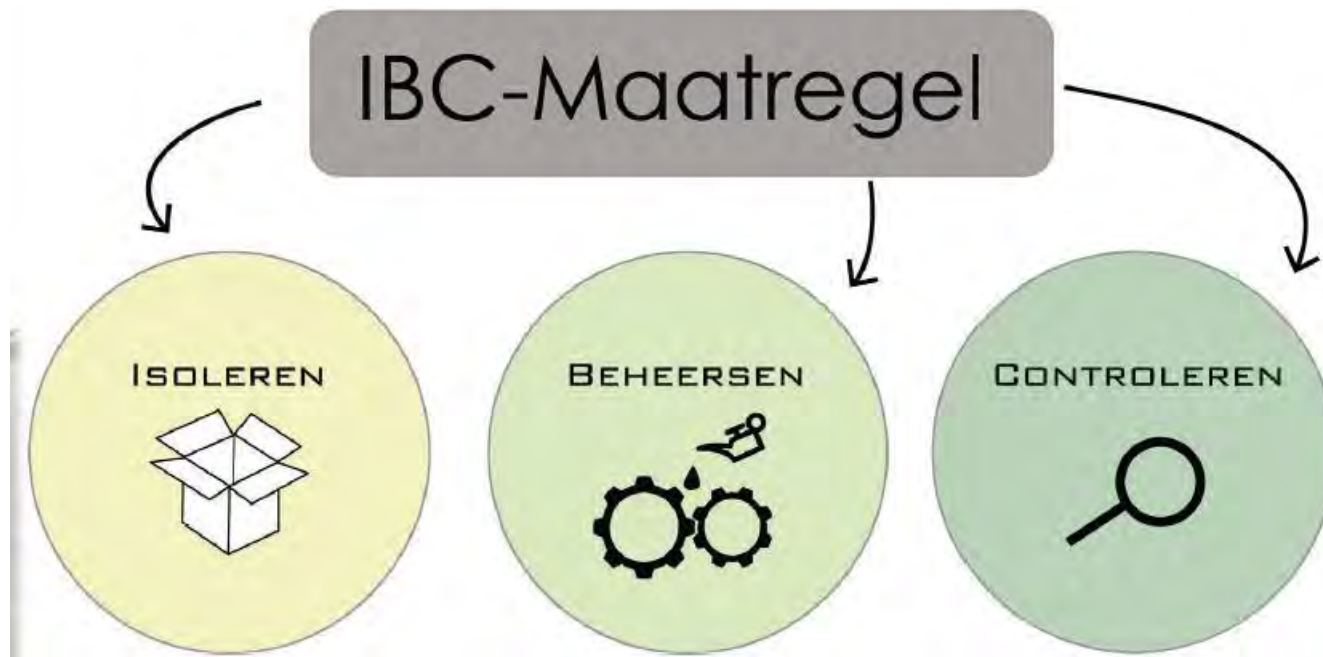
Mutual benefits

- Heat and cold exchange systems = renewable energy
- Soil pollution cleaned by water movements caused by HCE systems
- → plan HCE downstream the pollution flow in the subsurface

IBC

- Areas with soil pollution, with NO plans for complete sanitation
- Removal of pollution is too difficult, too expensive.
- Leads to limited options for land use
- IBC = Isolate, manage / control; monitor

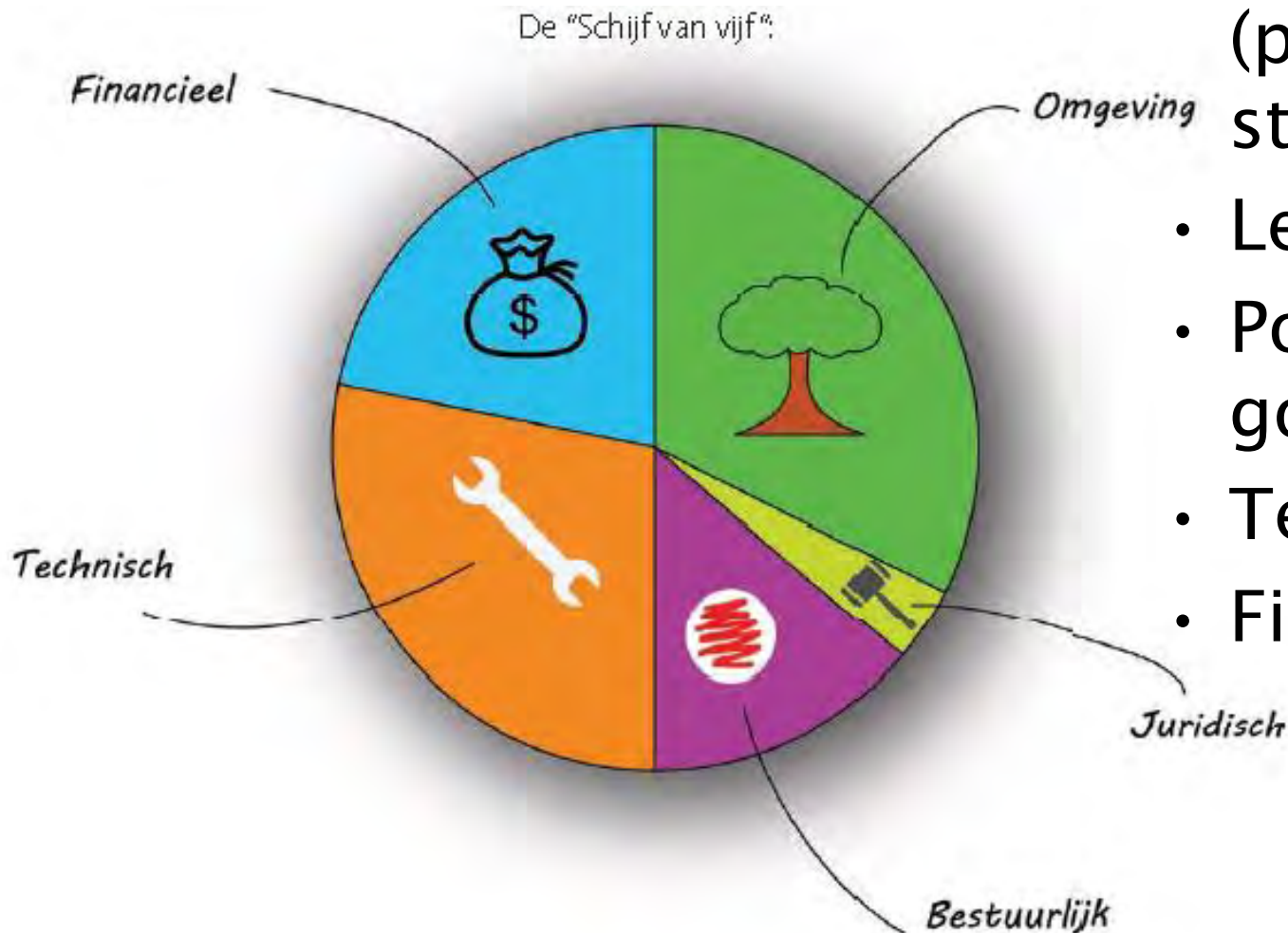
IBC:



Steps

- Identify problems and options for solutions
- Determine potential for redevelopment
- Identify / create drivers for redevelopment
- Combine interests
- Determine overall strategy and specific measures

Integrated analysis: 5 dimensions approach



- Environment (physical and stakeholders)
- Legal
- Policy and governance
- Technical
- Financial

Approach

- For each dimension: problem inventory and development of solutions
- Involvement of experts AND stakeholders in all stages of the process

Determine potential for redevelopment

Hoge(re) ontwikkelpotentie

> Stedelijke gebieden



> Braakliggend terrein



> Immobiele verontreiniging



Lage(re) ontwikkelpotentie

> Landelijke gebieden



> Bebouwd terrein



> Mobiele verontreiniging



- Urban vs rural
- Bare land vs built up area
- Steady pollution vs moving pollution

Identify / create drivers for redevelopment

- (Expected) health risks
- Complaints (noise, smell, landscape)
- Interested stakeholders (business, creative sector, environment experts)
- Money (maintenance too expensive; investors with a possible business case)

Combine interests

Mutual Gains Approach

- Identify interests, ideas and dreams
- Look for options to combine interests and create mutual benefit

Determine strategy



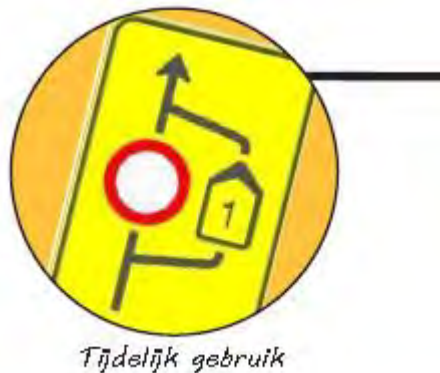
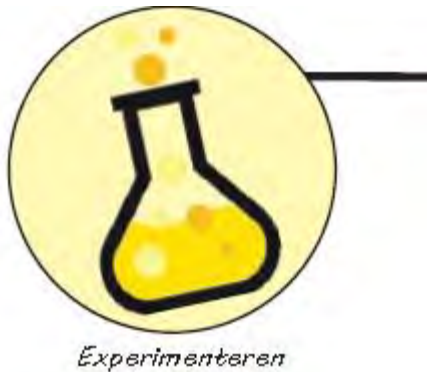
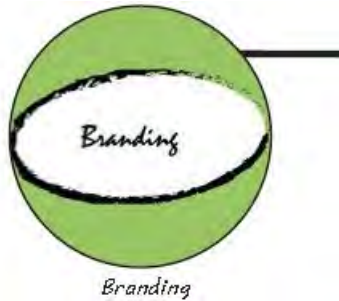
Gebied ontwikkelen

- Develop area



Heroverwegen

- Reconsider sanitation approach



- Branding / creating new image
- Apply technical / chemical experiments
- Develop concepts for temporary use










CASUS:
VETGASFABRIEK
AMERSFOORT

Voormalige Vetgasfabriek, Amersfoort

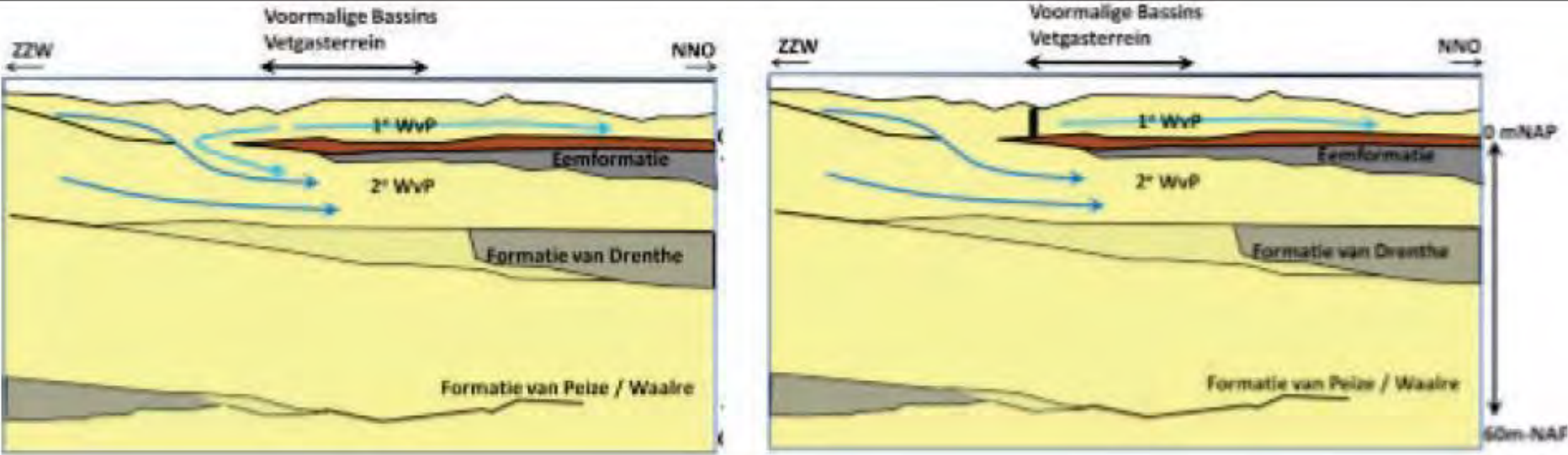
Overzichtstekening



Legenda

- | | | |
|---|---|--|
|  Voormalige bassins |  Brongebied 1e WVP |  Gerealiseerde ontwikkeling |
|  Locatie Vetgasfabriek |  Brongebied 2e WVP |  Geplande ontwikkeling |
|  Infiltratiesloot | | |

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Strategy

- Remove moving soil pollution gradually (long term approach)
- Accept limitations in land use
- Add functions in line with these limitations (urban garden; use of historic trains; neighbourhood park; housing / work space / parking lots where possible)

Urban garden



Waarom is dit idee geschikt voor op IBC-locaties?

- Veel urban gardens werken met het idee 'container gardening,' dit houdt in dat het tuinieren gebeurt in emmers en bakken. De planten maken nooit contact met de grond, wat zeer geschikt is voor locaties met vervuilde grond.
- Het is ook een geschikt idee voor tijdelijk gebruik voor een locatie. Als de locatie in permanent gebruik genomen zal worden kan de 'tuin' makkelijk verplaatst worden naar een andere locatie in de stad.

Bronnen: (Visser, 2017), (Visser, 2017), (Tumblr, 2016), (Tumblr, 2015)



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Re-use of old trains



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Urban park



Amsterdam, De Ceuvel

Seriously polluted area in Amsterdam north

Redevelopment into center for circular economy, as a result of a design contest

Main features

- Houseboats on land;
- Vegetation for phytoremediation;
- Research and knowledge exchange with respect to circular economy
- Restaurant / place to relax
- Temporary use

- <https://www.youtube.com/watch?v=D5eu3IH3BP4>
- <http://deceuvel.nl/en/>







Success factors

- Creativity / originality
- Dreams / expertise / perseverance
- Design and communication skills
(Branding)
- Creative and open minded visitors \
- Influence on surrounding area
(Buiksloterham)

Conclusion

- Soil and subsurface: many invisible and unknown functions
- impact on planning and decision making often underestimated
- Integrated approach necessary for sustainable development of subsurface and 'visible functions'.