Climate Resilient Estate Landscape in Baakse Beek

Towards a landscape architecture approach for water management, ecology, and spatial experience

P5 presentation

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Adapted from Google earth, 2019

Structure of presentation

» *Introduction*

» *Analysis and principle*

» *Application at regional scale*

» *Design explorations at local scale: Medler-Wiersse cluster*

» *Conclusion and reflection*

Introduction

Location


River IJssel
Baakse beek basin
Achterhoek
Medler-Wiersse Cluster
Estate landscape
Baakse beek
Baakse beek basin

15 Baakse Beek
Bolfoto © VIA Drupsteen 2014

Fascination: Estate Wiersse

Source: Estate De Wiersse

Source: Omkijkpunt

Source: Adel in Nederland

Fascination: Estate Wiersse

Problem statement: Estate landscape

Dennewater

Wildenborch

Vorden

't Medler

De Wiersse

Ruurlo

't Klooster

Low ground-water level

Land reclamation in 20th century

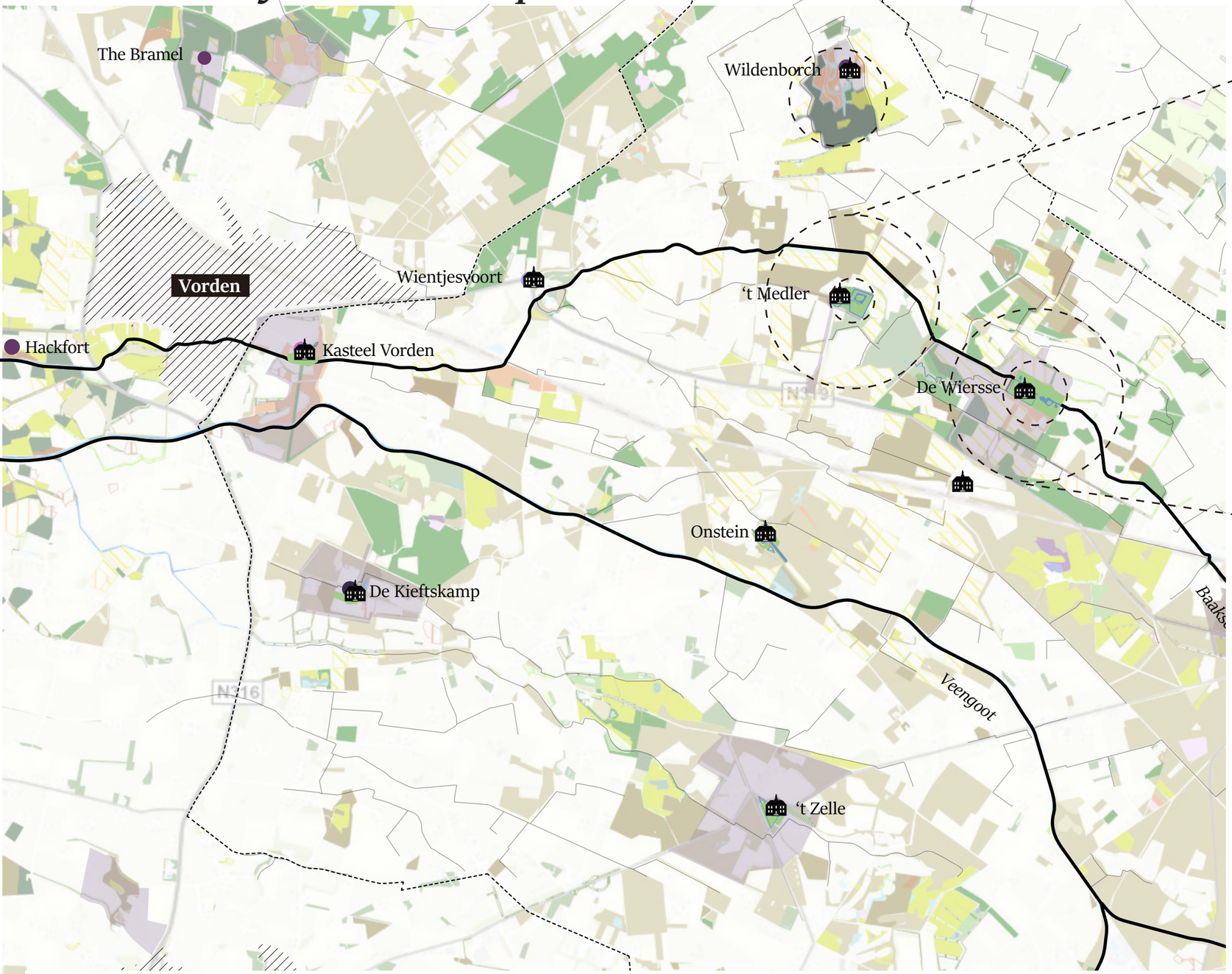
LEGEND

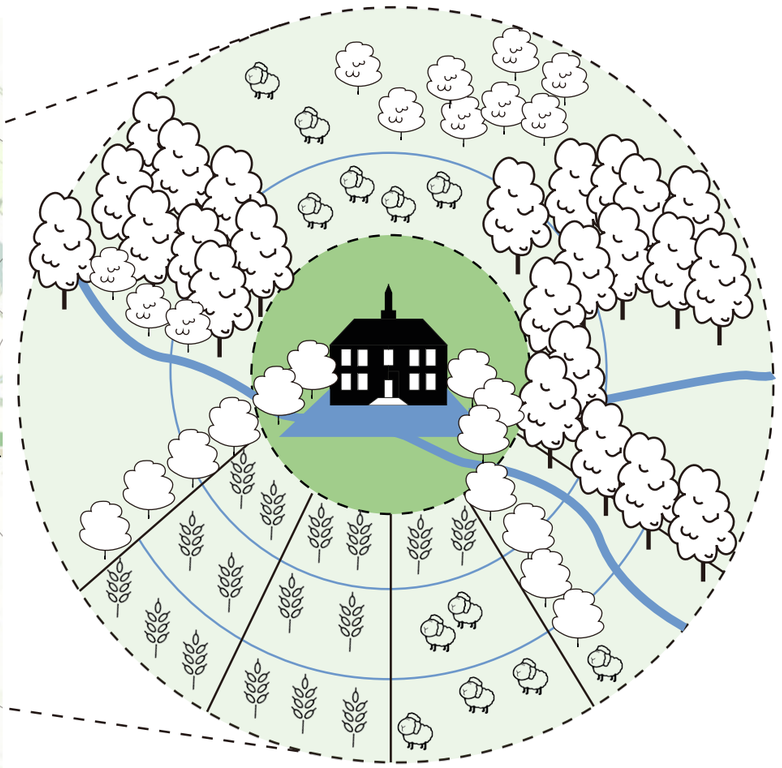
- Groundwater water catchment area
- Groundwater protection area
- Groundwater withdrawal area

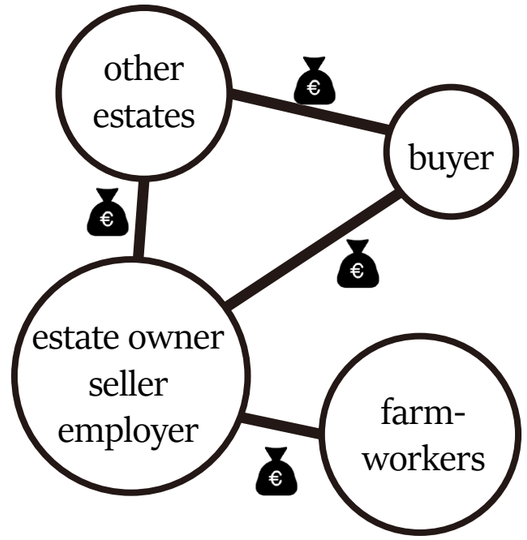
Withdrawals

- Drink water
- Industry
- Irrigation
- Source drainage
- Estate
- water flow
- Winter drainage
- Drought in streams

The value of estate landscsape





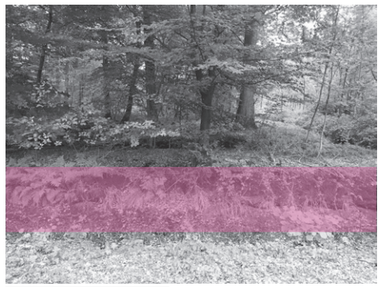


Beheergebied 2019
A02.01 Botanisch waardevol grasland
A02.02 Botanisch waardevol akkerland
L01.01 Poel en kleine historische wateren
L01.02 Houtwal en houtsingel
L01.03 Elzensingel
L01.05 Knip- of scheerheg
L01.06 Struweelhaag
L01.07 Laan
L01.08 Knotboom
L01.09 Hoogstamboomgaard
L01.16 Bossingel
L02.02 Historisch bouwwerk en erf
L02.03 Historische tuin
N03.01 Beek en Bron
N04.02 Zoete Plas
N05.01 Moeras
N06.04 Vochtige heide
N06.05 Zwakgebufferd ven
N06.06 Zuur ven en hoogveenven
N07.01 Droge heide
N07.02 Zandverstuiving
N10.01 Nat schraalland
N10.02 Vochtig hooiland
N11.01 Droog schraalgrasland
N12.02 Kruiden- en faunarijk grasland
N12.03 Glanshaverhooiland
N12.05 Kruiden- of faunarijke akker
N12.06 Ruigteveld
N14.01 Rivier- en beekbegeleidend bos
N14.02 Hoog- en laagveenbos
N14.03 Haagbeuken- en essenbos
N15.02 Dennen-, eiken- en beukenbos
N16.03 Droog bos met productie
N16.04 Vochtig bos met productie
N17.02 Droog hakhout
N17.03 Park- of stinzenbos
N17.06 Vochtig en hellinghakhout

The area is characterized by the many estates with old deciduous forests, castles and country houses, interspersed with agriculture.
Estate is a spatial, economic and social unit with not only building and garden but also its hinterlands and surrounding environment as a part of larger landscape

Problem statement: Estate landscape

Scarcity of water in estate landscape



Rabat forests

Used for water storage from bogs in history but become a wasteland today.

Arable land

Shortage of water for arable land and therefore have consequences on prodicivity.

Flow meadow

The meadow is no longer irrigated with water from streams.

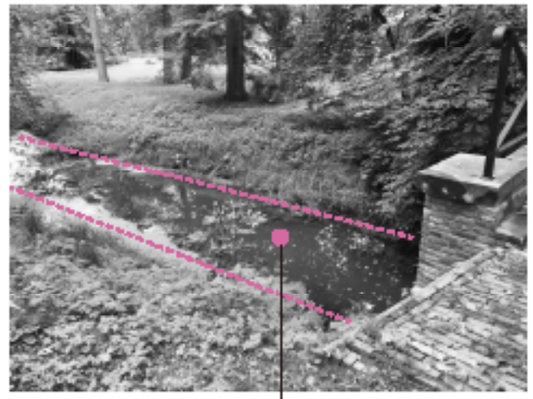
Forest stream

The streams are dry during summers and therefore poor water quality in forest.

Estate Moat

Lower water level in estate moat fails to protect the architecture.

Water ecology is threatened on estate ground

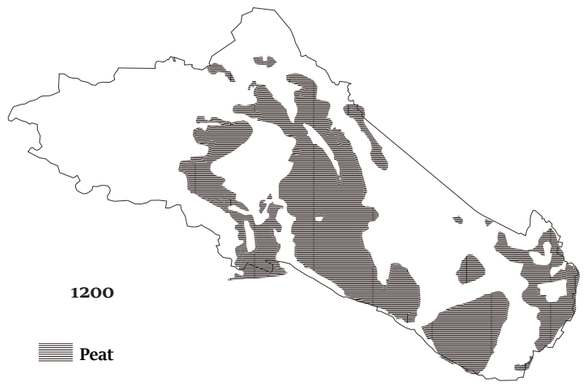


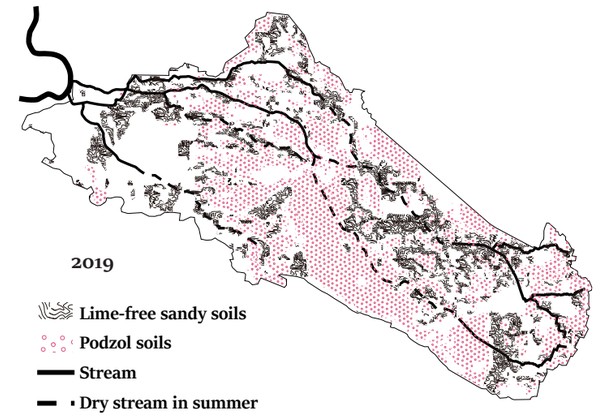
Stagnate water

Eutrophication

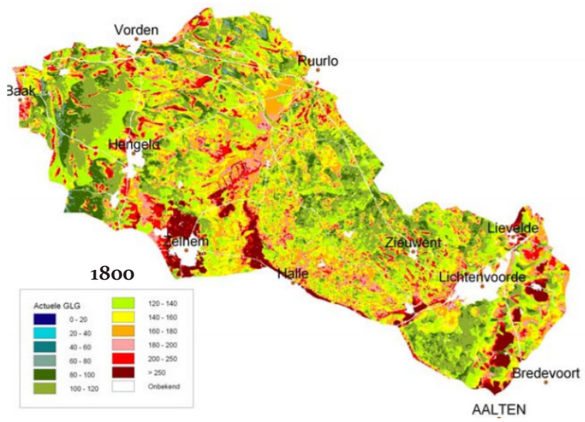
Weirs become barriers for plants and animals

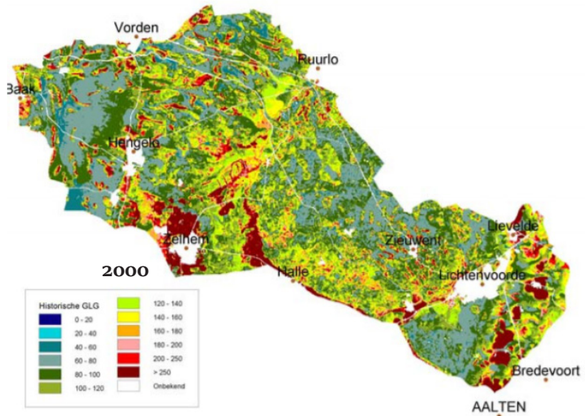
Problem statement: Baakse beek area





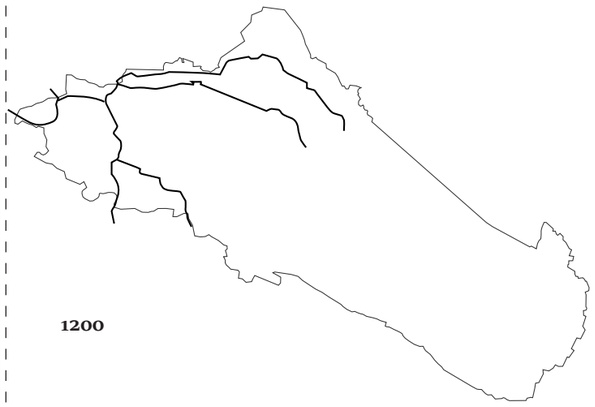
Soil lost capacity to keep water

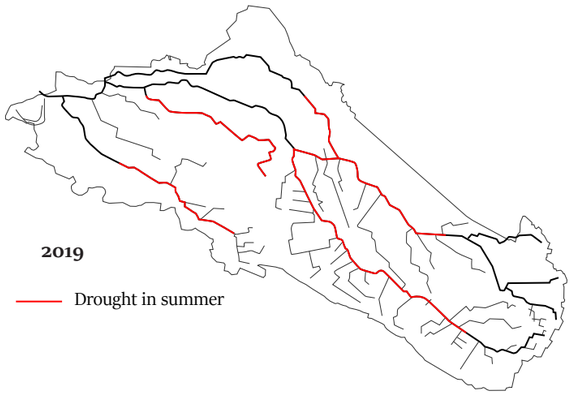




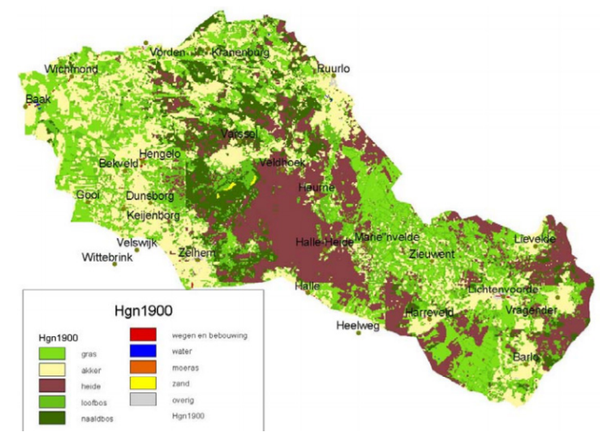
Lowest ground water levels of Baakse beek area (Source: Massop, 2007)

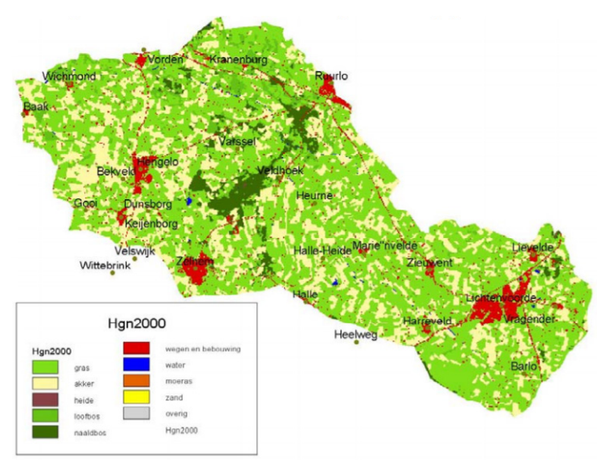
Groundwater level dropped





The stream is partly dried out in dry seasons





Land use is mono-functional

To combating floods and giving way to agricultural development, numerous changes in water system management and land use has been taken place. As a result, the land and water system in Baakse Beek area is no longer adaptable to the climate change.

(Source: Massop, 2007)

Problems and challenges: Conclusion

Water and Landscape ecology

- **The stream is canalized so the water cannot stay in landscape and the stream is partly dried out in summer.**
- **The banks are standardlized and lose diversity which means many flora and fauna are absent in landscape.**
- **Decrease in wet natures as a result of the dropped groundwater level. The hydrological relationship between landscapes is weak.**
- **Eutrophication is induced by excess nutrients that enter the water through fertiliser runoffs in agricultural areas, which polluted the stream.**
- **Decrease in woodland and heathland after land consolidation has broken the continuity of the ecology. Many flora and fauna lose their habitats.**

Spatial experience

- **The spatial coherence in the landscape is unnoticeable as the absence of water.**
- **Mono-functional landuse, stream pattern and nature typology makes the landscape no longer attractive.**
- **The value of the estate landscape need to be redefined.**

Research objectives:

To take values from the historical water management approaches
To find a balance between human and ecology in the landscape
To improve the hydrological relationship between estate, their hinterland, and broader area
To redefine the value of the estate landscape.
To provide building stones to address climate change

Research question:

How to develop a resilient estate landscape in the Baakse Beek region that integrates climate-proof water management, landscape ecology and spatial experience?

- **What is the local historical water management approach and how can they be integrated in a climate-proof landscape ecology design?**
- **What spatial design principles and cultural-aesthetics landscape elements would be applicable to fit the climate-proof landscape in estate area?**

The stream forest

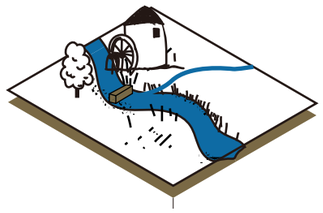
Analysis and principle

Values of the historical water management

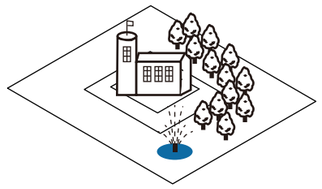
Three Categories

Three ways to dealing with them

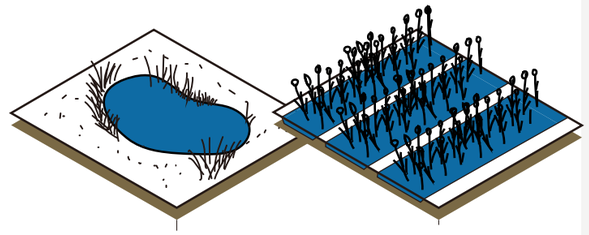
Existing & Ecologically or Aesthetically Valuable



Watermill



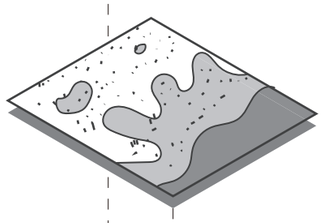
Aesthetic water feature



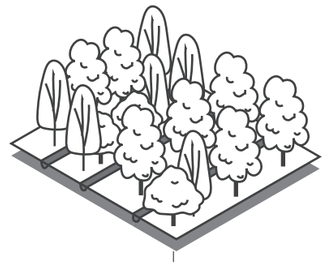
Inundation | Constructed wetland

Preservation & Improvement

Abandoned but Ecologically Valuable



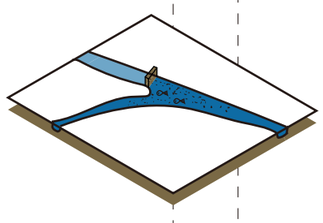
Flow meadow



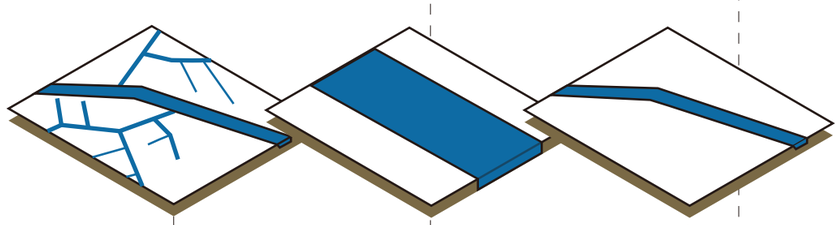
Grove forest

Adaptive reuse & Reconstruction

Existing but Less Ecologically Valuable



Longitudinal barriers

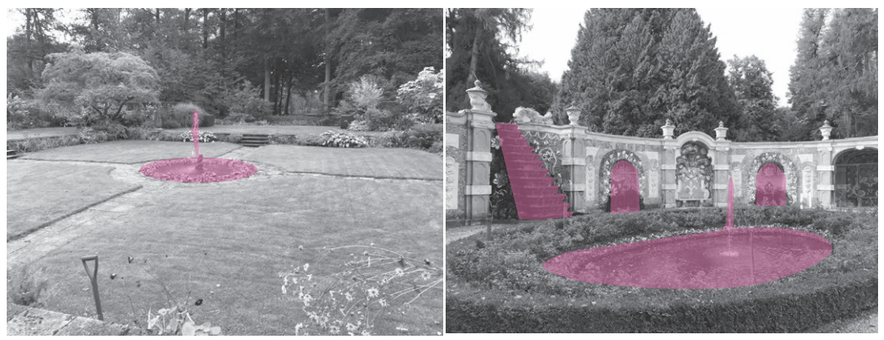


Drainage system | Standardization | Canalization

Removal or Re-naturalization

1200 1300 1400 1600 1700 1800 1900 2000

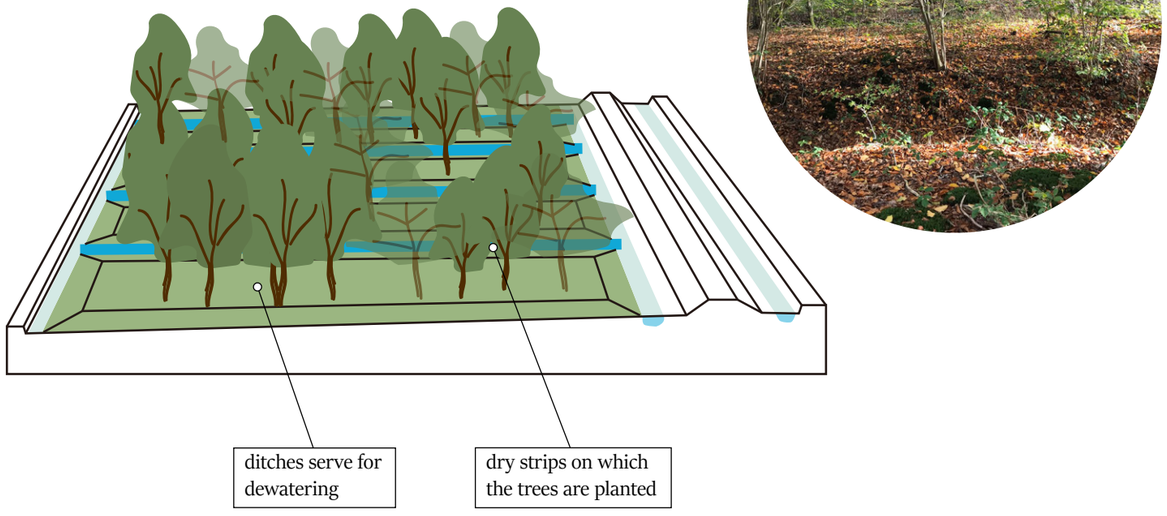
Aesthetics function of water infrastructure

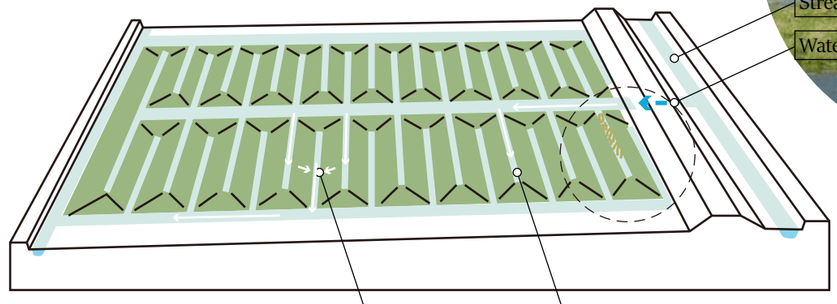


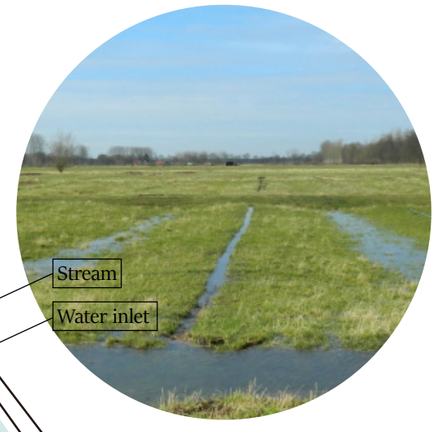
geometric garden style dominated during the 17th and 18th century

the middle of the 18th century the so-called landscape style

Dewatering and productive function of water infrastructure







Design principles

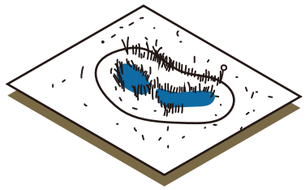
Three ways to dealing with them

Preservation & Improvement

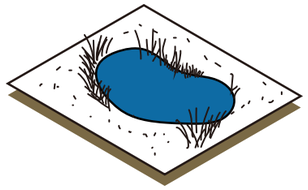
Adaptive reuse & Reconstruction

Removal or Re-naturalization

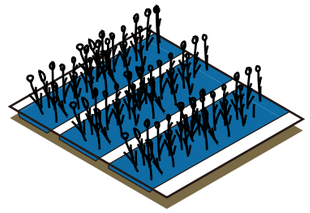
Aesthetically improved



Detention basin

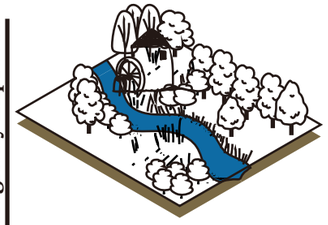


Retention pond



Constructed wetland

ecologically improved



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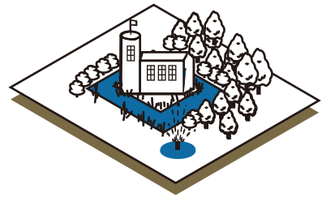
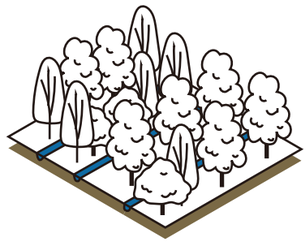
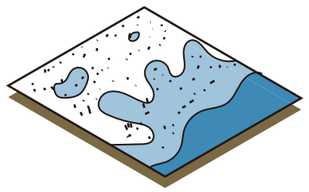


Aesthetic water feature

Water balance & Improved ecological quality

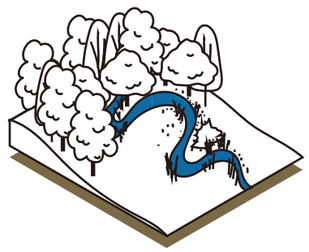


Grove forest

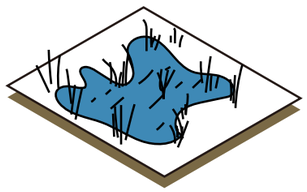


Flow meadow

re-naturalization



Forest cover in headwater areas

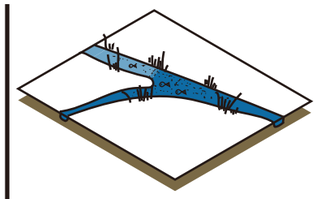


Wetland restoration

Re-meandering

Bank re-naturalization

Removal



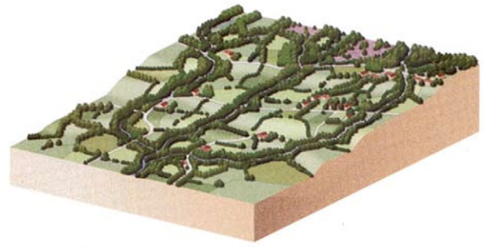
Removal of longitudinal barriers

Spatial typologies in Baakse beek area

Source: Van der Molen et al., 2012

Laaglandbeek (Hoogst Ecologisch Niveau)

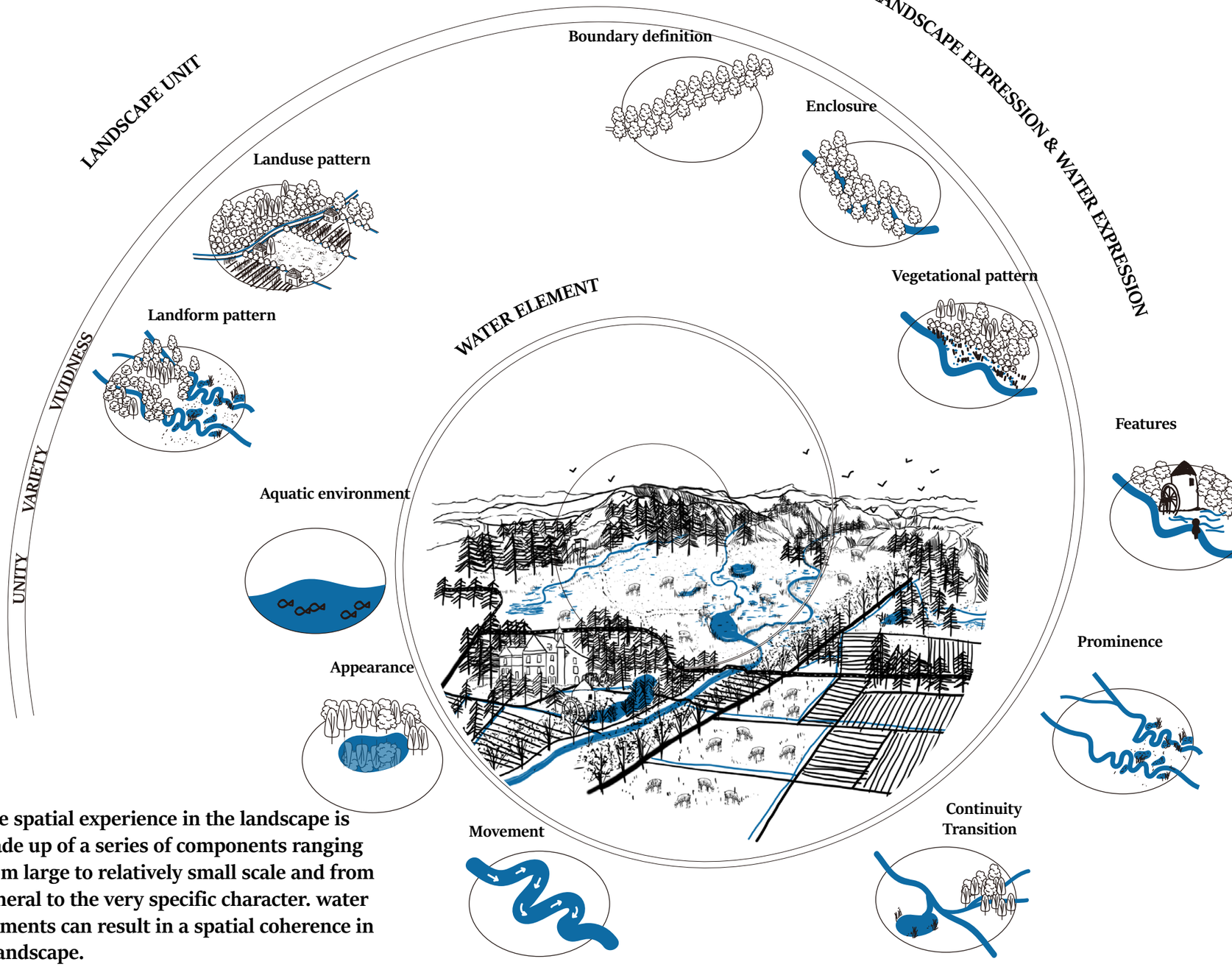
Moeraslandbeek (Hoogst Ecologisch Niveau)



Terrasrandbeek (Hoogst Ecologisch Niveau)

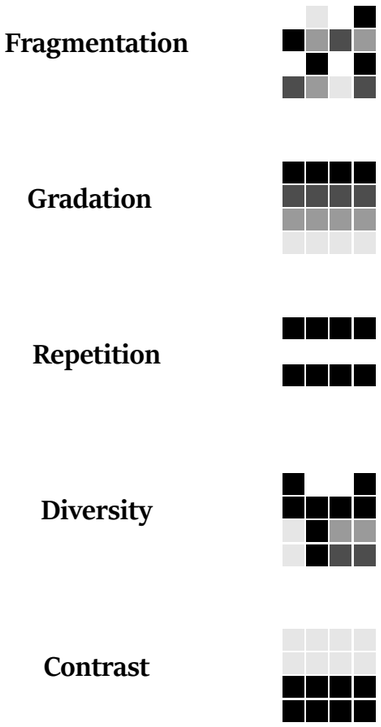
Estate landscape ***Sand ridge landscape*** ***Peat mining landscape*** ***Camp landscape*** ***Terrace edge landscape***

Spatial relationship between water and landscape settings - spatial design principle



The spatial experience in the landscape is made up of a series of components ranging from large to relatively small scale and from general to the very specific character. water elements can result in a spatial coherence in a landscape.

Spatial modification principles

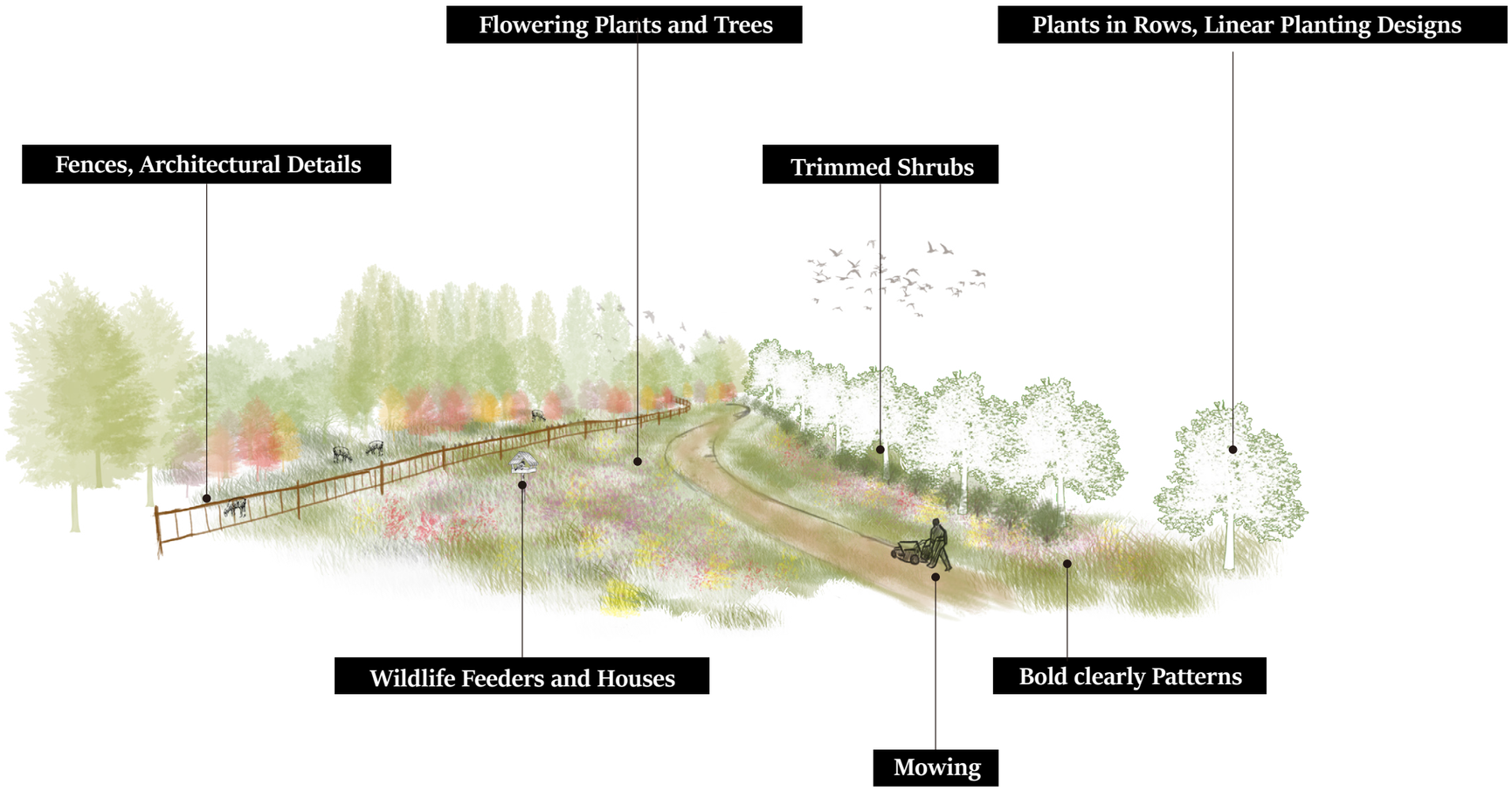


Spatial coherence in landscape could be rebuild through adjust the spatial layout of landscape elements like the landuse, vegetation patten or specific architectonic features to deliver or strengthen spatial feeling of contrast, diversity, repetition, gradation or even fragmentation.

Litton, R. B., Tetlow, R. J. (1974) Water and landscape : an aesthetic overview of the role of water in the landscape. Port Washington, N.Y.: Water Information Center.

Spatial design principle

Cue to care



Evidence of human impact is another field for communicate ecological function in landscape

Nassauer, J.I. (1995). 'Messy Ecosystems, Orderly Frames'. Landscape Journal, 14(2), pp.161-169

Application at regional scale

Drought in the stream (Source: Waterschap Rijn en IJssel, 2014)

Design objectives

Overall Goal

Future-proof landscape

Three key objectives

Communicate ecological function through spatial design

+

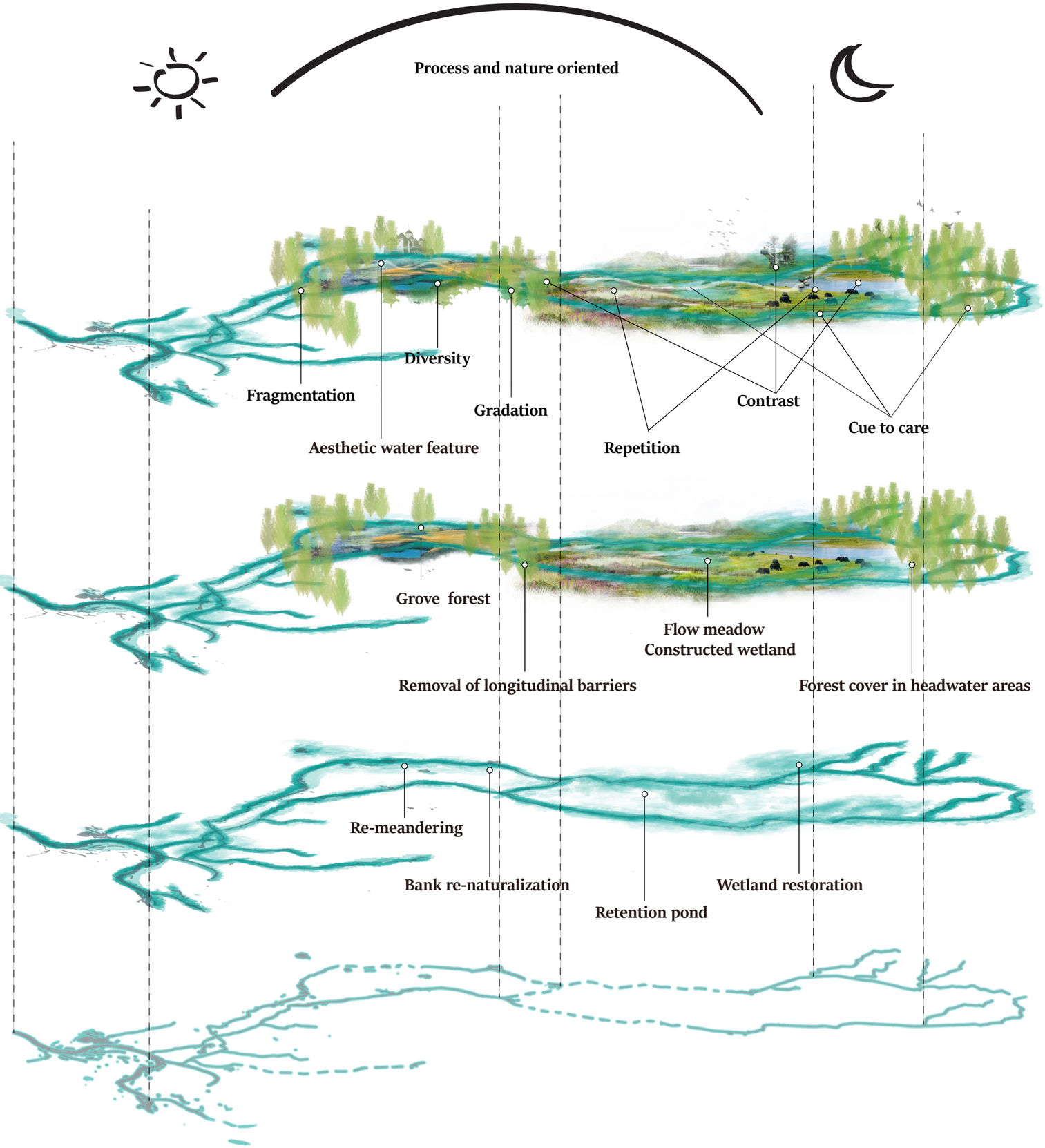
improved ecological qualities

+

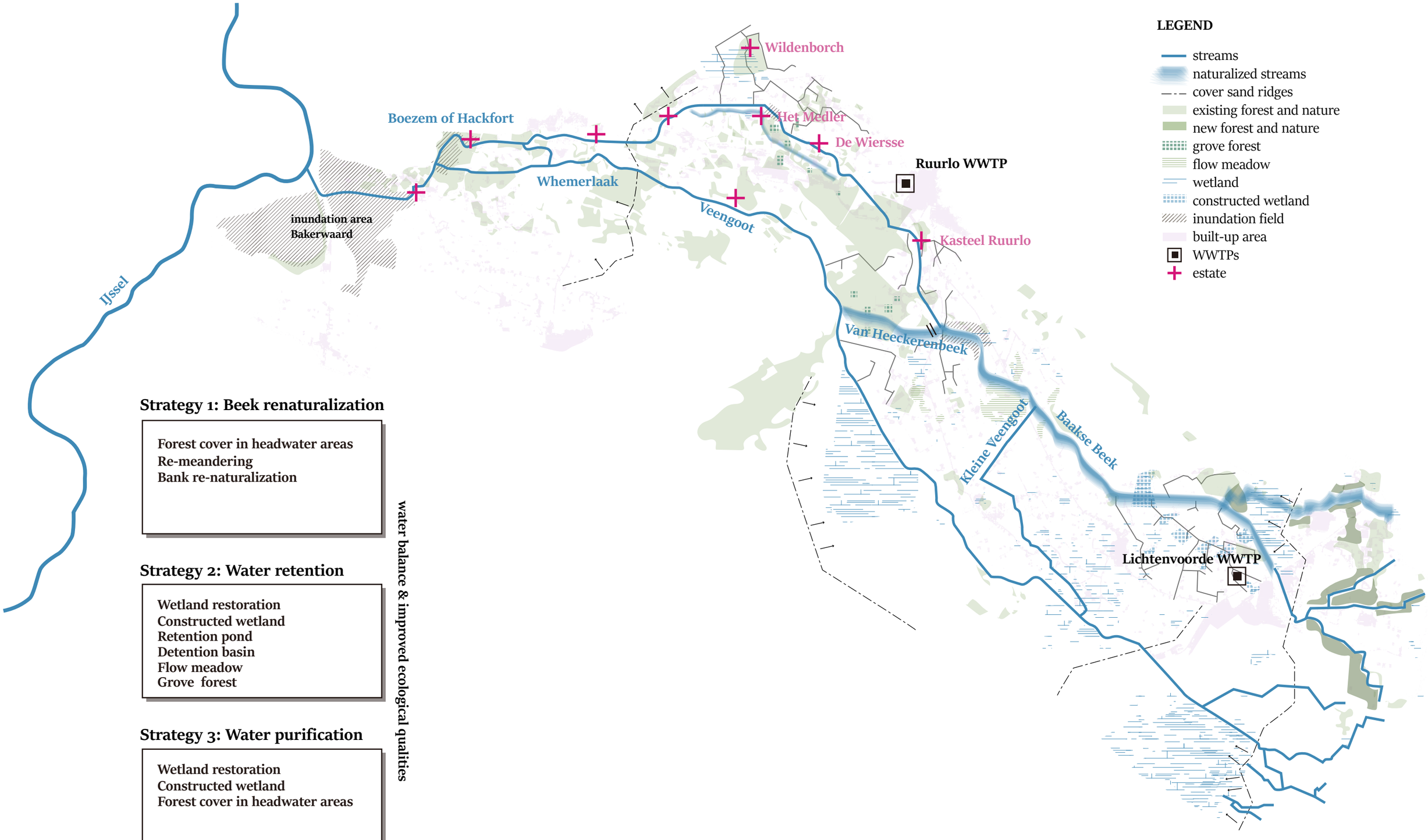
water balance

Current situation

vulnerable water ecosystem



Water and landscape ecology design strategies for Baakse beek catchment area



Strategy 1: Beek renaturalization

Forest cover in headwater areas
Re-meandering
Bank re-naturalization

Strategy 2: Water retention

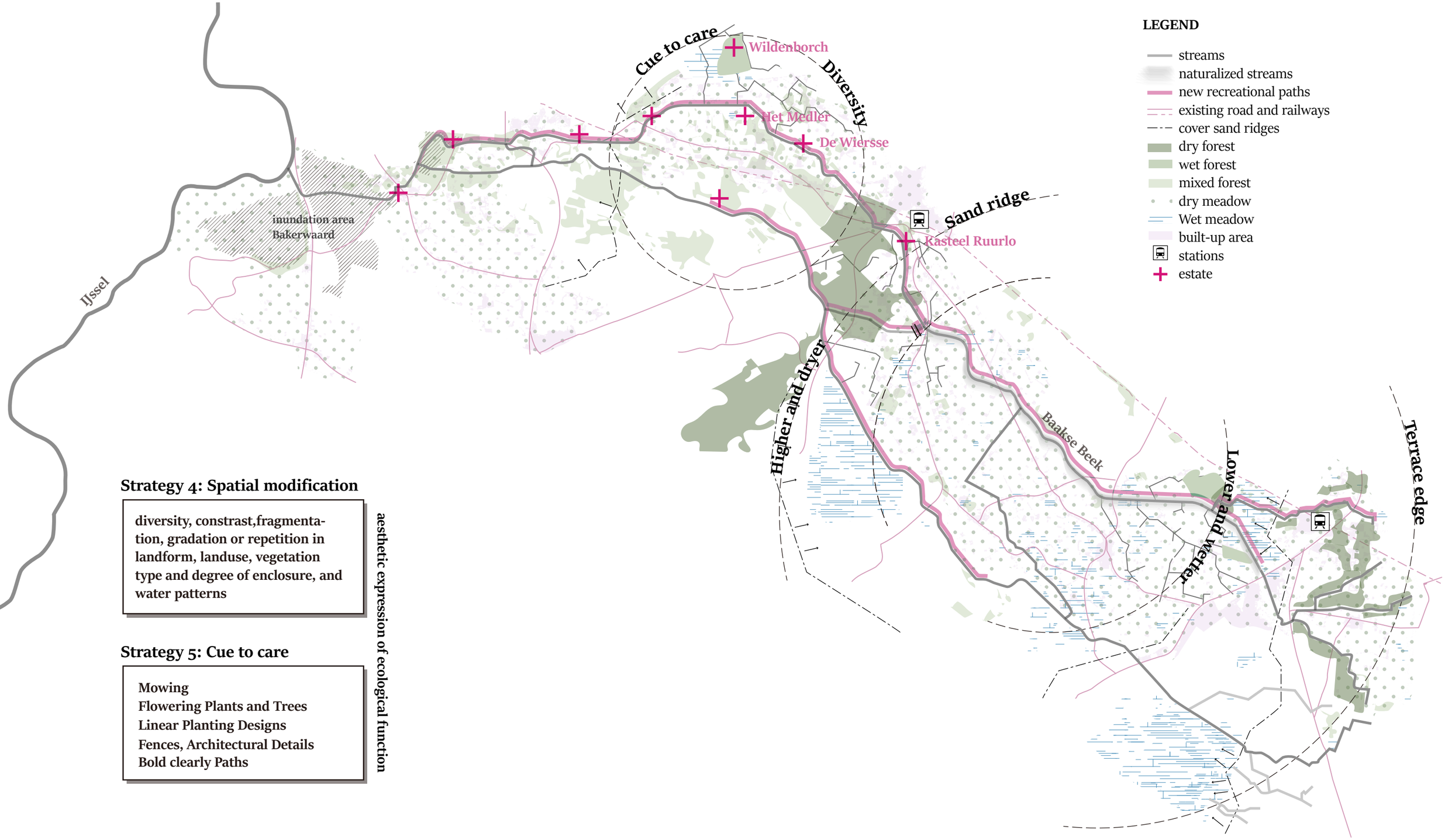
Wetland restoration
Constructed wetland
Retention pond
Detention basin
Flow meadow
Grove forest

Strategy 3: Water purification

Wetland restoration
Constructed wetland
Forest cover in headwater areas

water balance & improved ecological qualities

Spatial design strategies for Baakse beek catchment area



Strategy 4: Spatial modification

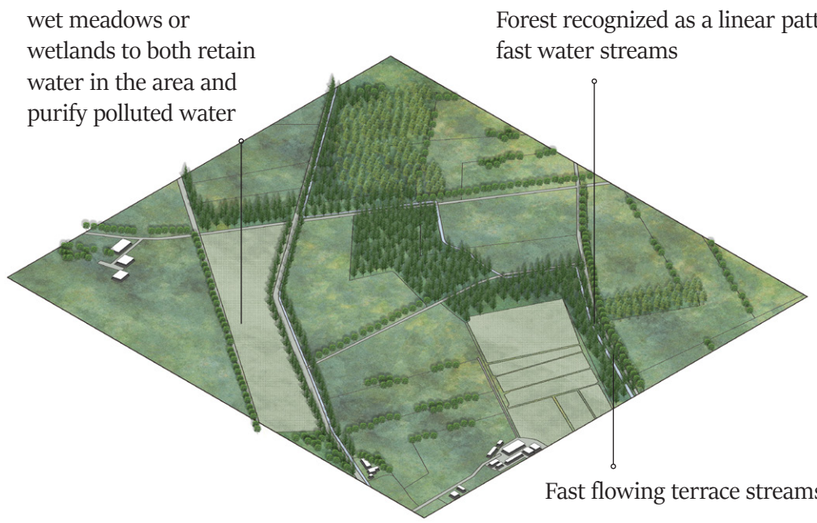
diversity, constrast,fragmentation, gradation or repetition in landform, landuse, vegetation type and degree of enclosure, and water patterns

Strategy 5: Cue to care

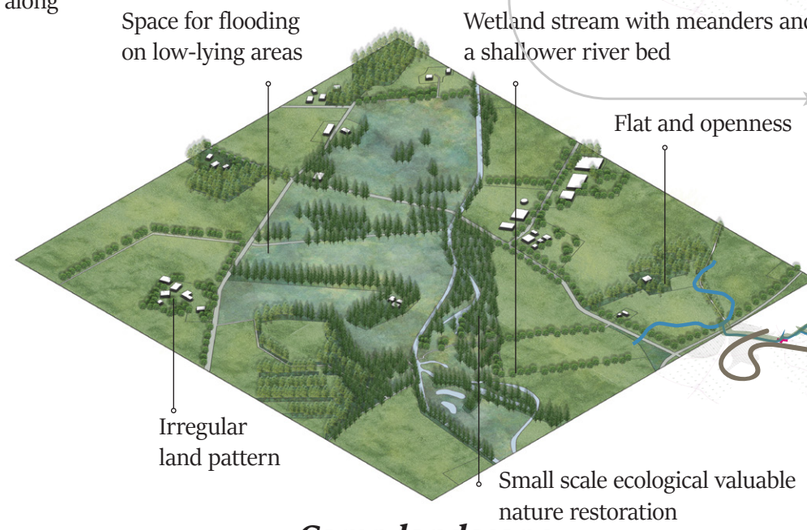
Mowing
Flowering Plants and Trees
Linear Planting Designs
Fences, Architectural Details
Bold clearly Paths

aesthetic expression of ecological function

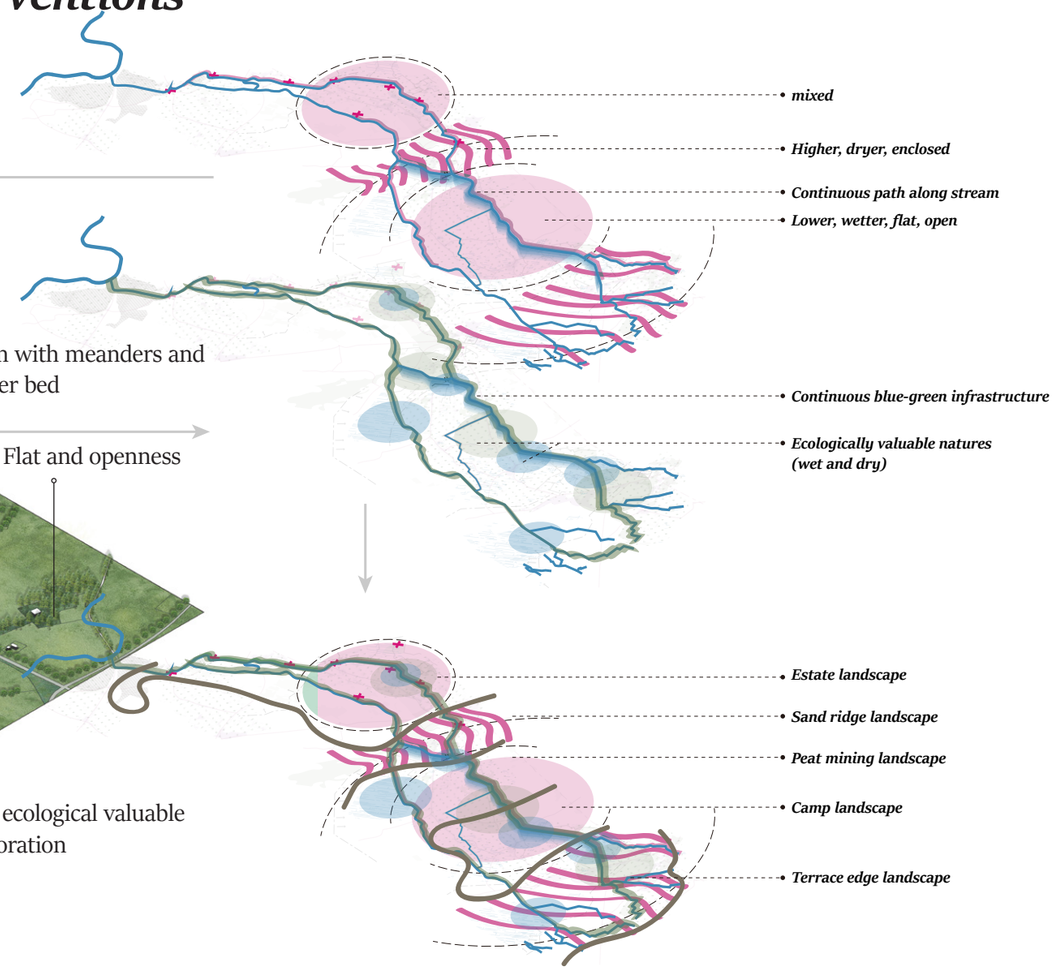
Overlap & Spatial characteristic in each landscape type after interventions

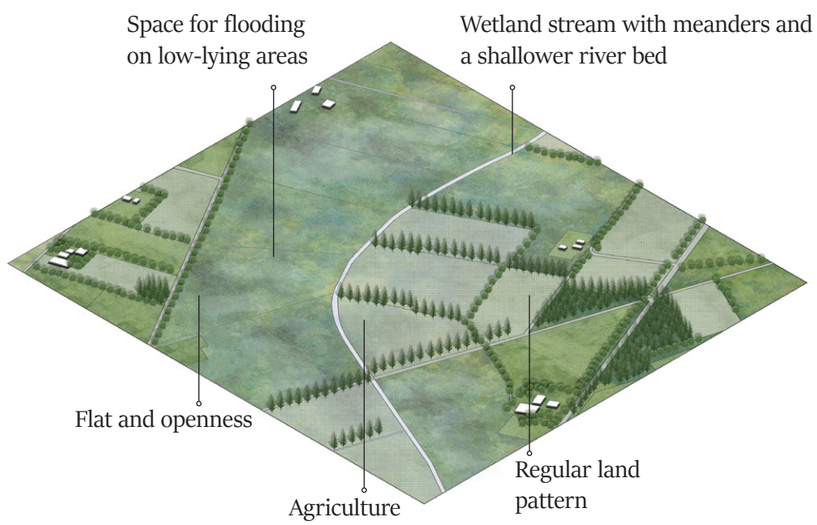


Terrace edge landscape

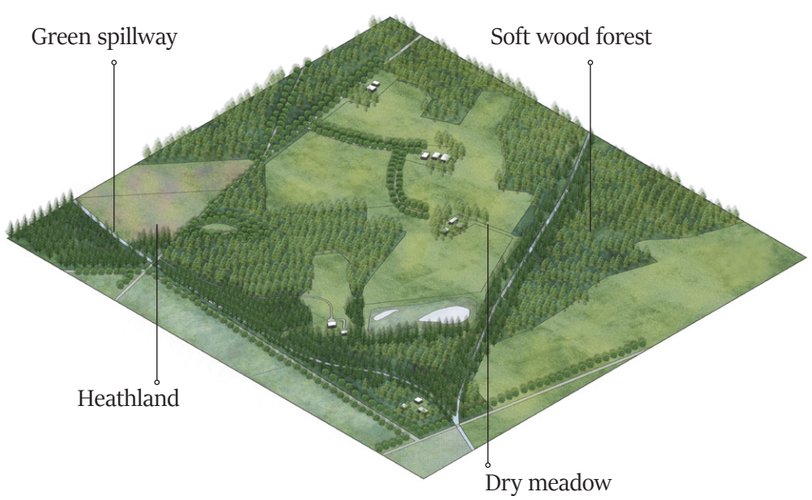


Camp landscape

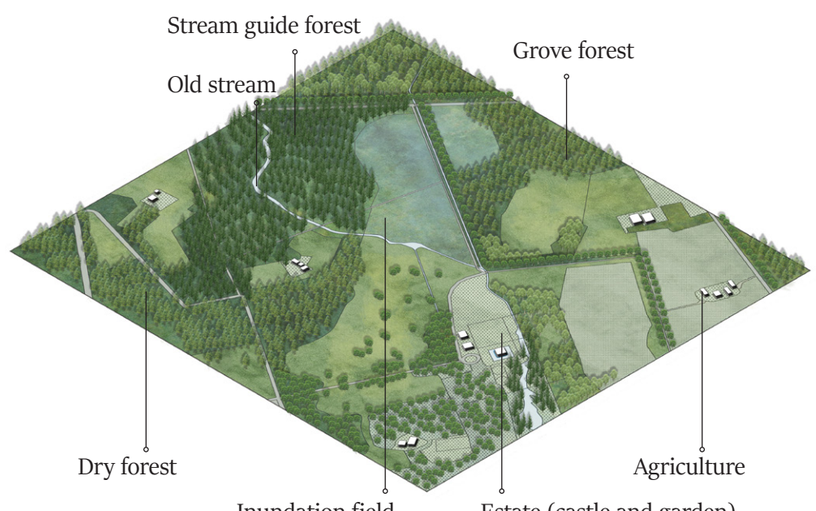




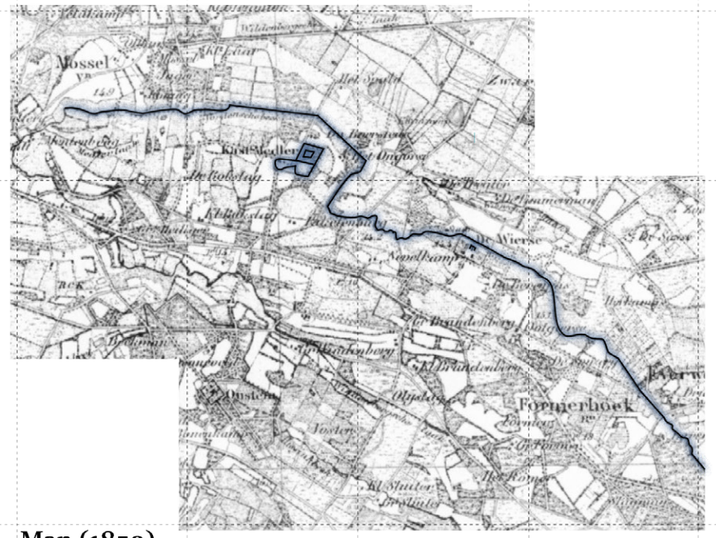
Peat mining landscape



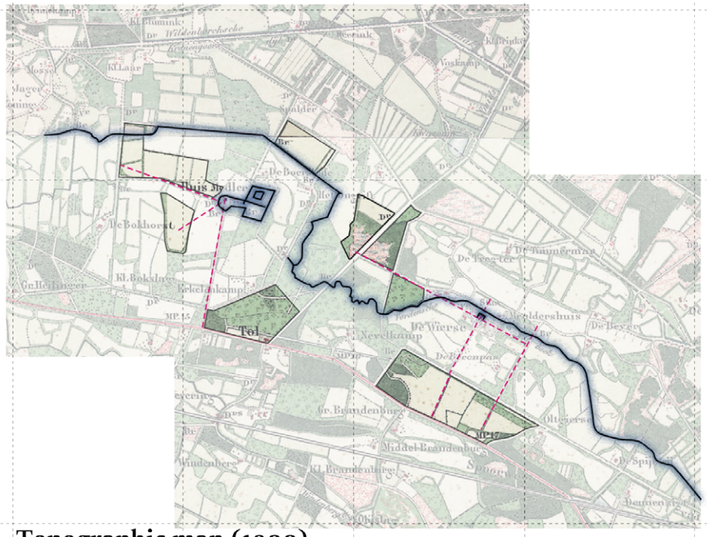
Sand ridge landscape



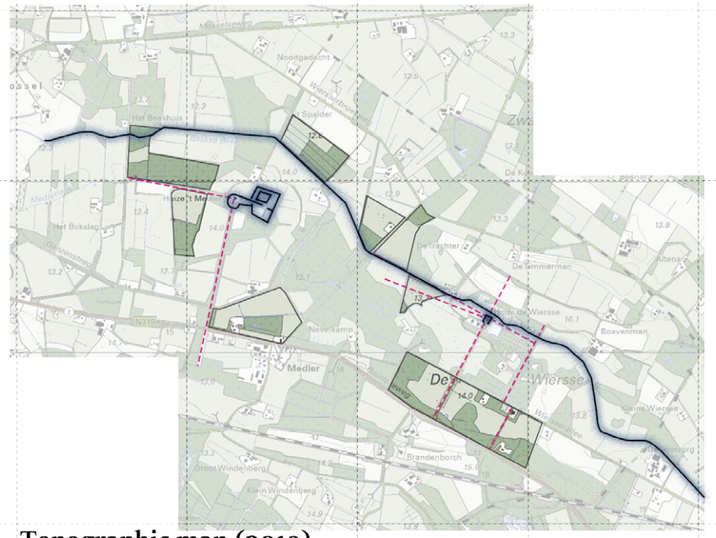
Estate landscape



Map (1850)



Topographic map (1900)



Topographic map (2019)

Medler-Wiersse cluster: the past

Design explorations at local scale

De Wiersse (Source: Estate De Wiersse)

Design approach: towards a rebalance in estate landscape

Landscape ecology model
- Water layer - basis
- Spatial layer
- Vegeration (nature) layer - ecology

Landscape aesthetics design
- Movement layer
- Cultural-aesthetics layer
- Spatial experience layer

Design toolbox

Stream renaturalization

Old stream restoration
Re-meandering
Bank re-naturalization

Wetness retention

Wetland restoration
Inundation field
Flow meadow
Grove forest

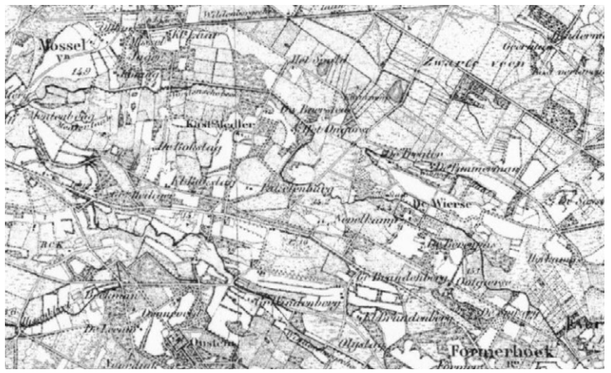
Water purification

Constructed wetland

Spatial modification

diversity, constrast,fragmentation, gradation or repetition in landform, landuse, vegetation type and degree of enclosure, and water patterns

Landscape ecology model 1

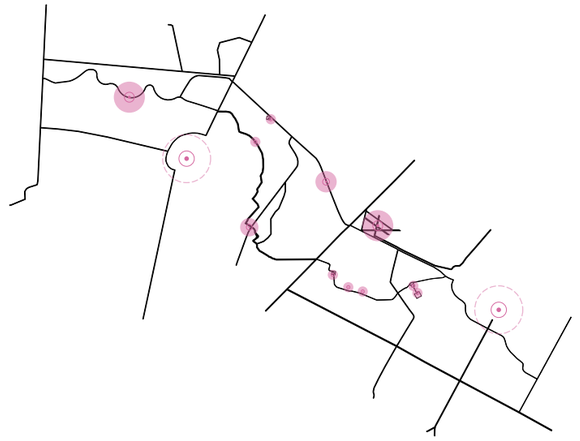


Landscape in 1850
history landscape restoration

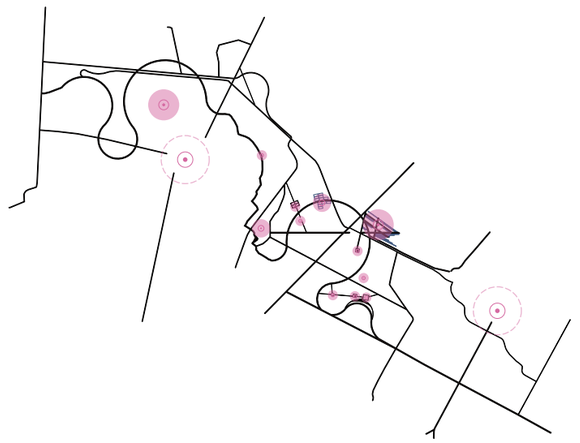
Landscape ecology model 2

Gelders nature network estate area plan
new natures, new functions in landscape

Spatial experience design option 1



Spatial experience design option 2



Design toolbox

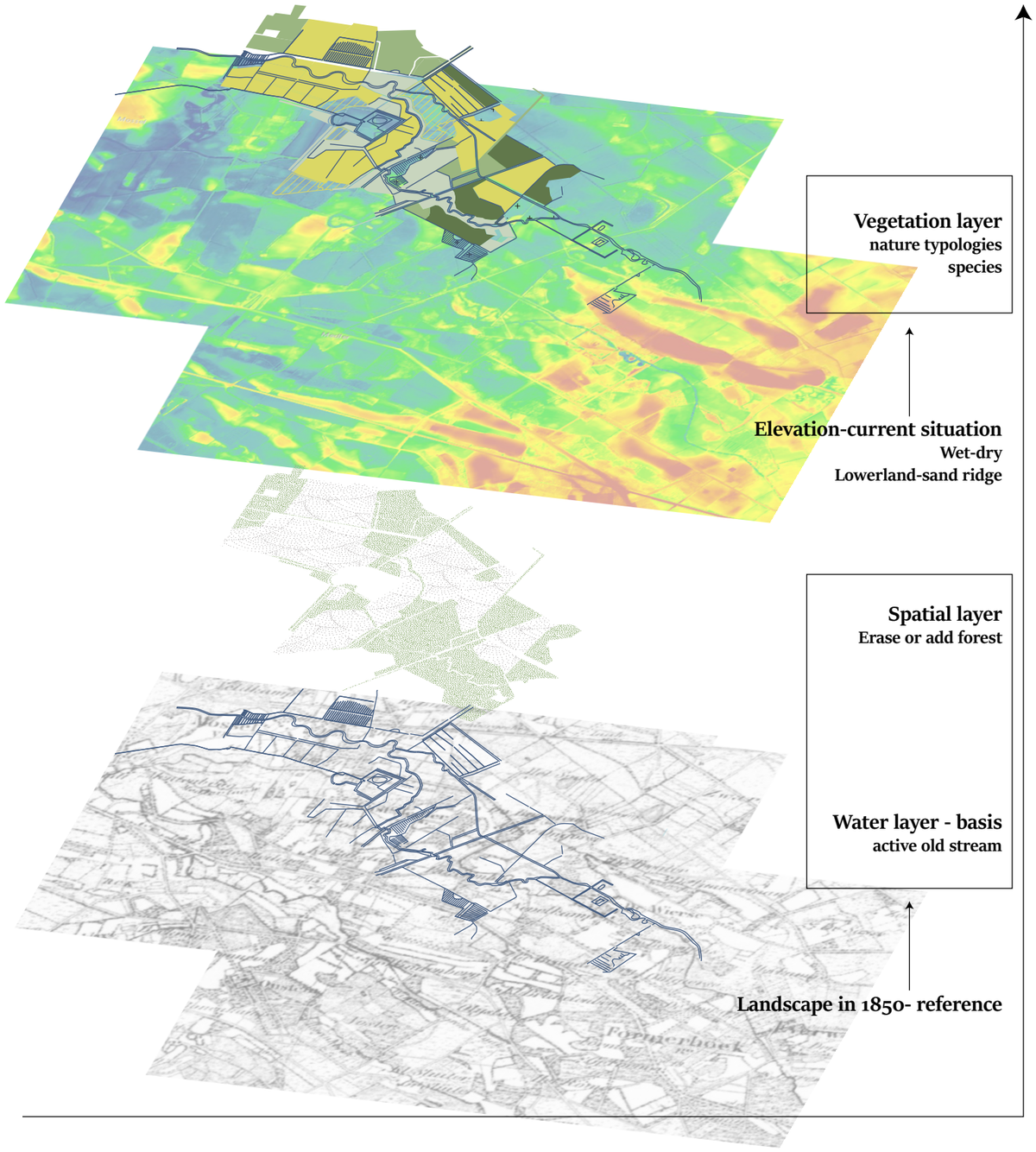
Spatial modification

Path/route
Views

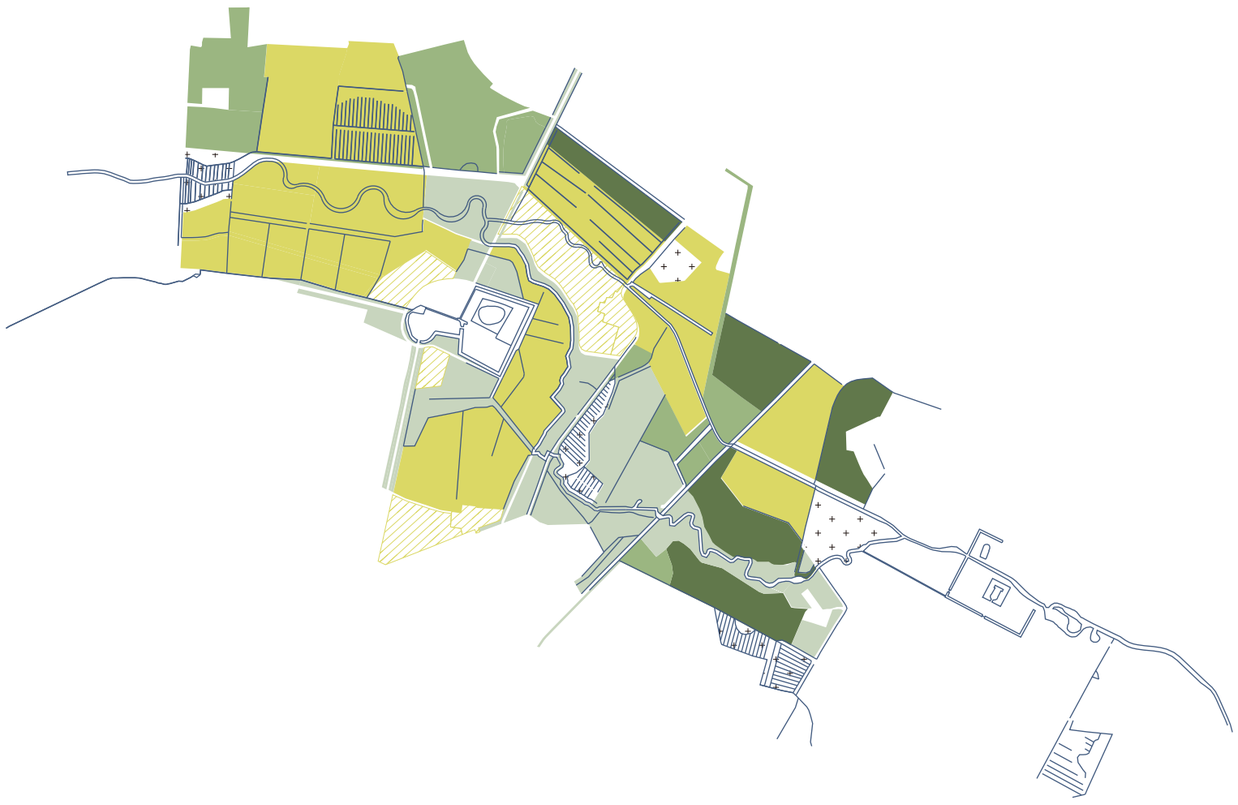
Cues to care/ cultural aesthetics elements

Flowering Plants and Trees
Water aesthetics elements
Watchtowers, bridge, platforms
Bold clearly Paths

Landscape ecology model 1: restoration of landscape in the past

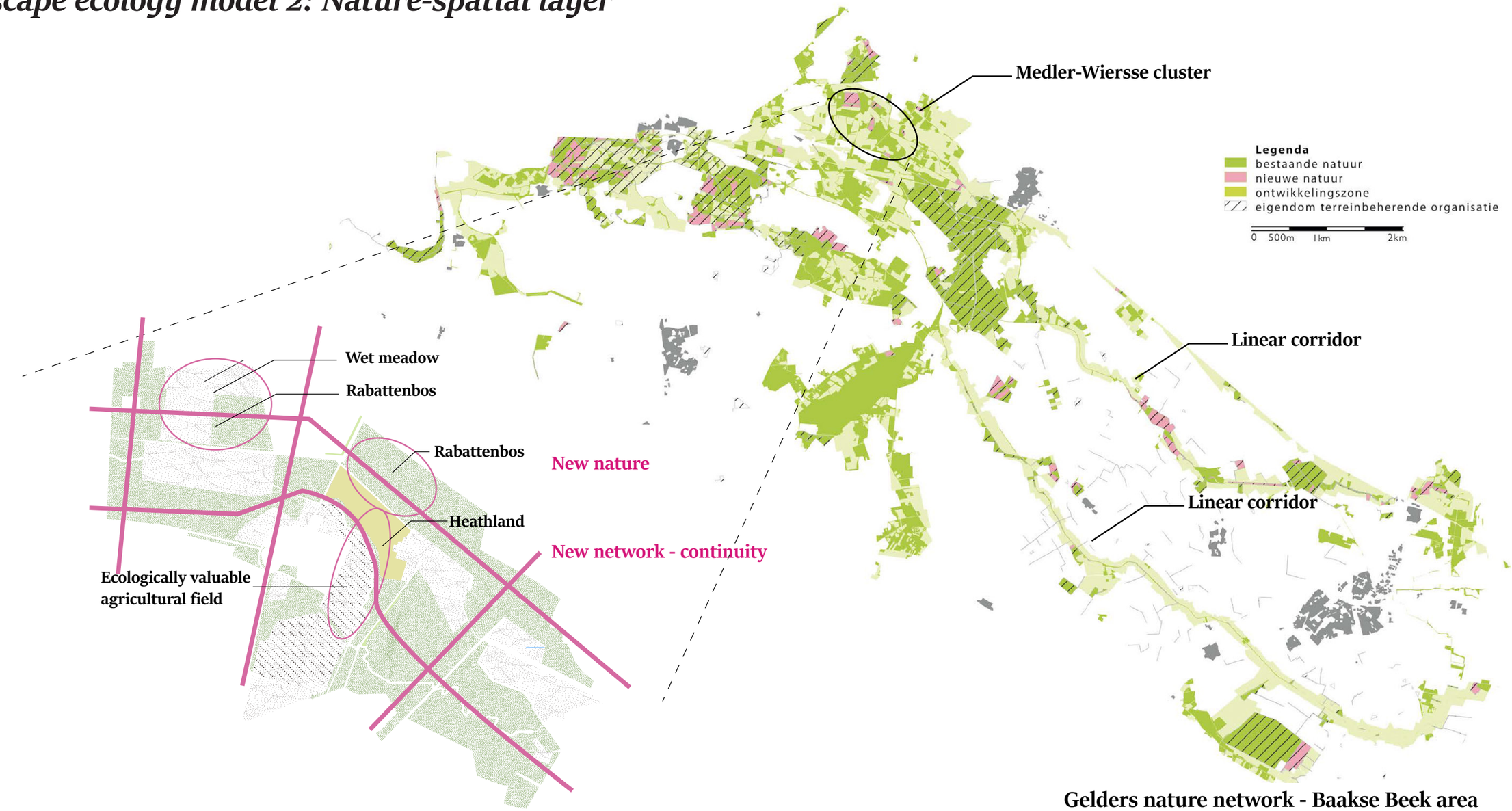


Landscape ecology model 1



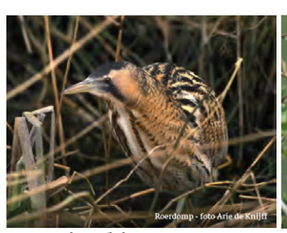
- Beech-oak forest
- Birch-oak forest
- Alder-Ash wood (Stream guiding forest)
- Moist meadow
- Dry meadow
- Alder fen wood (Grove forest)
- Waterway

Landscape ecology model 2: Nature-spatial layer

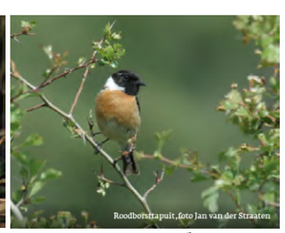


Gelders nature network - Baakse Beek area

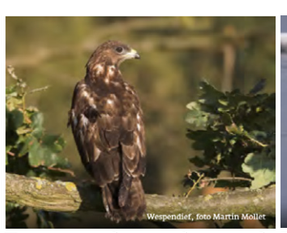
New network - diversity



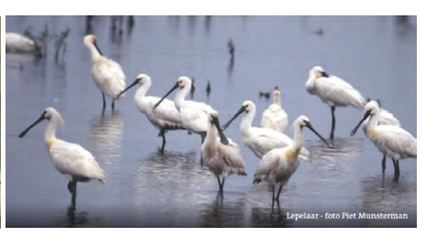
Eurasian bittern
(Roerdomp)



European stonechat
(Roodborsttapuit)



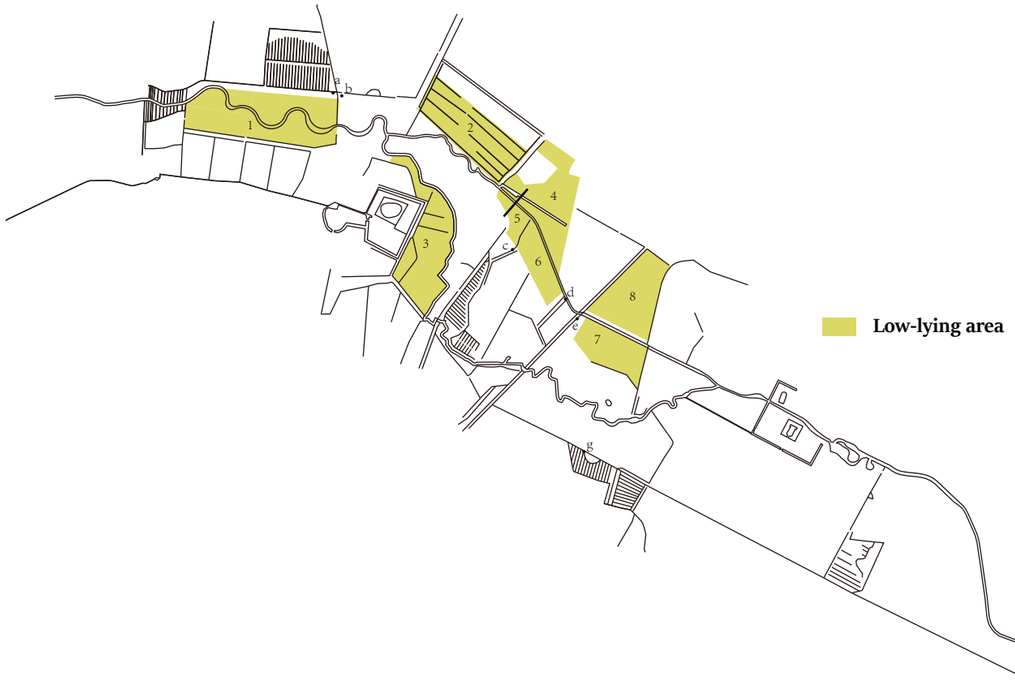
European honey buzzard
(Wespendief)

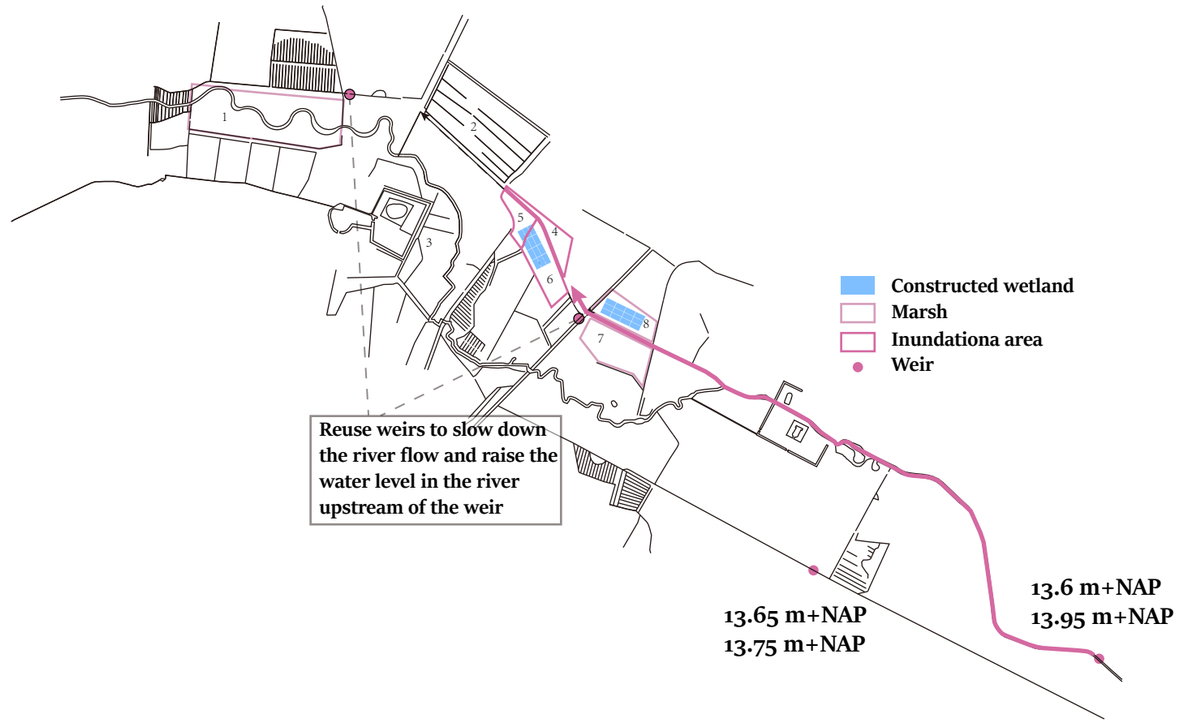


Eurasian spoonbill
(Lepelaar)

Goal:
In accordance with the Natura 2000 and Gelders Nature Network, an ecological network is built through naturalising the canal and connecting diverse ecological valuable natures including wetlands, heathlands, woodlands and arable land.

Landscape ecology model 2: water layer





Average water levels at monitoring point (weirs)

	Weir	high water level (m+NAP)	low water level (m+NAP)
a	Wiersse t Medler M	11.9	11.5
b	Stuw Medler	12.1	12.1
c	Wiersse t Medler C	12.5	12.2
d	Wiersse t Medler K	12.7	12.3
e	Wiersse t Medler L	12.8	12.3
g	Wiersse t Medler I	13.3	13.0

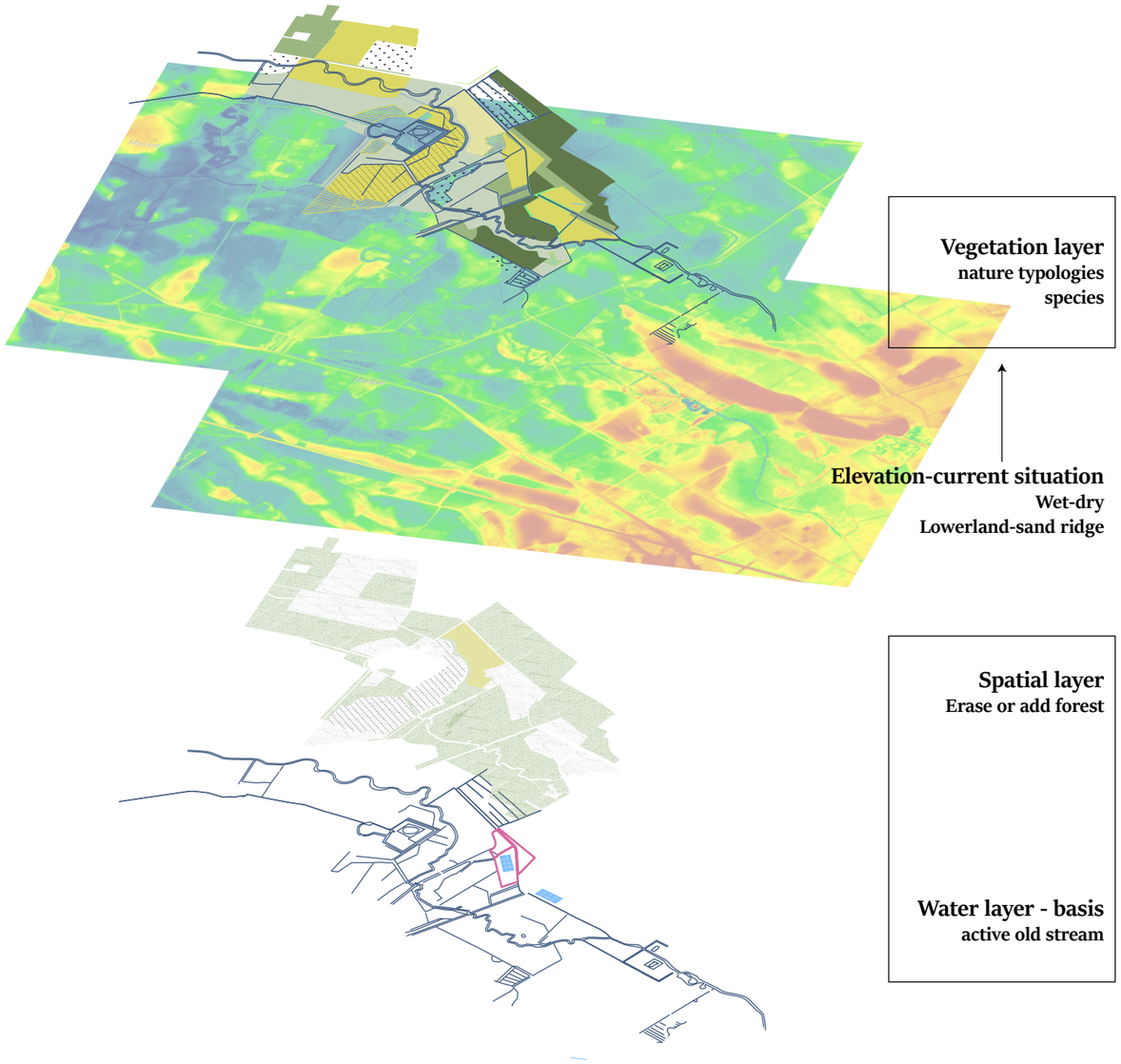
Levels of the wet meadows in stream valley (Environment model 1)

	ground level(m)	current groundwater level(high/low) (m-mv)
1	12.5	0.25-0.4/0.8-1.2
2	12.6	0.25-0.4/0.8-1.2
3	12.7	0.25-0.4/0.8-1.2
4	12.9	0.25-0.4/0.8-1.2
5	12.9	0.25-0.4/0.8-1.2
6	12.9	0.25-0.4/0.8-1.2
7	13.4	0.25-0.4/0.8-1.2
8	13.0	0.4-0.8/1.2-1.8

To bring back wetness and to improve water quality in estate, new water structures, for example inundation field and constructed wetland could be added to water layer.

(Source: Waterschap Rijn en Ijssel, 2019)

Landscape ecology model 2: new ecologically valuable natures and water elements



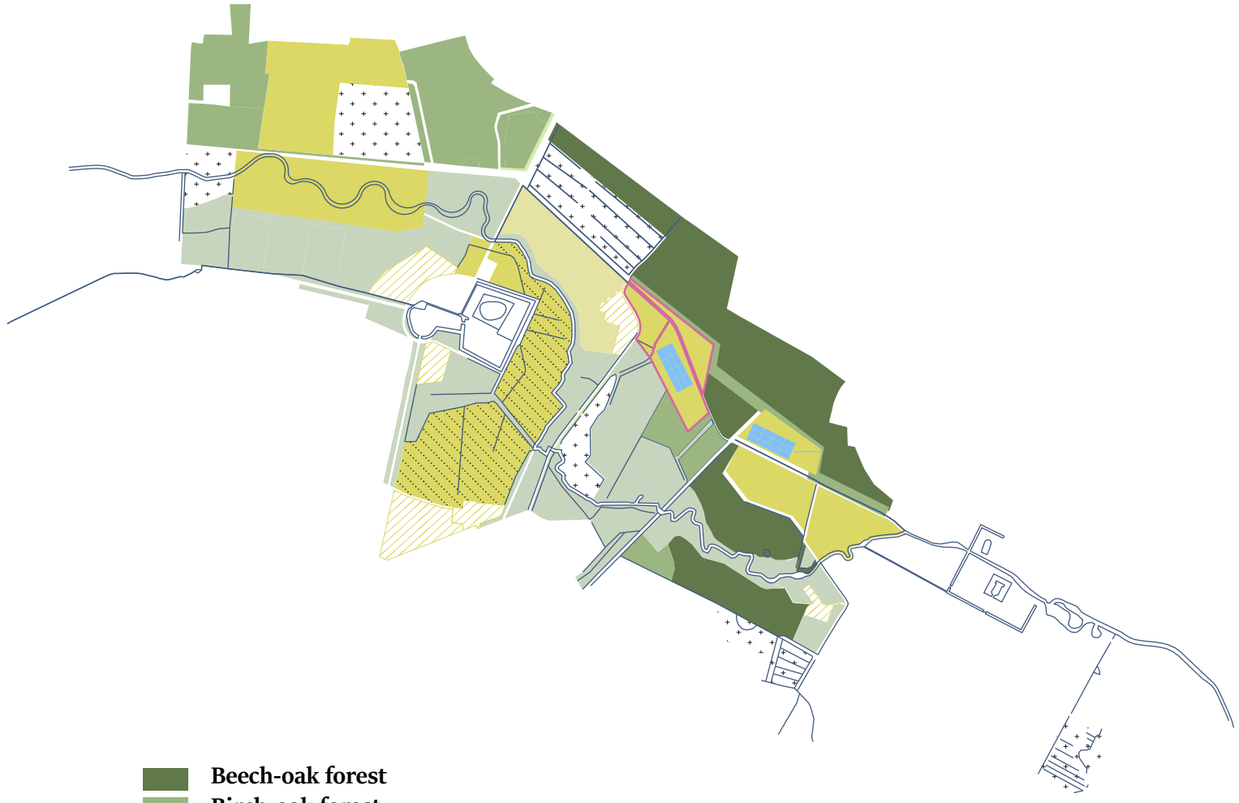
Vegetation layer
nature typologies
species

Elevation-current situation
Wet-dry
Lowerland-sand ridge

Spatial layer
Erase or add forest

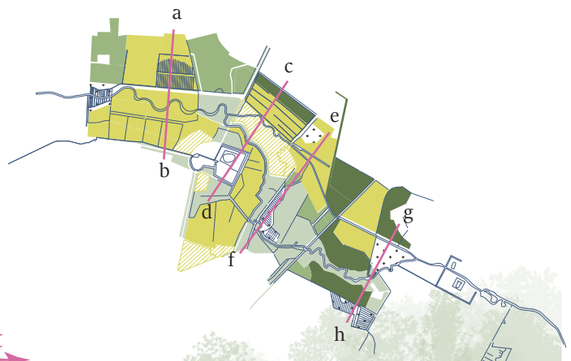
Water layer - basis
active old stream

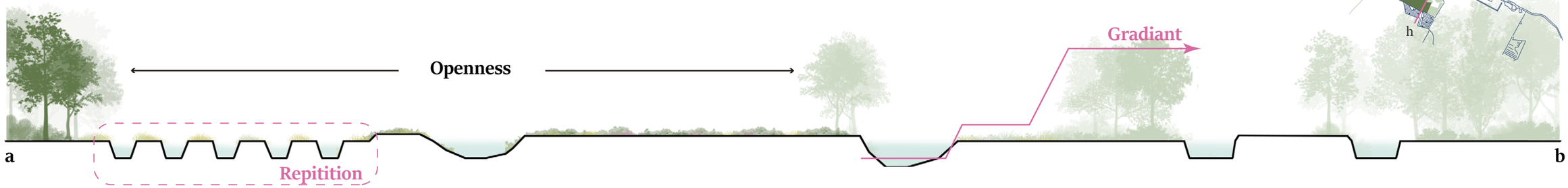
Landscape ecology model 2

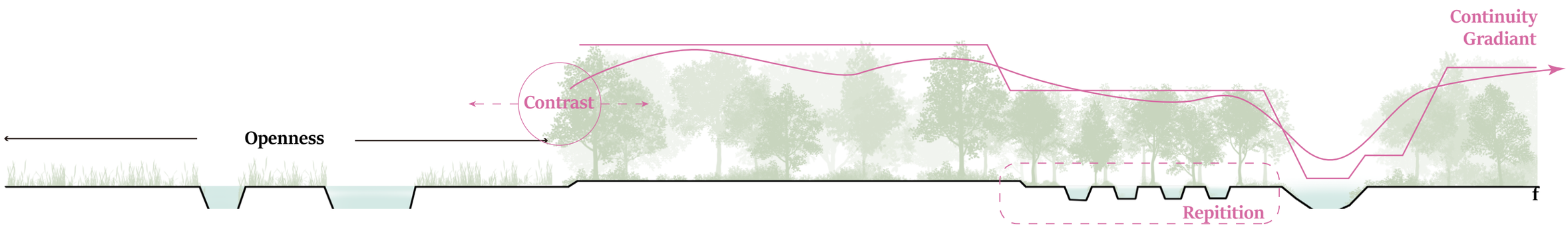


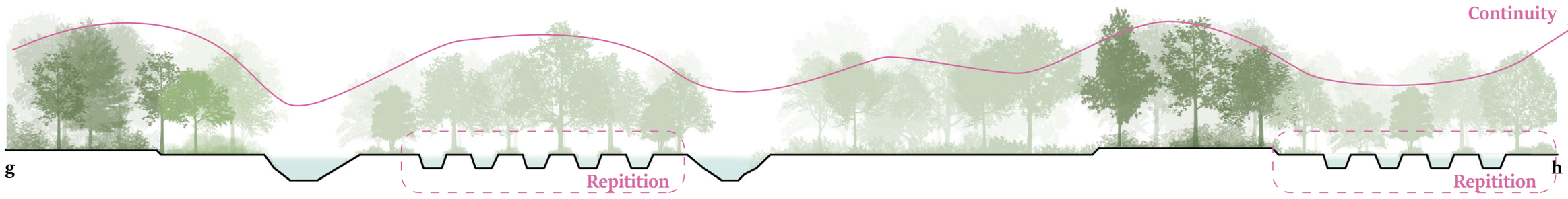
- Beech-oak forest
- Birch-oak forest
- Alder-Ash wood (Stream guiding forest)
- Moist meadow
- Dry meadow
- Alder fen wood (Grove forest)
- Heathland
- Waterway
- Constructed wetland
- Inundation field
- Ecologically valuable arable land

Landscape ecology model 1: spatial consequence

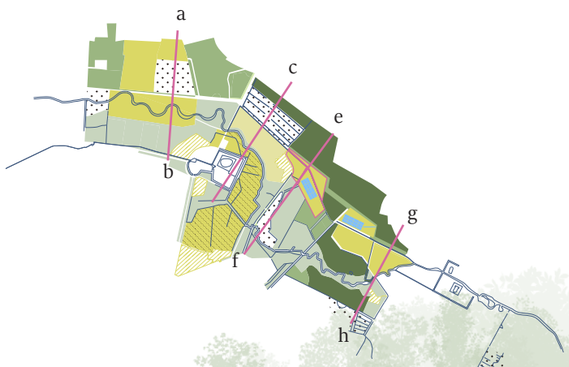


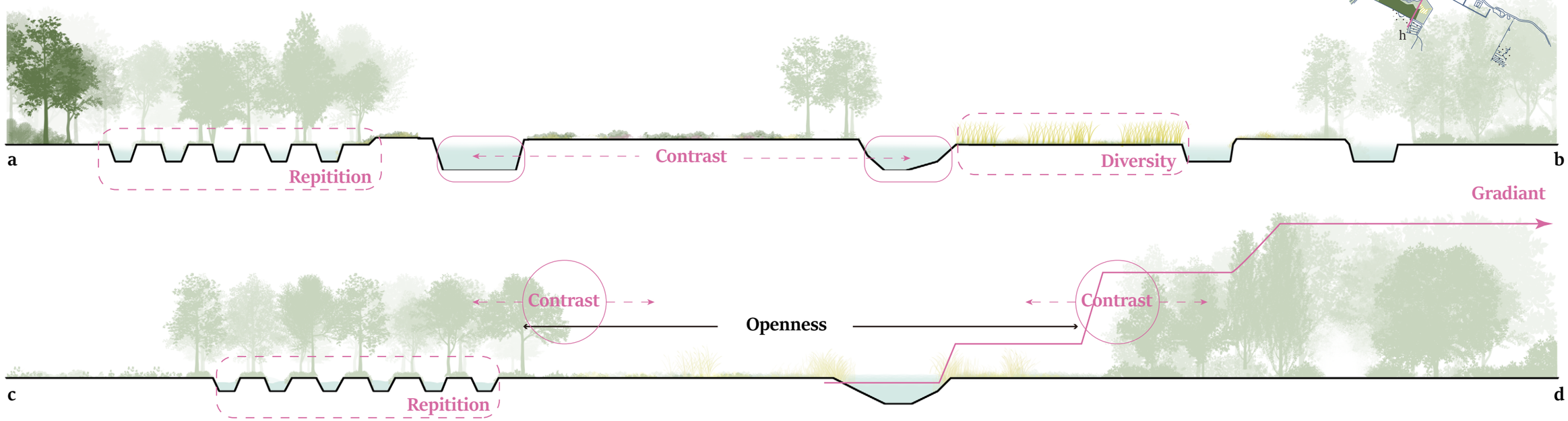


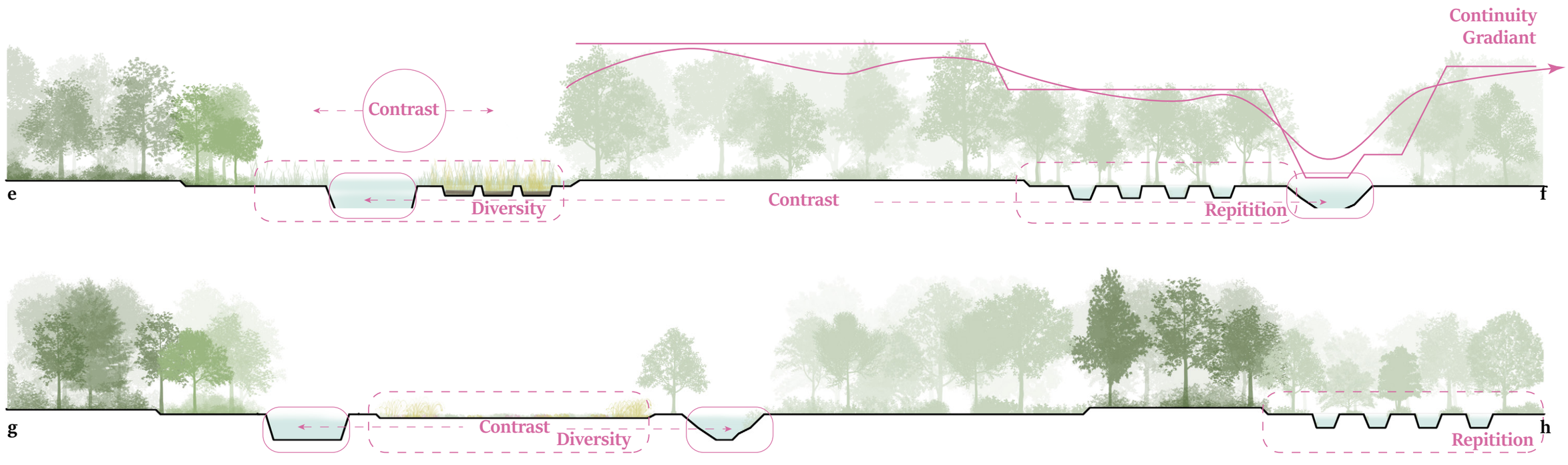




Landscape ecology model 2: spatial consequence

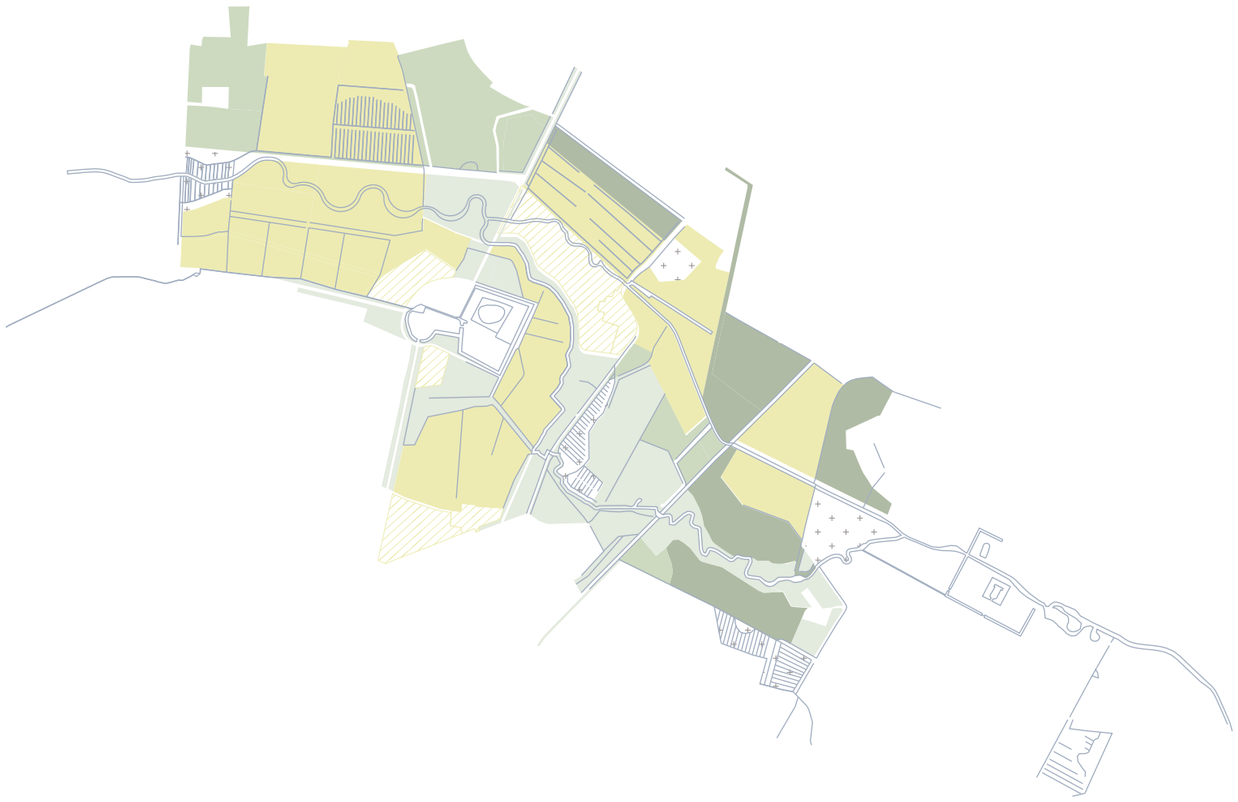




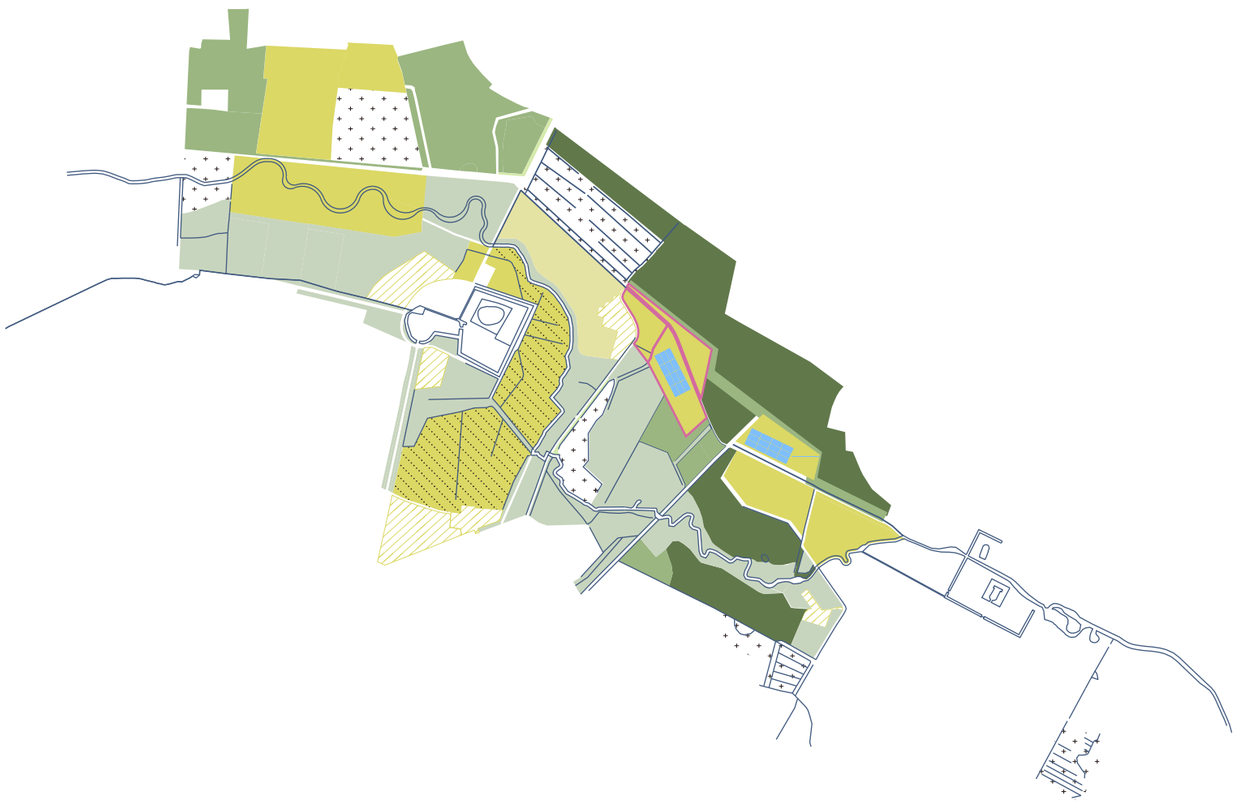


Landscape ecology models: comparison and evaluation

	Water			Ecology		Spatial consequence				
	Stream renaturalization	Wetness retention	Water quality	Connectivity	Biodiversity	Diversity	Contrast	Fragmentation	Gradation	Repetition
Model 1	5	2	0	4	3	3	3	4	3	4
Model 2	3	4	2	4	4	3	3	2	3	4



Landscape ecology model 1

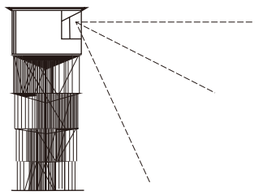


Landscape ecology model 2

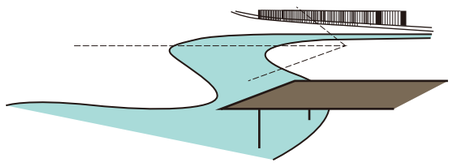
Spatial experience design: path and movement, cultural-aesthetics elements and placement

New cultural-aesthetics elements

Viewing point

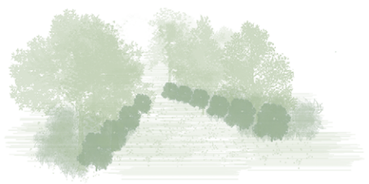


Watchtower

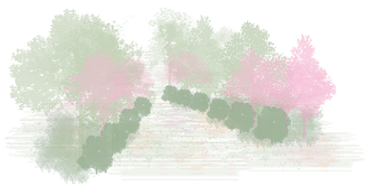


Bridge/Viewing platform on water

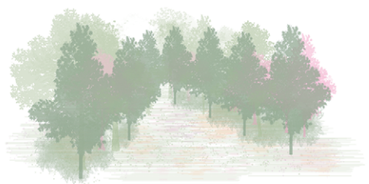
Planting elements



Trimmed shrubs

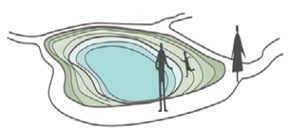


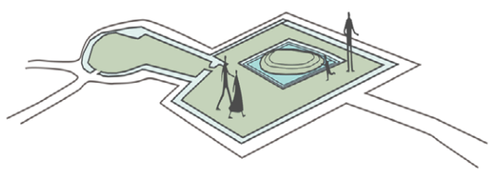
Flowering plants



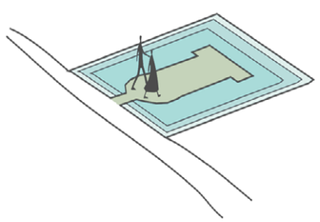
Plant in row

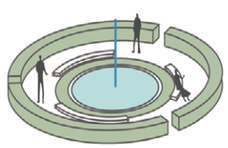
Water elements

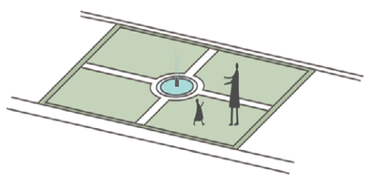




Ponds

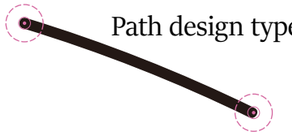




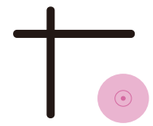


Fountains

Two ways to organize paths

	Functional purpose	Aesthetic appreciate transaction
 Path design type 1	Direct access	Coherent, orderly
 Path design type 2	Slower meandering exploration of the	Complex, mysterious

Six ways to place elements

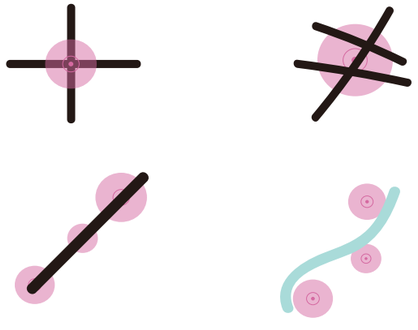
 At the junction	 Hidden, be away from path
 Path around edge of a space	 Space dispenses with paths
 On axis	 Along water edge

Two spatial experience design options based on landscape ecology model 2

Spatial experience design option 1

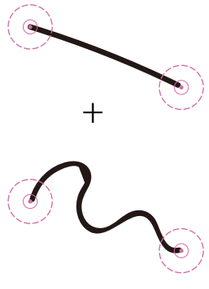
Path design

Place elements

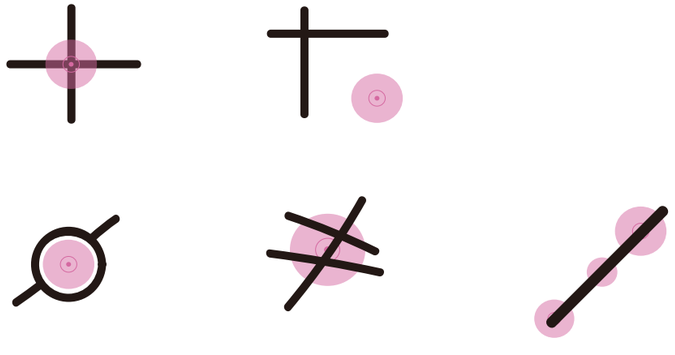


Spatial experience design option 2

Path design



Place elements



Vision

Water and landscape ecology

- **Strategy 1: Stream re-naturalisation**
- **Strategy 2: Bring back wetness**
- **Strategy 3: Water purification**

Spatial experience

- **Strategy 4: Spatial modification**
- **Strategy 5: Cue to care**

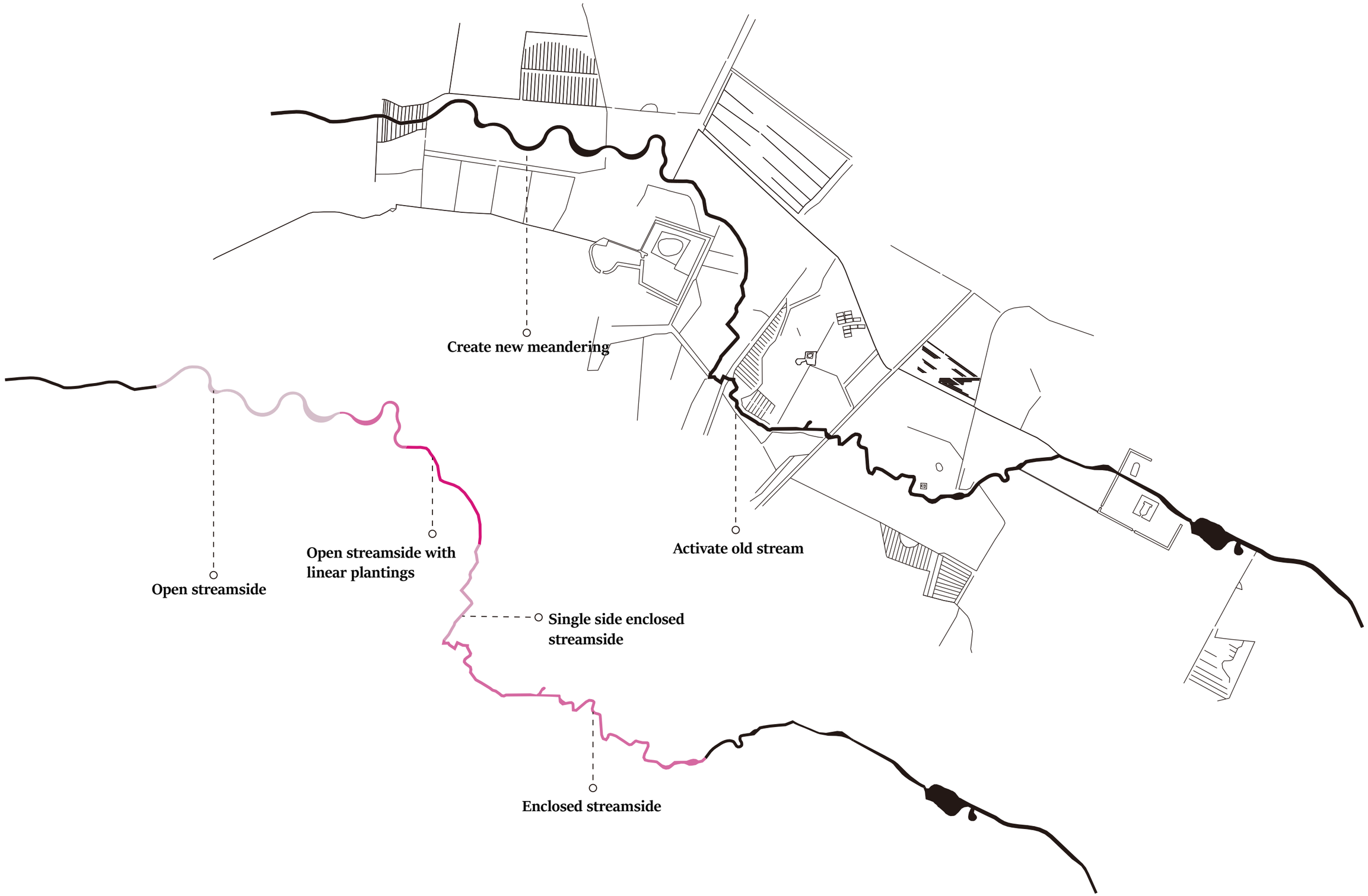
- Arable land
- Meadow
- Marsh
- Swamp
- Heathland
- Shrub
- Forest
- Grove forest
- New tree
- Color tree
- Linear plant
- Stream
- Pond
- Ditch
- Constructed wetland
- Paved path
- Mowed path
- Platform
- Building

Landscape ecology model 2

+

Spatial experience design option 2

Strategy 1: Stream re-naturalisation

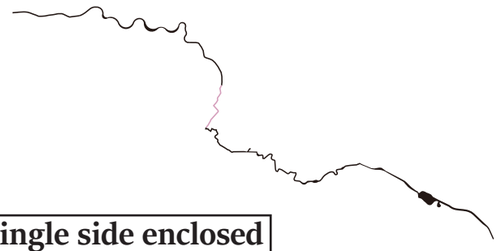


Stream bank naturalisation

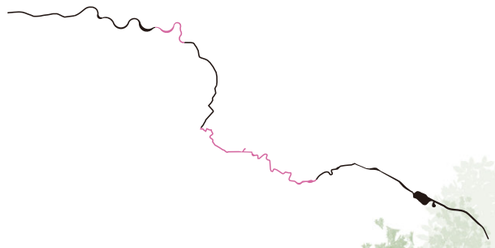
Open streamside

Open streamside with linear plantings

Stream bank naturalisation



Single side enclosed streamside



Enclosed streamside

Eco-system restoration: vegetation structure

Fagus sylvatica
Beech

Betula pendula
Silver birch

Fraxinus excelsior
Ordinary ash

Prunus avium
Sweet cherry

Alnus glutinosa
Black alder

Quercus robur
Pedunculate oak

Corylus avellana
Hazel

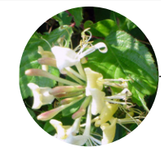
Crataegus monogyna
Common hawthorn

Sorbus aucuparia
Wild mountain ash

Sorbus aucuparia
Wild mountain ash

Rhamnus frangula
Sporke wood

Ribes nigrum
Blackcurrant



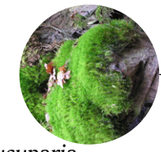
Lonicera periclymenum
Wild honeysuckle

Glechoma hederacea
Dog trot

Geum urbanum
Yellow nail herb

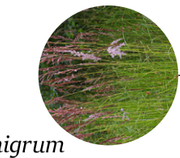
Hedera helix
Ivy

Rubus fruticosus
bushberry

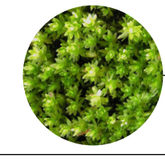


Dicranum scoparium
Gaff tooth moss

Deschampsia flexuosa
Sinuous smele



Calamagrostis canescens
Hen grass



Mnium hornum
Just star moss

Lysimachia vulgaris
Great adversity

Alder-Ash wood *(Pruno-Fraxinetum)*

Beech-oak forest *(Fago-Quercetum)*

Birch-oak forest *(Betulo-Quercetum roboris)*

Alder fen wood *(Carici elongata-Alnetum)*

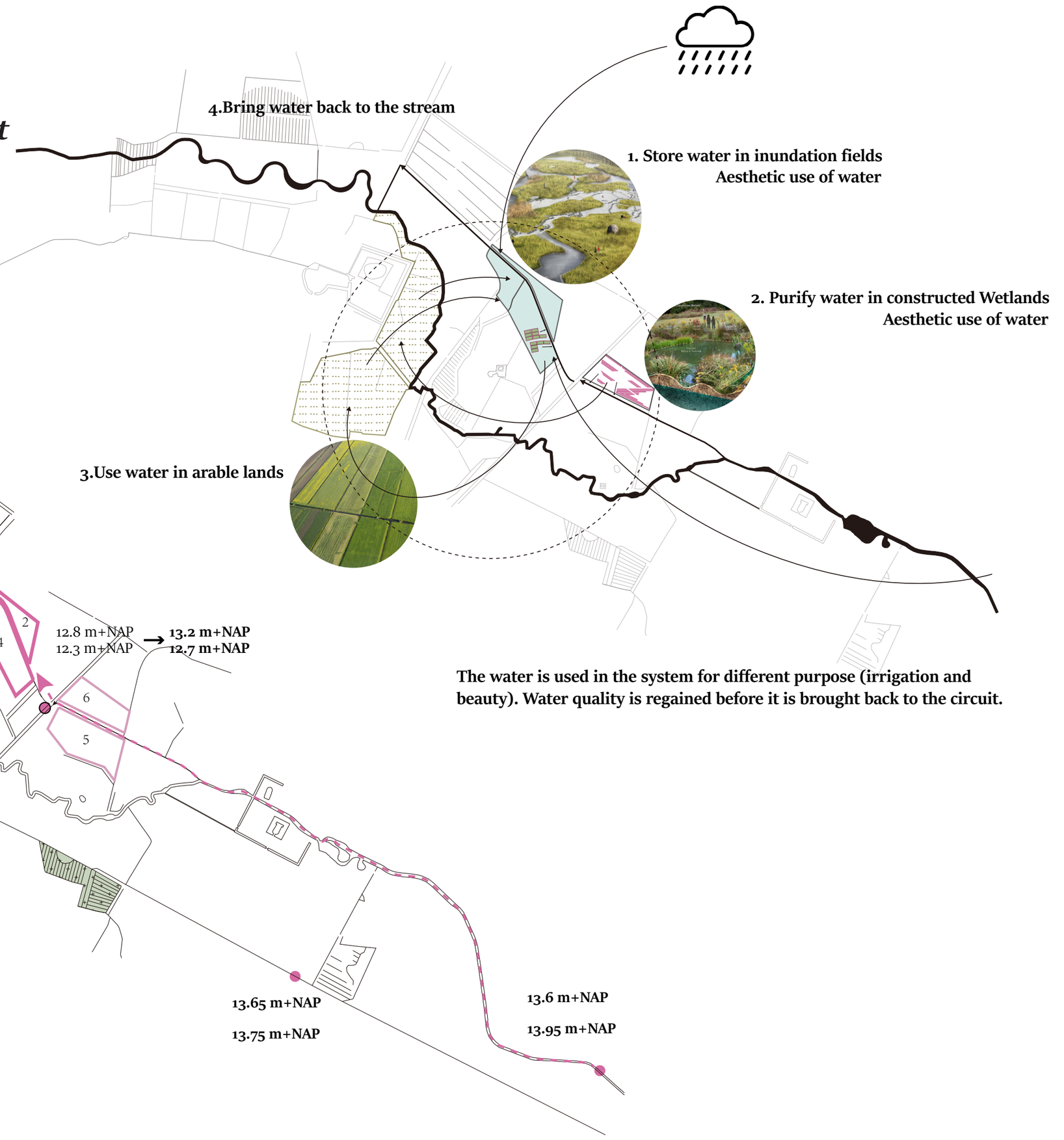
CANOPY

SHRUB

GROUND COVER

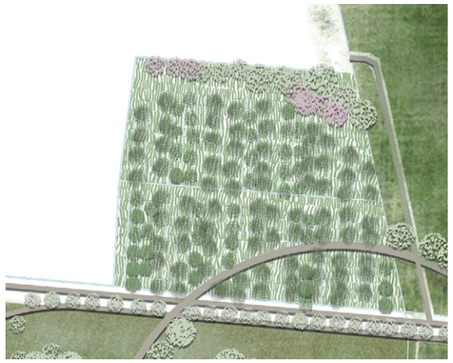
Strategy 2: Bring back wetness

Strategy 3: Water purification - circuit

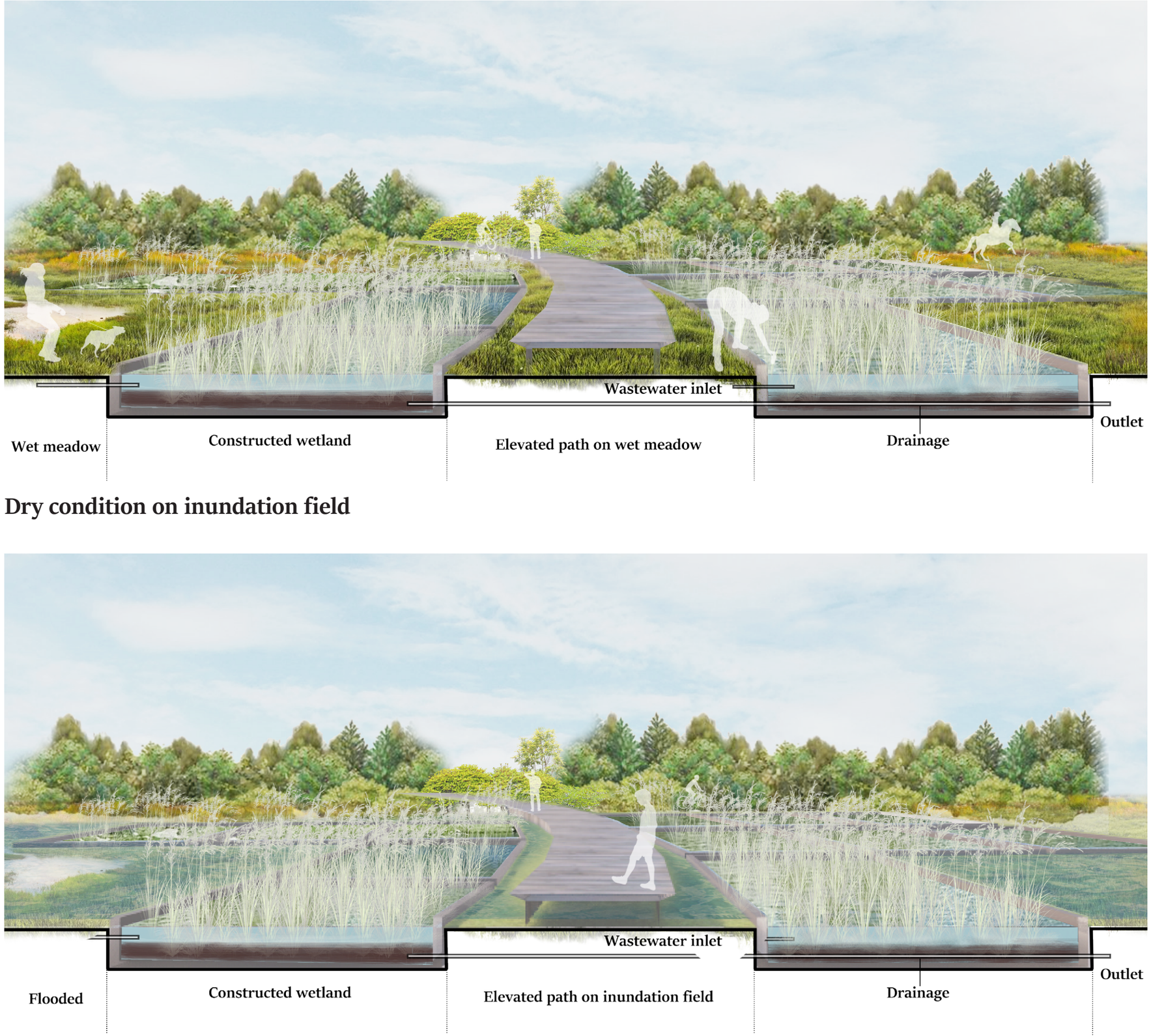


The water is used in the system for different purpose (irrigation and beauty). Water quality is regained before it is brought back to the circuit.

Rabattenbos



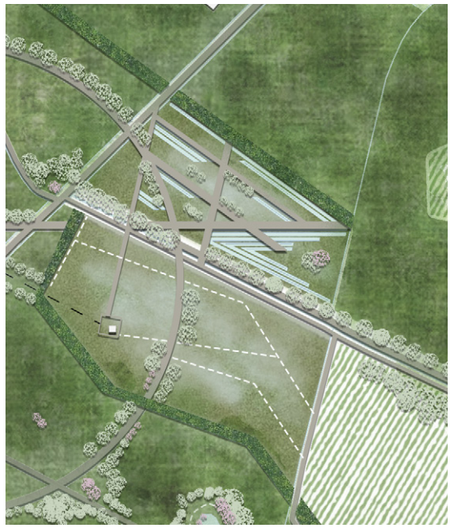
Inundation field and constructed wetland

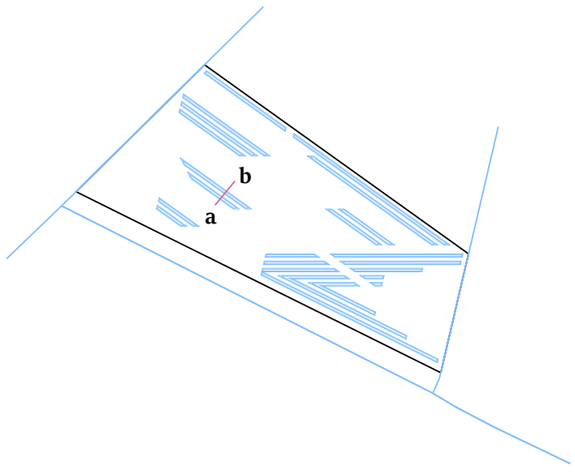


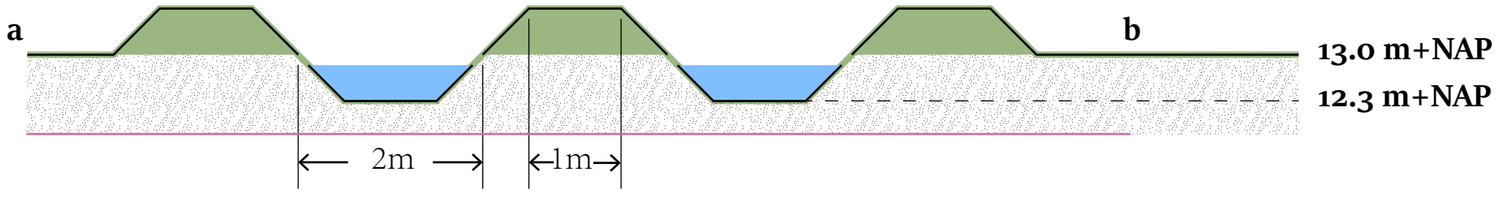
Dry condition on inundation field

Wet condition on inundation field

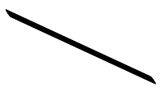
Flow meadow and constructed wetland

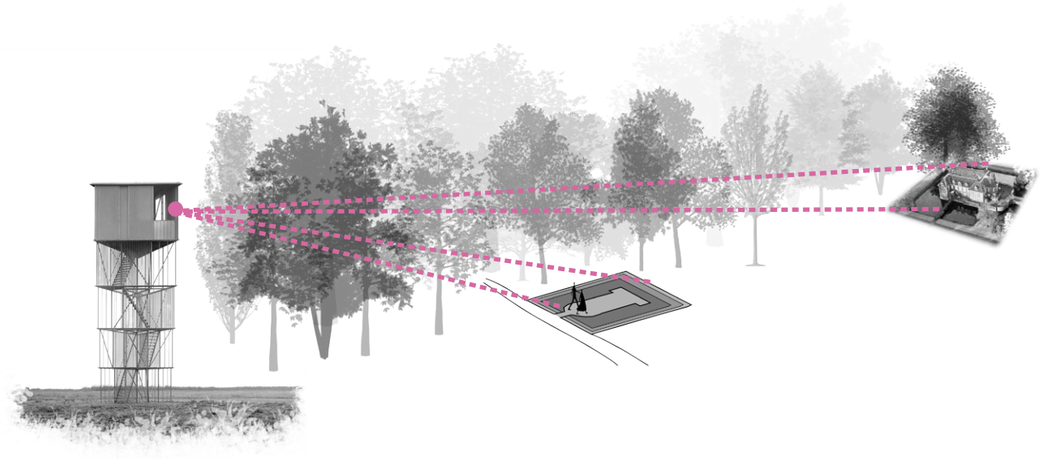






Strategy 4: Spatial modification (path and watchtower)

Physical layout (Path)	Aesthetic appreciate transaction
	Complexity, mystery
	Coherence, openness



View from a watchtower: dry meadow

View from a watchtower: wet meadow

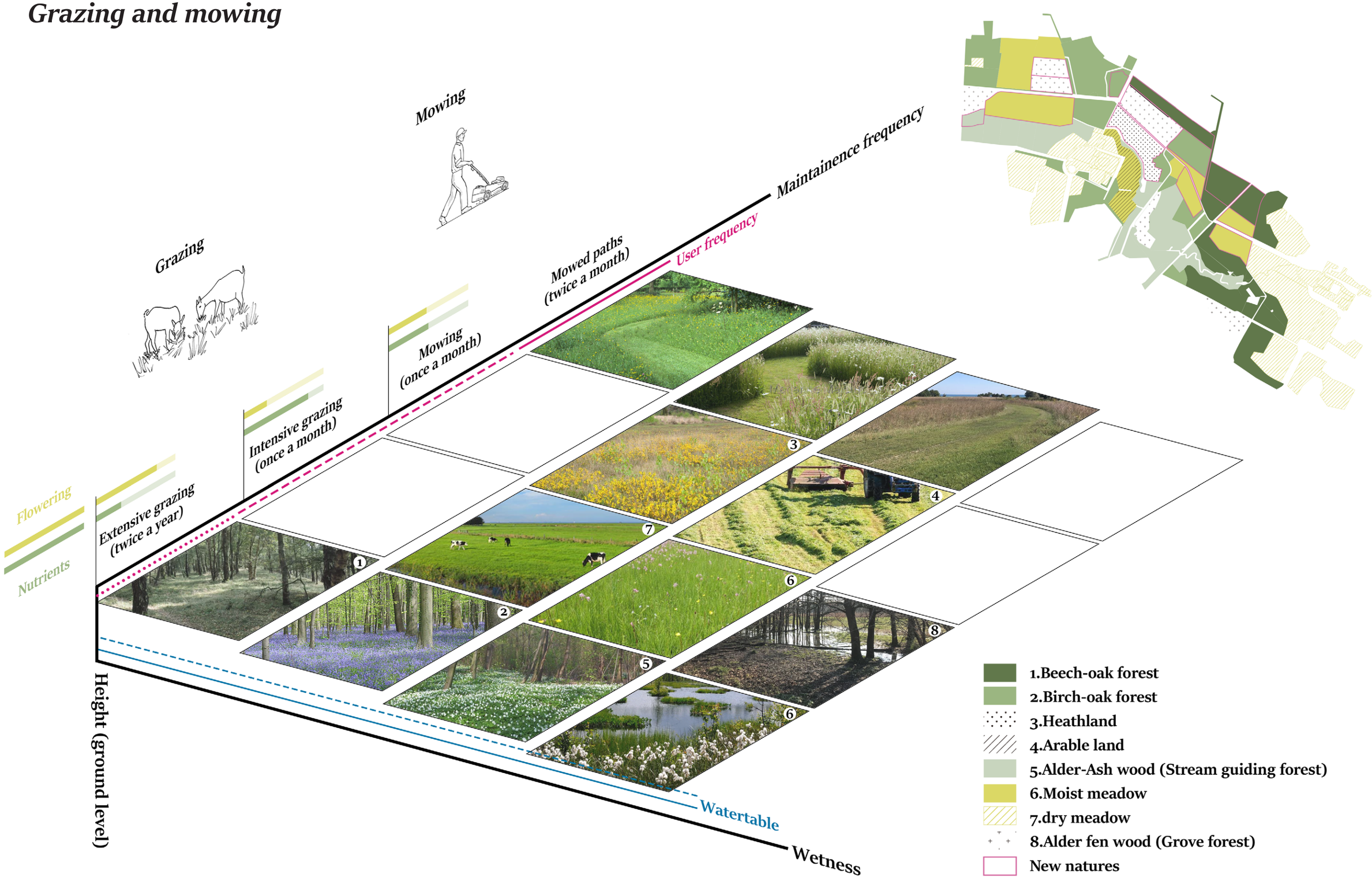
View from a watchtower: forest

Strategy 5: Cue to care

Mowed path

Mowing strips along human path

Grazing and mowing



Development over time: Agricultural field

Current situation

After 5 years

After 20 years

Development over time: Wet meadow

Current situation

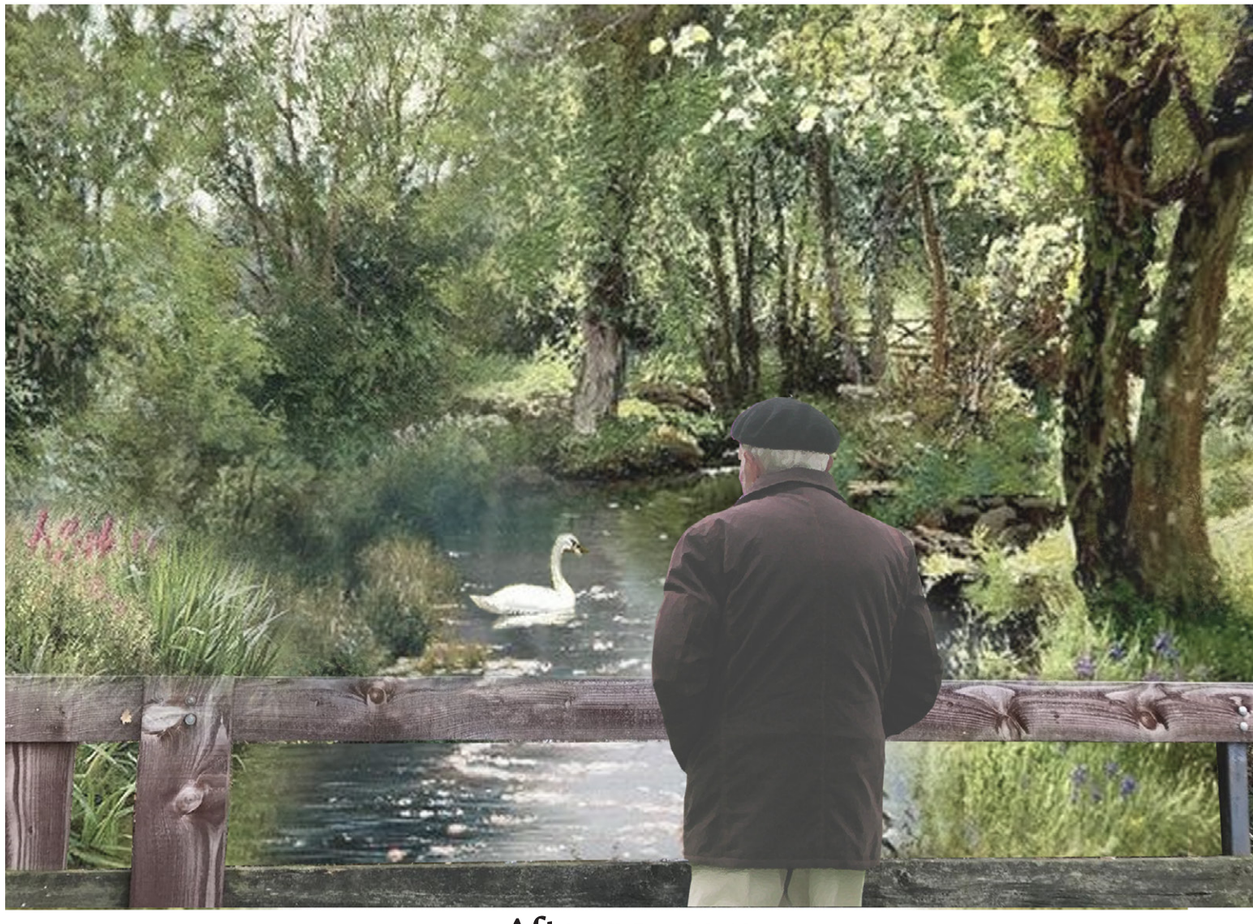
After 5 years

After 20 years

Development over time: Stream forest

Current situation

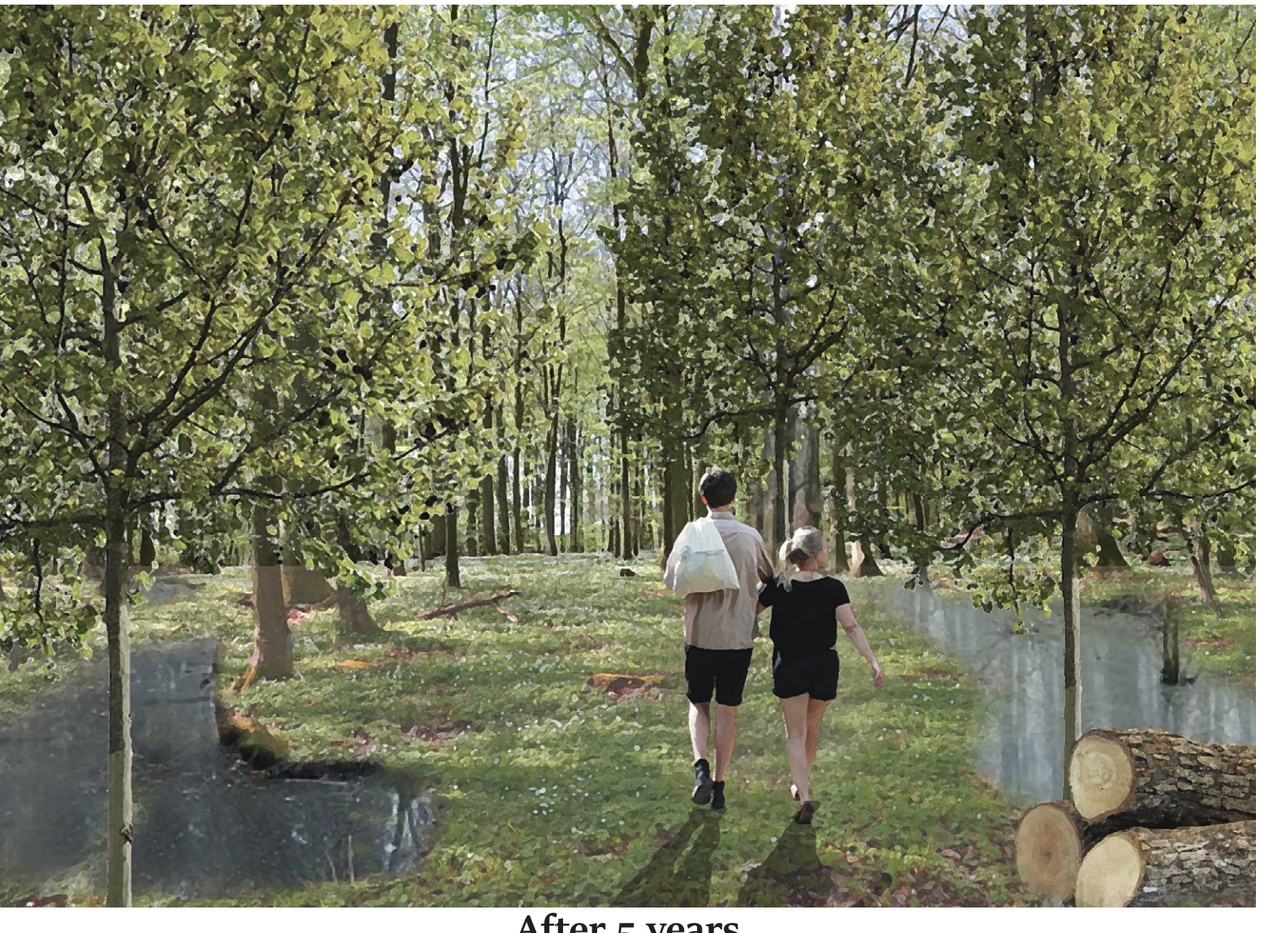
After 5 years



After 20 years

Development over time: Rabatten forest

Current situation



After 5 years

After 20 years

Reflection

» **Conclusion**

» **Research-design relation**

» **Limitations**

» **Societal relevance**

Thank you for listening and watching!