Forest landscape restoration for climate-adaptive estates

in the Baakse Beek region, Gelderland

王颜姣 Yanjiao Wang
48428478

MLA graduation thesis

08/2020

Forest landscape restoration for climate-adaptive estates
in the Baakse Beek region, Gelderland

MSc Landscape Architecture graduation thesis
TU Delft- Faculty of Architecture
Studio Flowscape
Lab Gardens of Gelderland

王颜姣 Yanjiao Wang 4842847
email:

First Mentor: Dr.ing. S. (Steffen) Nijhuis / Dr.ir. B. Cattoor
Second Mentor: Dr. Bob Ursem
Delegate of Board of Examiners: Ir. Roel van de Pas

Acknowledgement

First of all, I would like to thank my mentor team: Steffen Nijhuis, Bob Ursum, and Bieke Cattoor, for their time, patience, care and guidance throughout the special graduation year, which I will never forget. Their efforts on me motivated me to keep "how and why" in mind when doing research and design for the thesis. Many thanks to Steffen for accepting me as one of your students in the latter part of the academic year. I always appreciate your smart and clear advice on whatever I asked and the philosophy of life you shared by further sublimating good advice on the study. They are helpful, inspiring and encouraging. I want to thank Bieke as well for her guidance in my starting part of my thesis and helping me to focus on "forest". During this year, I most enjoy every meetup with Bob, my second mentor. You helped me to know the natural world in European land better and always gave me lots of compliments and encouragement after my presentation, which makes me confident to myself. In short, I am very grateful to have such great mentors like you.

Secondly, I would like to thank my best friend I made here, Yingjie. You are a good listener to me. So glad to be a friend with you in these two years, so that I can always have a person to discuss our assignments, daily life, and to exchange our souvenir after our respective solo-trip. Also, I would like to thank every teacher, classmate, friend and instructor I met at TU Delft and X in the past years, especially Yijing, Saskia, my GP Flink, Barsha, Bledi, Purvi, Tapasya and Shamangi. Extra caring and chatting with you gave me lots of strength in the first few months of 2020. You provide me with a good company, a positive attitude towards life and a healthy body.

Last but not least, I want to say thanks to my grandparents. You are always the ideal one to support me when I meet difficulties and calm me down when I feel stressed out for my confusion of youth. Equally thanking my parents in Wuhan for taking good care of grandparents and themselves. With your supporting, I could experience such an amazing and impressive journey in the Netherlands, where flowers, plants, wind, rain, cloud, sunlight, sea, cows, birds, friendly Dutch people and international people are what I will remember forever.

Well, my thanks to myself deserve to be specially mentioned here, since I am really proud of what I've learnt and what I've made efforts for, and I know I've grown so much during the graduation year:)

- Different historical developments may have occurred within one and the same “landscape”, some of which may have escaped attention.

Groenewoudt, B. J. (2012). Versatile land, high versus Low: diverging developments in the Eastern Netherlands. In Proceedings of the Latvian Academy of Sciences (pp. 54-69).

Abstract

The research focuses on the estate zone of the Baakse Beek region which is facing environmental problems mainly caused by historical human intervention and climate change.

Besides, in the Vorden cluster, as the land use changing caused by intense land reclamation and consolidation, the current agriculture productive landscape makes it not easy to perceive the rich historical layers.

The main research method of this study is research by design and the main goal is to explore the potential of forest landscape restoration to increase the resilience of the estate landscape in the face of climate change and to promote their cultural-historical values and identity. By restoring forest landscape, it provides a green infrastructure to the estate zone to gain more spatial experience, ecological benefits, as well as cultural value, so that vulnerable aquatic eco-environment and cultural identity can be promoted.

The research aims to design a climate-adaptive estate landscape as a green infrastructure that connects the estates, local history, ecology value and societal value through forest landscape restoration. This thesis primarily focuses on the territory of two estates, Het Medler and De Wiersse, where ecological restoration of the aquatic eco-system and cultural-historical landscape experience can be strengthened utilizing forest landscape restoration.

Key words: estate landscape, Baakse Beek, forest landscape restoration, climate change, culture heritage

View near the estate castle, De Wiersse.

CONTENTS

1.

Introduction

This chapter elaborates on the backgrounds and the objectives of this research.
First, the problem statement is addressed to show the main topic this thesis discusses. And the design goal related to these problems is stated in the research objective. The method applied to the thesis helps to structure the research procedure and make it more convincing. In the end, relevance from two aspects and limitation are discussed to review the whole project.

1.1 Background

The context of the study area, the Baakse Beek region, is located in the eastern part of the province of Gelderland (Achterhoek). There is the mainstream flowing from the east towards the west. On the way to the river Ijssel, the stream passes various types of landscape, such as eastern flood landscape (slow-flowing brook area), estate landscape (lowland brook area), sand ridge landscape (temporary brook area), health landscape (heath brook area), camping landscape (wetland brook area) and terrace edge landscape (terrace edge brook area). These areas are determined by each zone's identical landscape elements, geographical and ecological conditions (Baks, A. J., 2002).

However, the mosaic landscape we are looking at today is quite different from it used to be, especially for the estate zone, which is the main focus in this thesis. As a result of historical intervention from people, characteristics of the landscape in different time layers are fading away from the landscape and visitors' perception. Agriculture production land accounts for the majority of the land. More importantly, the aquatic ecology environment also suffers negative impacts from human activities and climate change, which make it difficult to provide fertile land for crops, places of good quality for people's living and habitats for animals.

The Baakse Beek region and Vorden cluster within the basin area, as study and experiment example in the thesis, presents opportunities to enhance its resilience to climate change and tell its estate landscape story through interventions of forest landscape restoration.

base map: www. arcGIS.com

1.2 Problem statement

In the context of intervening the study area through landscape methods, the thesis tends to address the following issues:

HISTORICAL ESTATE LANDSCAPE HAS CHANGED TO AGRICULTURE-DOMINATED LANDSCAPE, LACKING CONNECTION TO THE LANDSCAPE FROM THE PAST.

Historical human intervention in forms of deforestation has continuous negative impacts on the contemporary landscape, which make the clues of historical estate landscape hardly visiable and the forest landscape at that time damaged.

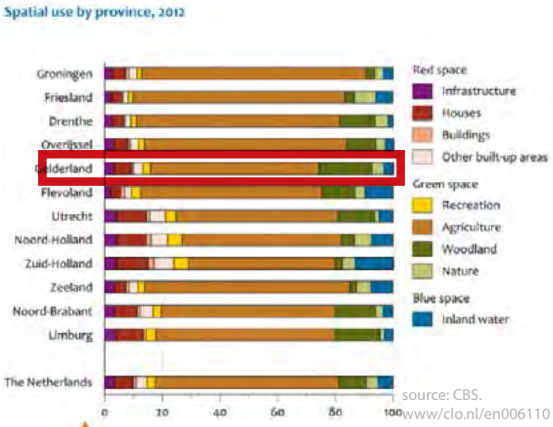
Photo credit : Jim-Goyjer

VULNERABLE AQUATIC ECOLOGY ENVIRONMENT IS SUFFERING FROM HUMAN INTERVENTION AND CLIMATE CHANGE.

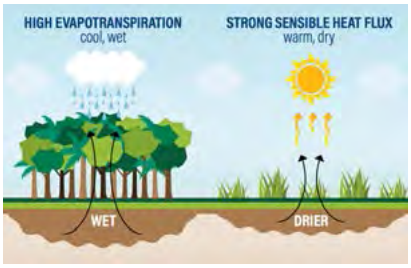
Apart from that, deforestation produces greenhouse gas emissions, which accelerates climate change. Along with this procedure, more environmental problems like increasing temperature, drought, low groundwater level and poor soil functions, emerge. In the study area, the negative effect on the hydrological environment is more obvious.

Meanwhile, possibities of the estate landscape are exposed.

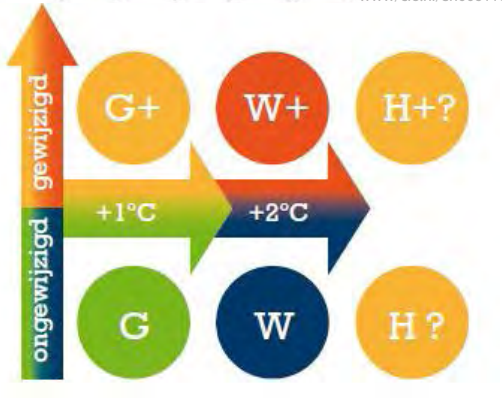
By researching the Vorden cluster, a green infrastructure through forest landscape restoration could be proposed to restoring the current estate landscape to meet present and future needs and to offer multiple benefits and land uses over time. Forest's capabilities, such as greenhouse gas emissions reduction, precipitation interception, storing water through the root system and people's well-being promotion, show its potential to improve the current estate landscape.



source: CBS. www/clo.nl/en006110



source: http://wriorg.s3.amazonaws.com/s3fs-public/ending-tropical-deforestation-tropical-forests-climate-change.pdf



source: Klein Tank, A., Beersma, J., Bessembinder, J., Van den Hurk, B., & Lenderink, G. (2014). KNMI 14: Klimaatscenario's voor Nederland. KNMI publicatie.

source: https://www.cbs.nl

1.3 Research Objective & Questions

The objective of this research is to explore the potential of forest landscape restoration to increase the resilience of the estate landscape in the face of climate change and to promote their cultural-historical values and identity. The approach is based on the understanding of the historical spatial development of the region.

The study will identify and test principles and strategies to reveal the connection among estates, landscape and cultural history, achieve the balance among aquatic ecological environment, landscape perception and agriculture and to promote climate change resilience.

To achieve the goal of the thesis, there are 4 main questions listed on the right side should be answered:

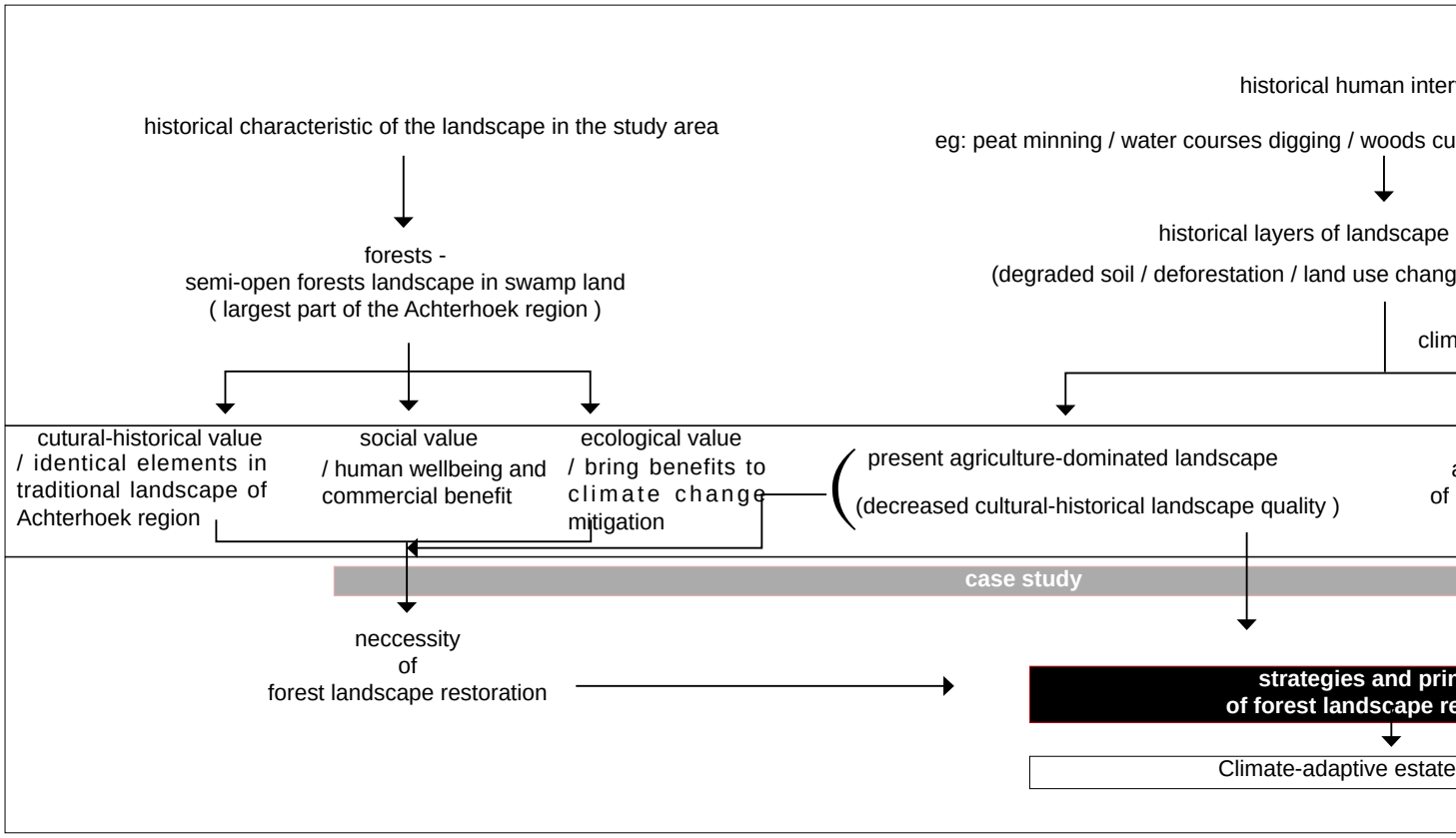
MAIN RESEARCH QUESTIONS :

1. How did historic deforestation affect the landscape through different levels?

2. What are the principles about forest landscape restoration to promote cultural-historical value and resilience to climate change in the estate landscape?

3. How to apply principles to the study area of different geomorphology types and land use to address challenges of landscape quality and climate change?

4. What are the lessons learnt from applying design principles of forest landscape restoration from 3 aspects of ecology, landscape characteritics and agriculture to make a new forest landscape in the estate zone?



1.4 Methods

THESE QUESTIONS WILL BE ANSWERED THROUGH RESEARCH BY DESIGN AND DESIGN RESEARCH.

In the beginning, site analysis through literature study on the body of knowledge of climate change, aquatic ecosystem and cultural heritage in Baakse beek basin and forest landscape restoration(FLR) can provide essential knowledge of the study area and theory support. During fieldwork and interviewing on-site, information collected through perception and discussion with local people gives a new insight into the research.

Mapping on the historical and current situation of the study area's landscape typology, ecology networks, land use and water system at different scales, revealing its potential from these aspects and the relationship between the past and the present.

Precedent study on cases related to forest landscape restoration, climate change mitigation and cultural heritage restoration can show the breadth or applicability of FLR principles.

A diagram to show the steps throughout the research and design work.

Based on the analysis indicating the cultural and ecological issues, the problematic situation of the study area gets revealed, which shows great potential for the design exploration to test principles and enhance the landscape quality.

Research by design is the main methodology which provides a platform to explore the spatial possibilities of future urban development after the previous analysis. After making it clear of the research objectives and comparing the site with other cases, formulating related principles and applying them reasonably to the study area is a vital step before design exploration.

1.5 Relevance and limitation

Academic relevance:

The project is intended to test forest landscape's ability to address the vulnerable aquatic environment and urgent climate change issues, such as continued low groundwater level and water quality, in the context of estate landscape.

Since the proposal is based on the understanding of the historical role of the dynamic landscape, it presents the approach to historical estate landscape revitalization and how a landscape can be planned as a process. Also, integrating ecological and societal values of forest landscape will help the estate landscape to meet contemporary as well as future needs.

Societal relevance:

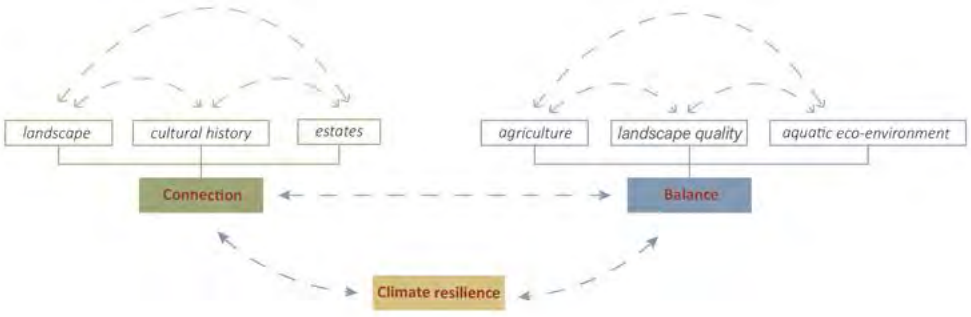
The study area has great cultural heritage resources in Gelderland province, which are managed by various stakeholders and estates owners. Thus, the thesis will contribute a vision from the landscape's perspective to the estate zone's further development. The thesis will take their needs and demands into consideration and try to find a balance among the benefits of municipalities, estates' owners, farmers, visitors and related organizations. The Achterhoek landscape after forest landscape restoration can stimulate local tourism so that the elevated status of the region and sustainable development can be gained. Meanwhile, people's well-being can be enhanced.

Limitations:

Though principles of forest landscape restoration have been successfully applied worldwide in similar cases, which will be discussed in chapter3, there are still some limitations in this thesis. Firstly, opinions and suggestions from local residents are not well collected for the sake of time. The intervention for a specific area in this proposal is following the framework of forest landscape restoration, which mostly is decided by its land use and morphology situations. Secondly, the cost of forest landscape restoration is not calculated in this thesis to see if the vision proposed in a practical way, but it do provides a promising possibility to introduce more trees to bring more comprehensive values and added profits.

1.6 Report Structure

The introduction shows the general background of the thesis, the starting point and goal of the research drawn out as well. In chapter 2, the main theoretical background is introduced to explain the basis of the research. In chapter 3, the analysis of the contemporary ecology environment, spatial experience and landscape compositions of the study area illustrate the challenges and opportunities. Principles and strategies based on cases study and previous analysis are proposed in chapter 4 to instruct its following application to the study area, which is present in chapter 5. The last chapter is about the synthesis, consisting of reflection and outlooks of the research.



A scheme to show the relevance this thesis would achieve.

2.

Methodology

This chapter explains how problem statement, research objects, research questions and methods are related to each other in the context of theories to contribute to the expected result.

2.1 Theoretical background

2.1.1. landscape anamnesis

The landscape is dynamic and integrated with multiple factors from both historical and contemporary intervention. Thus, it is vital to take a transformation perspective to build up a story based on water, soil, vegetation, land use and social structure. So that the story can help us to break down the limitation of our vision field towards the present-day view. Also, Antrop(2005) stated that the process and management of the traditional landscape in the past, as well as people's multiple relationships to the perceptible environment and its symbolic significance, provide valuable knowledge for the sustainable planning and management of the future landscape. So, it is important to consider historical development to maintain the site spirit.

The estate zone of Baakse beek region has experienced a series of natural impacts and human intervention and the deforestation process plays an important role in the landscape development of the area. To adapt to the poor soil condition of the area caused by historical intervention, special principles such as Rabattenbos get generated to restore characteristic elements for the landscape.

2.1.2. landscape as a structure

Regarding landscape as a relational structure help to make connections among various flows which contribute to sustainable development across scales.
Not only the environment, but also people's daily activities and intervention is involved in the process of shaping the landscape image, mentally and spatially (Nijhuis, S, 2013).

The fact that benefits and successful cases of forest restoration and rehabilitation can be seen worldwide already, which has the potential to respond to climate change issues, social problems, forest degradation and deforestation effectively (Chazdon, 2008). Forest landscape restoration in this thesis aims to develop a green infrastructure to connect different flows involved varied fields like ecology, society and cultural heritage.

2.1.3. landscape as a process

The way landscape presents herself is to present a dynamic process with varied story and interaction with different factors, rather than a product (Prominski, 2005). To understand the study area in this thesis, it's important to know not only the ecological negative effect of deforestation but also the societal context of deforestation over time. The reason behind the transformation from historical forest landscape transforming to the agriculture-dominated landscape can provide a clue to activate the site's potential.

2.2 Research strategies

2.2.1 Design research

- Site analysis through mapping and literature study.
The dynamic landscape is always a complex so that deconstruction is always necessary as a vital method to understand a landscape. Through mapping, the distribution of sandy soil, different types of forest, and the development of main streams, thesis-related information across time and scales can be derived to present situations in a different time and contribute to conclusions. Mapping, as an effective and inspiring tool, helps to reveal the hidden patterns of the landscape and provides clues to explore for study area's multiple possibilities(Nijhuis, S., 2016). By going through literature materials on lenses of climate change, aquatic ecosystem and cultural heritage in the Baakse Beek basin and forest landscape restoration, knowledge can be gained and historical development and the current situation can be compared clearly and convincingly.

- Site visiting
It also provides us with different perspectives to analyze the study area. Spatial experience and atmosphere perception on-site can inspire the design ideas as well.

- Precedent case study
Reviewing cases under similar topics helps to generate principles for the research. Principles extracted from successful projects can be integrated into the design of the thesis, which makes the research more practical than only based on a theoretical basis.

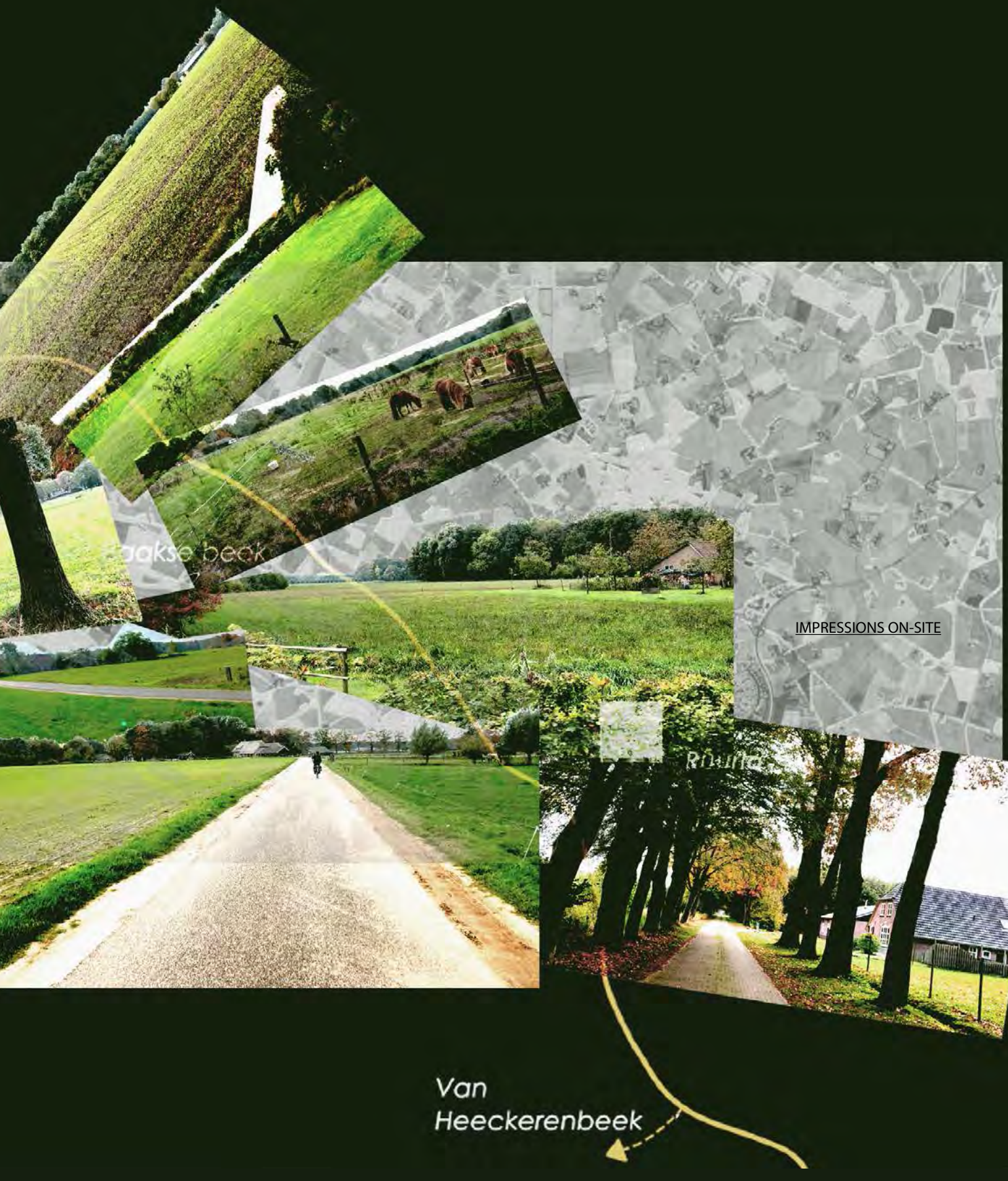
2.2.2. Research by design

An experimental design is necessary to present the result of the appliance of principles concluded from research (Nijhuis and Bobbink, 2012). In the process of research by design, visions for different lenses can be proposed to make a comparison and debate with each other for further study on a regional scale and local scale. With the reflection on the values of the design, it is a convincing approach to make the design have boarder impact on both academic and societal aspects. Based on the visions' overlapping, specific strategies and tools box are applied to specific corresponding areas to generate a design to answer the 2 main questions proposed in the previous chapter.

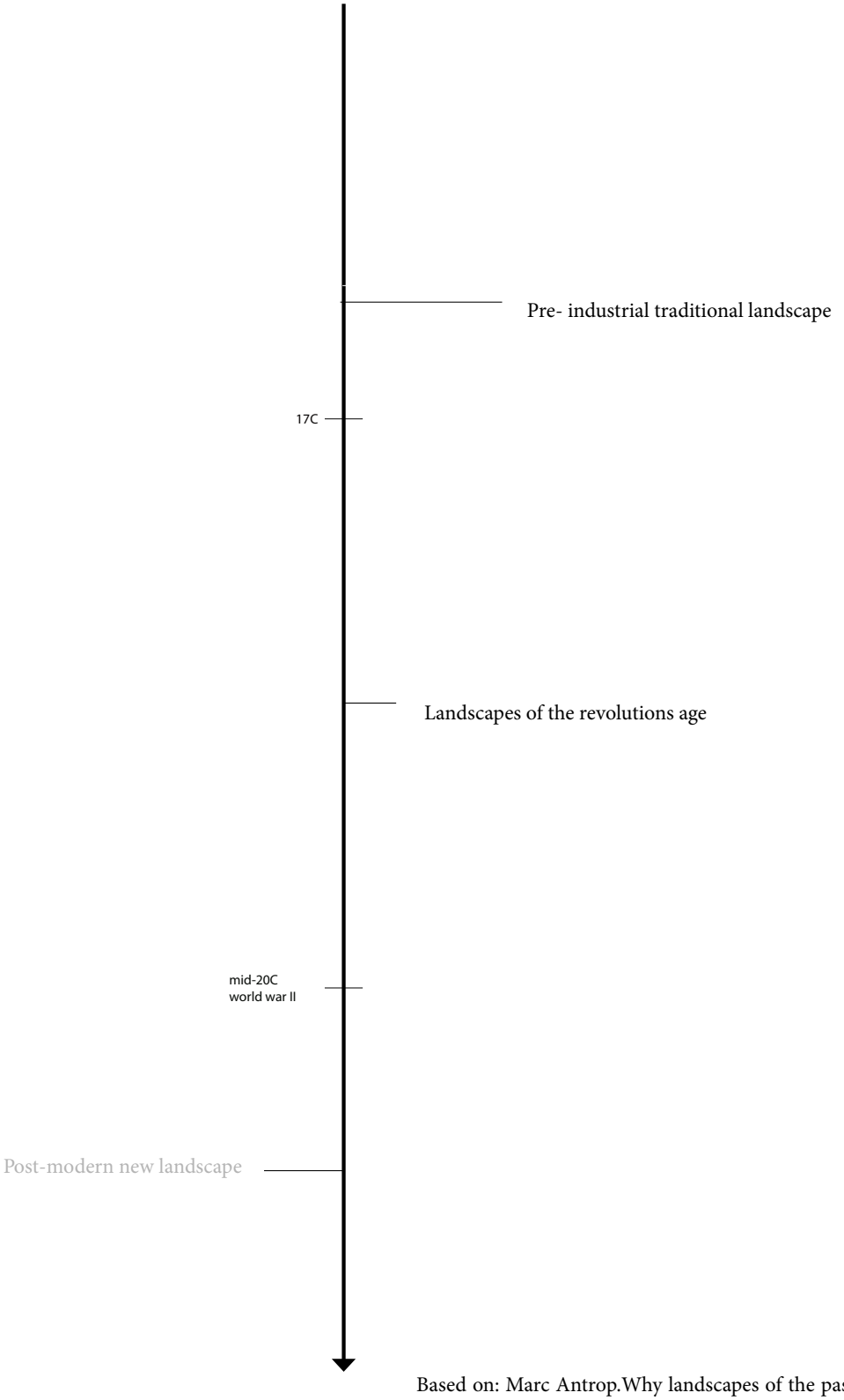
3.
Diagnosis

In this chapter, the relations between estate landscape and these 3 aspects are revealed to conclude the potentials of the site in the relation of forest landscape restoration.

Historical development in the estate zone illustrates the important role of the forest we might ignore in nowadays' landscape. Forest used to be the main element of the landscape before deforestation and being taken over by agriculture land.
And the 3 aspects are: hydrological environment, climate change and landscape perception.


IMPRESSIONS ON-SITE
Van
Heeckerenbeek

3.1 Historical context of the Baakse Beek region and estate zone



Based on: Marc Antrop.Why landscapes of the past are important for the future

During the last glacial period, the landscape in this region was characterized by swampy grassland, a species-rich deciduous forest and 15% of the region was covered with peat, which turned out to be a fertile and attractive area for vegetation's growth, animals and people's living. Gradually, more people moved to the region along the stream. They started to cut down trees for more agriculture land and more wood materials. Also, more watercourses got dug and extended.

During the revolution age, estates emerged along the middle part of Baakse Beek stream, which shaped estate landscape in this region in the early period, With a series of cultural revolutions, such as the Age of Enlightenment, demographic changes, land reforms, world wars, industrial revolutions and agriculture revolutions, etc. there was increasing demand for woods to develop canal networks, shipping systems and boost urbanization. Apart from that, more nature land got exploited for more farmland and softwood planting. Deforestation did negative impact on forest extension and people were gradually aware of the importance of environmental preservation.

The historical and contemporary development of the study area shows the process of the changing landscape.

Before the industrial revolution, the landscape went through accelerated deforestation and all remaining historical forests got disappeared in Eastern Netherlands as a result of over-exploitation.

To reverse the trend of forests' decline, governments also establish regulations to contribute to reforestation. Some of these regulations were made for promoting ecosystem, while some reforestation projects were for woods selling to boost the economy as well.

After world war II, post-modern new landscapes come into being. Historical development and people's planning shape the present landscape (Groenewoudt, B. J., 2012).

BAAKSE BEEK REGION

Old Baakse beek

Ijser river

Dense trees

Deforestation

Baakse beek
+ watercourses

Baakse beek
+ increasing watercourses

increasing farmland + meadows

reforestation

VORDEN CLUSTER

Forest

image source:
http://www.kunstwerktachterhoek.nl/

VORDEN

Estate Medler

Estate Onstein

Vorden castle

Estate
Wildenborch

De Weirsse

Estate Wientjse

Pre-industrial
traditional landscapes

Revolutions age:
breaking with traditions and the past

13C

14C

15C

17C- 18C

18C

Agriculture activities

the Age of Enlightenment

Demographic changes

Land reforms

French revolution

World wars

Industrial revolutions

image source:
https://www.google.com/imghp

Pre- industrial traditional landscape

Landscapes of the revolutions age

mid-20C
world war II

Post-modern new landscape

As for estate zone's development across time, not only the Baakse Beek stream and estates play an important role in this area, but also forests were the main identity of the landscape at that time and can maintain the ecology quality, though there is an obvious decrease of the forest after the comparison of the current forest situation and historical map in 1900 and descriptions of earlier times.

The current landscape makes the estate zone facing several problematic situations.

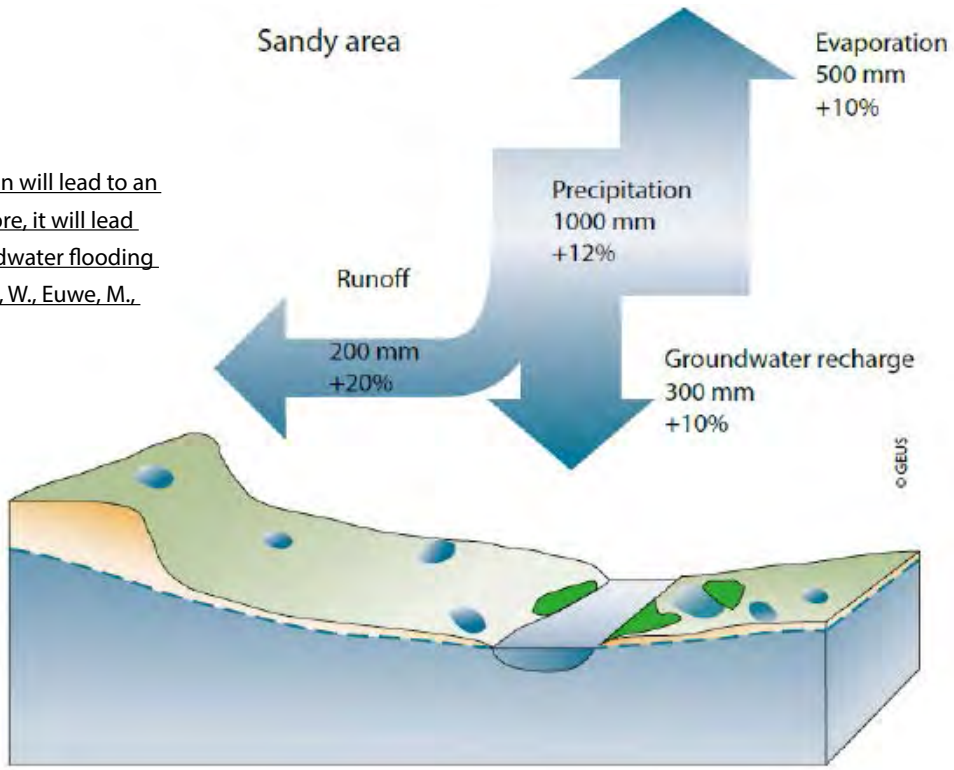
Timeline of the development of Baakse beek and Vorden cluster over the years, in terms of nature network change and anthropological influences.(see the diagram on the left)

3.2 Problematic situation

3.2.1 estate landscape and hydrology environment

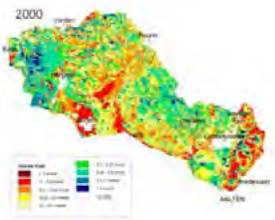
Considering the negative impacts from historical deforestation and land reclamation, the soil within this area cannot function well to capture moisture underground. This is also related to the fact that most of the soil in this area is sandy soil while peat had almost disappeared after historical reclamation.

In (flat) sandy areas, the increase in precipitation will lead to an increase in groundwater infiltration. Furthermore, it will lead to an increase in groundwater level and groundwater flooding (Auken, E. A., Bosch, A., Courtens, C., Elderhorst, W., Euwe, M., Gunnink, J., ... & Lebbe, L., 2011).



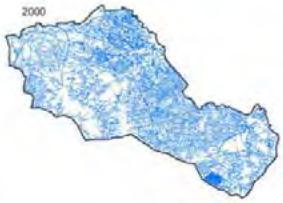
Source: Auken, E. A., Bosch, A., Courtens, C., Elderhorst, W., Euwe, M., Gunnink, J., ... & Lebbe, L. (2011). Groundwater in a future climate: The CLIWAT Handbook. The Cliwat Project Group c/o Central Denmark Region.

seepage infiltration

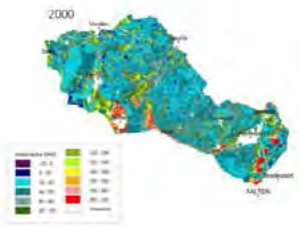


lowground water level

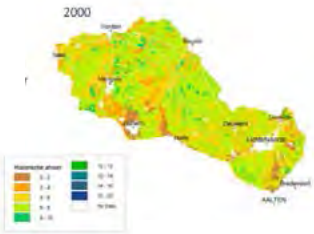
water courses



highground water level

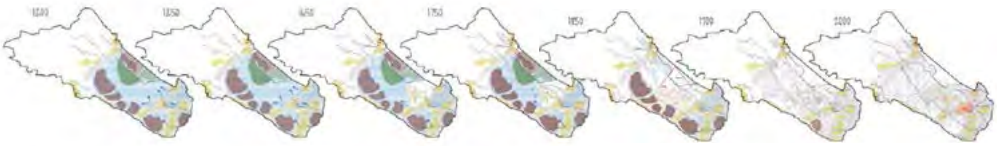


specific discharge per year



Water system conditions in the Baakse beek basin area (source: Massop, H.Th.L., Gaast, J.W.J. van der. (2007) Reconstructie van de historische hydrologie. Alterra report 1466, Wageningen.)

The low groundwater level in estate zone is always a big issue, even for the whole Baakse Beek basin area (Massop, H.Th.L., Gaast, J.W.J. van der., 2007). Because the main land use is traditional agriculture production land, which means fewer trees above the ground help to maintain the water, the ditches are always dry.

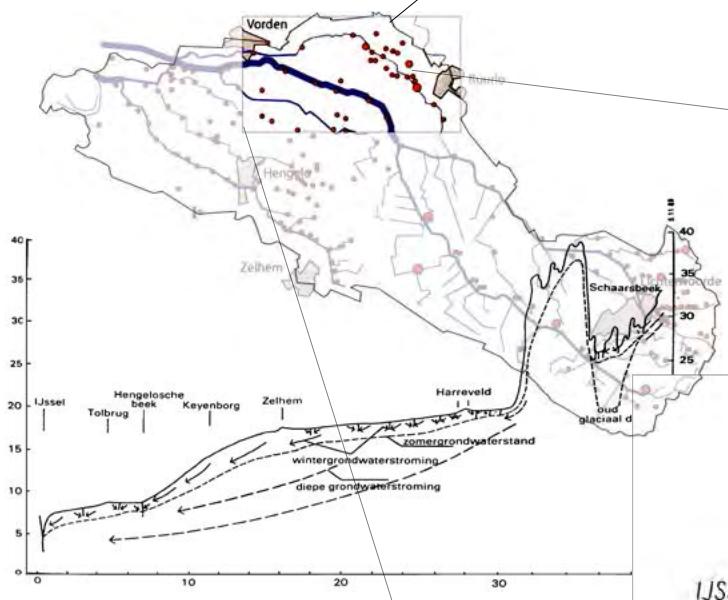


Peat mining timeline (Source: Vista landscape and urban design, 2010)

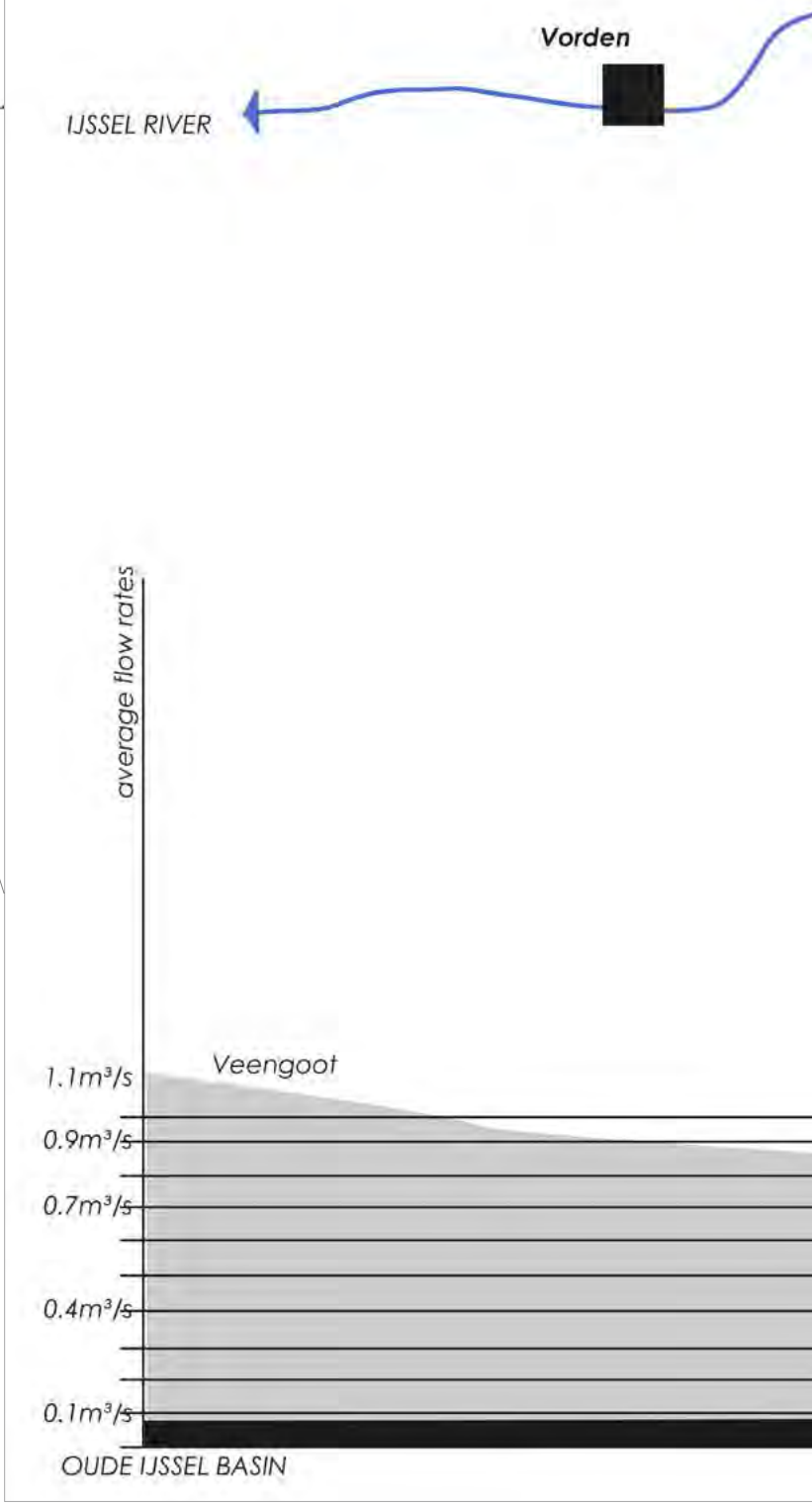
Numbers indicate future water balances as modelled by GEUS, The water balance is simplified from modelling the A2 scenario.

Historical peat mining also makes the soil type in this region change a lot.
Peat is hardly found in Baakse beek basin area now, thus the moisture underground is difficult to be sufficient (Vista landscape and urban design, 2010).

Weirs and cascades in the river basin

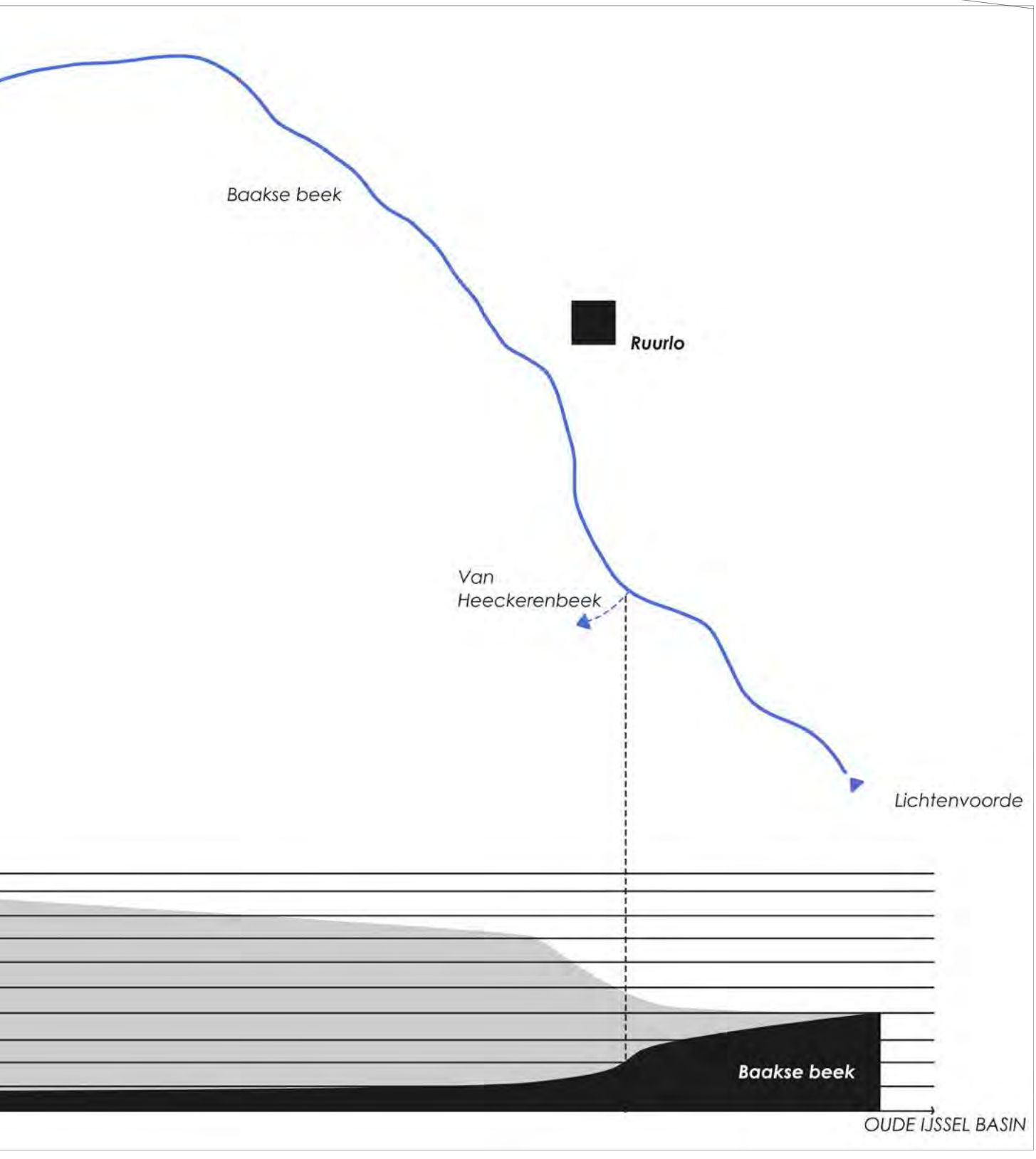


Average flow rate of Baakse beek is lower than other water courses (see the graph on the left) (based on: ntegral visie baakse beek-veengoot herstel de sponswerking rapport, 2007)



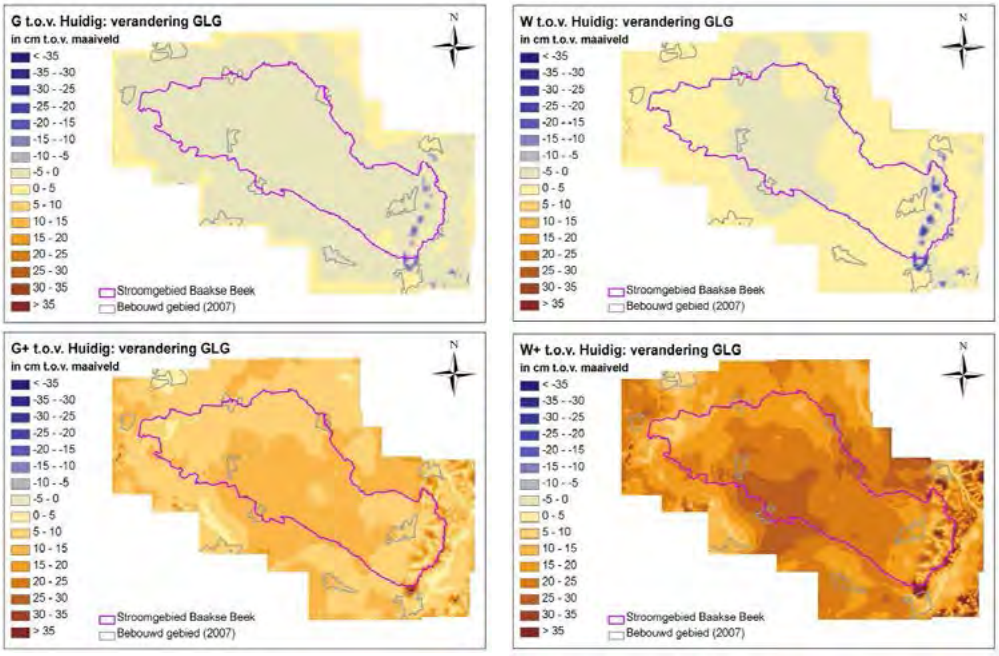
3.2.1 estate landscape and hydrology environment

Besides, after the construction of another watercourse, Veengoot, and wiers and cascades to control the upstream water level and drain the water effectively to the IJssel river, the water distribution in Baakse beek get decreased apparently (ntegral visie baakse beek-veengoot herstel de sponswerking rapport, 2007), which effect the eco-environment and landscape quality of this area.

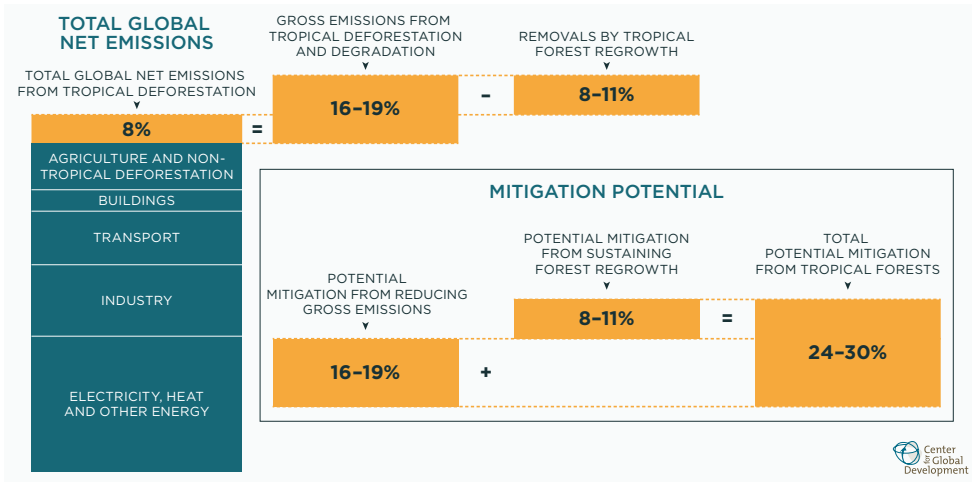

Baakse beek
Ruurlo
Van
Heeckerenbeek
Lichtenvoorde
Baakse beek
OUDE IJSSEL BASIN

3.2.2 estate landscape and climate change

The increasing drought scenario will make the ecological habitat for flora and fauna vulnerable. In winters, the main effect will be on the upstream of Baakse Beek, where water quality problem, like eutrophication, starts. Meanwhile, the estate zone area, as the middle reaches of the stream, will suffer from yield depression and lower quality of the landscape(hydrologisch perspectief baaks beek-veengoot rapport, 2013).

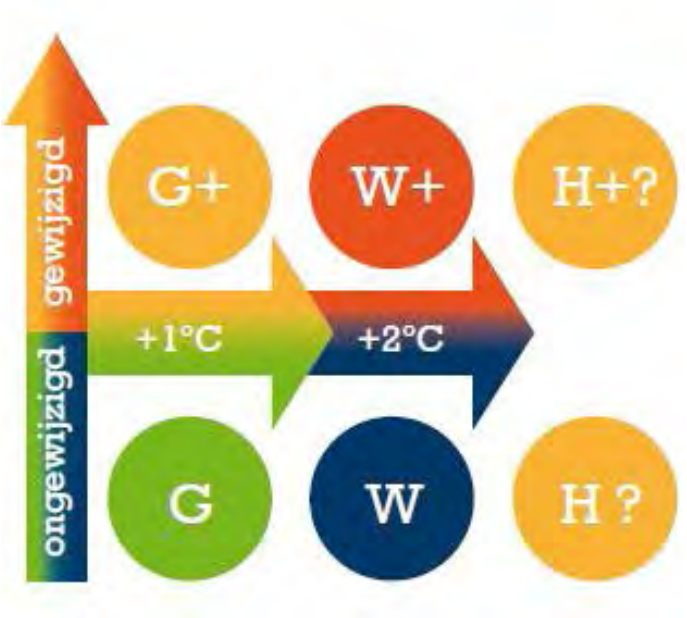


source: (left) hydrologisch perspectief baaks beek-veengoot rapport, 2013. (upright) Klein Tank, A., Beersma, J., Bessembinder, J., Van den Hurk, B., & Lenderink, G. (2014). KNMI 14: Klimaatscenario's voor Nederland. KNMI publicatie. (downright) Seymour, F., & Busch, J. (2016). Why forests? Why now?: The science, economics, and politics of tropical forests and climate change. Brookings Institution Press.



deforestation's impacts on climate change

On the one hand, greenhouse gas emissions from deforestation drive increasing climate change. On the other hand, climate change's impacts are mainly manifested in the rising temperature. According to STOWA(2014), Netherlands will face an increase in average summer temperatures of between 1 and 2 degrees Celsius in 2050 compared to 1990. It will lead to increasing drought in longer summer in the study area, thus the landscape is vulnerable.



climate change scenarios on temperature

Regional landscape feature

The basin area zoning map is based on: https://www.wrij.nl/,
six typologies drawing is based on: Baks, A. J. (2002).

3.2.3 estate landscape and landscape characteristics

Due to the deposits of wind-drift sands in the last Ice age, as well as factors introduced in previous paragraphs, there are diverse hight difference and landscape within the Baakse Beek basin area (Bloemers, 2010).

3.2.3 estate landscape and landscape characteristics

Nowadays, the region mainly consists of 6 different landscape typologies and study area in this thesis is the estate landscape in lowland brook area. This classification and descriptions are derived from *Water indicator: ecological profiles of the water nature in the province of Gelderland. Pt. B. Stagnant waters,* Baks, A. J. (2002).

1. Estate landscape

The estate landscape is located in the lowland area of the north Baakse Beek basin. With the stream flowing from the terrace edge at Lichtenvoorde towards Ijssel river, the landscape is also characterized by several estates with historical buildings, parks and gardens. These landscape elements make the landscape have great potential in cultural-heritage and ecology development (Baks, A. J., 2002).

2. Heath landscape

Heath landscape is located in the upstream area of Baakse beek basin and there exits some natural hard or raised bogs on the land which are surrounded by stream branchings. Based on the wet peat land, new stream 'Veengoot' was constructed to drain water quickly, which makes the flat area lose its ability to contain water nowadays when there's extreme rainfall or a dry season (Baks, A. J., 2002).

3. Terrace edge landscape

Terrace edge landscape is located on the terrace edge of the East-Nederland plateau near Lichtenvoorde. The fast-flowing, moderately acidic stream there is in the upstream area of Baakse beek basin (Baks, A. J., 2002).

4. Eastern flood landscape

With the flowing of the Ijssel river, the landscape there is quite wet and always effected by the flooding issue in winter (Baks, A. J., 2002).

5. Sandridge landscape

Sandridge landscape is located in the plateau area of the basin. It's always very dry and there's only temporary stream flowing. The stagnant layer there is shallow, because of water evaporation in increasingly hot summer (Baks, A. J., 2002).

6. Camping landscape

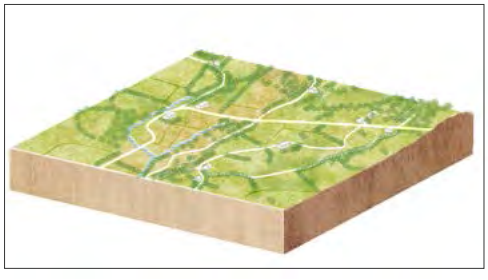
Camping landscape area is located in the Pleistocene basin of East Gelderland. It's the upstream part of Baakes Beek. It used to be wetland with moesland brooks flowing, while nowadays most of the streams are fragmented or dry because of climate change impact and dense agriculture activities (Baks, A. J., 2002).

1. Estate landscape

4. Eastern flood landscape

2. Heath landscape

5. Sandridge landscape



3. Terrace edge landscape

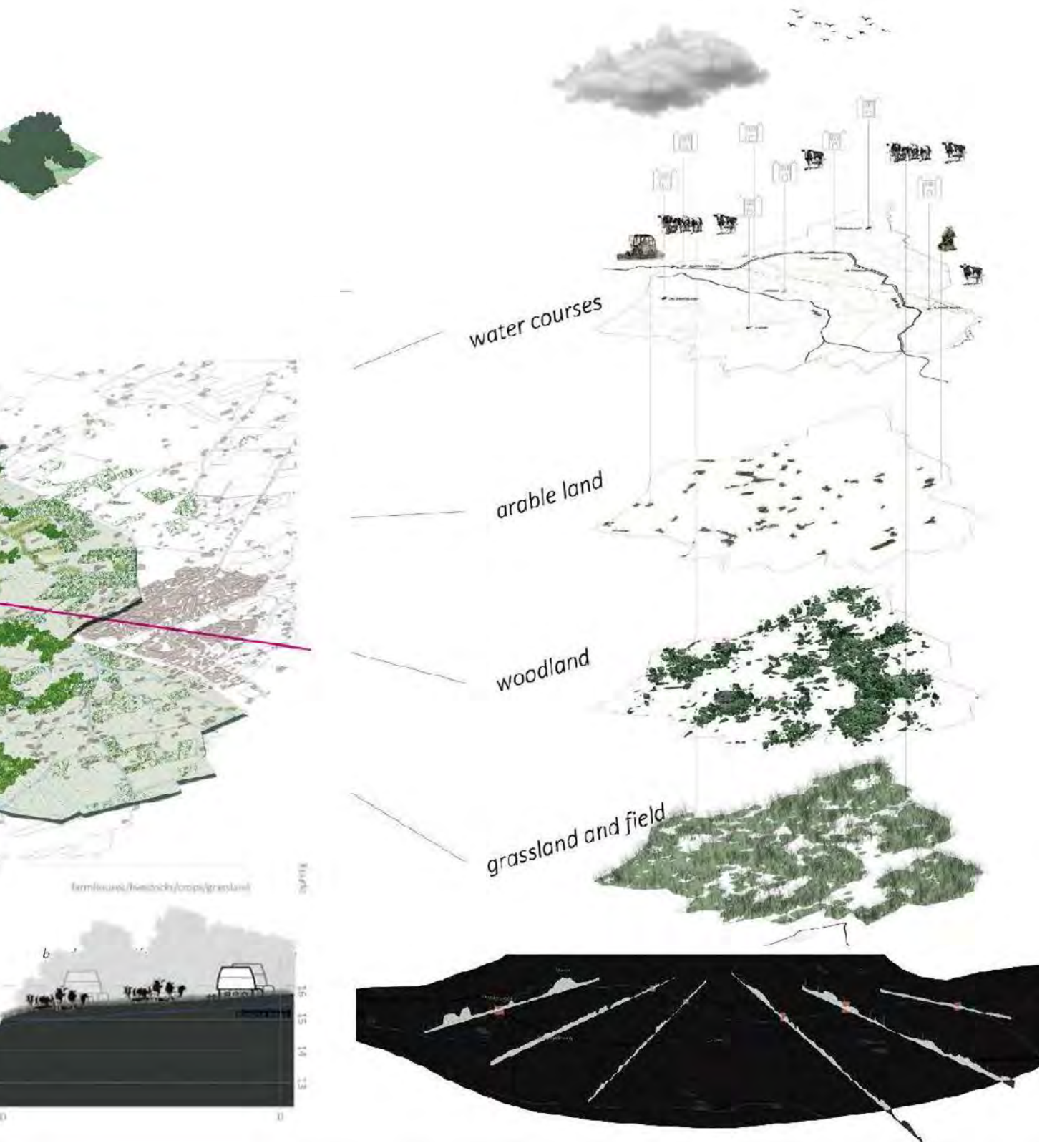
6. Camping landscape

Diagrams are derived from: (Baks, A. J., 2002)

3.2.3 estate landscape and landscape characteristics

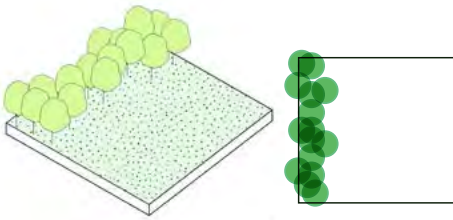
Landscape characteristics in estate zone nowadays is not splendid as what people used to perceive in the zone. A large majority of the land now is occupied with grassland and crops land with open view.

Schemes of landscape typologies, perspective drawing for the overview landscape and cross section scheme of estate area's programs to show the current landscape situation in Vorden cluster.

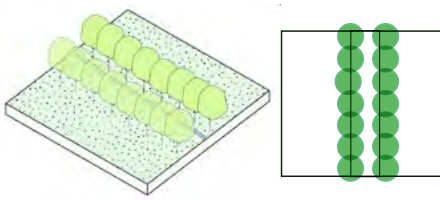


based on: https://gelderland.maps.arcgis.com, https://ahn.arcgisonline.nl/ahnviewer/

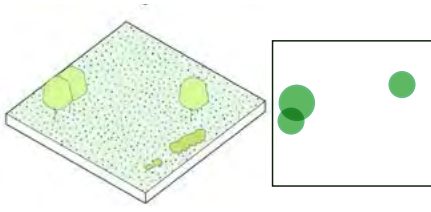
According to the study results of field trip and corresponding land use conditions, there are 12 spatial typologies shaped by trees concluded. (right)

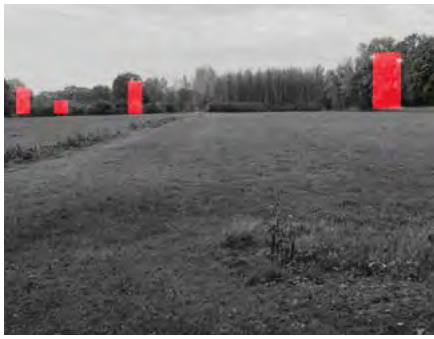


forest frindge area



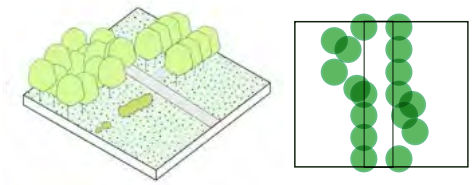
avenue



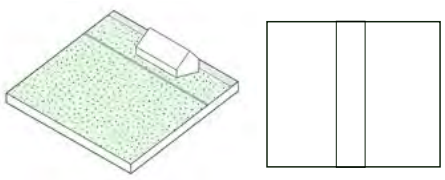


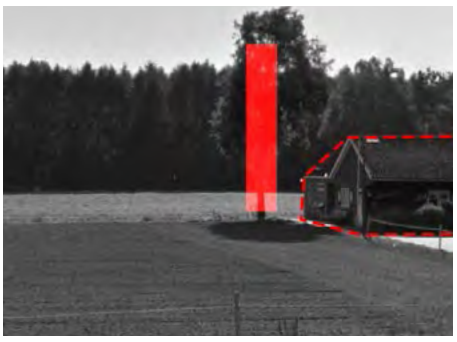
grassland with single tree

Spatial experience

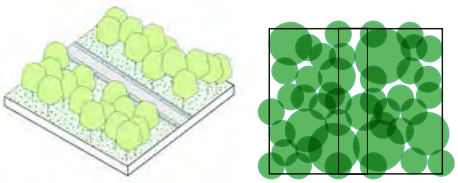


path near farmland with border tree

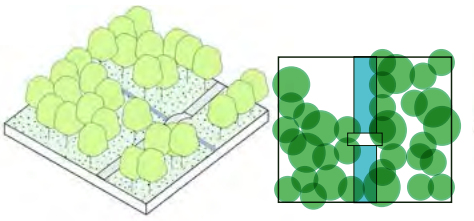




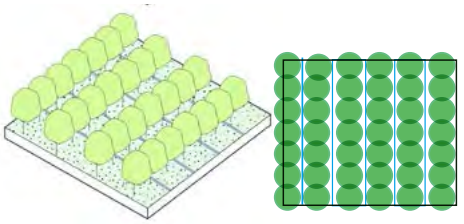
farmland



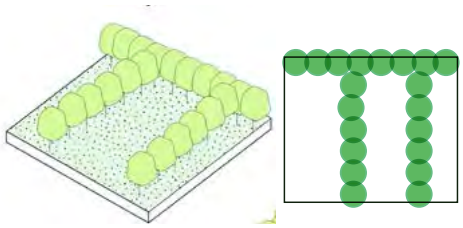
path under forests' canopy

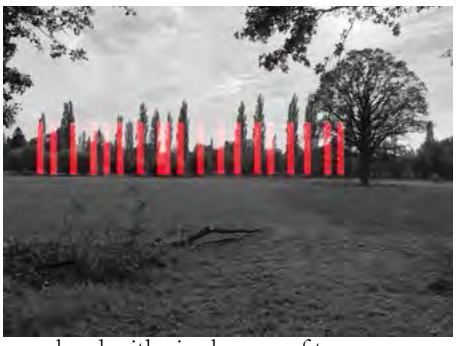


waterfront area with a bridge in forest

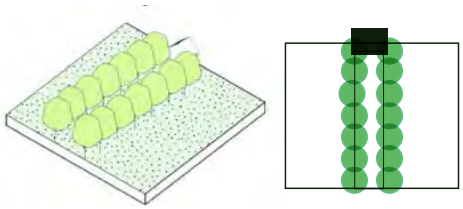


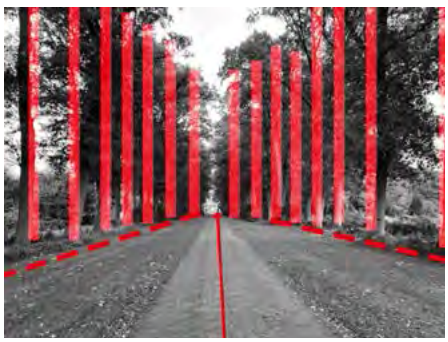
traditional forest with dry ditch



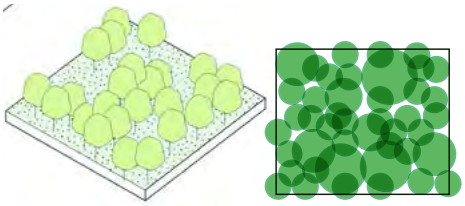


grassland with single row of trees

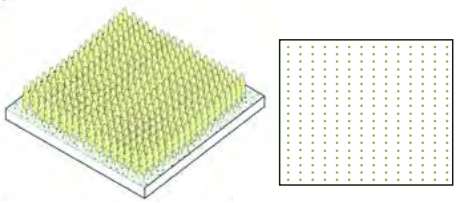




boulevard towards heritage castle



forest area

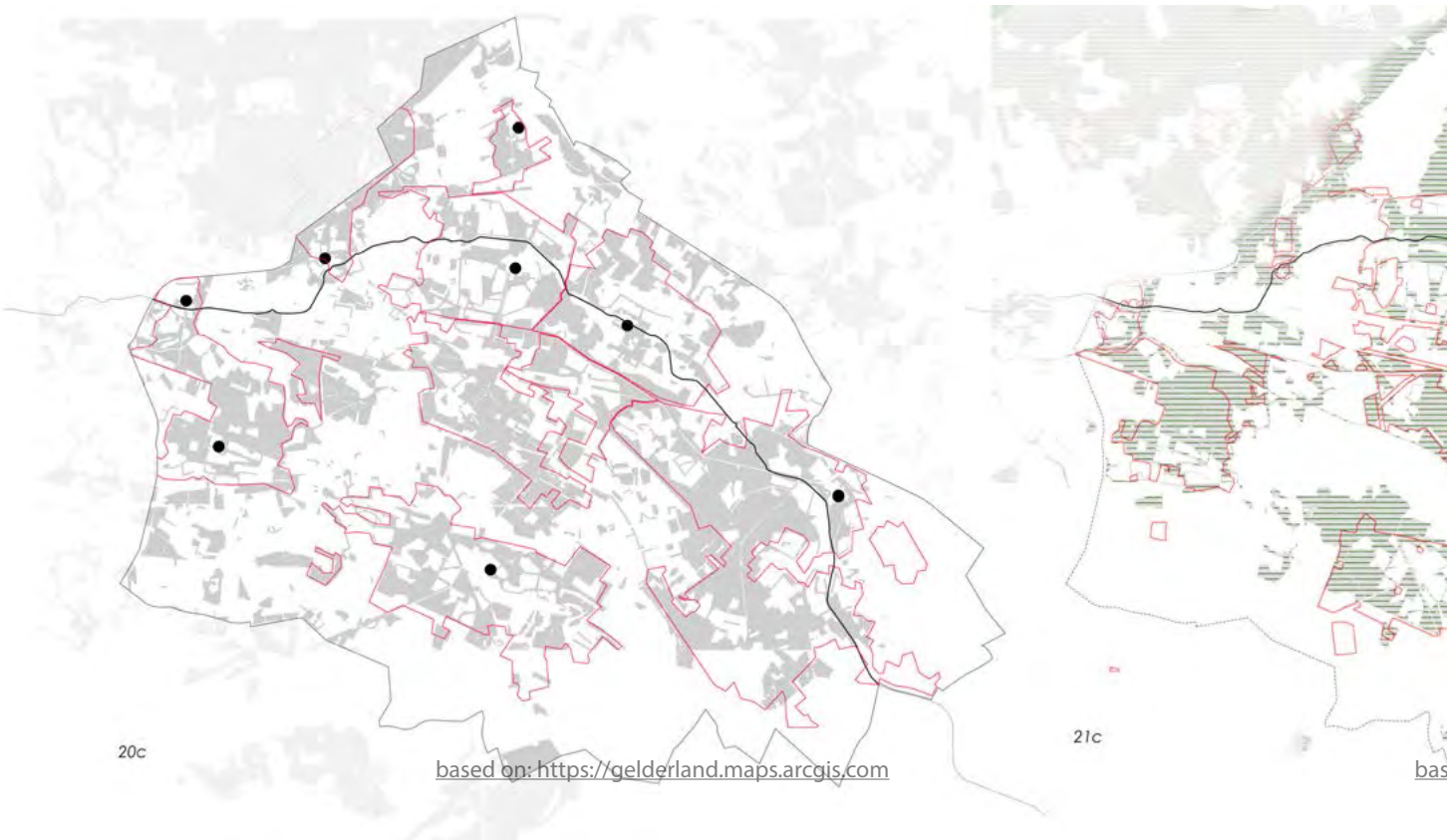


crop land

Besides, forest, as an important component in historical landscape view, especially of estate territory, and the main role of nature network, are fragmented, after deforestation during these years(Nijhuis, S., 2017). To some extent, estate zone's cultural-historical value, along with the decreasing forest landscape, is taken up by the mono-functional landscape.

As for the few existing forests, most of them, mainly consisting of coniferous trees, are imposed to produce wood materials and non-wooden productions.
Although the economic values of these cash trees get revealed, the long-term development of the forest, especially from ecological, societal and cultural-heritage respects, seems missing for its low diversity.

forest development



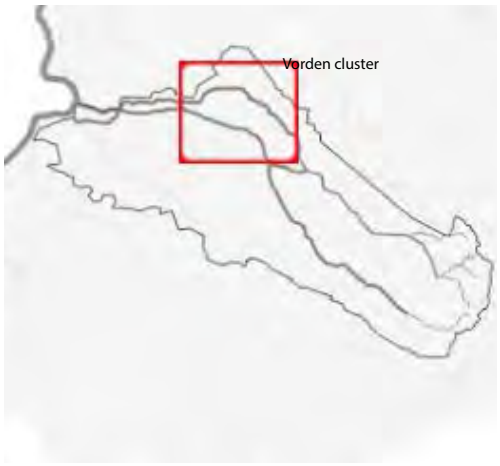
based on: https://gelderland.maps.arcgis.com

1900

poor eco environment condition
for trees' growth

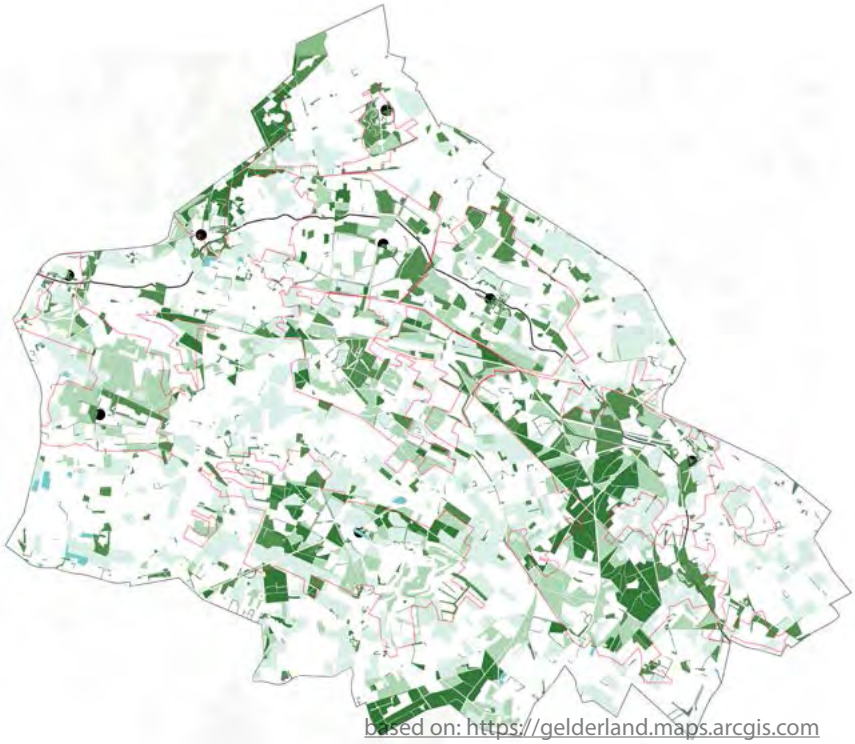
forest

castle



current forest types

based on: https://gelderland.maps.arcgis.com



based on: https://gelderland.maps.arcgis.com

2010

estate boundary

Baakse Beek

aakerland

coniferous forest

mixed forest

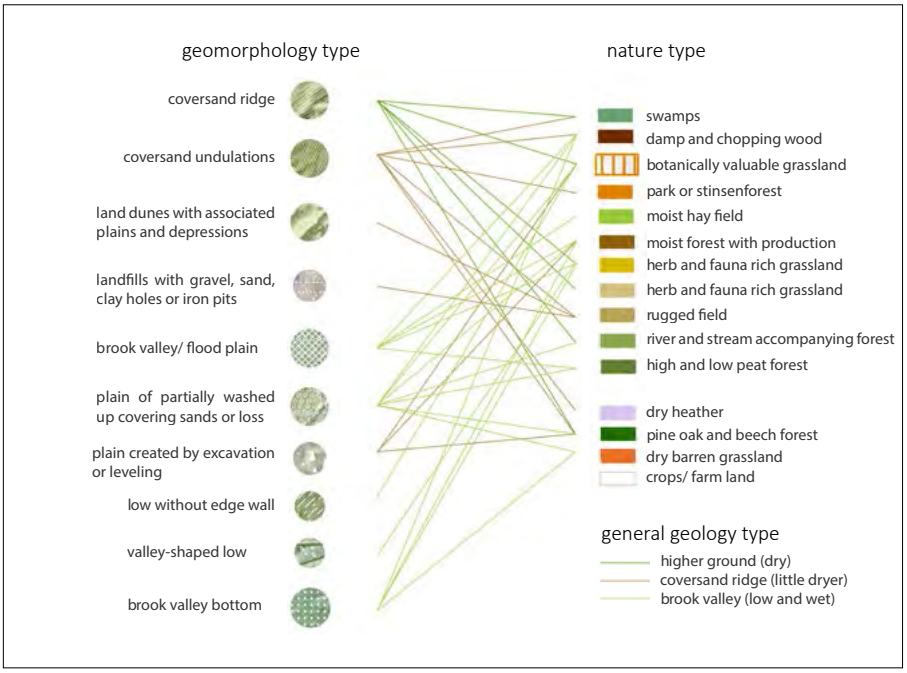
broadleaf forest

nursery forest

Forests distribution and nature type, geomorphology.

Overlapping of the geomorphology type and current nature type was made to explore the link between current landscape and it's primary geomorphology (see the map above and the legend with general description on the right side).

After historical interventions from different aspects, the relationship between geomorphology type and current nature type of the estate zone is shown in the diagram on the top right.



General description for geomorphorlogy types in the legend:

1.coversand ridge: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 0.25 - 1.5 (m) / mainly created by aeolian processes.
2.coversand undulations: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 0.25 - 1.5 (m) /mainly created by aeolian processes.
3.land dunes with associated plains and depressions: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 1.5 - 5 (m)/ mainly created by aeolian processes.
4.landfills with gravel, sand, clay holes or iron pits: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 1.5 - 5 (m)/ Landforms with anthropogenic origin.
5.brook (valley) flood plain: Flat; steepest slopes <¼ degrees and max height difference from environment 0.25 - 0.5 (m) /mainly due to fluvial processes in a geological era in which no (peri) glacial conditions prevailed.
6.plain of partially washed up covering sands or loss: Flat; steepest slopes <¼ degrees and max height difference from environment 0.25 - 0.5 (m)/ mainly created by aeolian processes.
7. plain created by excavation or leveling: Flat; steepest slopes <¼ degrees and max height difference from environment 0.25 - 0.5 (m) / Landforms with anthropogenic origin.
8. low without edge wall: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 0.25 - 1.5 (m) /mainly created by aeolian processes.
9.valley-shaped low area: Elongated shallow trough (<5m); steepest slope <1 ° degrees and max height difference from environment 0.25 - 0.5 (m) /mainly arose during a geological era with periglacial conditions.
10.brook valley bottom area: Elongated shallow trough (<5m); steepest slope <1 ° degrees and max height difference from environment 0.25 - 0.5 (m) /mainly due to fluvial processes in a geological era in which no (peri) glacial conditions prevailed. (Description source: Zinck, J. A., 2013)

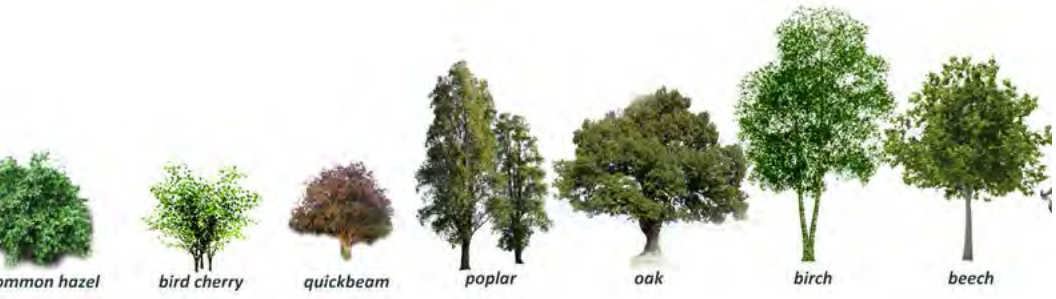
General description for geomorphorlogy types in the legend:

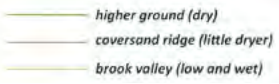
1.coversand ridge: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 0.25 - 1.5 (m) / mainly created by aeolian processes.
2.coversand undulations: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 0.25 - 1.5 (m) /mainly created by aeolian processes.
3.land dunes with associated plains and depressions: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 1.5 - 5 (m)/ mainly created by aeolian processes.
4.landfills with gravel, sand, clay holes or iron pits: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 1.5 - 5 (m)/ Landforms with anthropogenic origin.
5.brook (valley) flood plain: Flat; steepest slopes <¼ degrees and max height difference from environment 0.25 - 0.5 (m) /mainly due to fluvial processes in a geological era in which no (peri) glacial conditions prevailed.
6.plain of partially washed up covering sands or loss: Flat; steepest slopes <¼ degrees and max height difference from environment 0.25 - 0.5 (m)/ mainly created by aeolian processes.
7. plain created by excavation or leveling: Flat; steepest slopes <¼ degrees and max height difference from environment 0.25 - 0.5 (m) / Landforms with anthropogenic origin.
8. low without edge wall: Fairly flat, low-lying; steepest slopes ¼ - 1 (2) degrees and max height difference from environment 0.25 - 1.5 (m) /mainly created by aeolian processes.
9.valley-shaped low area: Elongated shallow trough (<5m); steepest slope <1 ° degrees and max height difference from environment 0.25 - 0.5 (m) /mainly arose during a geological era with periglacial conditions.
10.brook valley bottom area: Elongated shallow trough (<5m); steepest slope <1 ° degrees and max height difference from environment 0.25 - 0.5 (m) /mainly due to fluvial processes in a geological era in which no (peri) glacial conditions prevailed. (Description source: Zinck, J. A., 2013)

3.2.3 estate landscape and landscape characteristics

According to each area's specific geomorphology conditions, generally, there should be 4 types of forest communities (see the diagram below) in the corresponding areas. They are the potential nature forest for this region, which means they are naturally supported by the habitats of different moisture level, geology conditions and soil formations. Thus, these natural forest communities could help to maintain the biodiversity and reveal the ecological gradient for the landscape. (Beech mentioned below will not be recommended to be introduced to the study area, since it's not originally from the Netherlands and its role in enhancing ecological quality, in this case, would not be that helpful.)

However, as previously analyzed, there is a missing link between current landscape typologies and its identity (original-natural forest landscape), as well as the link among the current nature type and the historical estate landscape.





Forest communities species are based on description from Leuschner, C., & Ellenberg, H. (2017).

3.3. Conclusion of diagnosis: challenges and opportunities

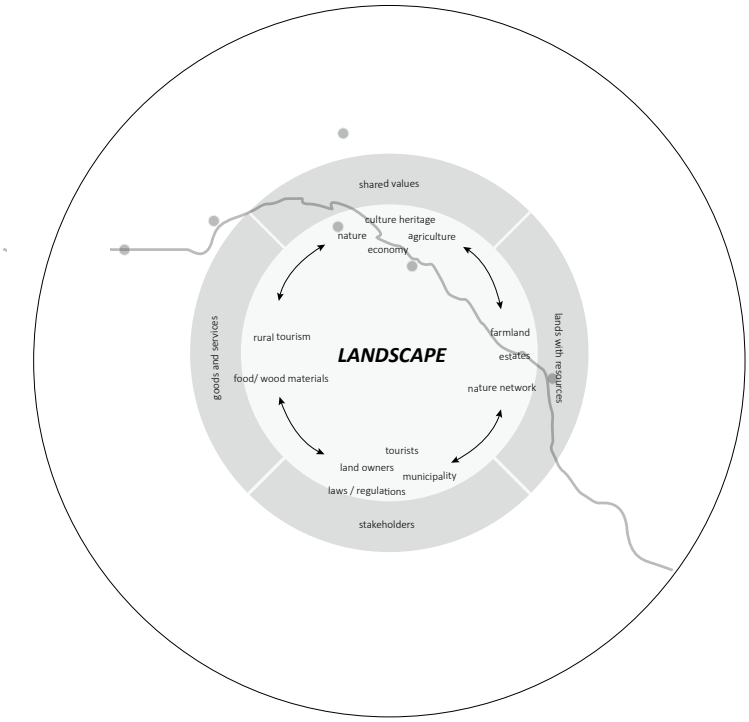
The estate zone of Baakse Beek basin area now is being challenged by issues from both ecological and landscape quality aspects.

Firstly, under the negative impact of deforestation, vegetations and crops in estate zone live in a dry habitat where the aquatic ecosystem is vulnerable. Sandy soil with fewer fertilizers also makes people aware of the increasing difficulties of this area's further development.

Secondly, as for the changing climate we are facing, though there is the uncertainty of how the ecosystem in the study area will respond to temperature rise, potential vulnerability to climate change, which has negative impacts on many aspects, deserves further sustainable strategies to address.

Thirdly, considering that the site exists rich materials in natural and cultural background, the estate zone's cultural-historical landscape is promising to be revealed. Even though there still exist many estates, problems from aspects of accessibility, cultural-historical landscape experience, negotiations among stakeholders and the relations between geomorphology condition and nature type, contribute to the lack of connection to the estate landscape from the site spirit, from the past.

Thus, as for the Baakse Beek region, especially the estate zone of which, there are opportunities in the balance between the ecological environment and agricultural production needs to be considered and promoted. Similarly importantly, the landscape spatial quality of estate zone is necessary to be enhanced.


shared values
culture heritage
nature
agriculture
economy
goods and services
rural tourism
food/ wood materials
LANDSCAPE
farmland
estates
nature network
birds with resources
tourists
land owners
municipality
laws / regulations
stakeholders

4.
Strategies & Principles

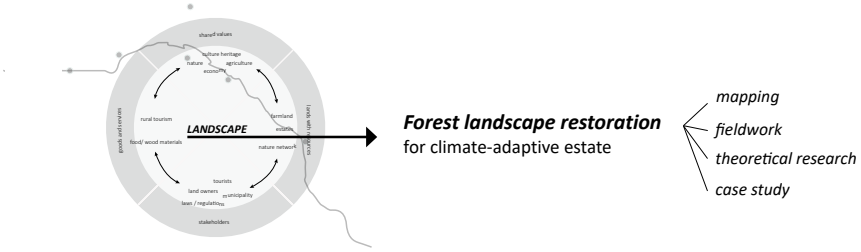
This chapter extracts strategies and principles to respond to the conclusion of site diagnosis in the previous chapter. Similar cases are studied to strengthen the capabilities of these design strategies and principles. This chapter also helps to contribute to a vision for the site, which will be proposed in chapter 5.

4.1. “Adaptive“ Forest landscape restoration as the main strategy

Here, the forest landscape is understood as the main element of the historical identity of the study area. It has great potential and offers multiple possibilities to address the problems the region faces and at the same time adds new qualities to the area.

The concept of Forest Landscape Restoration (FLR) arose in 2000 (Chazdon, R. L., Brancalion, P. H., Laestadius, L., Bennett-Curry, A., Buckingham, K., Kumar, C., ... & Wilson, S. J. ,2016). Forest landscape restoration (FLR) is defined as a process that aims to regain ecological functionality and enhance human well-being in deforested or degraded landscapes (GPFLR,2020).

FLR is not only about trees planting but also focuses on the landscape to meet present and future needs and bring other benefits in the long-term aspect. It incorporates multiple forest values to provide livelihoods and Eco-system services from a local scale to a regional scale.



According to FAO, forest’s values broadly consist of three parts: ecological value, social value and cultural value. As for the ecological value, fighting climate change, regulating the hydrological cycle and providing unique habitats are the functions it carries but it’s not only that. In terms of cultural value, forests are a backdrop for local history, some myths and stories.

Also, forests provide places to learn about nature and ourselves, which are a source of artistic inspiration meanwhile. Since forests can promote people’s well-being through adjusting employment situation, refining the living environment. It also functions well in the field of social and economic.

According to GPFLR(2020), the principles of forest and landscape restoration are:

1.Focus on landscapes
2.Maintain and enhance natural ecosystems within landscapes
3.Engage stakeholders and support participatory governance
4.Tailor to the local context using a variety of approaches
5.Restore multiple functions for multiple benefits
6.Manage adaptively for long-term resilience

These principles involve not only trees’ role into consideration, but also show concern to human well-being and societal needs. Based on these principles from literature research as a guideline, the strategies and principles for the thesis can be concluded with more convincing support.

FLR also has been widely applied to projects all over the world and gain positive achievement.

4.2. Case study

4.2.1. The Metro-Forest Project in Thailand

The Metro-Forest project, located on an abandoned site of Bangkok, aims to reclaim valuable land mainly for enhanced environmental awareness, ecosystem and climate change mitigation through reforestation, which is similar to the goal of the thesis. The site used to be excavated intensively for soil. However, the ecology environment quality got decreased and the site was abandoned after people's excavation.

The reforestation work is to create an ecological forest where species had once established territorial populations around Bangkok during mid-19th century would be planted, considering these dominant species of the area contains ecology value and can reflect Bangkok's former landscape.

The new forest not only can provide ecological effects but also make public education and experiencing enjoyment happened under the canopy. Apart from that, maintenance of the site will look for the forest to manage itself, as no management is the best management. Outdoor exhibitions also will be introduced to the forest to encourage visitors' new observation in the landscape and boost the further development of the area as well (Angsana Boonyobhas, 2016).

Site challenges
- No function
- Low perception of the former landscape
- Vulnerable ecosystem

Extracted lesson
- The historical landscape can provide a reference for future's landscape, from both ecological and cultural perspectives.
- The ecological forest with added values shows potential to achieve sustainable development.

source: Studio Schep, 2012

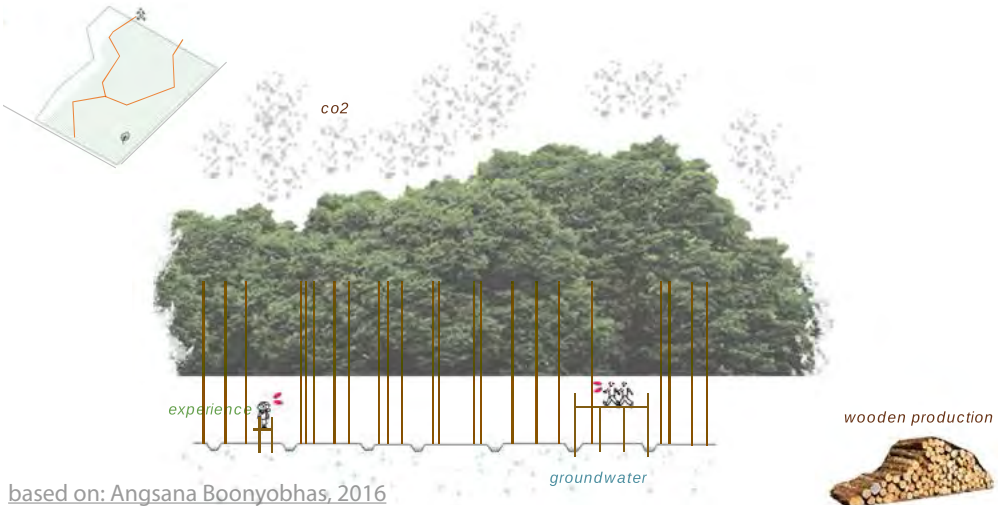
4.2.2. Rabattenbos Eindhoven in the Netherlands

The Rabattenbos, typical traditional forest type, is applied in the forest area of Stadswoud, which meanwhile introduce an attractive, recreational area to the original production forest. In combination with the presence of pools in the area, the forest also play an important role as an ecological structure for aquatic fauna (Studio Schep, 2012).

Site challenges
- Mono function

Extracted lesson
- This project Transform a mono-functional production forest into a multifunctional forest with not only wooden production but also an ecological habitat and recreational experience.

source: Angsana Boonyobhas, 2016



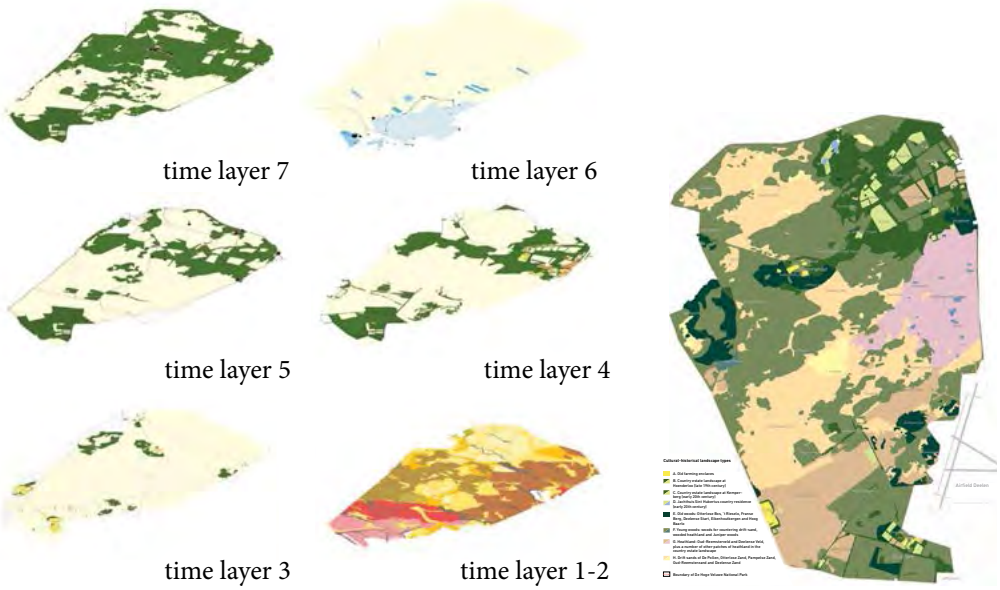
based on: Angsana Boonyobhas, 2016

4.2.3. De Hoge Veluwe nature park in the Netherlands

De Hoge Veluwe National Park is the largest contiguous and independently managed nature reserve in the Netherlands.The Stichting Het Nationale Park. De Hoge Veluwe foundation was formed in 1935 to maintain the independence of the lifework of Mr Kröller and Mrs Kröller-Müller and enable more visitors to enjoy their creation. The foundation is a non-profit organization and conducts its operations virtually without grants. The Park attracts between 500,000 and 600,000 paying visitors a year. The Park, together with the Kröller-Müller Museum on its land, is from many perspectives a unique combination of nature, art and architecture. The Park and Museum jointly form an important driving force for the regional economy. The Park is an important source area for biodiversity within the Natura 2000 Veluwe area (Hnsland, 2010).

Site challenges
- A higher level of quality needs to be maintained
- Remaining competitive with other recreational destinations

Extracted lesson
- financial autonomy through a collaborative effort
- an area-specific approach promoting a coherent image of the cultural-historical landscape to bring narratives to life and make them perceptible.



1 and 2 The ice-age landscape and from pre- and protohistory (ca. 200,000 – ca. 10,000 years ago: ca. 8,000 – 2,000 BCE) | 3 The Middle Ages and early modern Veluwe landscape (ca. 800 – ca. 1,850 CE) | 4 The country estates and reclamation landscape (1846 – 1909) | 5 The landscape of the Kröller-Müllers (1909 – 1935) | 6 The landscape of the Second World War (1940 – 1945) | 7 The landscape of De Hoge Veluwe National Park (1935 – present)

4.2.4. New Forest National Park in England

The New Forest is located in Southampton of England, where deciduous woodland once existed and later replaced naturally by birch and eventually beech and oak around 12,000 years ago. Historical development and human intervention lead to forest clearing areas for cultivation. Considering the poor condition of the soil, "waste" heathland and grazing land for horses were the main land use, rather than large-scale agriculture production land.

The Open Forest is also linked to the surrounding landscape types by its rivers and streams and their catchments. Managing pressures such as human activities require areas outside of the core forest to help provide offsetting functions. Because there will be increasing visitors in the national park, new ways to ensure economic sustainability are being sought and an alternative green infrastructure with recreation activities are proposed to deflect visitor pressure.

source: Plan, N. F. B. A., 2012

Restoration of coppice woodland in the forest fringe and restoration of plantations on ancient woodland sites back to semi-natural broadleaved woodland is a conservation priority for forest fringe area. Also, the area where rivers cross the forest fringe will be conserved as habitats supporting several species (Plan, N. F. B. A., 2012).

Site challenges
- vulnerable ecological condition
- visitor pressure

Extracted lesson
- For forest fringe area, coppice woodland is restored for semi-natural broadleaved woodland on its ancient sites.
- The area where rivers cross the forest fringe will be conserved as habitats supporting several species.
- Introducing recreation program into landscape to deflect visitor pressure.

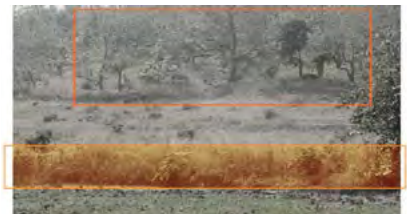
4.2.5. Resilient rural livelihoods through restoration and sustainable natural resources management in India

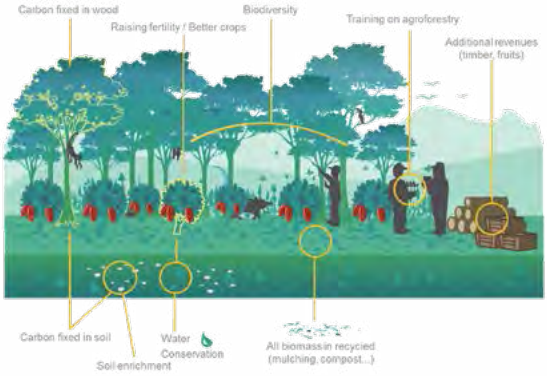
To respond to the negative impact from loss of biodiversity, declining agricultural productivity, forest degradation, soil erosion and climate-change-related problems in Mandla district, India, eco-restoration as an integrated method is used. Ecosystem-based measures, mainly in forms of forest restoration and agroforestry, as well as management on forestry and agriculture, are conducted in this project. Over 500 hectares of forest are conserved with richer species than before. The implemented agroforestry interventions on forest fringes not only support the stabilisation of the ecosystem but also provide the locals with livelihood sources and income increase (Somya Bhatt, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2019).

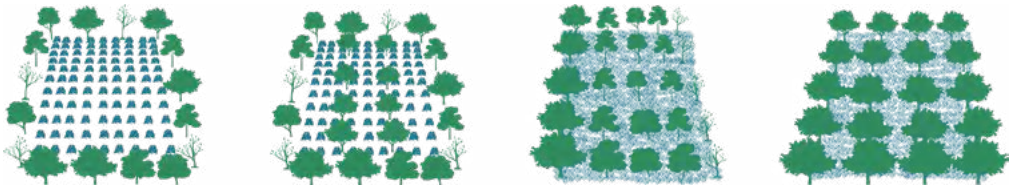
Site challenges
- vulnerable ecological condition
- low income

Extracted lesson
- transforming open field into agro-forest for multiple values.

Different agroforestry models







source: PURproject, 2020.

4.2.6. Borkener Paradies in Germany

The Borkener Paradies is a German nature reserve which used to be a forest pasture area for cattle for centuries.The Borkener Paradies is surrounded by an old meander of the river Ems and contains multiple landscape features (eg. Meadows, forests, shrubs and dunes), which give the nature reserve a park-like character.

'Hudewald' system applied in Borkener Paradies presents the way of balancing farming and eco-environment preservation. Shrubs function as a natural fence for these cattle and also play an essential role in biodiversity maintenance (Vera, F. W. M., 2000).

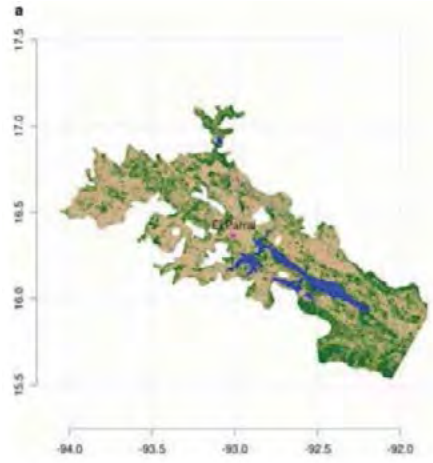
Site challenges
- vulnerable ecological condition
Extracted lesson
- Applying 'Hudewald' system to enhance the ecological environment and integrate farming into the landscape at the same time.

4.2.7. Fresh Breeze Afforestation Project in Chiapas, Mexico

Afforestation as the main approach is used to repair the degraded forest clearing area in the state of Chiapas, Mexico. To increase the forest connectivity and permeability, diffuse mosaic of forest, open woodland and scattered trees of various species are planned. In this project, further actions are focused on protecting and managing major links between conservation reserves to assist their long term viability (Fresh Breeze Afforestation Project., 2014).

Site challenges
- Forest clearing area's degrading

Extracted lesson
- Replanting trees of rich species.



sandy area, the Central Valley of Chiapas: forested areas are represented by dark green; the non-forested matrix by tan

(source: http://proteak.com/index.php/es/).

4.2.8. the hills of Chetian village, Changting county, China

The small town in China used to account for about a third of the eroded land in Changting county and always suffered from barren soil condition. Since 2003, researchers have conducted afforestation and grass planting on site to improve fertilization of the hills. Species which have resistance to tough habitat but also bring the farmers money are encouraged to be planted.

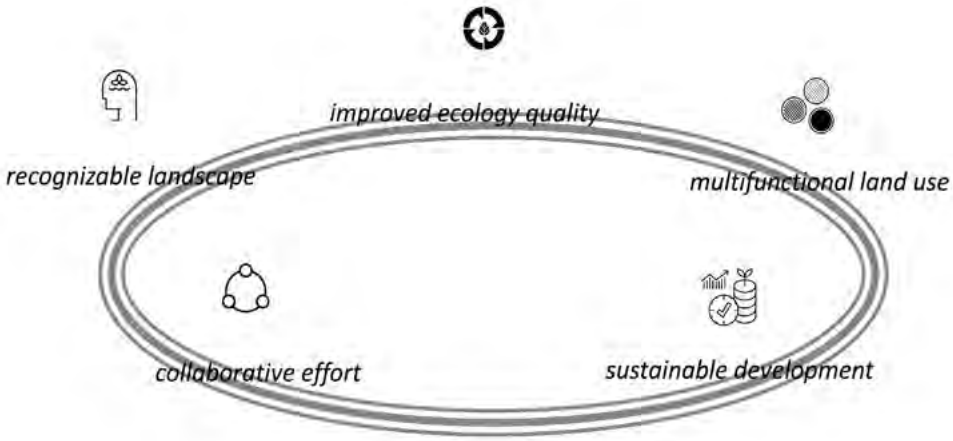
As the initial achievement of the promising project, mountains are turned green and a farmer's net annual income got increased up 13% per year on average (China Daily, 2012).

Site challenges
- barren soil condition

Extracted lesson
- Replanting trees of rich species.

source: China Daily, 2012

4.3. Design strategies



To address the problems stated of the estate zone, 5 main FLR-related strategies concluded and supported from the landscape of the Baakse Beek region, literature research and case study, are proposed below, which can be applied to the further design to achieve the proposed goal of the thesis.

- recognizable landscape
- improved ecology quality
- multifunctional land use
- collaborative effort
- sustainable development

4.4. Design principles

To deal with the site-specific problems, design principles and spatial interventions are proposed, like implantation and reinterpretation of history and lost landscape elements, new structures for enhanced landscape quality, smart farms, reforestation, afforestation and intensified land use, according to different problematic situations.

Smart farms

Manure recycle system is an important step for smart farms construction. The artificial intelligent application will be introduced to fertilization activities so that the pollution to the soil and water can be decreased. Also, planning for species composition of agriculture production and mowing regimes control also can be applied to contributing to smart farm, since maintenance of mowing is not only important for species compositions of vegetables and crops but also play a vital role for species-richness of the natural grassland (TEN CATE, M. A. R. I. A. N. N. E., & GÜSEWELL, S., 2003).

Reforestation

To adjust the ecological quality and combat climate change, land with more forests covered, instead of mono-functional grassland, is the main output of re-instating ecological processes through forests. Based on specific habitat conditions of target sites where forests once existed but removed for other use, corresponding tree types and species will be chosen to form climate-smart forests so that values of crosscutting aspects can be added as well (Palombi, L., & Sessa, R., 2013).

Afforestation

For the area where forests didn't exist before, transforming the fragmented farmland, especially of small size, and grassland into forests of related species can help to repair the ecology and capture CO2 and energy to achieve climate resilience. Agroforestry and buffer corridor will be the special forms of afforestation, which are explained when applied to the study area in design.

Implantation and reinterpretation of the old and lost landscape elements

The existing estate zone mostly is privately owned by estates' owners and farmers, who have limited ability to maintain the historical buildings, fountains, watermills, avenues or important trees. These landscape elements are vital clues for visitors to experience the historical identity of the landscape, though sometimes they are easily ignored without strengthening and interpretation. The implantation and interpretation work tend to provide visitors with more readable landscape nodes to approach the culture layer of the space.

New structures for enhanced landscape quality

Since not all the estates' territories are open to the public and the accessibility also needs to be improved. The interventions by planning path networks and outlooks to make corresponding areas public and welcoming for people's visiting. As for the existing farmland within the estate zone, parcels connected will be organized as a whole and get maintained. The soft and functional transition between forest and farmland will be introduced through big trees and shrubs. The forest fringe area will be paid special attention to, considering it is vital both ecologically and agriculturally.

Agroforestry + Water management + Leisure and recreation

Large areas of agriculture use land are one of the factors contributing to the low resolution of the landscape. Agroforestry would be the ideal solution to enrich programs of the agricultural land and maintain the basical function as food production. Cooperated with vegetations, historic stream and new pond are reacitivated to help to sponge water and also for waterfront viewing. Creating more activity space for visitors, in forms of recreational and educational nodes, will provide a good platform to perceive.

Design principles

improving ecological quality

smart farms

manure recycle

species composition and mowing regimes control

reforestation

- climate-smart management of landscape elements
- mixed forest

afforestation

-co2/ energy capturing and storation
-Smart interactive service and infrastructure

transformation and expansion of nature area
-from natural grassland to forest
-forest construction on arable land

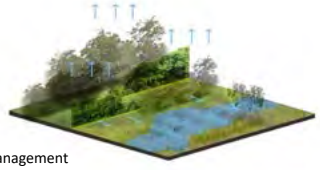
recognizable landscape

implantation and interpretation of the old and lost elements

new structures for enhanced landscape quality

multifunctional land use

- agroforestry



- water management

- space for leisure and recreation

4.5. Toolbox

Based on proposed design strategies and principles, toolbox, as shown below, is to present potential ways to intervene in the current landscape in specific situations. To detailing the design principles applied, spatial relations among vegetations, open space and visiting routes are shown.

More detailing information, like materials, species of vegetation communities and pathwidth etc, will be presented in the following 2 chapters for design exploration.

Although all the interventions have overall effects more or less related to each design principles, they still have some different focus.

Tools, like A, B, C, D, are mainly to promote forest park's accessibility and provide visitors with a good spatial and cultural landscape experience.
Tools, like E, F, G, H, I, are mainly to improve the ecological environment and present the historic landscape through traditional forest type.
Tools, like J, K, L, are mainly to improve the ecological environment and enrich the site's functions.

A

constructing view p

D

appropriate design
stream crossings

G

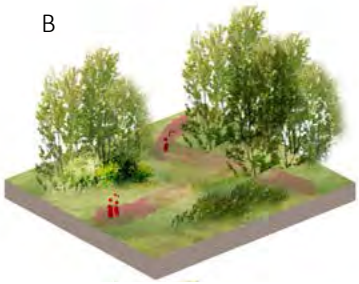
mixed forest park

J

forest ripairian bu

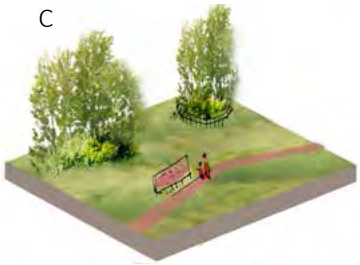
oint

B



elevated pathway

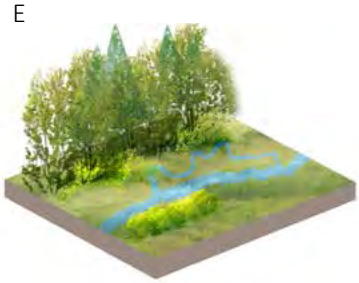
C



education spot

n of roads and

E



reconstructing former brook

F

rabatten bos

H

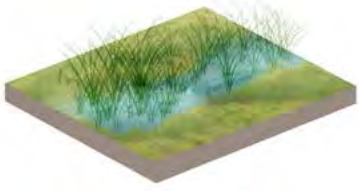
forest meadow

I

hedgerows fringed forest

ffer

K



helofytenfilters

L

forest garden

A

constructing view point

To provide visitors an ideal perspective to view the estate landscape, view point in forms of platform or observation tower are introduced at proper points along the spatial axis.

B

elevated pathway

Forest areas has potential to be opened and elevated pathway can make these areas accessible to visitors. Also it can avoid excessive impacts on the exisiting natural balance.

C

education spot

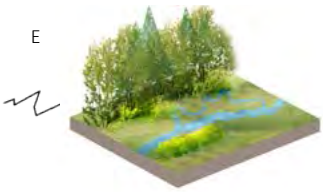
Along the paths or trails in semi-open forest areas, education spots with information board or historical landscape compositions are proposed to enhance people's awareness of the cultural-historical value of the forest landscape in the estate zone.

D

appropriate design of roads and stream crossings

To bring the role of water back to the landscape and make streams visible, small bridges are constructed to maintain the experiencing routes' continuity when near the waterfront area.

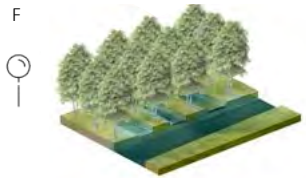
E



reconstructing former brook

Former brook contains multiple values from historical and ecological aspects. To strengthen the circulation in site's water system, remeandering historical streams are constructed for enhanced water and soil conservation.

F



rabatten bos

To restore water in ditches and accumulate moisure in soil, rabatten bos, a type of historical forest community typology, is restored in wet low-lying areas, eg. brook valley. When it's rainning season, rabatten bos with its ditches also can drain water quickly to prevent flooding. It provides a resilient tool to manage water for corresponding areas.

G

mixed forest park

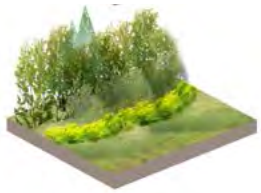
The intervention in form of mixed forest park means adjusting existing forest communities to adapt to the geomophorlogical conditions and introducing park elements (like A,B,C,D) in combination to reveal multiple values of forests.

H

forest meadow

Forest meadow is a habitat proposed in open area of forest areas. Also, it's a traditional system involving natural low-intensity grazing and natural conservation. So that high species diversity could be maintained by applying forest meadow, meanwhile it could boost eco-tourism in the landscape (Leuschner, C., & Ellenberg, H, 2017).

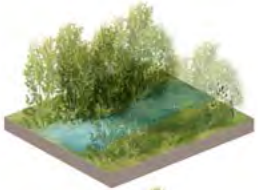
I



hedgerows fringed forest

To plant small trees or hedgerows in forest fringe area is the main intervention. Hedgerows fringed forest could add multiple values to the fringe area, since production can be harvested from productive trees, fruit trees or shrubs planted, which meanwhile bring more green from different layers to cover the ground. Thus, economic value and ecology value are promoted.

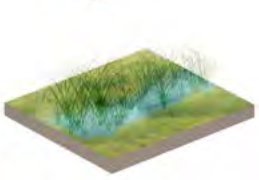
J



forest ripairian buffer

To conserve the valuable water system in landscape, trees combined with shrubs are planted in form of forest ripairian buffer. It can provide functions of filters, animals' habitat and recreational places, etc.

K



helofytenfilters

To treat eutrophic water and enhance water quality by natural plants' capacilities, helofytenfilters are applied in streams or swales where purification is required. Besides, it can provide habitat for birds. Generally, there are different variants of helofytenfilters, eg. vertical, horizontal, flow field (Tooske Hofman, 2019).

L

forest garden

Instead of only planting crops for agricultural income, agroforest can provide multiple plans for planting species from crops, vegetable to low-stem fruit and high-stem fruit. Moreover, recreational farming acitvities can be introduced to agroforest as well. Thus, it not only increases income from agriculture products, but also reveal values from ecological and societal aspects.

5.
Design exploration

In this chapter, the vision of the estate landscape in Vorden cluster is proposed by applying design strategies and principles of forest landscape restoration in an adaptive way.

How the proposal reveals the new estate landscape's societal, cultural and ecological values is discussed in this chapter. The gradients inspired by these 3 layers also help to make estates' forest landscape recognizable and more resilient to climate change, which response to the problem statement proposed in the first chapter.

View from the avenue of H' Medler towards the area outside the estate.

5.1. Introduction

Based on the previous analysis and strategies and principles proposed, the thesis will integrate them logically into the study area.

The estate landscape in vorden cluster area will be the testbed in this thesis to experiment principles and strategies proposed. The new forest landscape will contribute to the most important backbone of the strategic plan.

As for the Baakse beek basin area, there are 6 landscape types based on its local geological conditions. According to the 6 landscape types, different landscape features will be strengthened to promote its hydrological environment and its landscape perception as well.

5.2. Application of strategies and principles

Based on the FLR options framework (Hanson, C., Buckingham, K., DeWitt, S.,& Laestadius, L.,2015), the new estate landscape proposed for the estate zone integrates several critical interventions that together result in a more resilient ecological environment and appropriates people's wellbeing (see diagram below).


Social/Cultural value
Ecological value
RUURLO
RUURLO
without trees covered
existing (degraded) forests
under permanent management
under intermittent management
degraded mangrove
other protective land or buffer
afforestation
reforestation
silviculture
agroforestry
improved fallow
mangrove restoration
riparian tools, e.g. remeandering, rabatten forest restoration, ripairian buffering, etc..
0
1000
2000

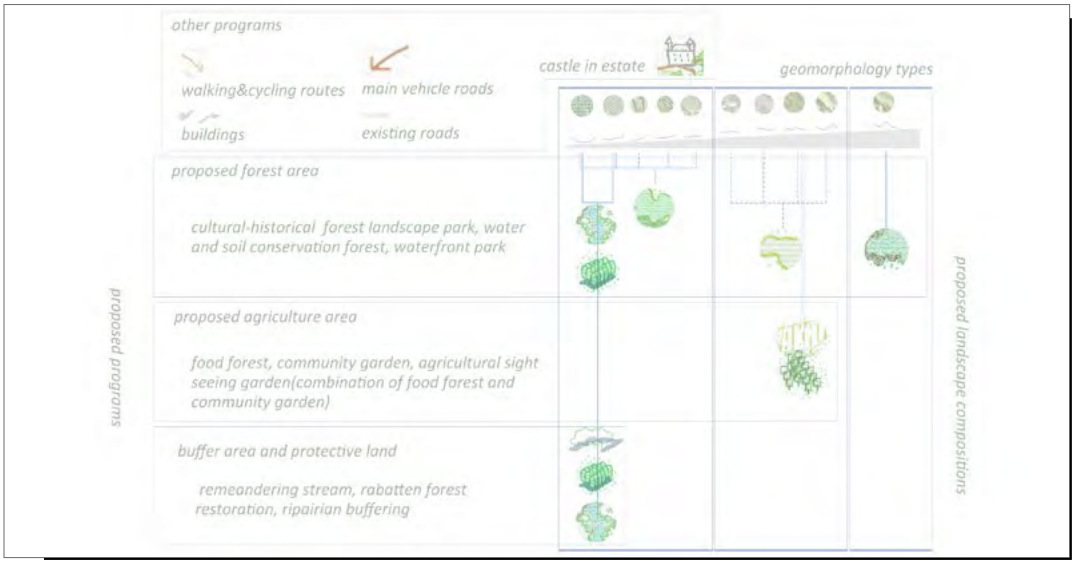
5.3. Vision

The design employs three lenses, 1) ecology 2) recognizable landscape and 3) agriculture as a multilayered FLR approach for addressing different dimensions of a thriving estate landscape.

ecology

recognizable landscape

agriculture


other programs
walking&cycling routes
main vehicle roads
buildings
existing roads
castle in estate
geomorphology types
proposed forest area
cultural-historical forest landscape park, water and soil conservation forest, waterfront park
proposed agriculture area
food forest, community garden, agricultural sight seeing garden(combination of food forest and community garden)
buffer area and protective land
remeandering stream, rabatten forest restoration, ripairian buffering
proposed programs
proposed landscape compositions


RUURLO

Ecology layer

How the forest landscape can enhance the ecological condition in the cluster?

The ecology layer is based on the FLR framework and the geomorphological conditions of the area.

Through planting trees based on vegetations' ecological adaptability: from dry to wet, the new green infrastructure would contribute to increasing water storage capacity, water and soil conservation and rich biodiversity.

tree groups

+

fringe forest

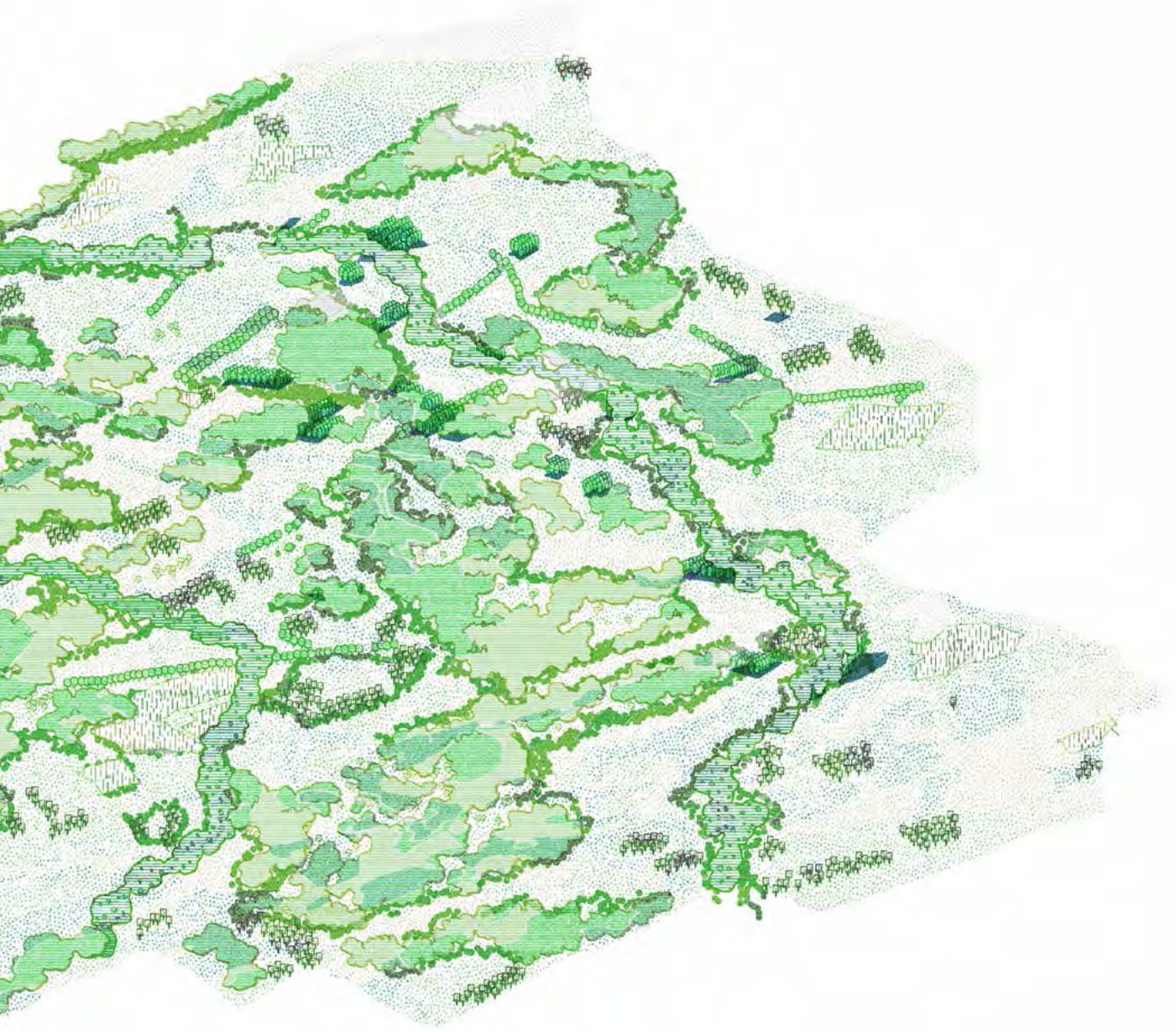
+

forest meadow

wet forest lands

medium moistu

dry forest lands



scape

ure forest landscape

scape

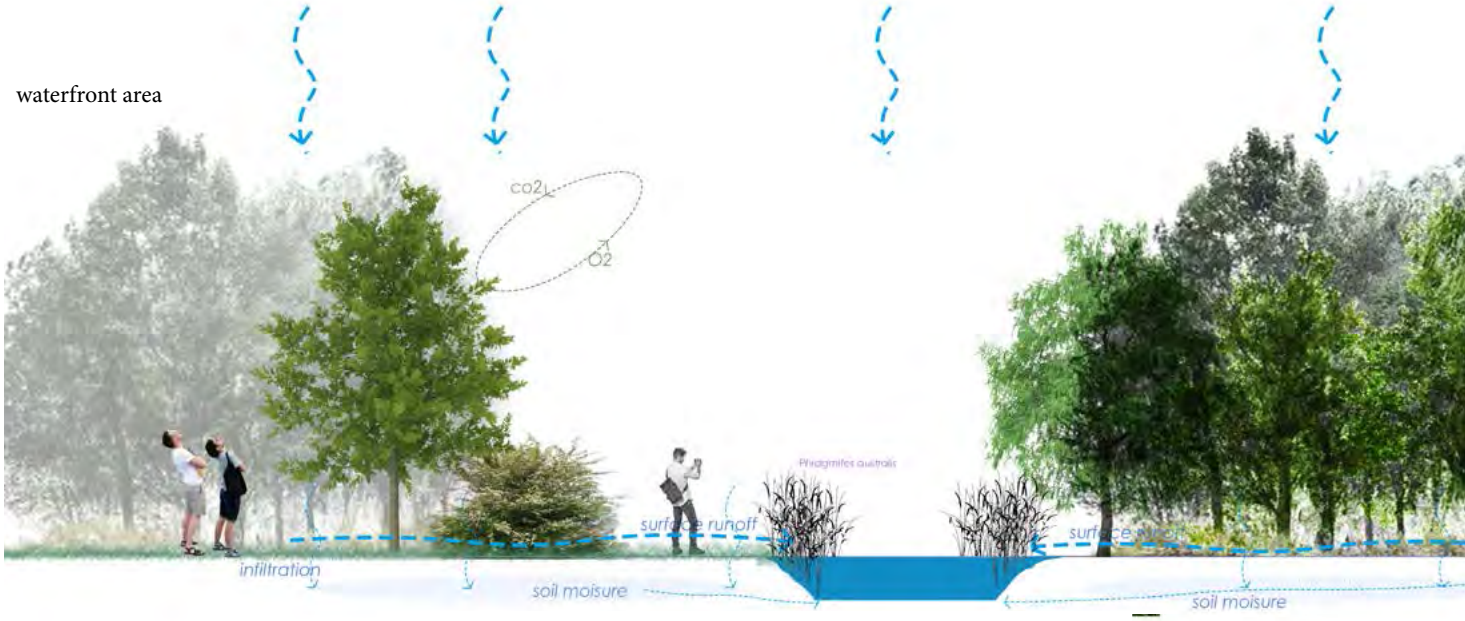
riparian buffer

rabatten forest

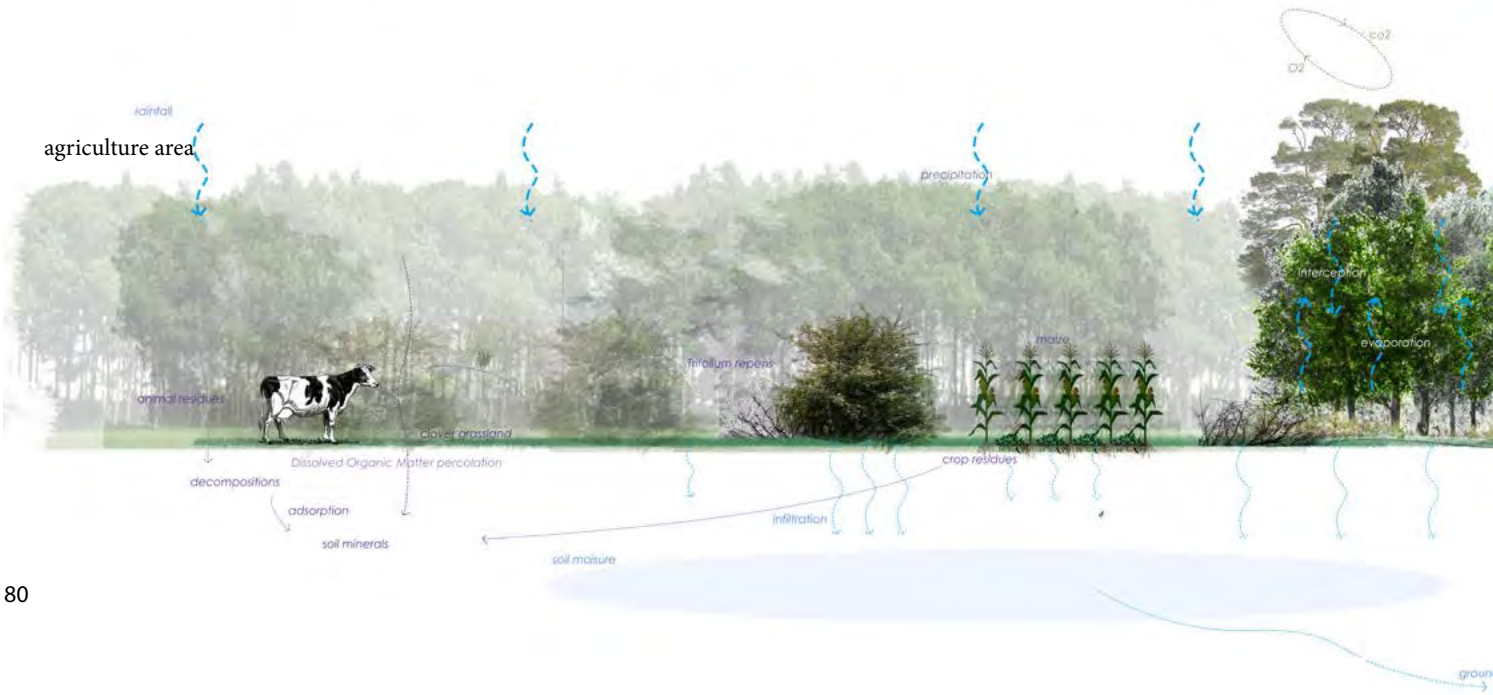
agricultural area with water conservation

forest area

waterfront area



agriculture area



dry/ moderate dry

beech-oak forest

- Water circulation in the new estate landscape

After enriching species and layers in the natural network of vorden cluster, the relationship with water flow gets stimulated as well.

birch-oak forest

wet

alder-ash forest

Since trees and vegetation in lower layers play an essential role in the hydrological circulation system, precipitation would increase and the evaporation of water can be blocked effectively by deciduous trees with board leaves (Gerrits, A. M. J., 2010). Thus, soil moisture can be accumulated and maintained underground. Besides, leaf residues and dissolved organic matter percolation help to increase soil minerals.

swampy alder grove

moderate dry

birch-oak forest

Affected by trees' ecological values, landscape quality gets enhanced. Trees' enclosure also contributes to sufficient and clean water in the stream so that visitors can enjoy the nice view.
Through forest landscape restoration in the agriculture area, hydrological circulation also gets stimulated. Crops and trees with wide leaves are chosen to help to decrease water runoff and increase soil minerals.

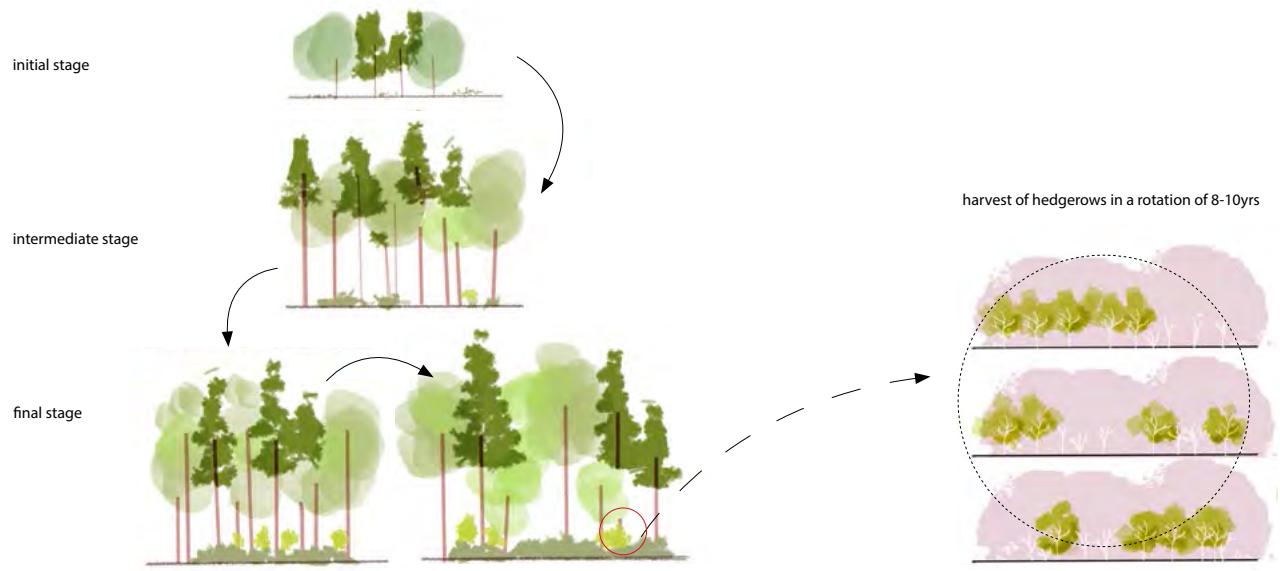
5.3.1. ecology : from dry to wet

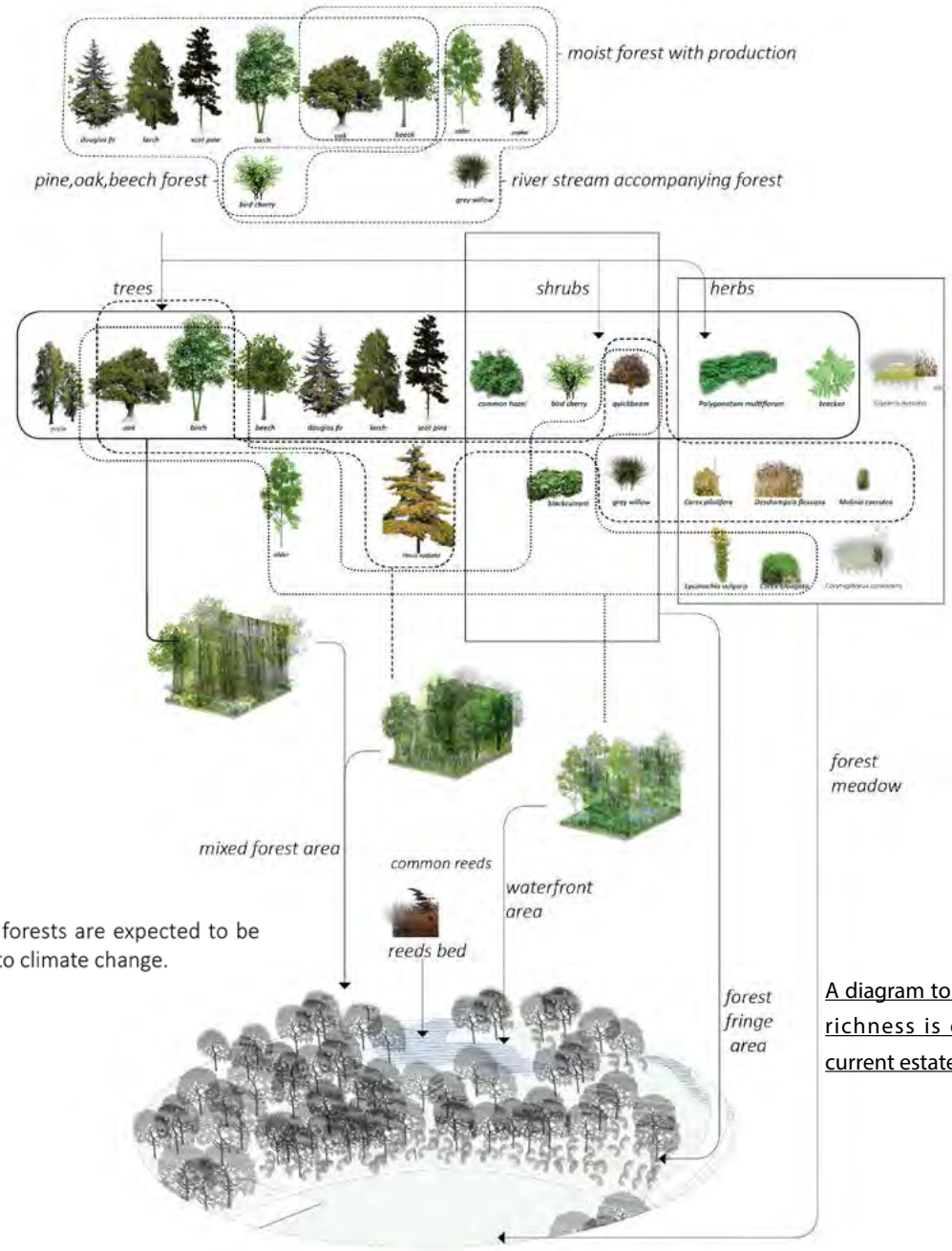
As for the current situation, forest communities in the estate zone are not in the most suitable condition, not only for the tree itself but also for the landscape in the estate zone. They are mainly for wood production and lack a variety of species to maintain the ecology environment, especially the hydrological environment.

The estate landscape with rich species after restoration creates a better connection between landscape and the ecology environment, meanwhile, it can enhance people's interaction with nature.

After constructing the forest landscape restoration in Vorden cluster, the green infrastructure will gradually develope into a climax forest, which has larger capacilities than forest at initial stages to contribute to stable and resilient eco-system. Also, climate change changes forests' compositions, functioning, productivity and their habitats to affect the dynamic balance of the ecosystem (Morin, X., Fahse, L., Jactel, H., Scherer-Lorenzen, M., García-Valdés, R., & Bugmann, H., 2018).

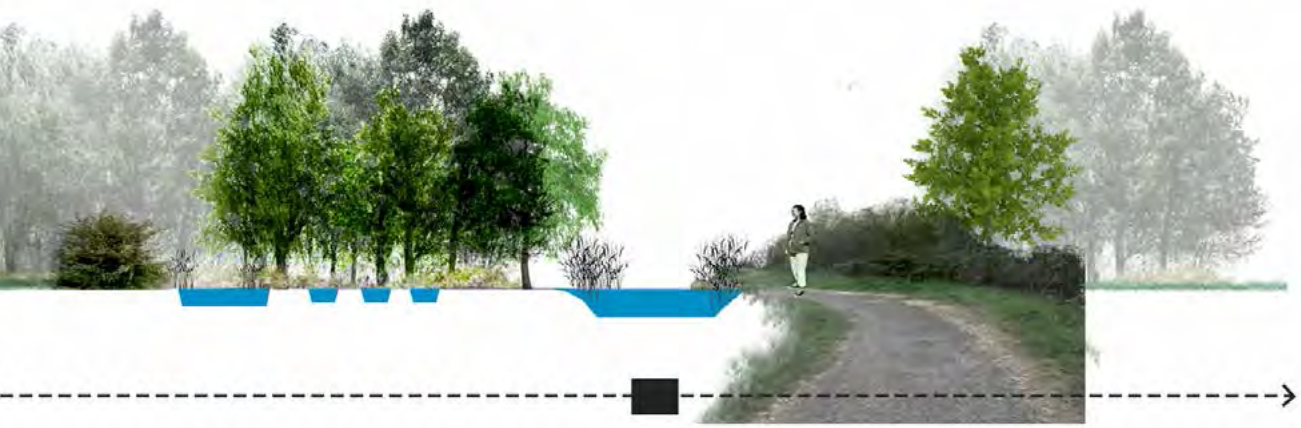
<u>forest succession</u>





high-diversity forests are expected to be more resilient to climate change.

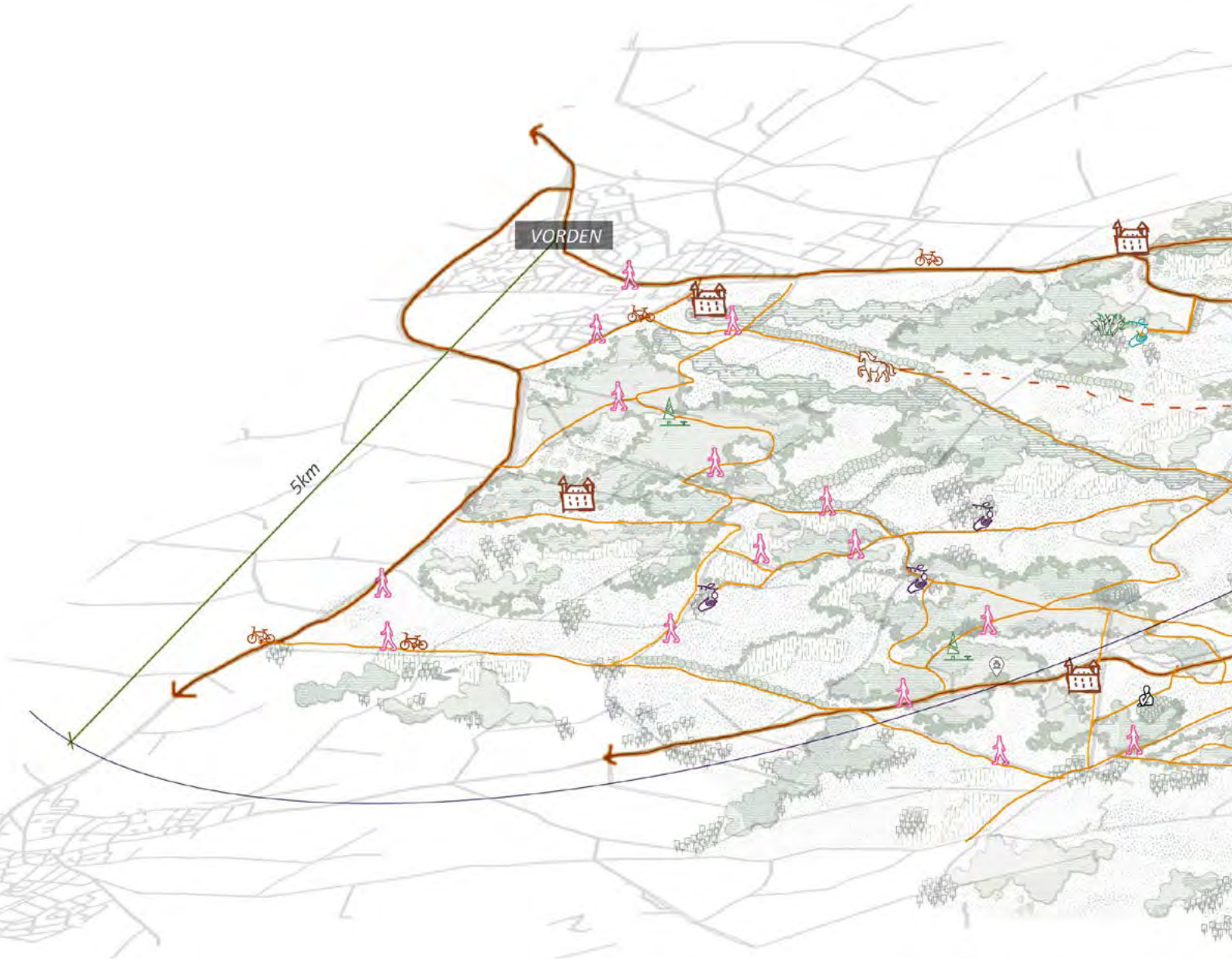
A diagram to show vegetation species richness is enhanced after FLR in current estate landscape.



Recognizable landscape layer

How the forest can promote landscape characteristics and experience in the cluster?

The recognizable landscape layer is based on the optimization of the existing accessibility network and redefines several recreational routes for multiple activities. New educational and recreational destinations are introduced.



horse riding route

walking & cycling routes

main vehicle roads

existing roads

horse riding

agricultural sightseeing

education

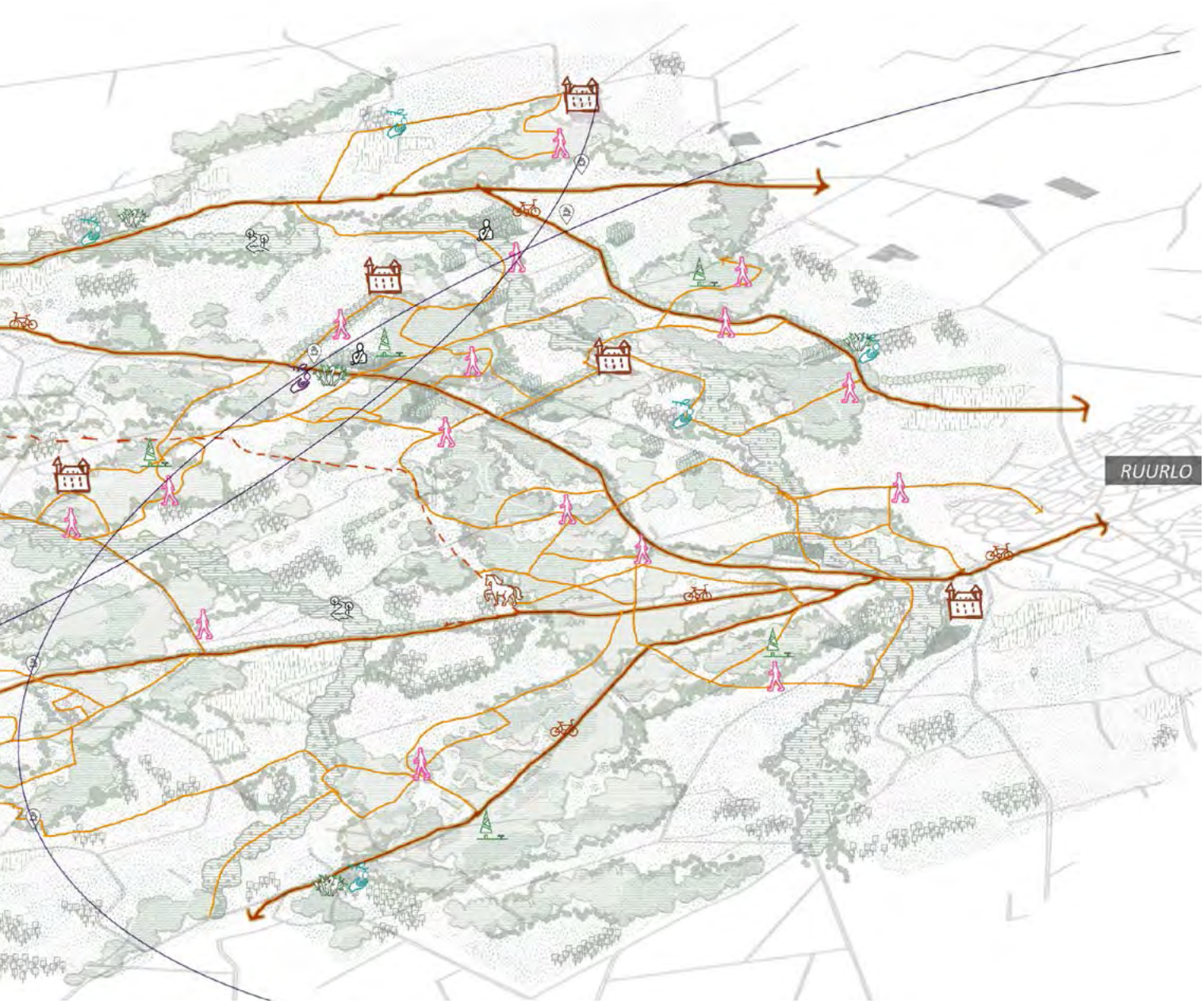
walking

biking

cultural- historical fore

historical attraction

rural restaurant



est landscape park

waterfront leisure park

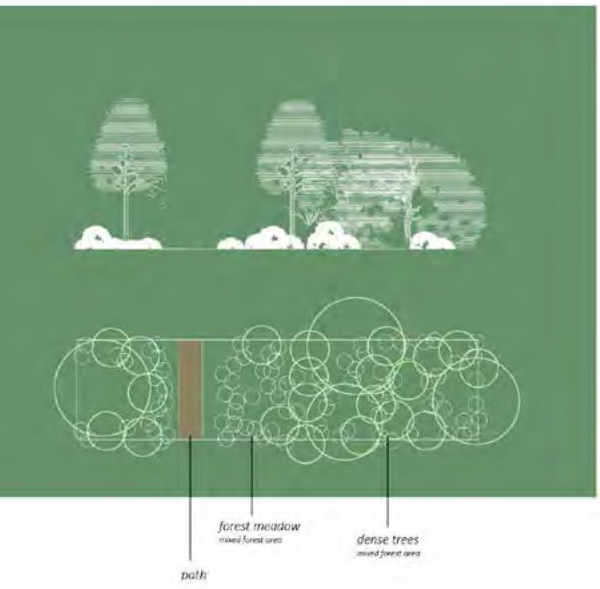
resting point

To strengthen the connection between the historic forest landscape in the east Netherlands and the contemporary estate landscape, to make the estate landscape more perceivable, several spatial typologies are introduced to proposed programs.

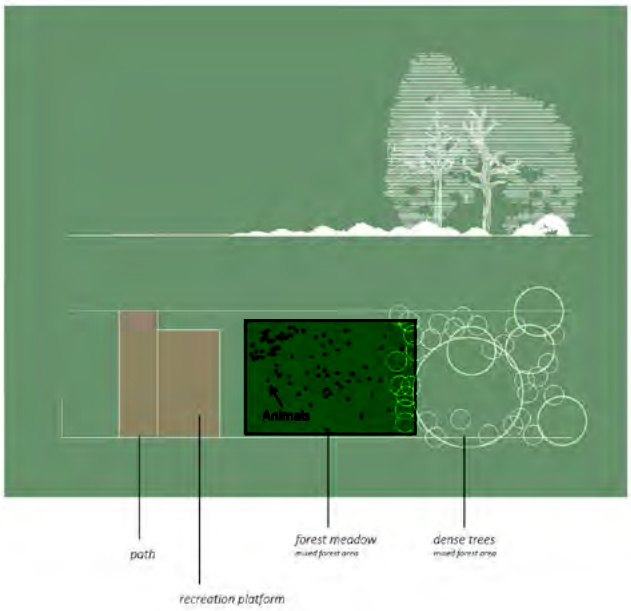
They are traditional forest types historically playing the main role in the Achterhoek region, which provide people with diverse and meaningful spatial experience.(see the diagram on the left and the schematic section below)

- current situation

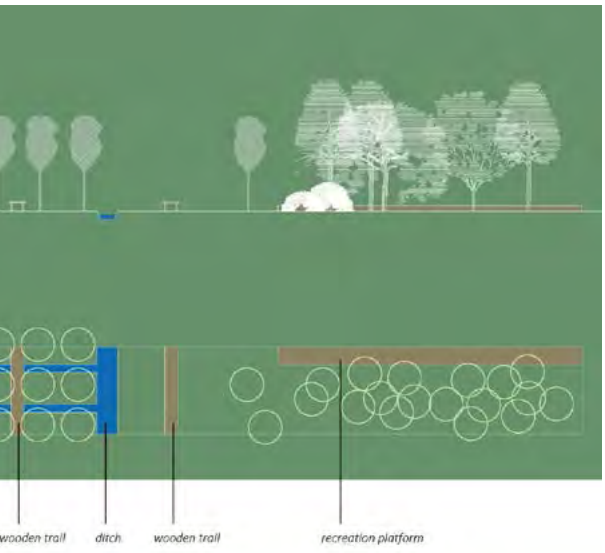
Forest meadow in forest park area



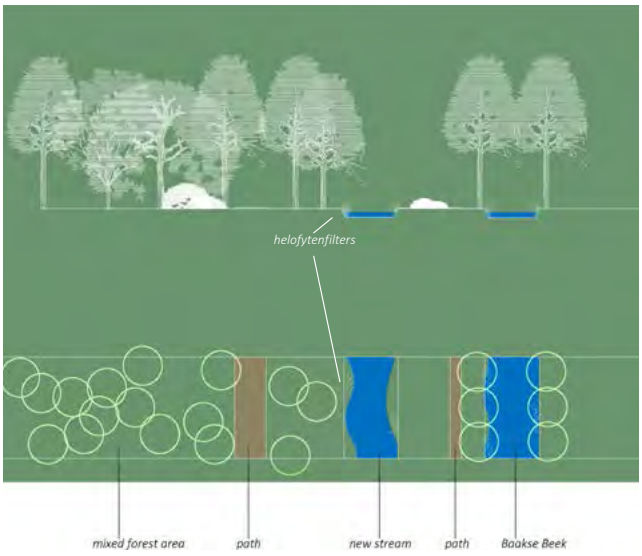
Forest meadow in open area

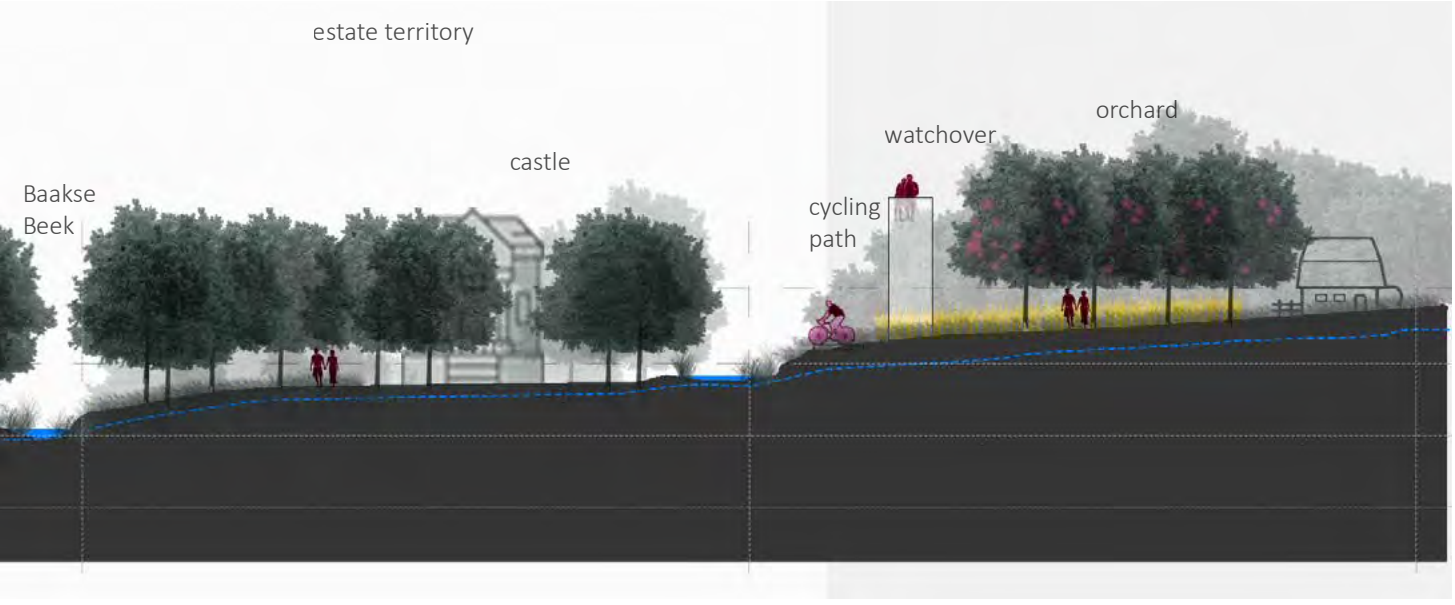


Rabatten bos

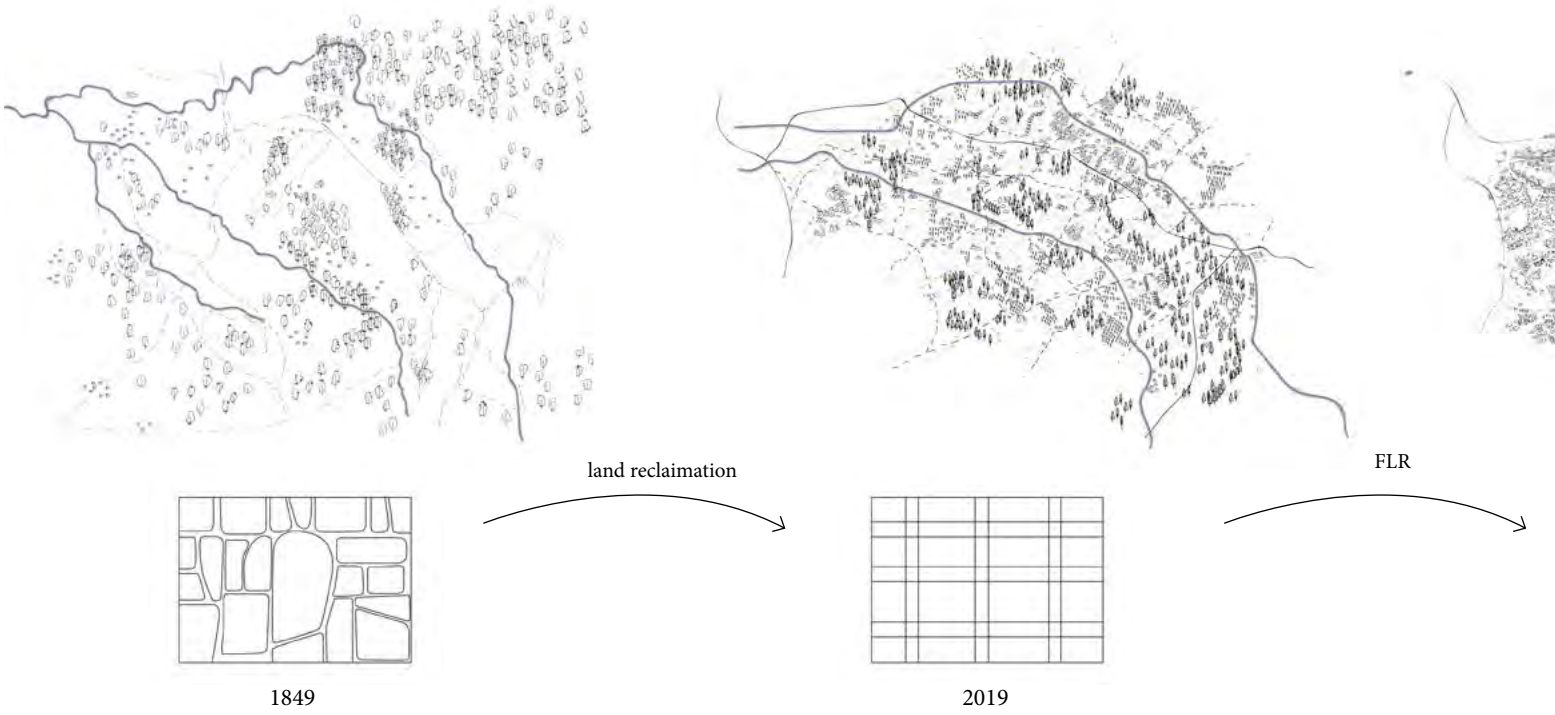


Green buffer of the stream remeandering





SUCCESSIVE PHASES OF LANDSCAPE PATTERN



drawings of 1849 and 2019 are based on historical maps (https://www.topotijdreis.nl/)

5.3.2 recognizable landscape : from the present to the past

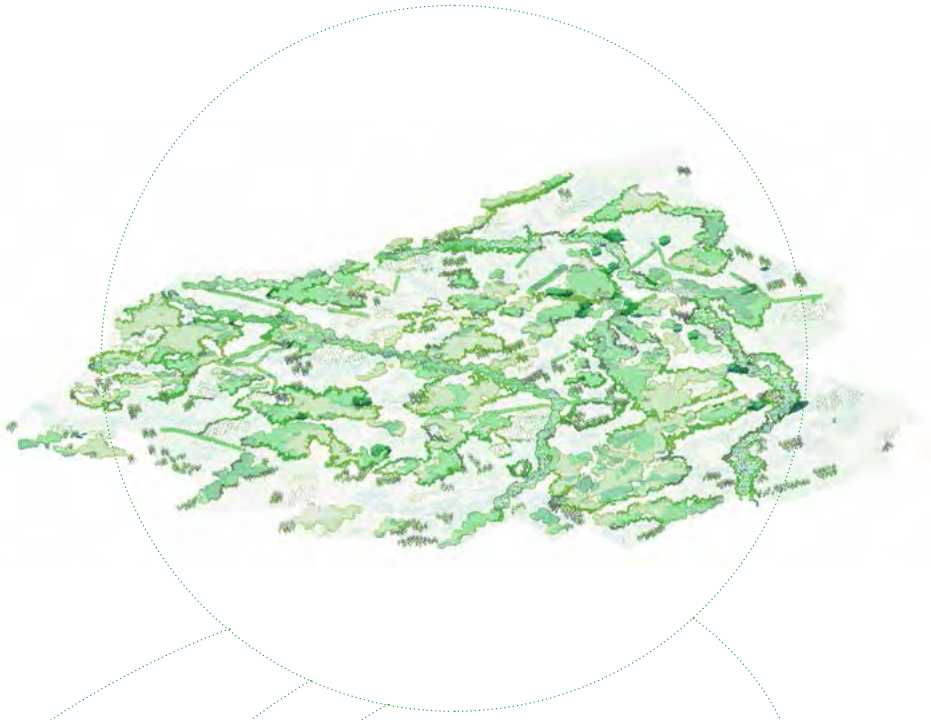
Restore the spatial pattern

The grid-like spatial pattern of the contemporary landscape is also the result of historial land reclaimation without consideration of eco-environment and future development. The homogenized landscape make the story behind the current estate landscape even harder to be perceived.

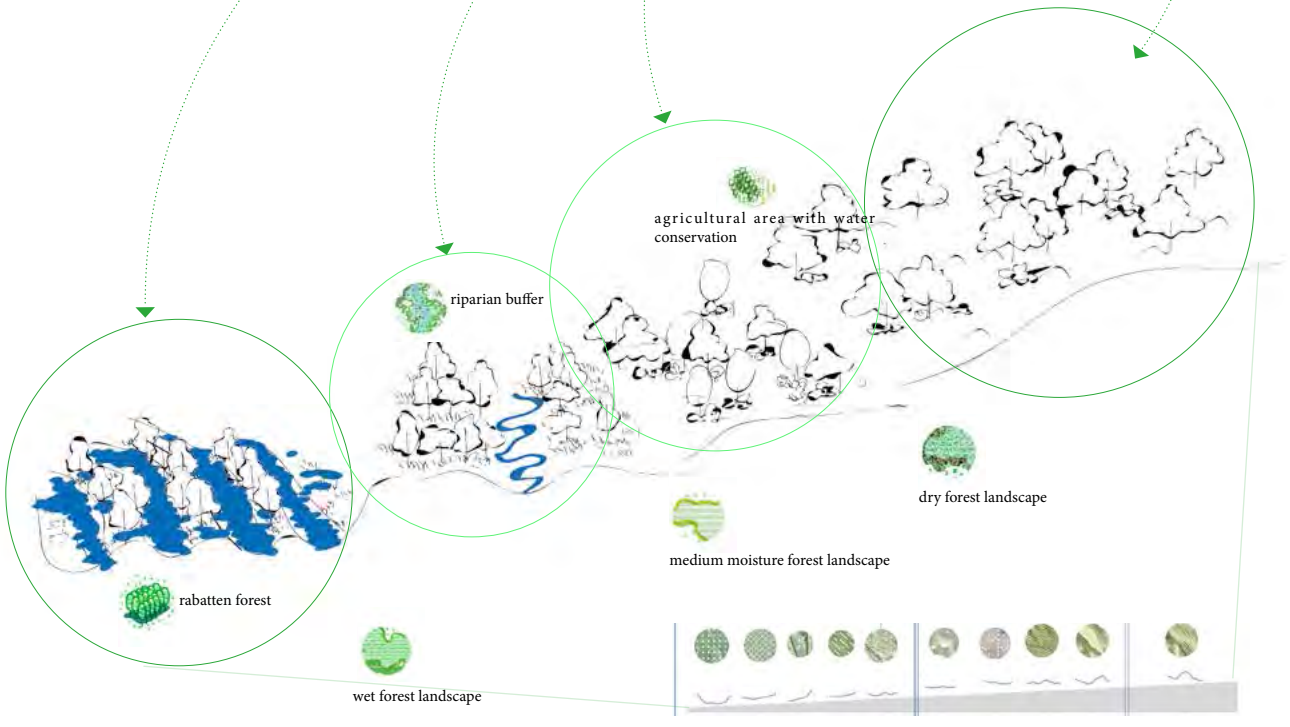
Through interventions of FLR, the organic spatial pattern would be restored, which is similar to the historical situation, but with more resilience.

Based on the ecology layer, proposed historical forest communities help to organize these tree groups to restore the relation between forest landscape typologies and estate landscape experience (as the diagram on the right indecates).

ECOLOGY LAYER AS A BASIS

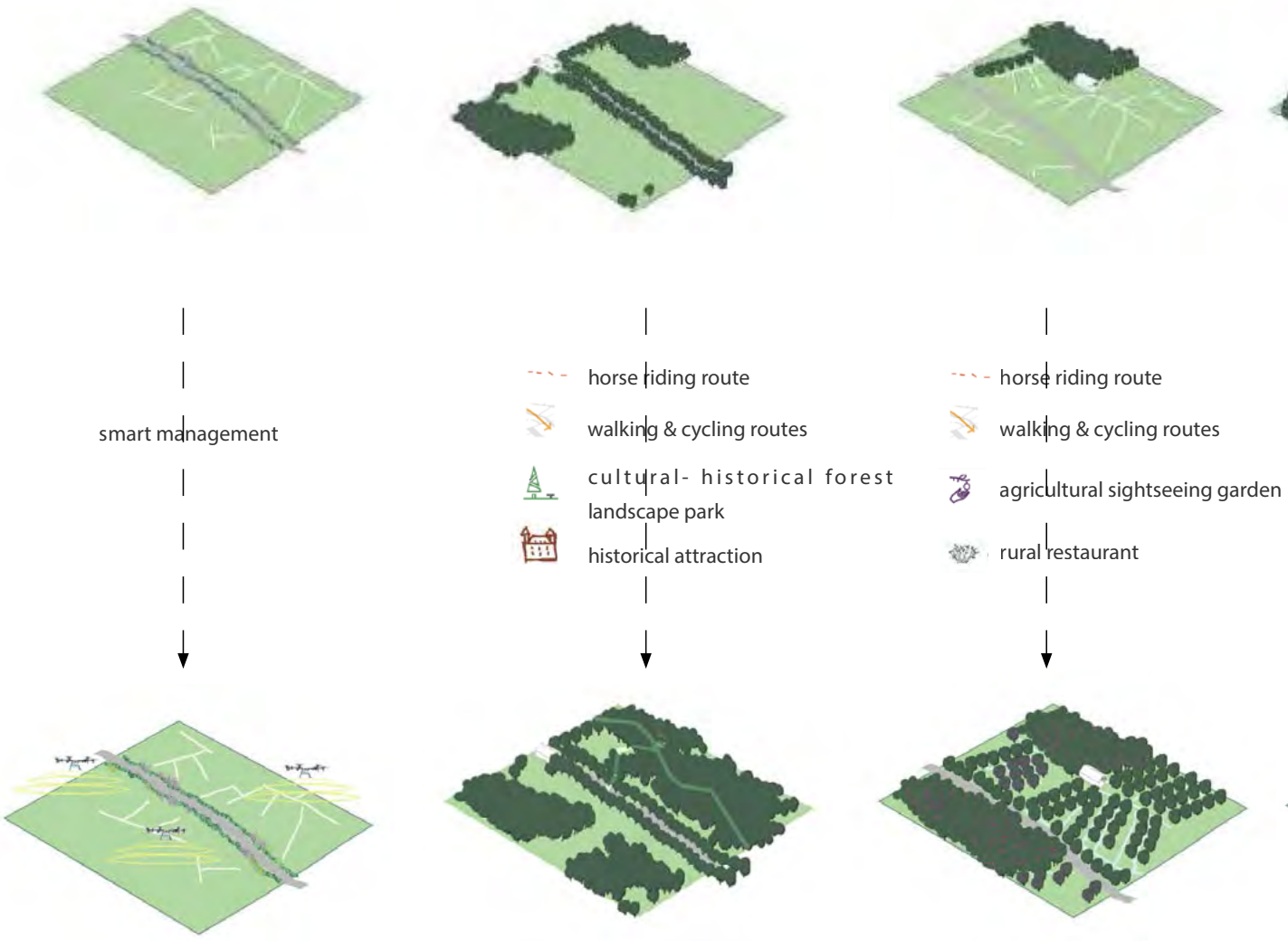


SPATIAL EXPERIENCE OF THE ESTATE LANDSCAPE AFTER "FLR"



5.3.2 recognizable landscape : from the present to the past

More trees are proposed in different programs for multiple activities. A new forest landscape could be restored and shaped in the context of estate landscape, to contribute to a more perceivable way to understand the landscape.



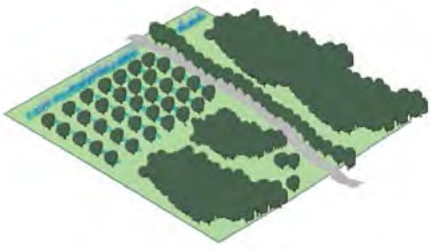
enclosed landscape forest

horse riding

walking & cycling routes

cultural- historical forest landscape park

waterfront leisure park



horse riding

walking & cycling routes

waterfront leisure park

5.3.2 recognizable landscape : from the present to the past

Diverse forest types contain historic meaning towards culture.

Rabatten bos

Forest meadow in open area

gree

the present

the past

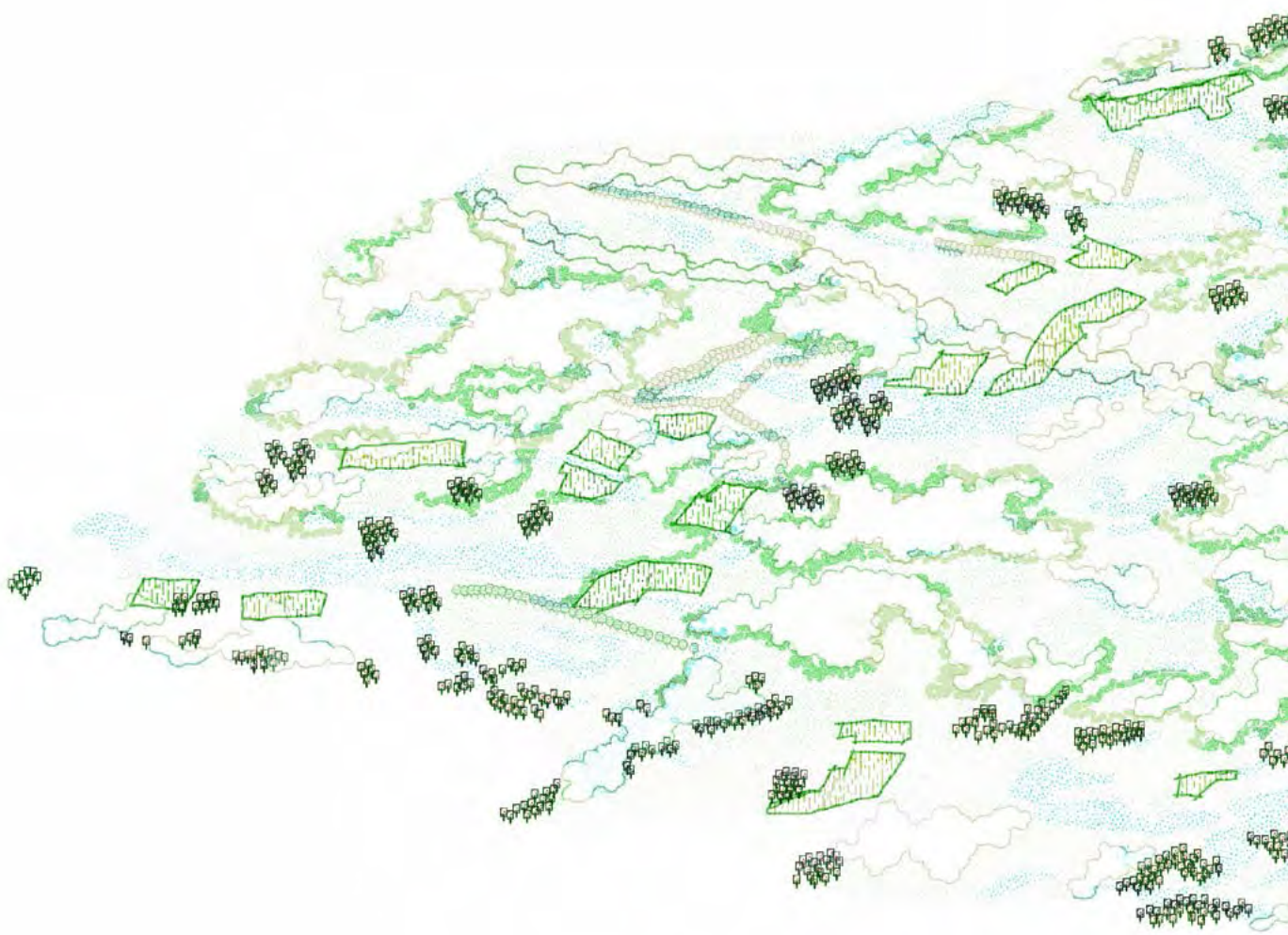
n buffer of the stream remeandering

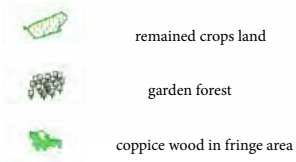
Forest meadow in forest park area

AGRICULTURE LAYER

How the forest can improve existing agriculture conditions in the cluster?

The proposed agriculture layer is to cooperate with the new green infrastructure and sustainably promote agriculture activities, mainly in the method of agroforestry.





5.3.3. agroforestry: from producing to interacting

The potential of agricultural development is promising, considering currently it's the main land use of the whole region. However, to enhance it and make it smart, fragmented agriculture lands are proposed to be applied with agroforestry strategies.

1. Normally, the agriculture area is located near ditches so that water source can be attained effectively. Thus, it shows good potential for the recirculating vertical flow constructed wetland's application in the vegetable garden area. The sustainable alternative technology helps to improve the water quality, reduce sanitation problems, and increase crops yields (Garcia-Perez, A., Harrison, M., & Grant, B., 2011).

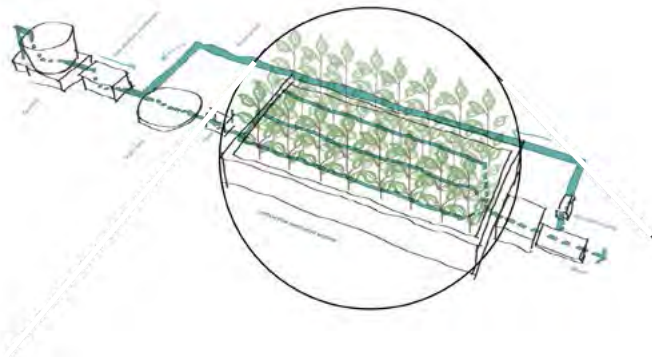
2. As for the agricultural sightseeing garden, it's the combination of visitors interaction and agriculture products producing. The garden also contains diverse layers to make better use of limited land, soil nutrition and daylight for vegetables and fruits growing (Berezan, R., 2010).
Lower layers are occupied with berry fruit shrubs and perennial herbs. They are proposed mainly for seasonally producing and farm picking activities for tourists to gain more economic and societal benefits.

3. As for the remained crops land, smart management and monitoring are of necessity.
Maincrop species ideally should be broadleaf crops, like maize, and cooperated with small trees or hedge planting, so that the nutrients and water circulation can be stimulated, which is good for increasing the yield.

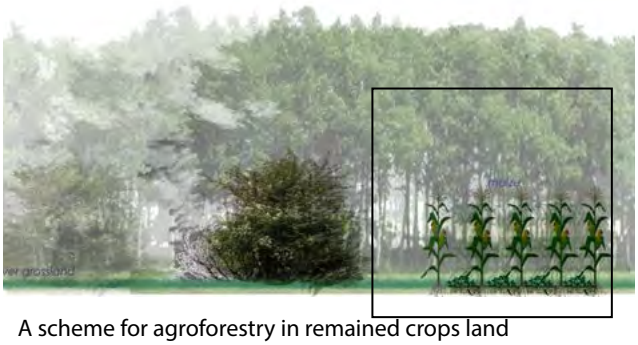
4. Considering the wooden material production is one of the main producing activities in the region, the opportunity of this field's development should be considered as well.

So that the study area shows the potential of introducing coppice woodland as a sustainable form of production forest. Interacted with farming activities, fodder trees, like willow, black oak and hazelnut, are proposed to be planted in the fringe area.

A scheme to show food forest planting pattern.



A scheme for recirculating vertical flow constructed wetland. Based on: Garcia-Perez, A., Harrison, M., & Grant, B. (2011).



A scheme for agroforestry in remained crops land

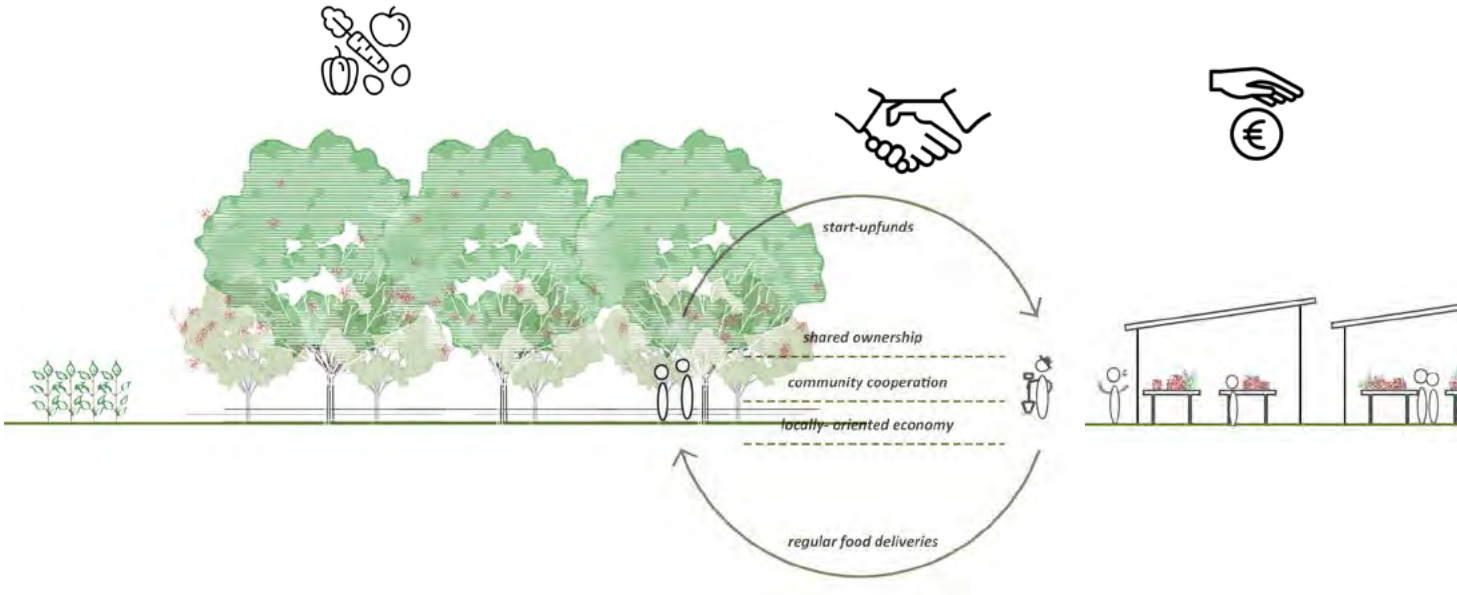
A scheme for agroforestry for wood production

Reasonable planting calendar in agricultural garden maintains markets' demanding and farmers' benefits. Also, it shows more opportunities for visitors engaging with the landscape from the agricultural aspect.

The garden forest not only can provide a recreational rural destination for tourists and food production, but it can also help to support the Leader project 'Achterhoek: Ark for high-stem fruit'. Apple trees of specific local species are planted in the garden forest to preserve the special kind of heritage in the region.

According to the Handbook of high-stem fruit, 7 species of apple trees listed on the right side are selected to be introduced in the study area.

Through integrating agriculture products producing, farms with recreational activities, the gap among farmers, local food and people gets closed. Meanwhile, it attracts more tourists to have a visit.



CSA model

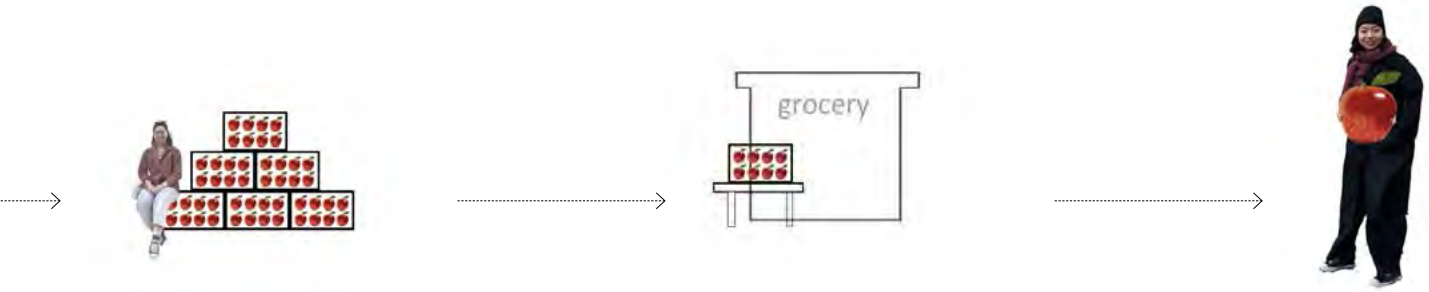
Bismark
'Brabantse Bellefleur'
Ingrid Marie
Keuleman
Koningszuur
Notarisappel
Zoete Bloemee

source: https://www.leaderachterhoek.nl/projecten/achterhoek-ark-voor-hoogstamfruit/

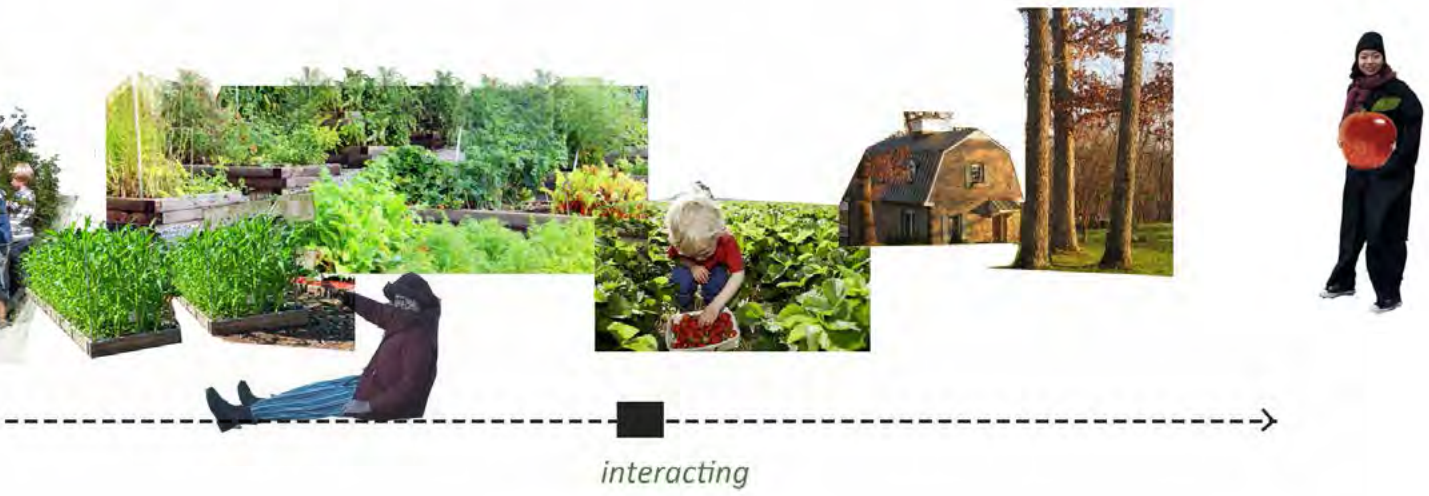
5.3.3. agroforestry: from producing to interacting

At least 4 steps are needed before consumers getting products and the freshness of foods will be affected due to the time-consuming procedure.

However, agroforestry strategies and marketing model make the products exchange procedure time-saving and recreational at the same time. The agricultural area is not only a place for producing but also a recreational and edible landscape for people's engaging.



current situation

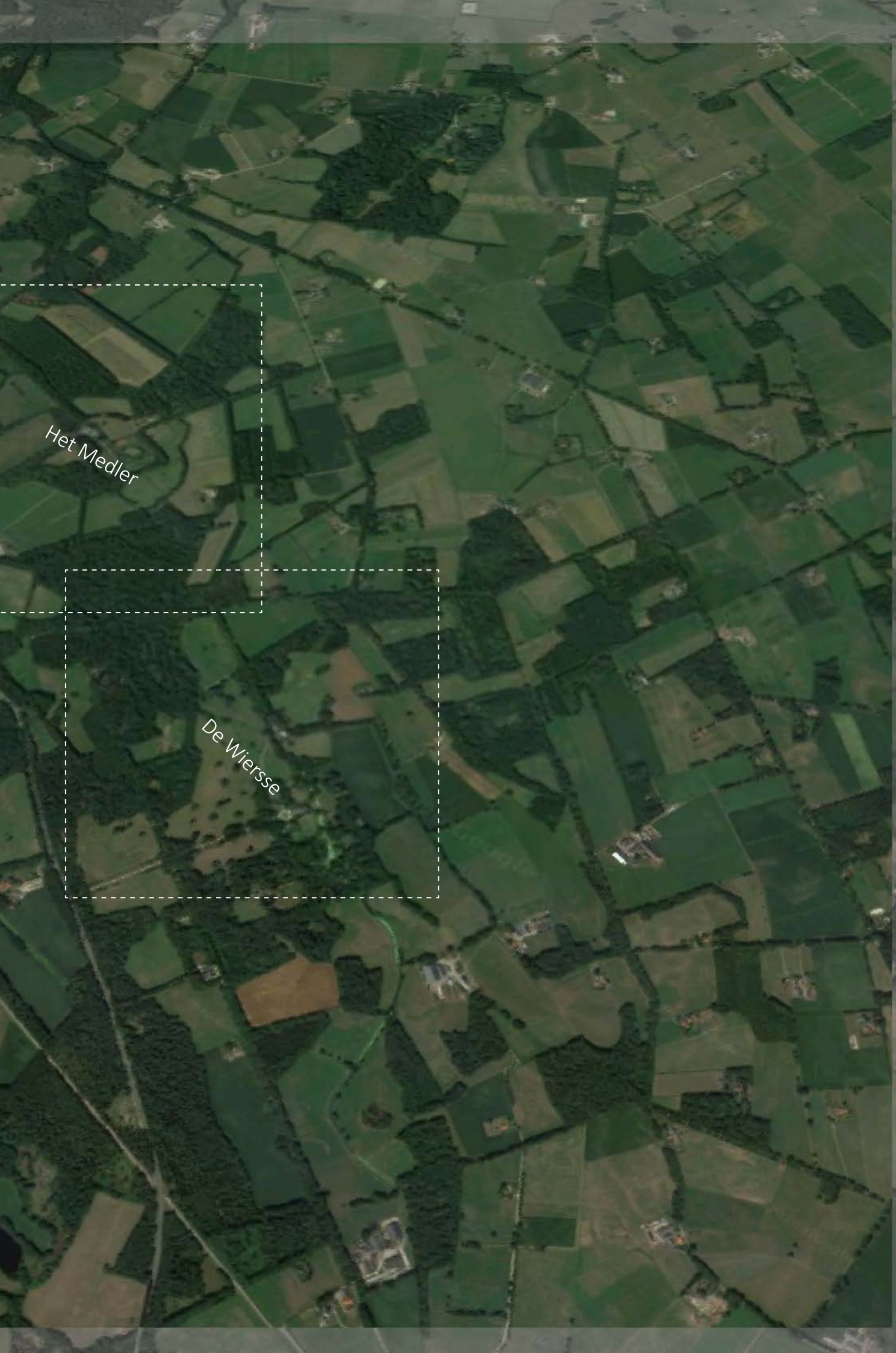


proposed situation

6.
Design exploration at the local scale (Het Medler and De Wiersse as cases)

What are the potentials of H' Medler and De Wiersse when faced with FLR design principles?

- In this chapter, how design principles are applied to 2 estates (Het Medler and De Wiersse) is discussed. The assignment has been indicated in the strategic plan at regional scale in the previous chapter, and this chapter will present how estates will look like after forest landscape restoration and how the proposed landscape inside estate territory respond to the design goal.


Het Medler
De Wiersse

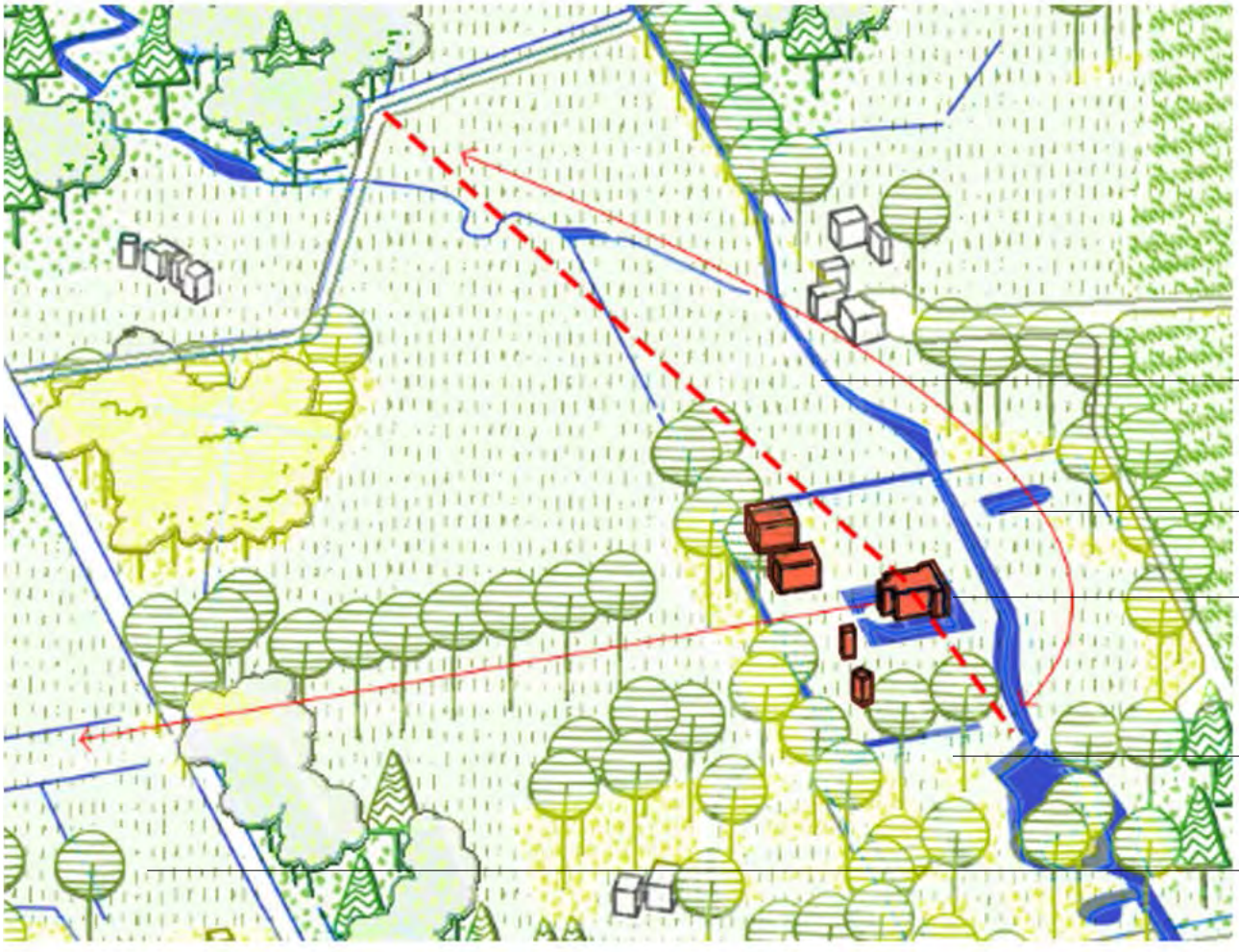
6.1. Analysis and design for De Wiersse area

6.1.1. Analysis

De Wiersse together with its park and gardens are designed in a formal style and integrated into its surrounding landscape. Varied land utilities, like farming and crops planting, are involved within the estate's territory, considering that the location is ideally close to water.

Historical landscape compositions, such as rabatten bos, landscape sightline, the house and statues, also survive from a long time ago.

Line of sight in De Wiersse



characteritics compositon

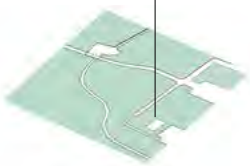
english style landscape

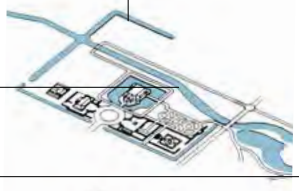
moat and stream surrounding the estate

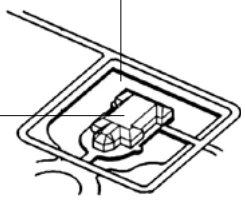
historical building: estate cattle

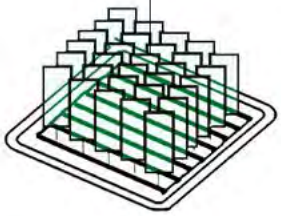
relic statues and formal garden

historical forest type : rabatten bos



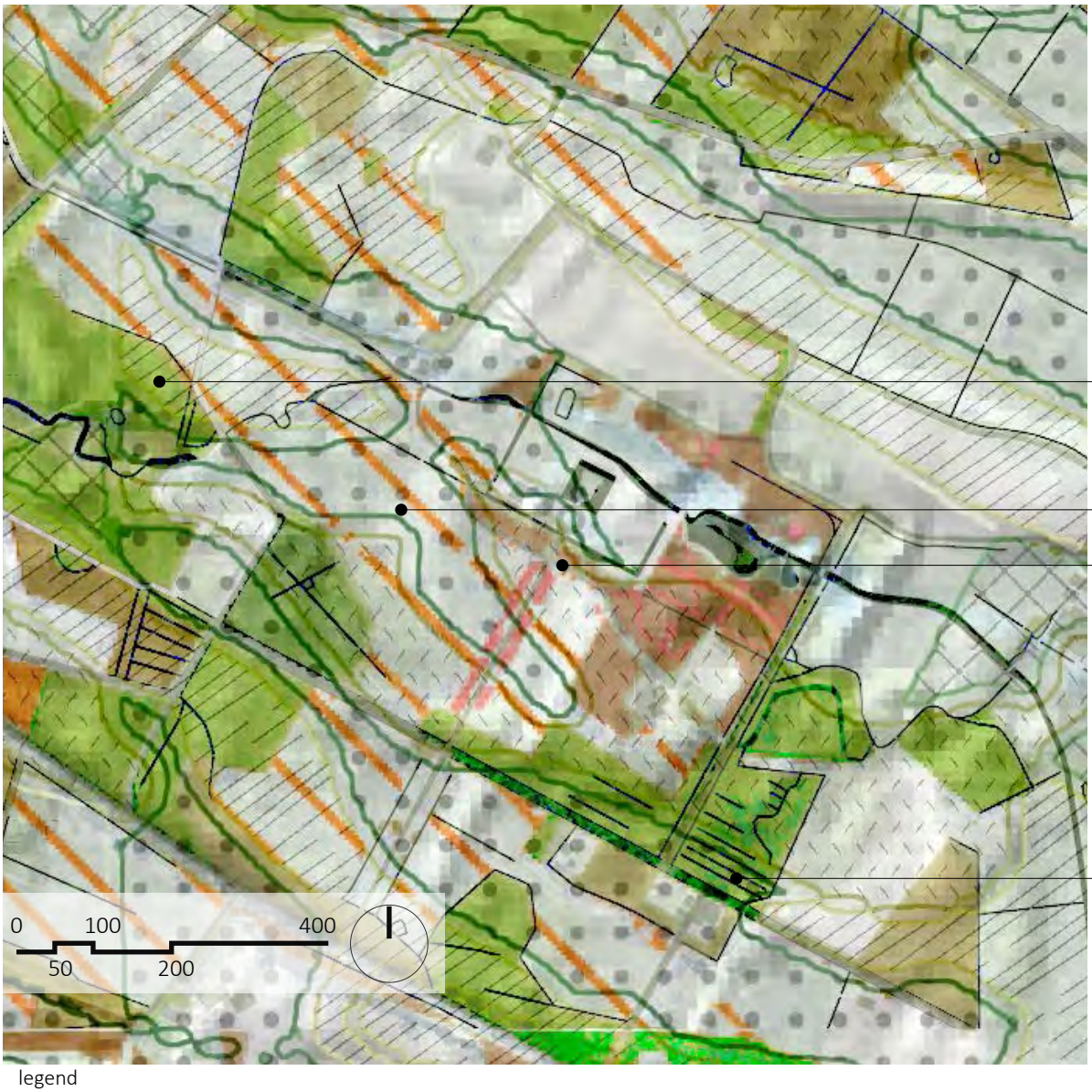


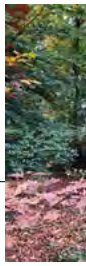




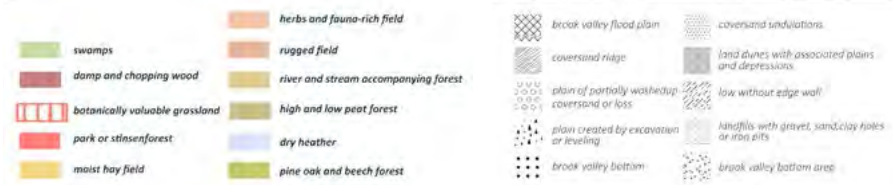
6.1.2 De Wiersse's current situation
(land use and geomorphology type)

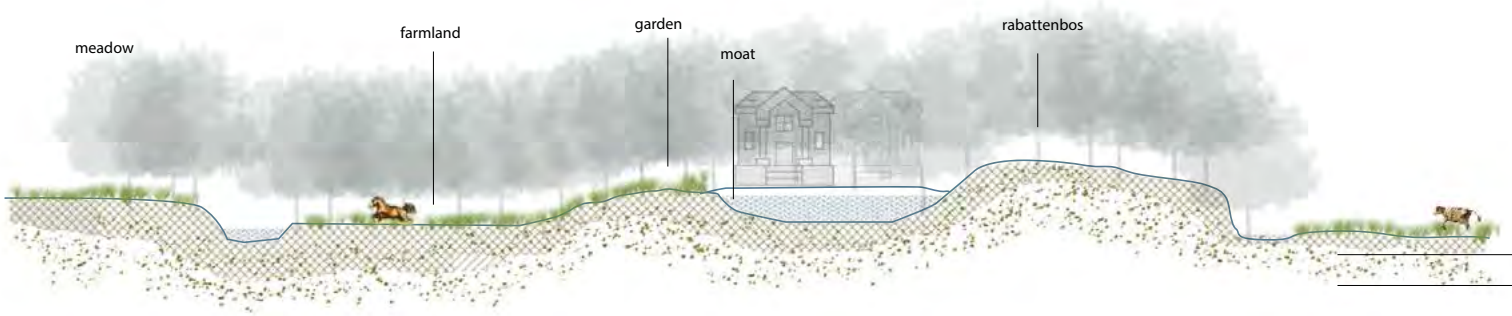
dry forest
(brook v
ridge+ co





legend

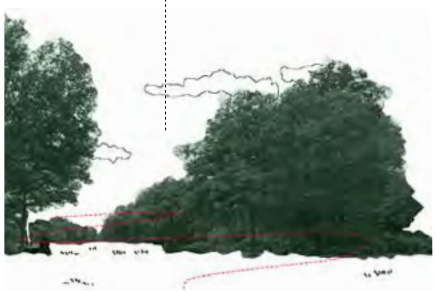




valley bottom + coveresand
versand undulations)

lacking accessibility

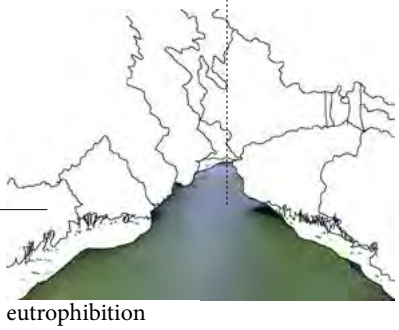
botanical valuable grassland
(brook valley bottom + coveresand ridge)



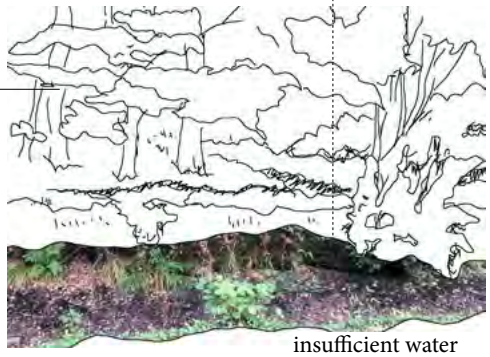
with english style view sight line

dry ditch in rabatten bos area
(near brook vallye bottom and coversand undulations)

the moat under dry forest
(near coversand undulations



eutrophibition

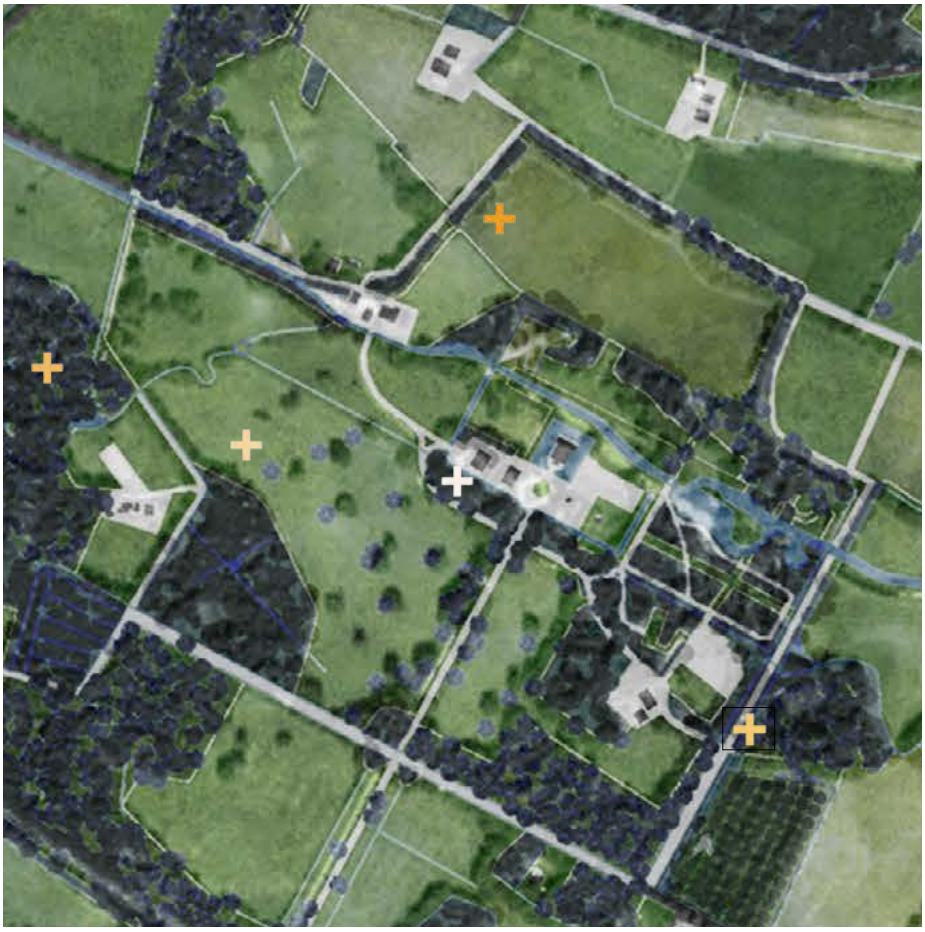


insufficient water

Nowadays, water shortage and low water quality are the main challenges the remarkable estate is facing.

Apart from that, how strategies of forest landscape restoration help to maintain the English style landscape in the estate is also a question for the design assignment to respond to.

clay
sand



current situation

main interventions

silviculture

restoring existing rabatten bos for water storing

enriching the vegetation species based on the geomorphology condition of the dry area and introducing helophyte filter to the stream to purify the water.

planting forest communities based on its geomorphology conditions and introducing trails in the enclosed forest to make it accessible.

agroforestry

based on the existing meadow and fragmented farmland nearby, garden forest is introduced to maintain the agriculture producing and to preserve the local apple species. Moreover, it is also a recreation destination for farming experience.

afforestation

introducing corresponding forest communities to the grassland's surrounding area; making the botanical valuable grassland area forest meadow for natural grazers to preserve the rich-species of herbs and shrubs.

current situation + interventions

6.1.3. vision and system design

vision

legend

1. existing buildings in the estate
2. existing estate park and orchard
3. trail in forest
4. rabatten bos experience
5. forest meadow
6. historic stream
7. agriculture forest
8. vegetable garden
9. forest park
10. existing road towards the castle


8
7
1
2
10
3
4
400

Main programs

i. historic stream (6)
Apart from restoring and reconnecting the historic stream, corresponding tree communities are introduced to form a green buffer for enhancing the ecological environment and strengthening the role of the stream, to make it visible to people.

ii. forest park (9)
To enhancing people's experience in the estate landscape, the existing forest of the estate is proposed to be restored based on the framework of FLR and accessible to visitors after planning several paths inside. Also, a new pond connected with the Baakse Beek is proposed for better landscape view in the park and functions as a retention pond for resilient development.
In this park, there are also some resting nodes, trails and meadows for the various recreational and cultural-historical experience.

iii. forest meadow (5)
Forest meadow area is proposed where it is managed as botanical valuable grassland. Rather than planting more trees only for more enclosed green covering, the green area with rich vegetations is remained as open grassland but with some solitary planting and shrubs to develop grasslands with natural potential. Thus, vegetations at ground layer get restored and enriched while English style landscape sightlines are shaped. Natural grazers, like local Konik horses, are introduced to keep the grassland fertilized and contribute to vivid eco-landscape view meanwhile.

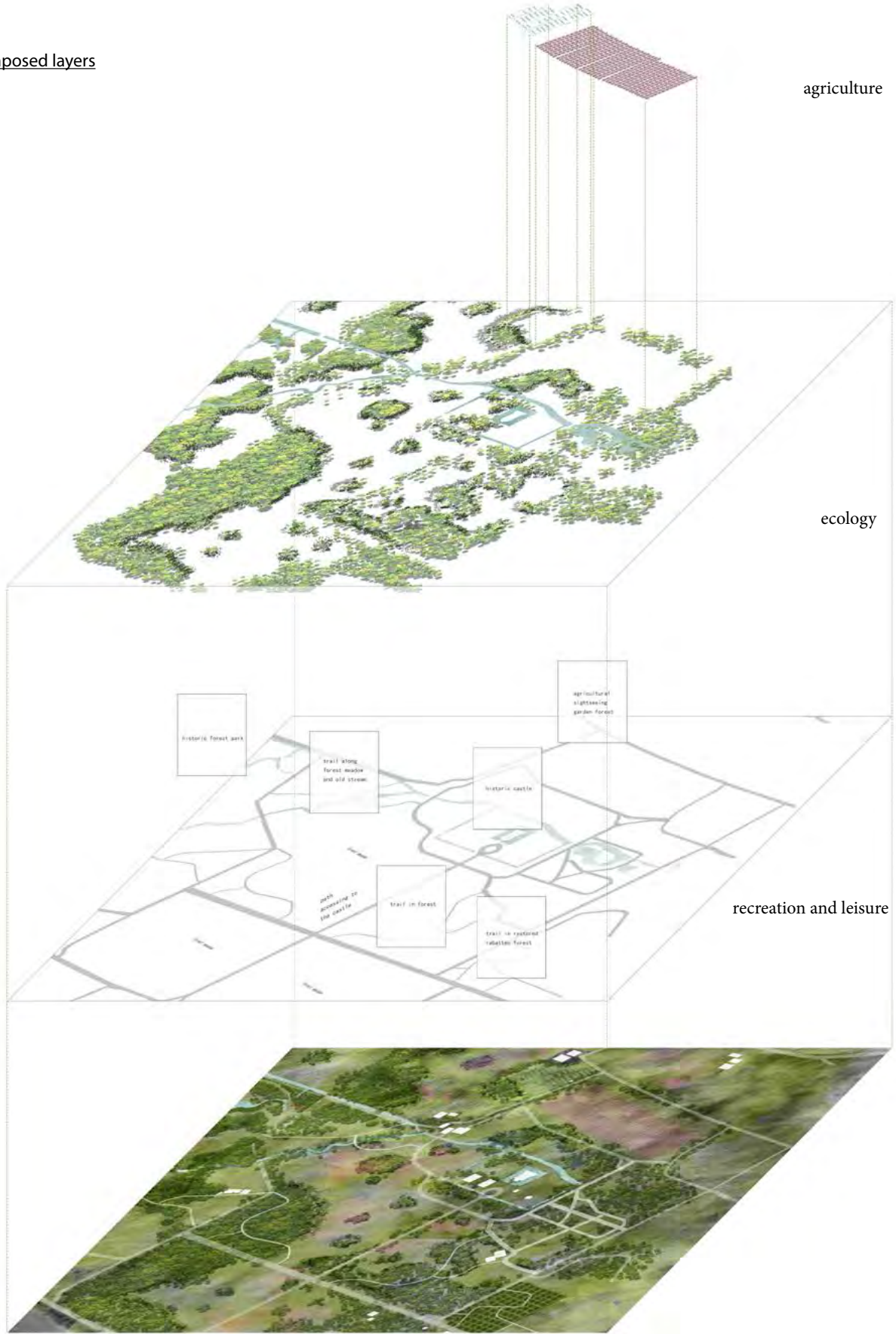
iv. agriculture forest (7) & vegetable garden (8)
Following the framework of FLR and considering the historic farmhouse, the existing meadow is proposed to be transformed into agriculture forest and vegetable garden. Not only the function of agriculture producing gets maintained, but it's also an attracting place for agricultural experiencing and sight-seeing.

v. rabatten bos experience (4)
Based on existing rabatten forest in the estate area, intervention mainly in forms of trees' restoration and wooden trails are introduced for functional reconstruction of water and soil reservation, as well as visitors' historical experiencing.

vi. existing road towards the castle (10)
The main road towards the castle is proposed to be maintained. Alongside the road, there will be rows of trees to strengthen the formal spatial atmosphere. The proposed forest meadow nearby also provide people English style landscape sightline.

vii. trails in the forest (3)
Opening up the existing forest groups, trails are introduced to invite visitors' interacting and to connect the visiting routes, so that recreation value of the area can be promoted.

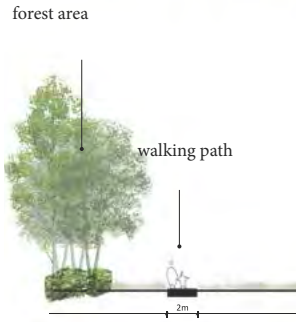
Decomposed layers



Konik horses, “the most recent descendant of the wild horse” (Vera,1984), as natural grazers are introduced to the semi-open area of the forest to maintain the botanical-valuable grassland in an ecological way. The koniks, compared to other grazers, are not picky to the grass species they eat, which help to ensure the diversity of grassland's vegetation species (Cosyns, E., Degezelle, T., Demeulenaere, E., & Hoffmann, M., 2001).

Type of pasture	Stocking density (kg/ha^{-1} / LSU ha^{-1})	Relative grazing intensity	N fertilisation (kg N ha^{-1} year^{-1})	Use intensity
Wood pasture	100-400/ 0.2-0.8	< 30	Increasing from 0 up to 400 and higher ↓	Low
Open wooded pasture	100-400/ 0.2-0.8	< 50		Low
Fenced pasture	500-1000/ 1-2	50- 100		Moderate
Alpine common pasture		30- 150		Moderate
Fenced pasture	1000- 1800/ 2-3.6	75- 150		Moderate
Continuously grazed pasture with silage cut	2200/ 4.4	150- 250		High
Rotational pasture	1500-2500/ 3-5	150- 300		Very high
Strip- grazing	2000-3000/ 4-6	175- 450		Very high

The livestock density in live weight or livestock units (LSU) per ha. The pasture performance is relative to a good continuously grazed pasture = 100 (corresponding to 2000kg carbohydrate units per ha). source: Leuschner, C., & Ellenberg, H. (2017).

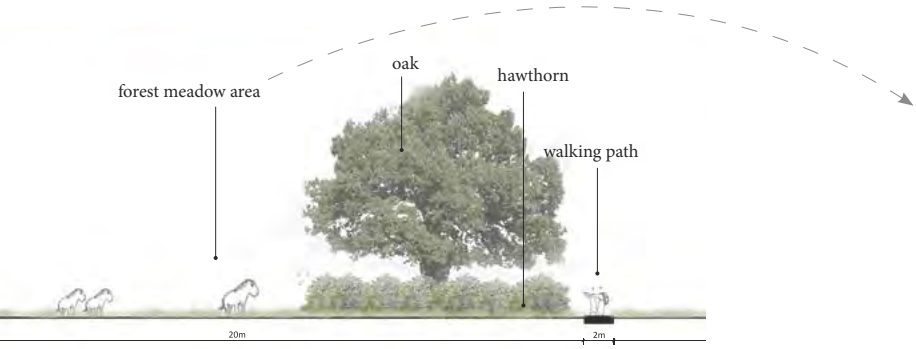


According to the guidance of grazing management (see the table above), the stocking intensity for the open grassland is proposed to be 0.2-0.8/ LSU per ha and the relative grazing intensity would be less than 50. (Leuschner, C., & Ellenberg, H., 2017). Also, the management guidline for botancial valuable grassland recommend that the livestock should be limited to maximum 2/LSU in the growing season, while unlimited grazing could be conducted beyond growing season (Bij12, 2017). Through this low intensity grazing way for konik horses in the forest meadow area, both ecological and societal value could be enhanced (WallisDeVries, M. F., Vries, M. F. W., Bakker, J. P., Bakker, J. P., van Wieren, S. E., & Van Wieren, S. E. (Eds.)., 1998).

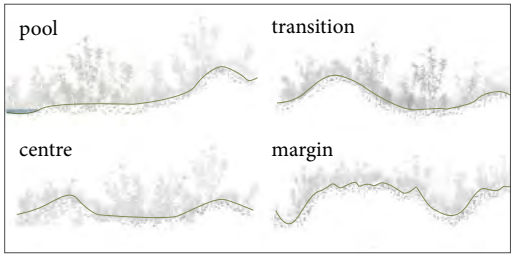
+ afforestation

Diverse vegetation species, such as arteria, viper, snakeweed, crown of bears, beaver, pale sedge, sinuous clover, bristles, bush, broad orchid, threadweed, real caraway, real cuckoo flower, yellow bedstraw, yellow morning star, spotted orchid, winged stag hay, common brunel buttercup, common marguerite, common rush, common bird's milk, common buttonwort, golden oats, harebell, nordic bedstraw, nordic sedge, eastern morning star,rapunzel, reed orchid, red eyebright, shaggy plantain, stinking ballote, hawberry, peaty odor, field sage, flesh-colored orchid, ragwort, meadow chervil, fragrant night orchid, wild marjoram, briny rusk, black-blue rapunzel, black sedge, etc., could be observed in the grassland (Bij12, 2017).

On the flat grassland, there still exists some microrelief contributed by dynamic water level, which allows various vegetation species cover the land. Low intensive grazing help these bogs accumulate fertility and maintain biodiversity of flora and fauna (Leuschner, C., & Ellenberg, H., 2017).voluptas platus esequam dolupta.

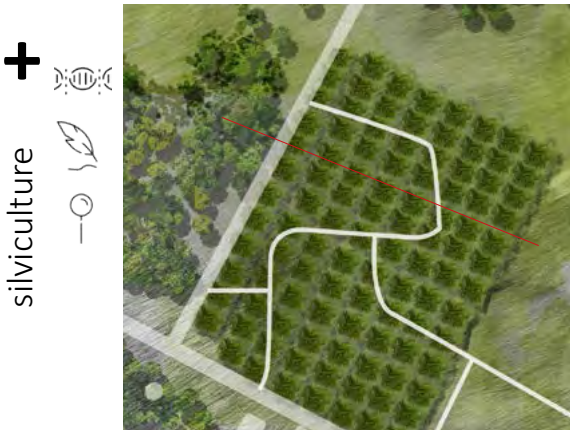


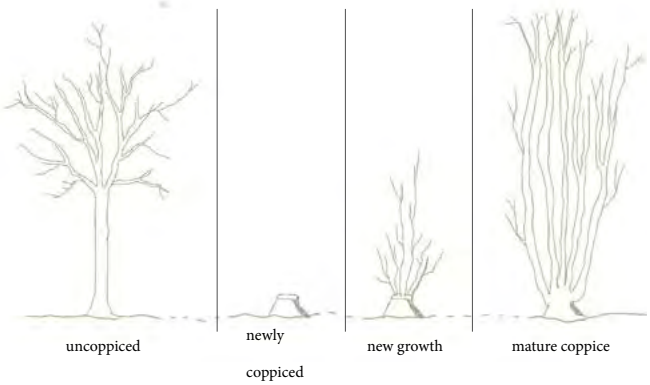
A scheme to show different microrelief types of different moisture levels (based on: Jahns 1969)



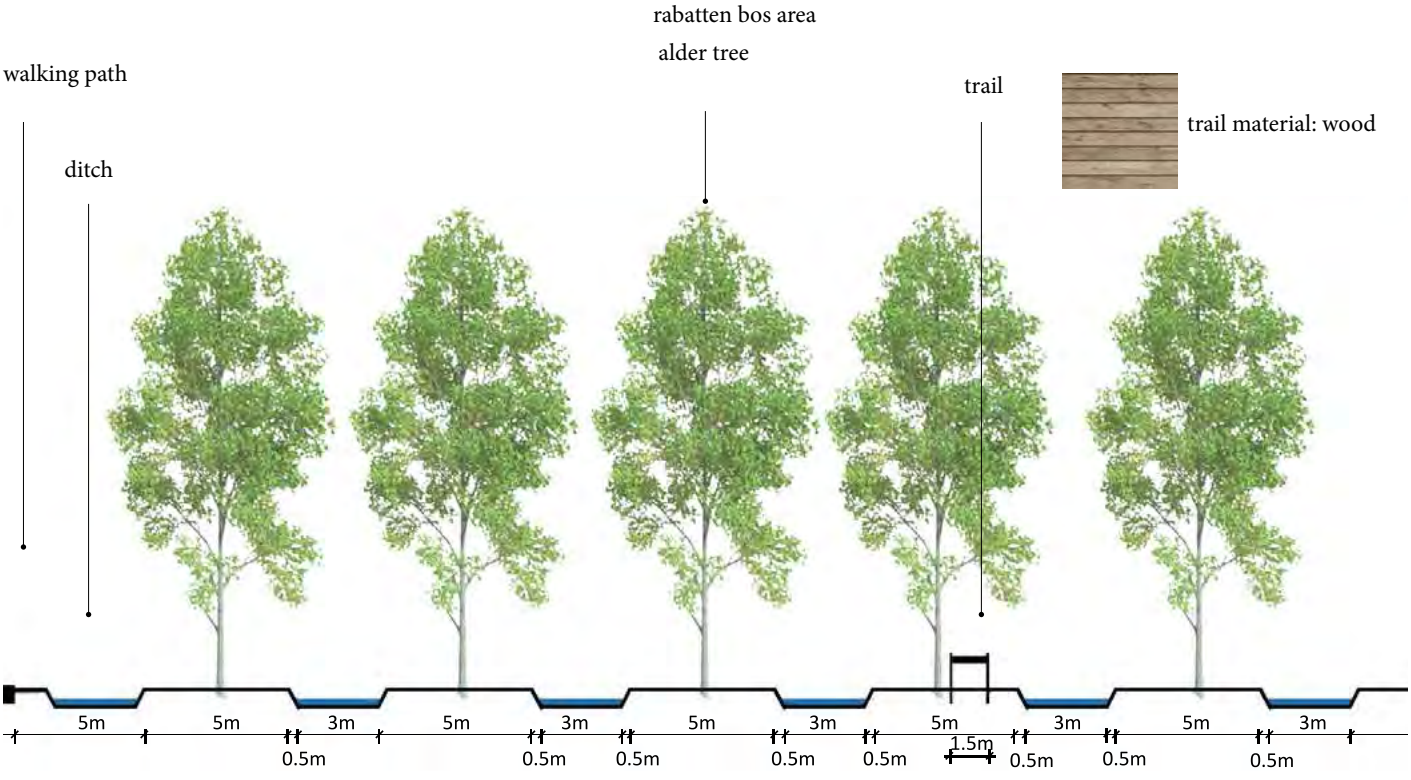
Forest meadow not only reserves the existing botanical valuable grassland but also collaborates with Konik horse to provide a vivid historical landscape to visitors.

The existing historical rabatten bos will be restored.With wooden trails, people can walk across the historical forest area. It also help the estate area to maintain water.
Rabatten bos, mainly consisting of alder trees, also can function as production forest. The alder species can be harvested to provide a great fuel source. (Tobias Roberts,2017) As for alder tree, the coppicing cycle could be 8-12 years. (Bartlett, D., Laina, R., Petrović, N., Sperandio, G., Unrau, A., & Županić, M. (2018).) Coppicing could offer a more sustainable and dynamic method for wood production and forest management.

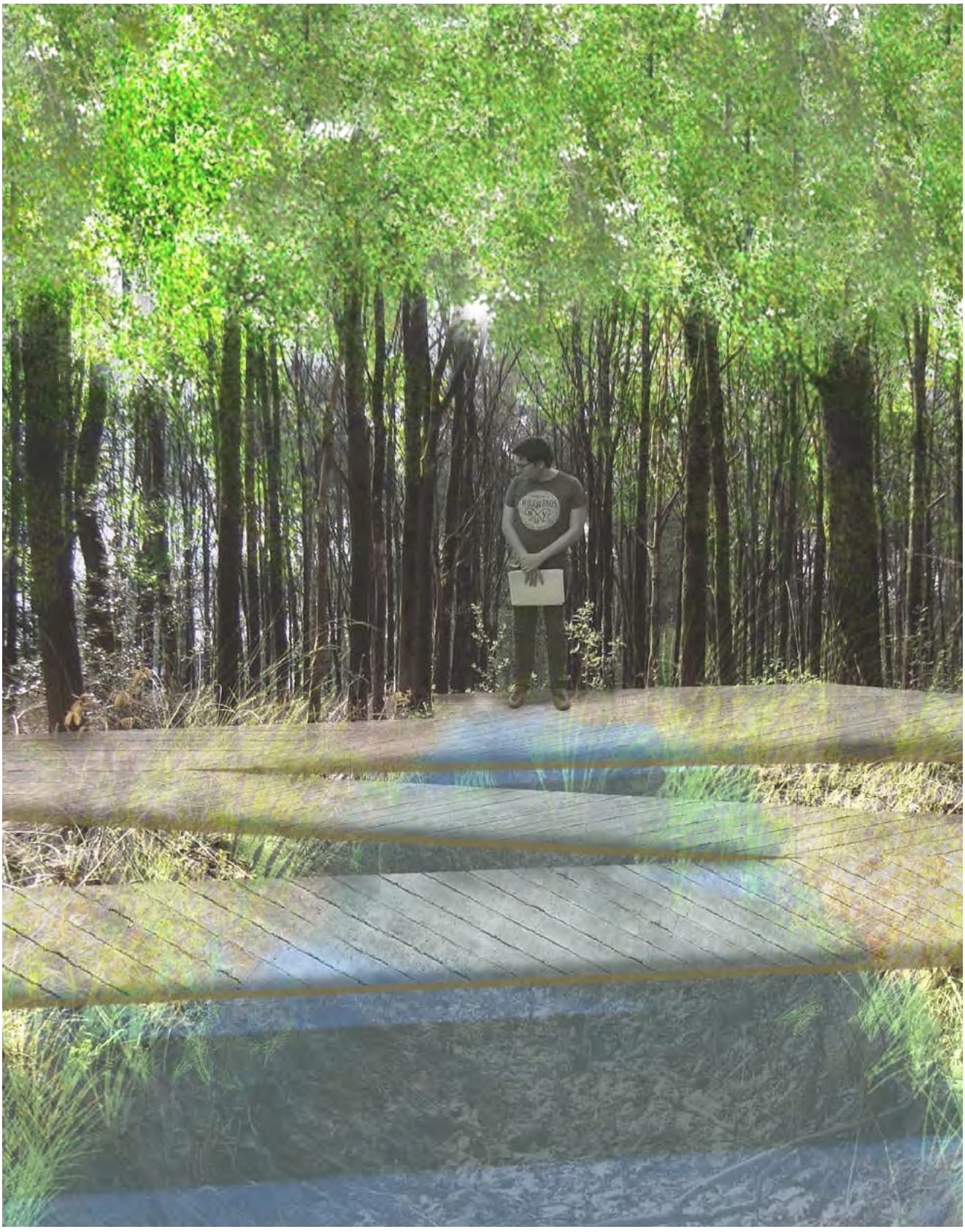


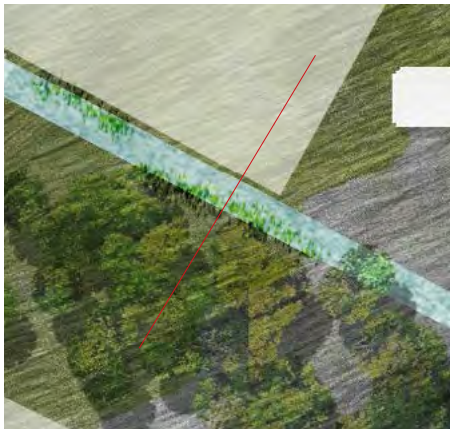


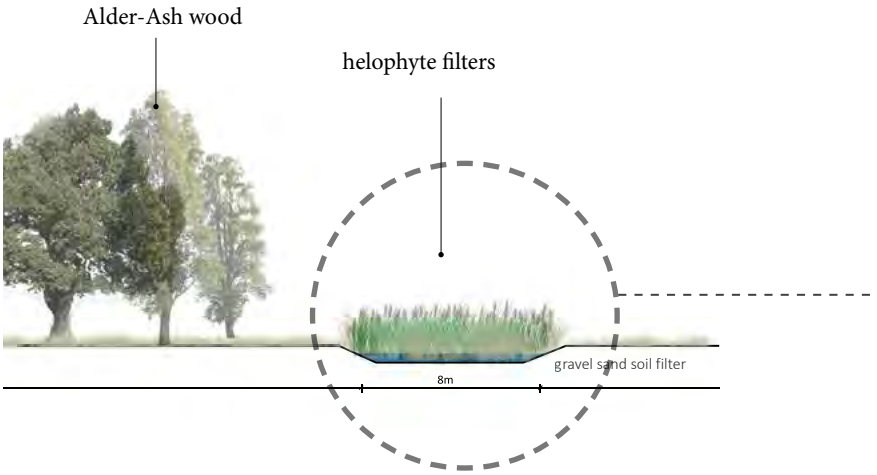
A diagram to show different stages of coppice development. (based on: http://dorsettreeworx.co.uk)

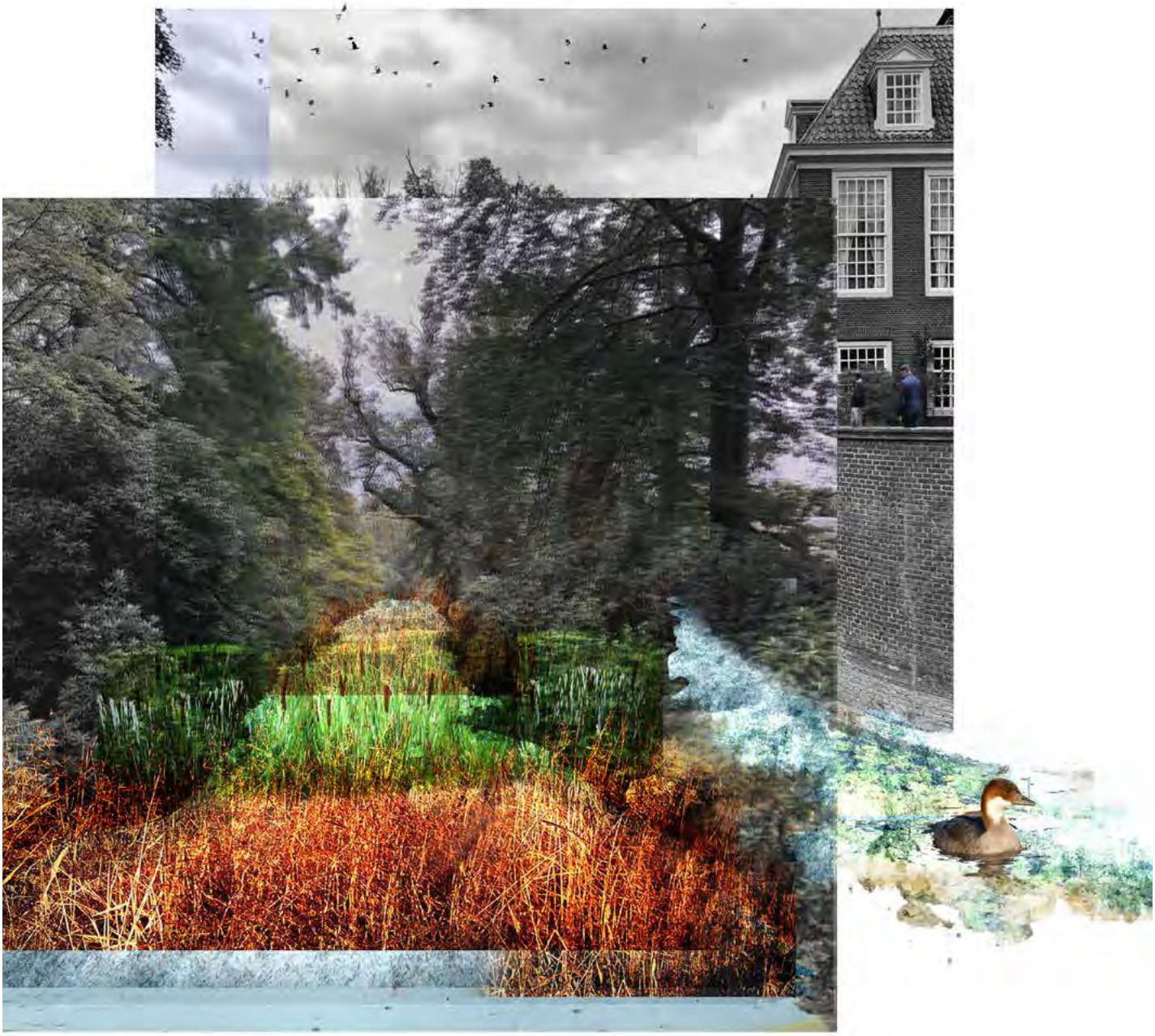


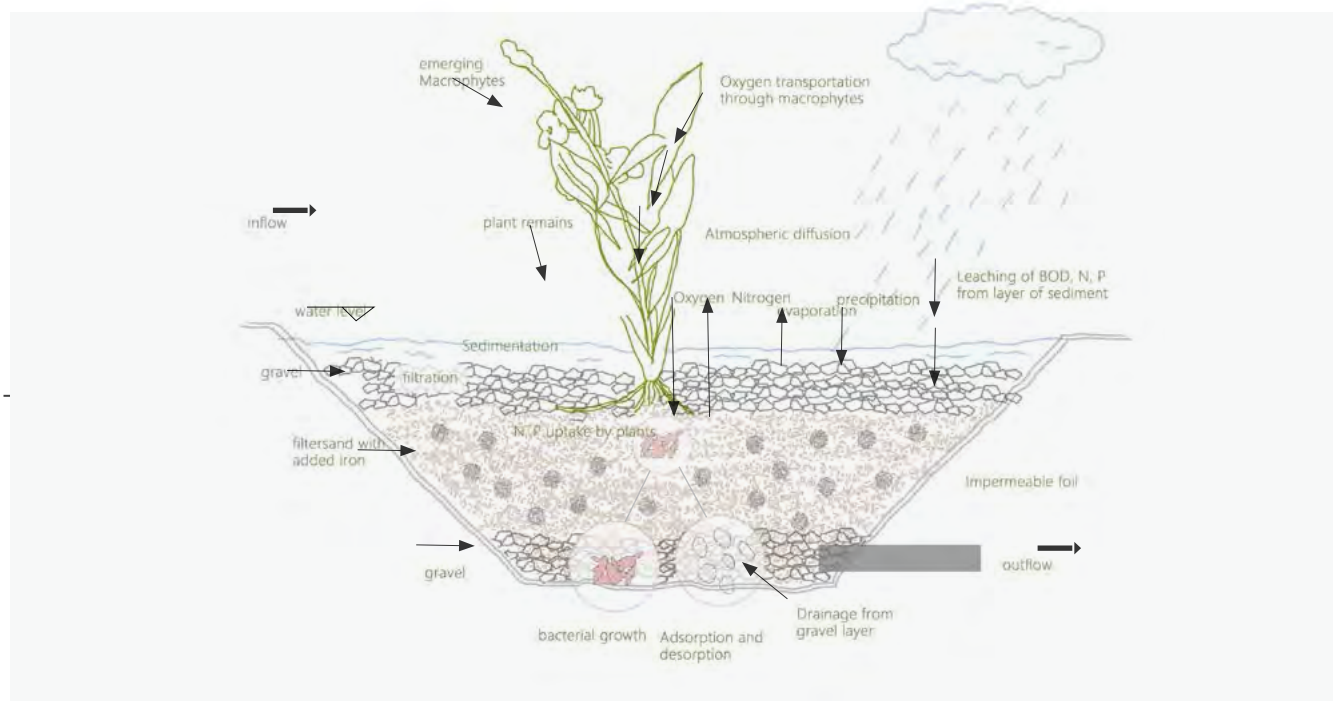
Rabatten bos after restoration can offer people a new attractive recreational place to view the historial forest type. Dynamic water level in ditches can be observed when it's rainning season and dry season.

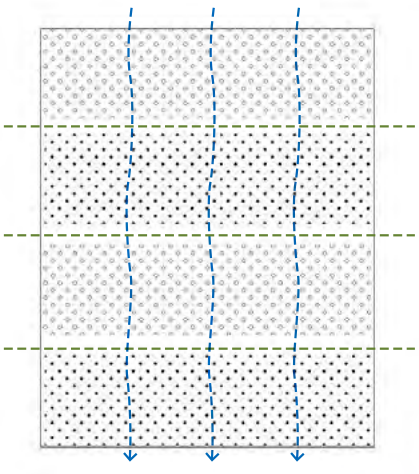





Alder-Ash wood
helophyte filters
gravel sand soil filter
8m







A scheme to show the planting pattern.
The initial planting density is recommened to be 4-6 pieces/m^2. And planting should be conducted in spring and each year, mowing of these helophytes should be conducted in autumn or winter each year to ensure the younger one can still functions. ((Brix, 1997))

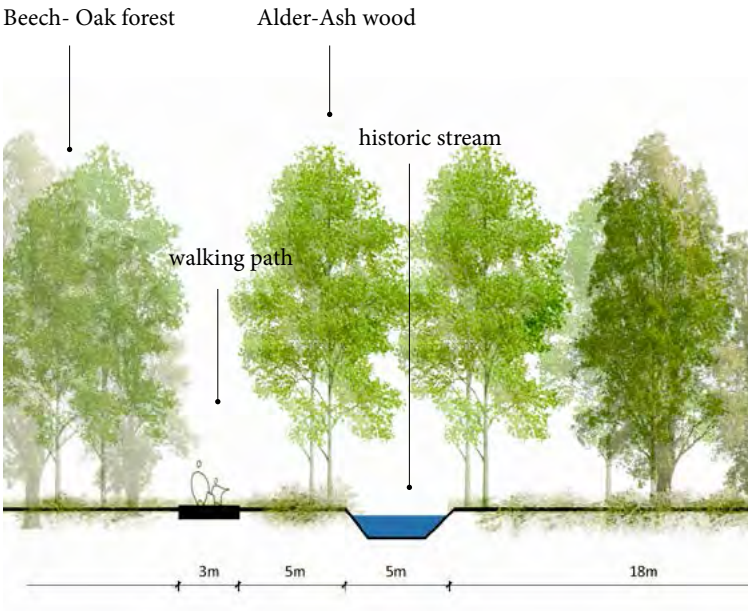
Helophyte filters proposed in the territory of De Wiersse is to address the eutrophibition issue in the estate's water system. With the help of common reeds and narrow-leaved cattail grown in combination, heavy metals uptake from the water can be increased effectively.

Typha angustifolia has higher removal rate of total phosphorus and organic matter than Phragmites australis, but the average reed has a higher degree of total nitrogen. Moreover, the effect of common reeds on bacterial diversity in water body is greater than that of cattail, which is affected by plant microbial interaction and can influence water quality (Li, Y. H., Zhu, J. N., Liu, Q. F., Liu, Y., Liu, M., Liu, L., & Zhang, Q.,2013).

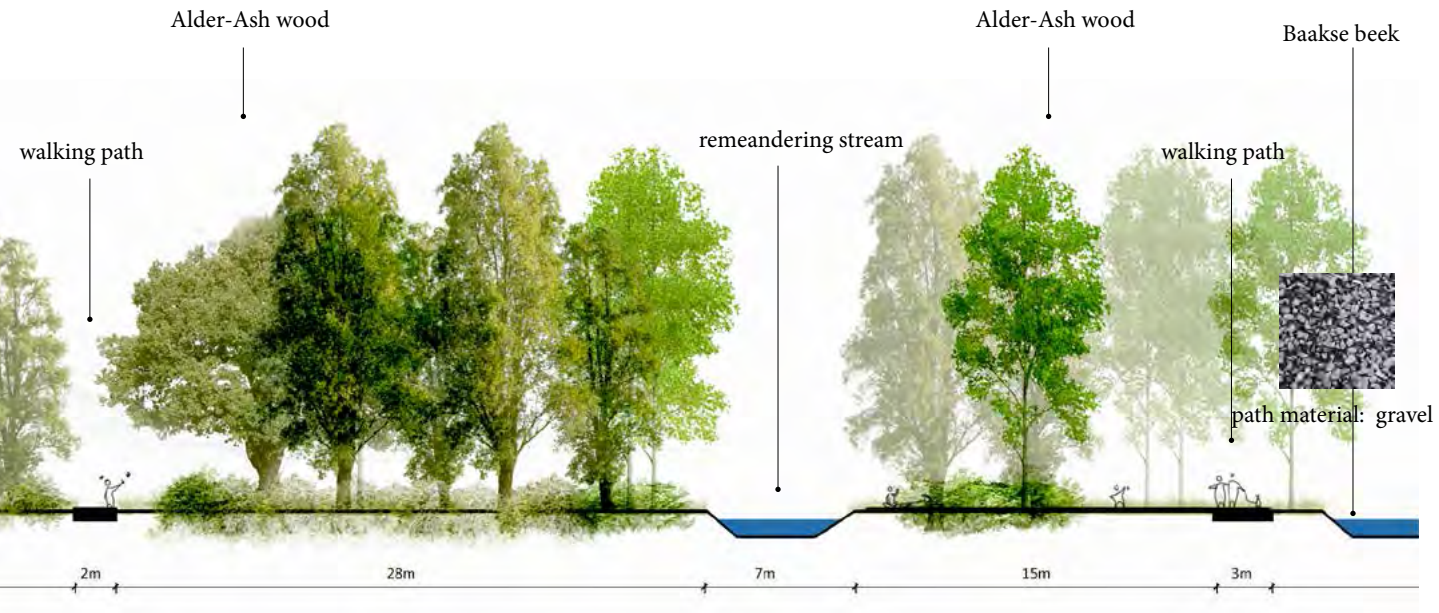
After purifying water in the ditches by horizontal helopytefilters, water quality could be enhanced. And animals like ducks and fishes could go back to the moat and bring more vitality to the estate as well.

+

silviculture

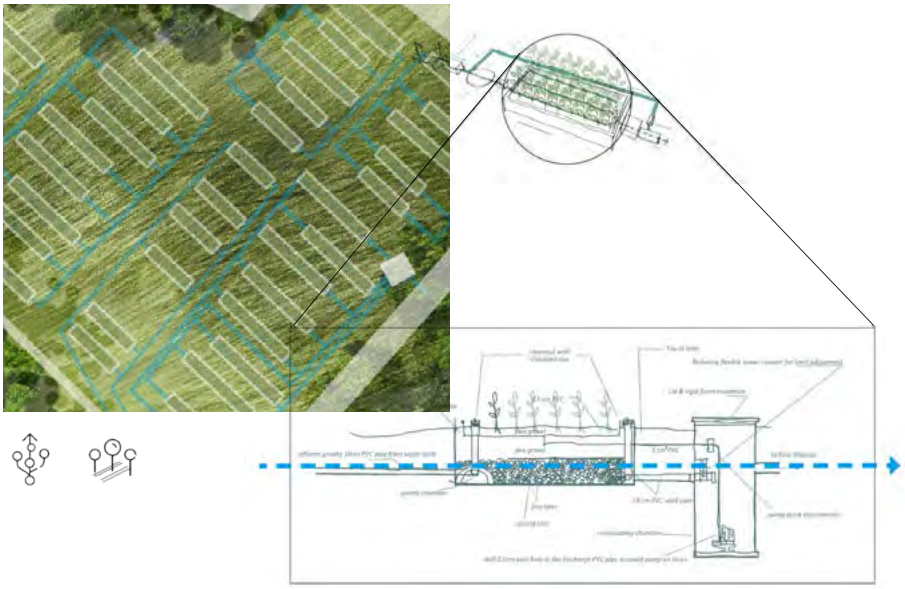


After opening up the old forest area, visitors can experience the natural enclosure and exploring for the historical clues through the new estate landscape. New stream flowing from Baakse beek can reminds people of the moist landscape it used to be and also provide people with opportunities of sightseeing. Apart from that, it stimulates the water circulation and enrich the species of flora and fauna.



To purify the water in ditches nearby and make the soil suitable for vegetation's growth, the recirculating vertical flow constructed wetland (RVFCW) is proposed to be applied to the vegetable garden. The sustainable alternative technology to grow crops helps to remove pollutants from wastewater, which afterwards can be transformed in to fertilizer for crops, thus the agriculture yield gets increased also.

+ agroforestry



+ agroforestry

The existing meadow area is transformed to be a forest garden for farm picking activities and fruit-producing.

6.1.4. FLR and De Wiersse

The new estate landscape of the De Wiersse includes a new riparian buffer zone and helophyte filters around the Baakse Beek, the historic stream and watercourse near the estate. This increases water storage capacity and enhances water quality.

Historical forest types are proposed for promoting the existing forest and silviculture at the estate. More trees will enhance carbon dioxide sequestration and increase the 'sponge' capacity of the area. Besides, it will remind people of the historical forest landscape, as a signifier of regional identity. Also, mono-functional and industrial agricultural land is transformed into multifunctional forest gardens with agroforestry, which stimulates biodiversity and stimulates visitors' engagement with the landscape.

Thus, with restoring forest landscape consisting of different forest densities and a variety of typologies, the estate's ecological and societal values will be strengthened. It will also make a positive impact on the landscape of other estates, i.e. Het Melder downstream of De Wiersse.

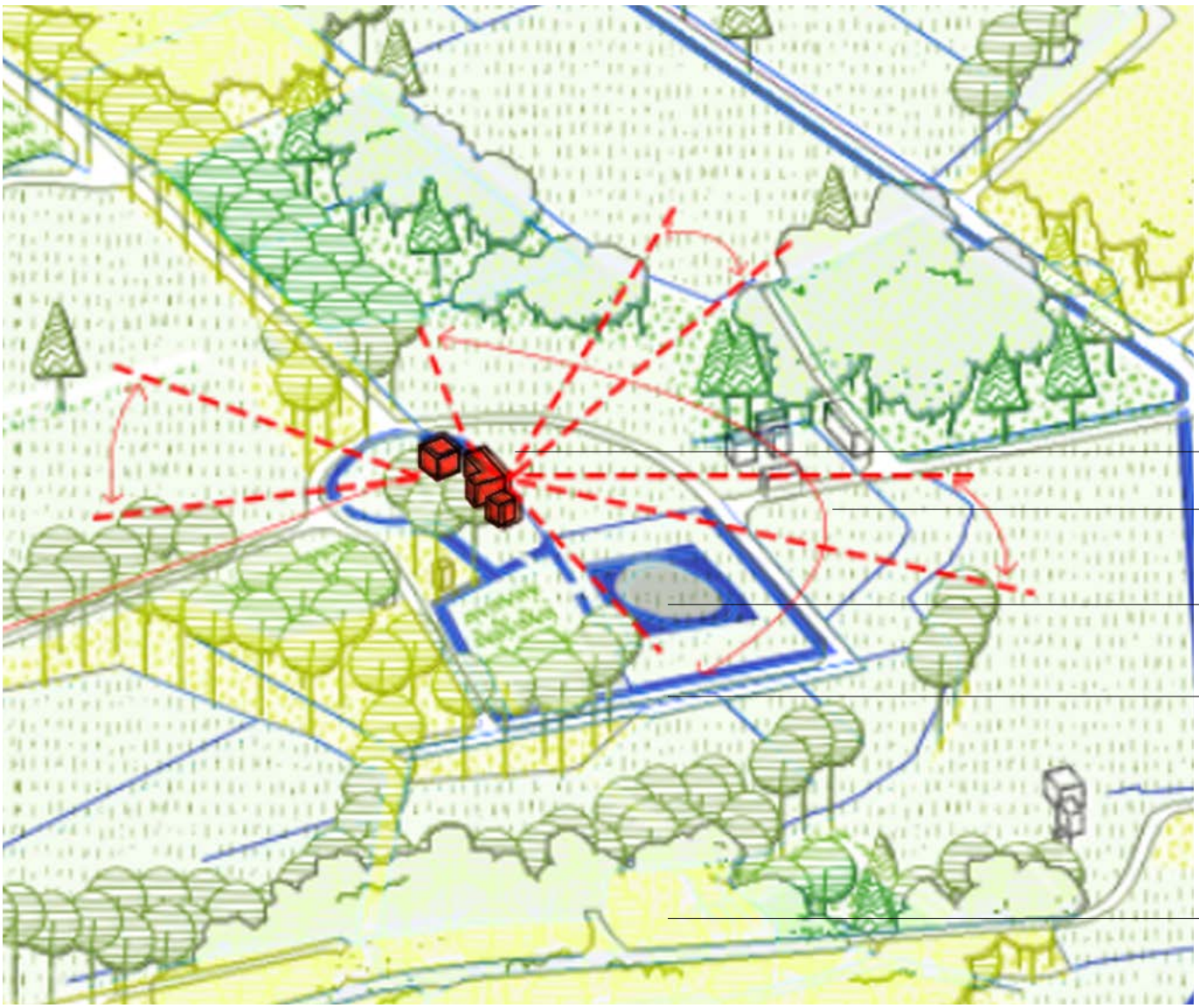
6.2. Analysis and design for Het Medler area

6.2.1. Analysis

Surrounded by a moat, the main house of H' Medler is located in a higher ground. while farms and storage houses are located in the lower ground. The history of exchanging land to farmers makes farmer houses within the estate area containing the rich historical value.

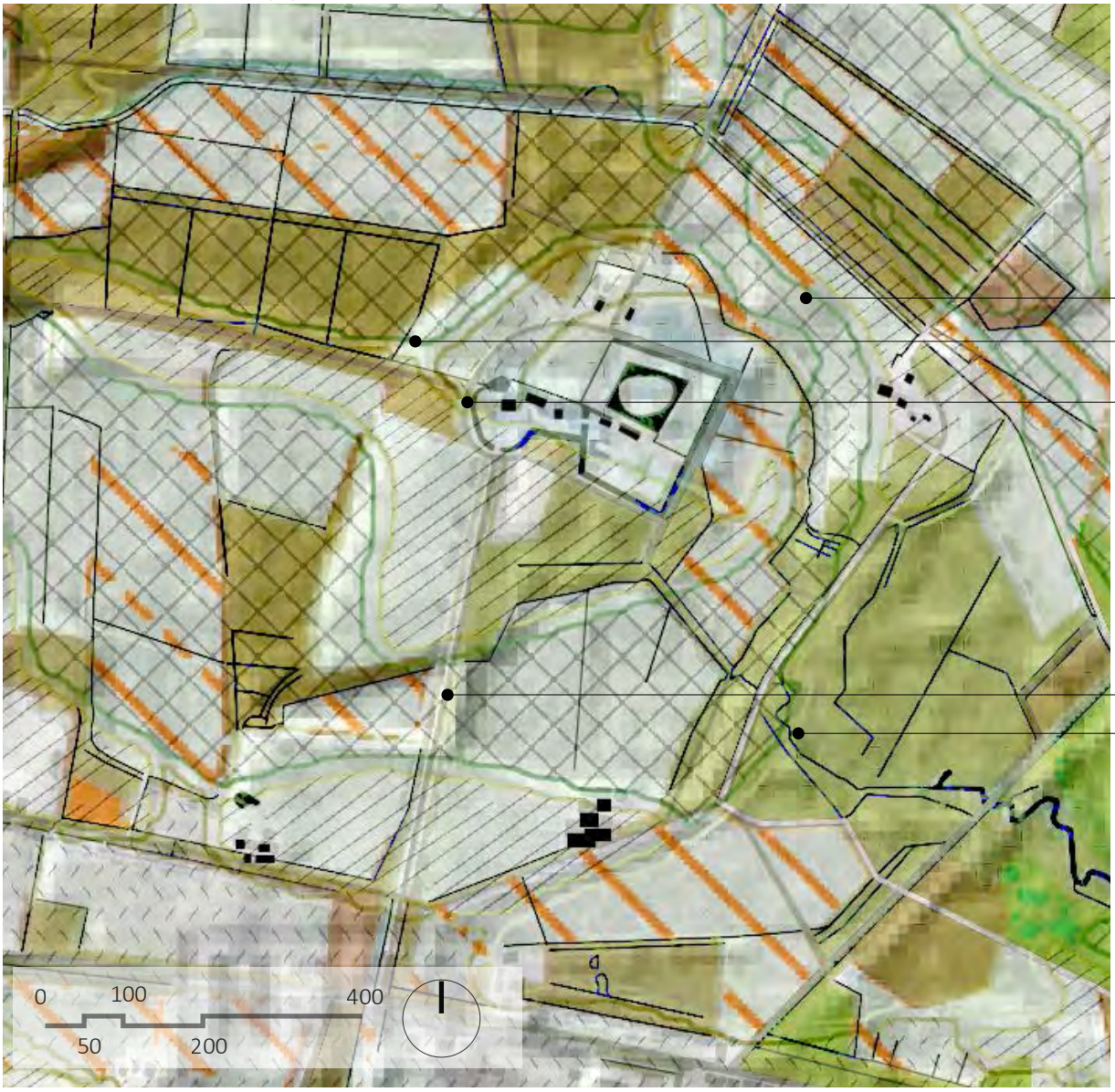
Houses, with road networks as connection and good maintenance, in the scene of unique landscape make the whole estate more attractive.

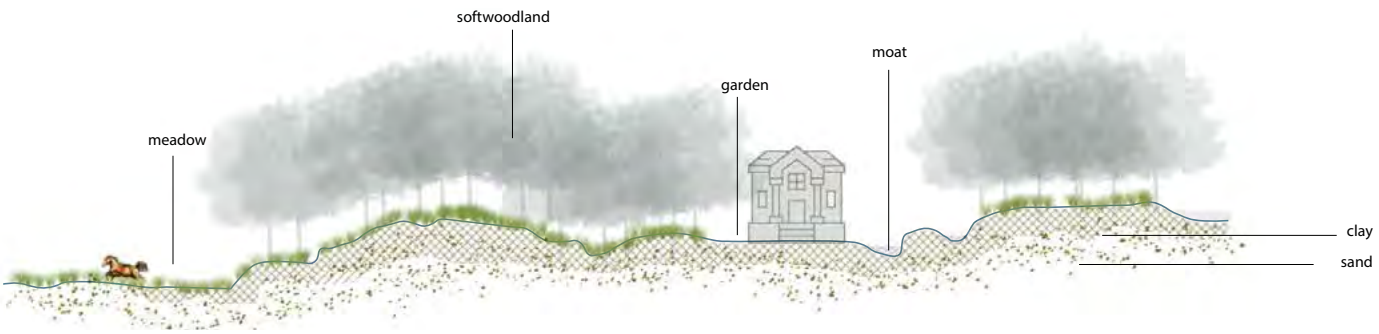
Line of sight in Het Medler



characteritics compositon

6.2.2. Het Medler's current situation
(land use and geomorphology type)



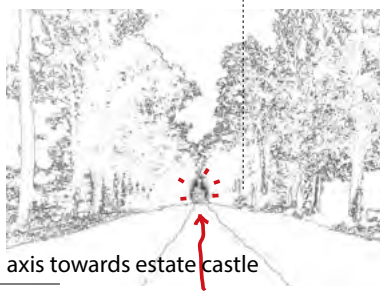


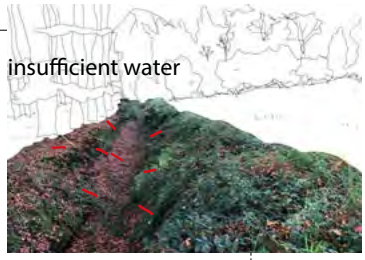
otanical valuable grassland
coversand ridge + brookvalley flood plain)

moist forest for production
(brook valley flood plain)

rugged field
(coversand undulations)

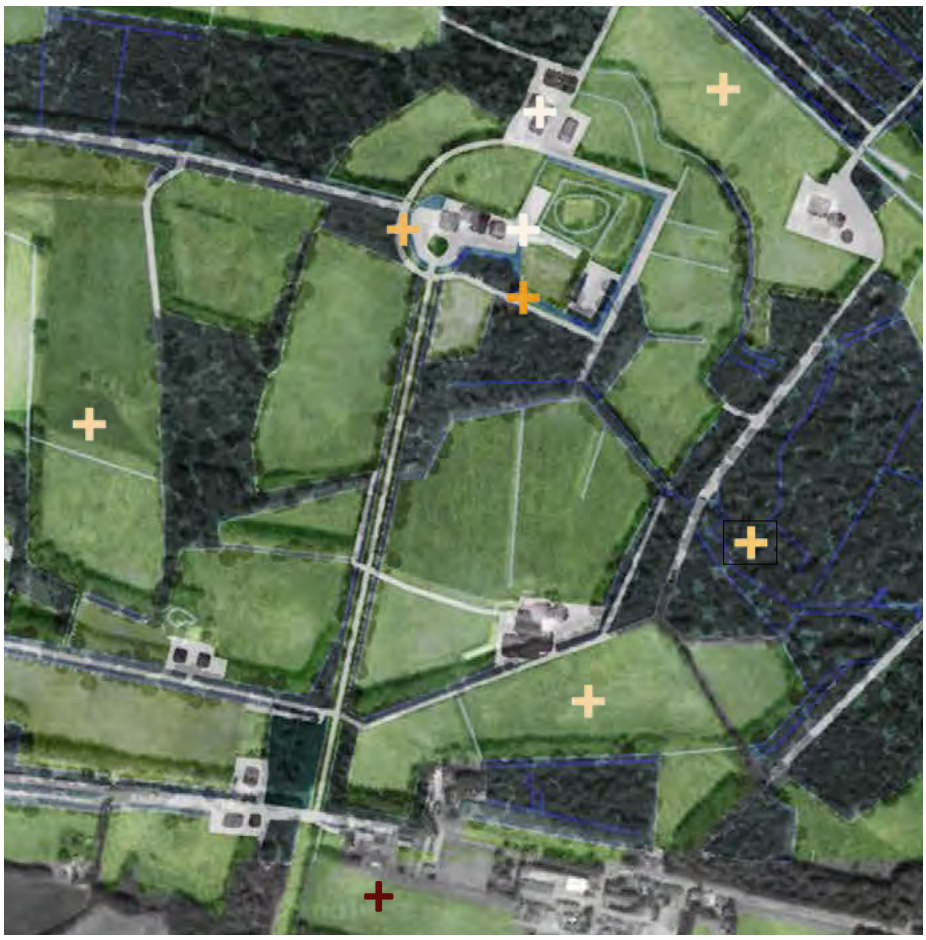
tree lines
(coversand ridge +
coversand undulations)





dry ditch in river stream accompany forest area
(brook valley bottom)

Meanwhile, current situations, like insufficient water in ditches, species less forest community, lacking access to the estate and meadow without practical functions, are challenging the resilience of the estate and show the opportunities to be promoted.



current situation

main interventions

silviculture

enriching the vegetation species based on the geomorphology condition of the dry area and introducing helophyte filter to the stream to purify the water

restoring rabatten bos for water storing

introducing moderately-dry-area-related vegetations for high landscape perception quality / introducing bridge or path make the estate more accessible

afforestation

introducing corresponding forest communities to the grassland's surrounding area; making the botanical valuable grassland area forest meadow for natural grazers to preserve the rich-species of herbs and shrubs.

agroforestry

Garden forest is introduced to activate the monofunctional meadow and farmer houses. Moreover, it is also a recreation destination for cultural and agricultural experience.

current situation + interventions

6.2.3. vision and system design

vision

legend

1. existing buildings in the estate
2. existing road towards the castle
3. estate experience garden
4. historic farm house and agriculture garden
5. estate heritage and agriculture garden
6. trails in forest
7. forest meadow
8. forest park


4
1
5
6
6
8
3
0
100
400
50
200

Main programs

i. estate experience garden (3)
Near the main road and surrounded by a restaurant, companies and sports club, this piece of clearing area with corresponding strategies will be afforested. To satisfy different users' demanding, agroforestry principles and CSA model are introduced as well. Thus, the connection with estate H'Medler is strengthened and positive socioeconomic influence can also be generated.

ii. trails in the forest (6)
Forest meadow area is proposed where it is managed as botanical valuable grassland. Rather than planting more trees only for more enclosed green covering, the green area with rich vegetations is remained as open grassland but with some solitary planting and shrubs to develop grasslands with natural potential. Thus, vegetations at ground layer get restored and enriched while English style landscape sightlines are shaped. Natural grazers, like local Konik horses, are introduced to keep the grassland fertilized and contribute to vivid eco-landscape view meanwhile.

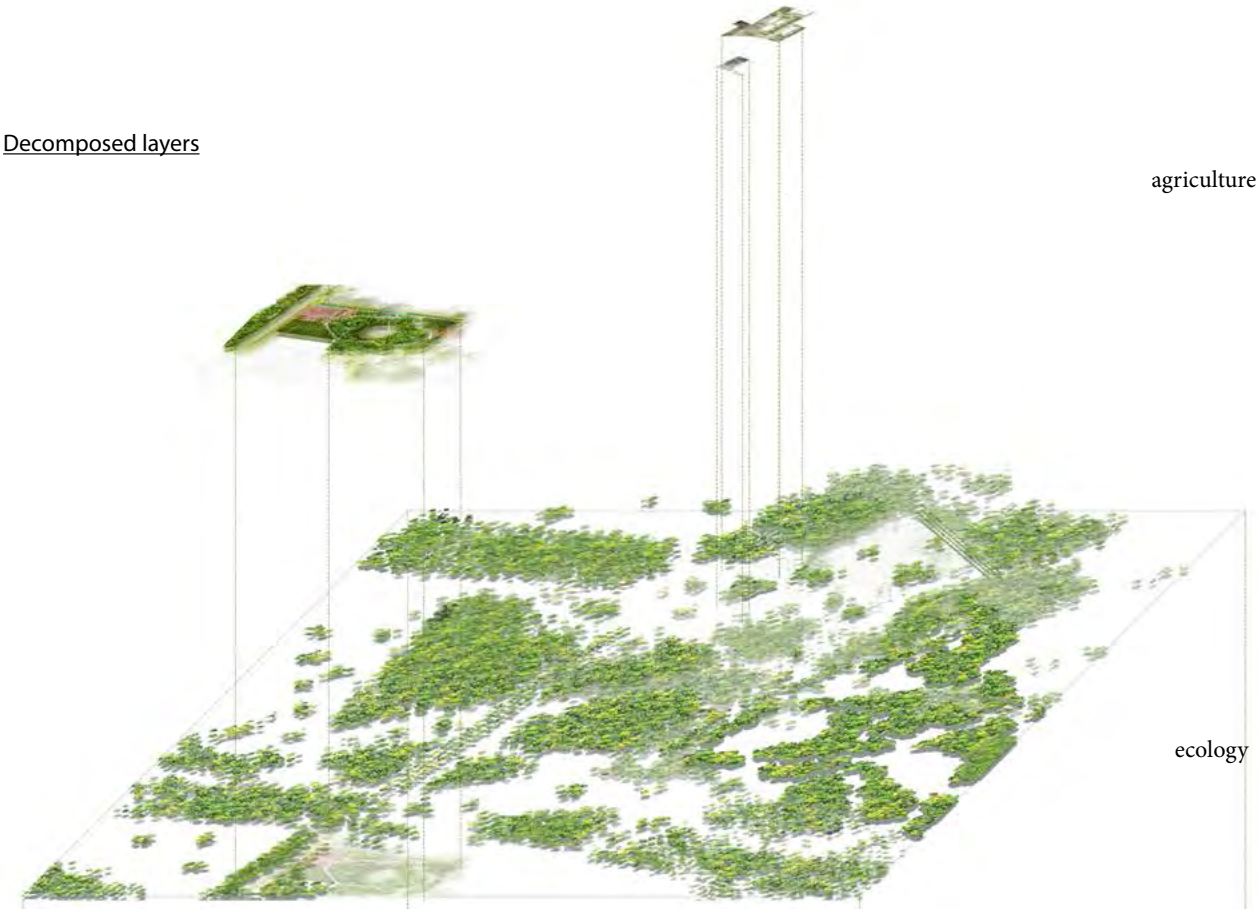
iii. forest meadow (7)
Forest meadow area is proposed where it is managed as botanical valuable grassland. Rather than planting more trees only for more enclosed green covering, the green area with rich vegetations is remained as open grassland but with some solitary planting and shrubs to develop grasslands with natural potential. Thus, vegetations at ground layer get restored and enriched while English style landscape sightlines are shaped. Natural grazers, like local Konik horses, are introduced to keep the grassland fertilized and contribute to vivid eco-landscape view meanwhile.

iv. historic farmhouse and agriculture garden (4)
Historic farmhouse inside the estate territory will collaborate with proposed agriculture garden provide visitors' with interactive cultural sightseeing destination. From the ecology aspect, fruit trees and RVFCW proposed here can contribute to enhancing the hydrological environment through trees' capacity of intercepting precipitation and effective water purification by RVFCW.
v. estate heritage and agriculture garden (5)
Near the island close to the estate castle, agriculture garden is proposed to strengthen the cultural-historical role of these two building as farmhouses. Also, the garden is proposed to be linked to the island, which is a probable original location of the estate castle. Thus, the cultural-historical value of the site could be promoted. The existing historic tennis playground remains for visitors' rich visiting experience here.

vi. forest park (8)
To enhance people's experience in the estate landscape, the existing forest of the estate is proposed to be restored based on the framework of FLR and accessible to visitors after planning several paths inside. Also, a new pond connected with the Baakse Beek is proposed for better landscape view in the park and functions as a retention pond for resilient development.
In this park, there are also some resting nodes, trails and rabatten forest restoration for the various recreational and cultural-historical experience.

Decomposed layers

agriculture



ecology

landscape perception

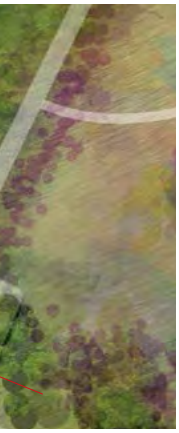
1. Historical farmhouse, together with newly added garden forest attracts visitors to interact with the estate and know it better.

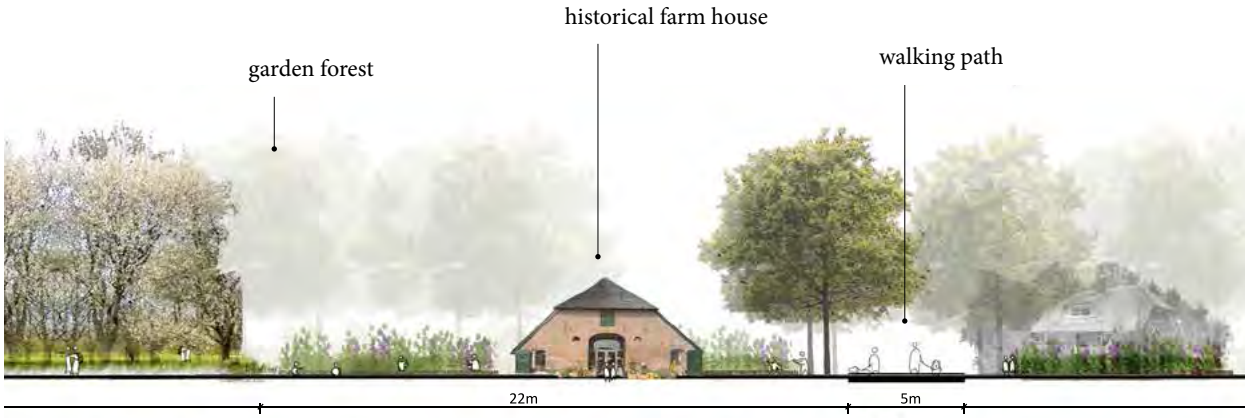
2. The probable original location of the castle brings the mysterious story to the small island for people's exploration. On the other side of the moat, visitors can enjoy recreational activities and view as they want.

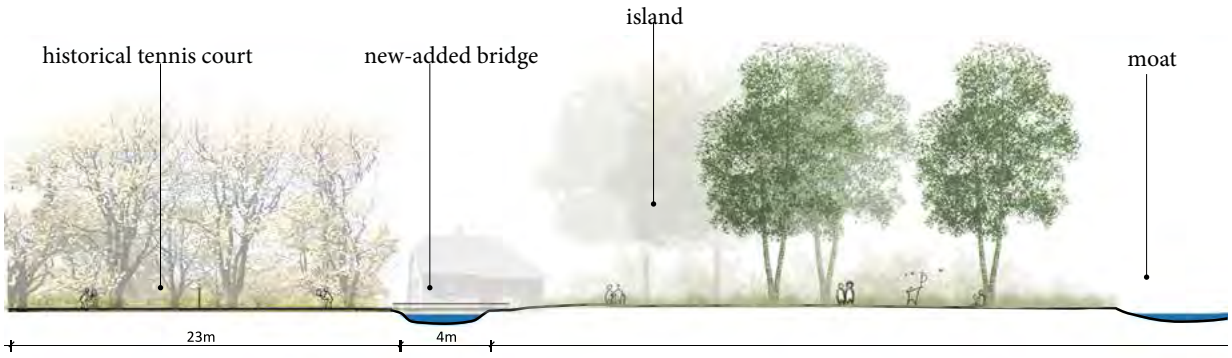
+ agroforestry

Two historical farmhouses offer visitors multiple experience in the estate, sighting seeing, playing tennis as people here used to do and visiting the island for potential historical remains. Also, it strengthen the estate's history of exchange lands to farmers and make people aware that by transforming the meadow area into garden forest.

+ agroforestry



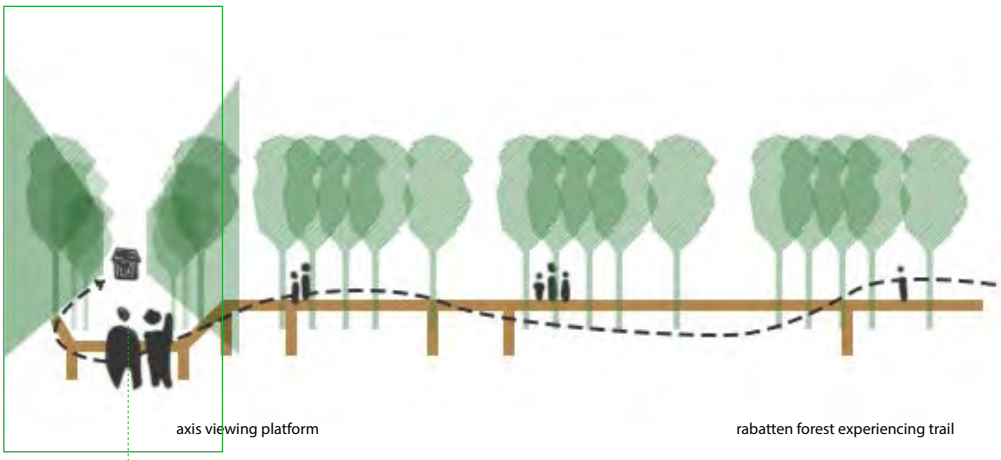

historical farm house
garden forest
walking path
22m
5m


island
historical tennis court
new-added bridge
moat
23m
4m

+ agroforestry

To connect the inside and outside of the estate, a forest garden on the extending line of the avenue towards the estate castle is proposed for experience the similar spatial atmosphere and landscape programs inside the estate. Meanwhile, vegetables in the garden can be supplied to the local restaurant for added profit.

Historical farmhouse, together with newly added garden forest attracts visitors to interact with the estate and know it better.



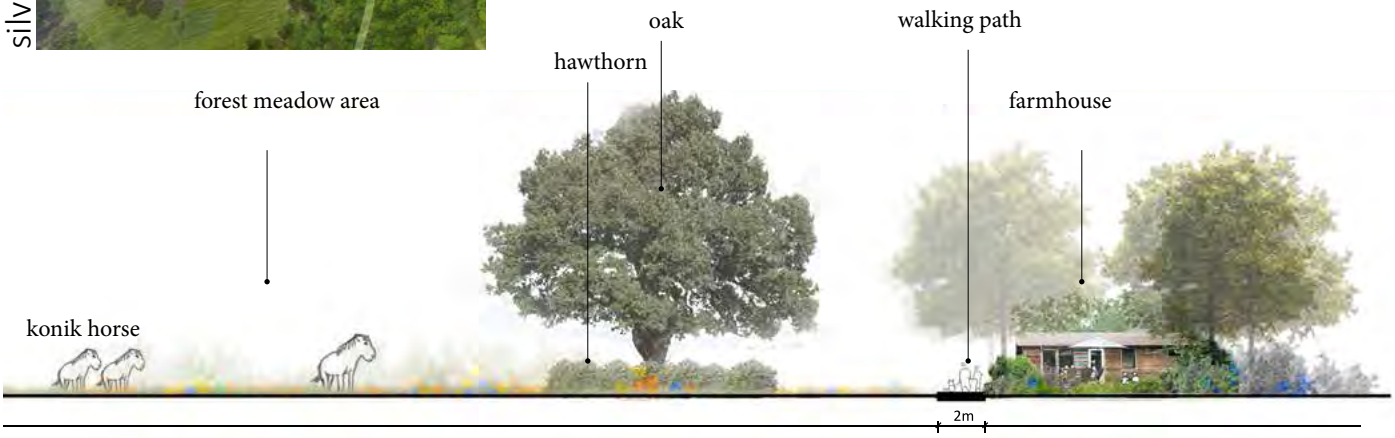
axis viewing platform

rabatten forest experiencing trail

trail material: wood

silviculture

Farmhouse together with forest meadow brings more "original ecological view" to the estate. Meanwhile, it can be an effective tool to manage the botanical-valuable grassland.



Curvy paths provide a forest park with an atmosphere consistent with the historical estate, which consciously lays out its landscape compositions in the traditional English style.

silviculture

path material: gravel

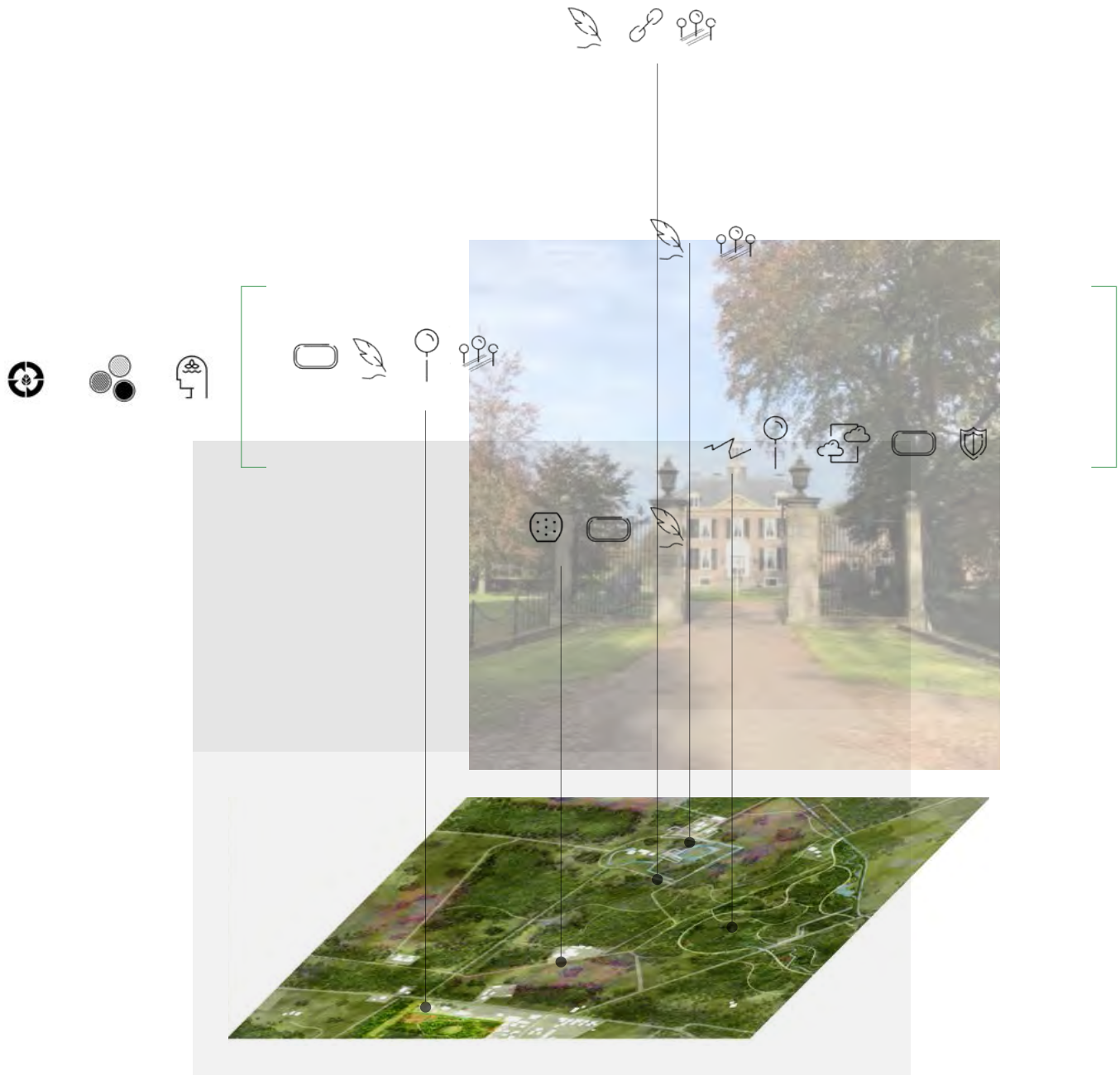
Walking along the path, people can experience different spatial enclosure from forest. Visitors can view the natural grazers on the open grassland, semiopen landscape shaped by shrubs and trees and enclosed forest with dense trees.

6.2.4. FLR and Het Medler

The new estate landscape proposed for Het Medler provides possibilities for exchanging land with farmers by introducing agroforestry programs in such a way that the historic farmhouses could interact with the scene nearby and people are more aware of the cultural-historical clues in the area.

Moreover, these interventions also bring benefit to the ecological environment. Water quality and quantity issues are addressed by planting trees and stimulating natural growth with native species and plant communities according to local conditions.

Also, the relation with De Wiersse and surrounding landscape of estate's territory could be revealed through the green and blue link proposed in the new forest landscape, both in physical space and visual space.



6.3. Phasing and development

The intervention through forest landscape restoration provides a development model for a resilient cultural-historical landscape. Phases of different development are taken into consideration according to various dynamics.

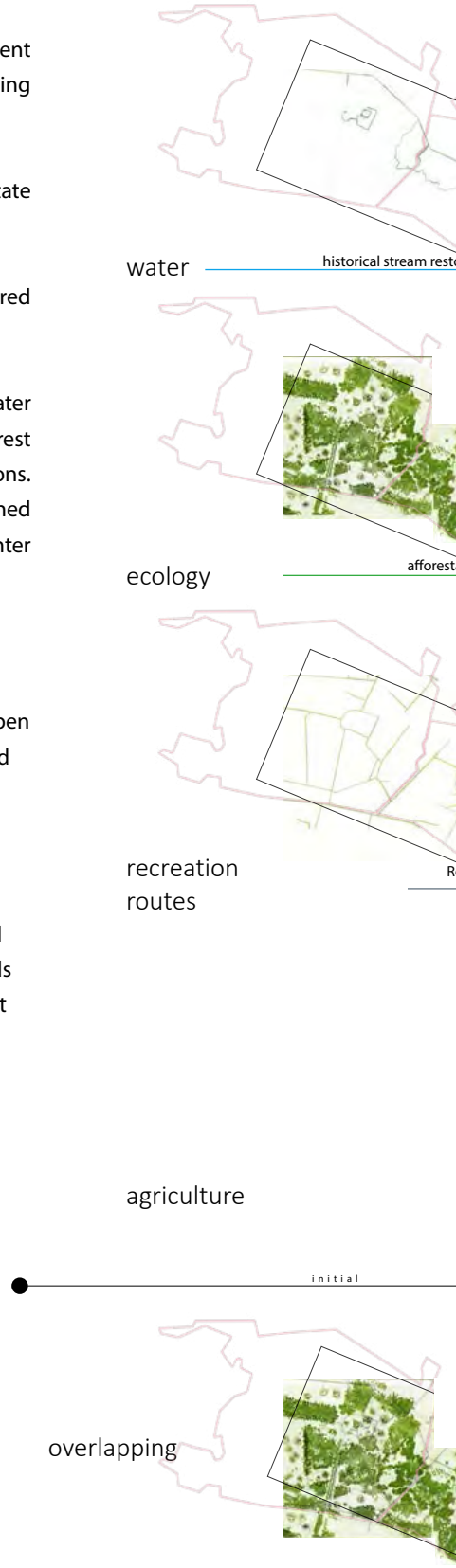
Based on phases of forest succession, the proposal provides a dynamic climate-adaptive estate landscape through FLR to Het Medler and De Wiersse.

1. In the beginning, to create conditions for better ecology environment, historical stream is restored firstly.

2. Also water treatment infrastructure like helophyte filter is introduced to enhance the water quality. To add more ecological value, afforestation and reforestation are conducted. Different forest communities are planted in the corresponding area according to its geomorphology conditions. Potential rabatten forest is restored at this stage. The main road towards estate castle is strengthened through rows of trees aside. Routes in the existing forest area are constructed to allow visitors to enter the enclosed nature of estates.

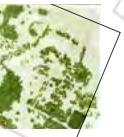
3. In the following years, trees are getting taller and their canopy and roots start to expand. Hydrological circulation and soil function gradually get enhanced after the first few years. For historical landscape view, such as forest meadow, Konik horses are introduced to grassland and open forest area to maintain the semi-open space. Agriculture land and meadow start to be transformed into multifunctional lands, such as forest garden, to boost tourism development and agriculture producing at the same time.

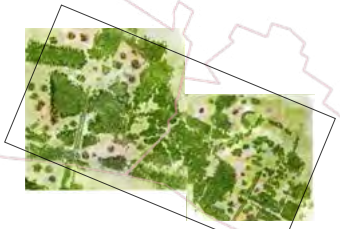
4. Around 50 years later, forests are growing into climax forest and the green coverage keeps expanding. Gradually, there exists a green link between the two isolated estates, from both spatial experience and ecology aspects. There is abundant water in the Baakse Beek after previous periods and new meandering stream alongside the Baakse Beek is constructed as a retention pond. Also, it can serve as a reminder of the old stream to make people aware of the site's history.



oration

remeandering stream construction





ation + reforestation + rabatten bos restoration

managing forest according to historical forest types + forest

outes in the existing forest area

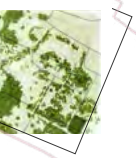
Routes in the forest park

constructing forest gardens inside and outside the two estates

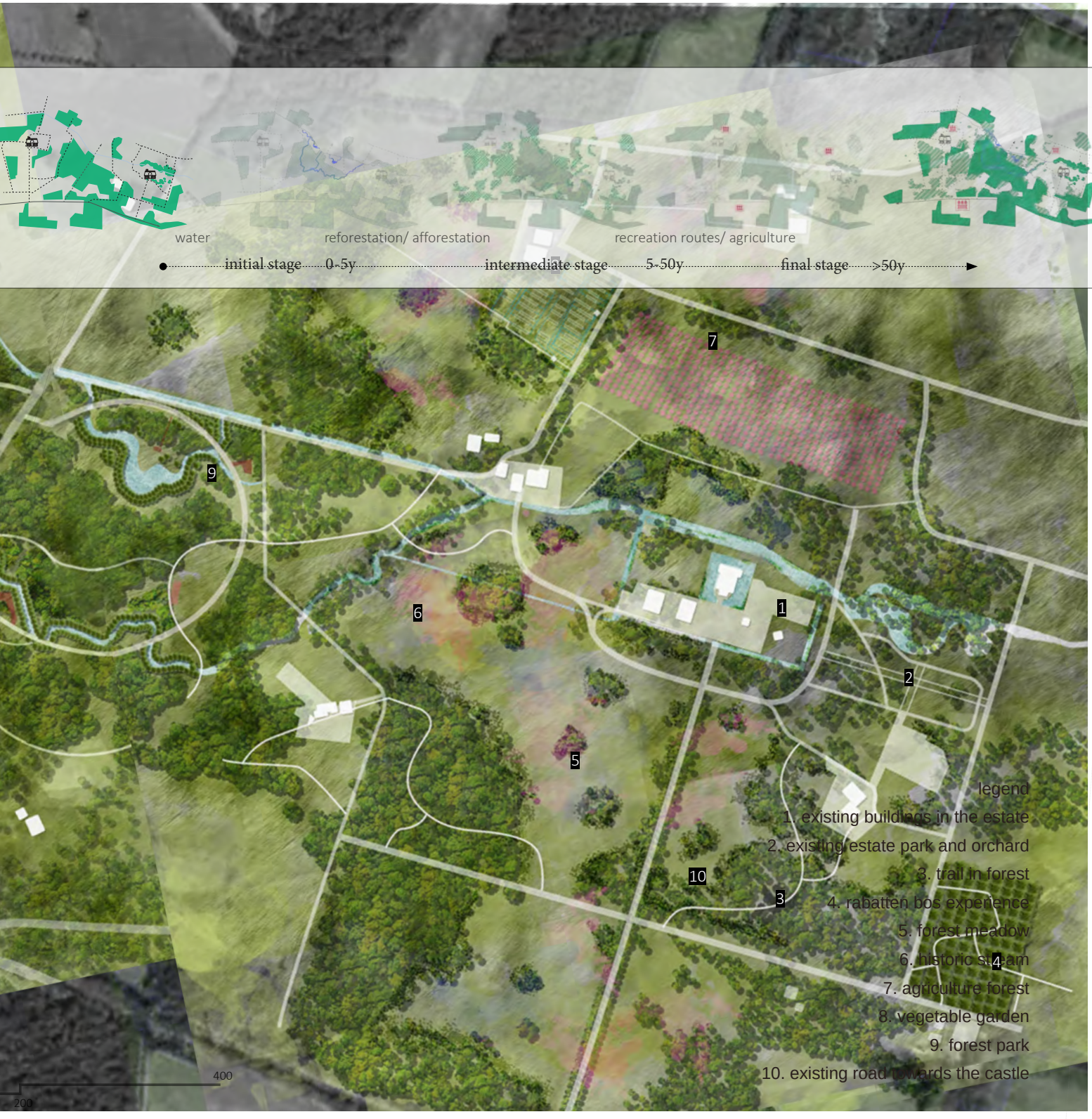
intermediate stage

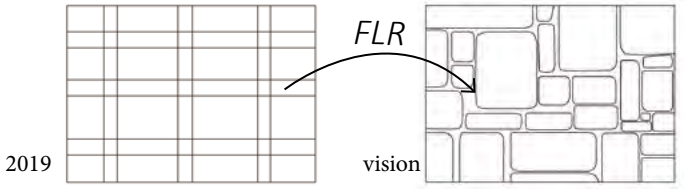
final stage

>50y



In the final stage of the landscapes' development and construction and, as the plan above shows, the new forest landscape across these two estates' territories reactivate the historical blue links between De Wiersse and Het Medler. Moreover, the role of the old forest between these two estates and other green spaces are redefined to welcome a new spatial and ecological connection between estates. Garden forests inside and outside of estates also introduce interactive platforms for various people to engage with the cultural-historical landscape.


water
reforestation/ afforestation
recreation routes/ agriculture
initial stage 0-5y
intermediate stage 5-50y
final stage >50y
7
9
6
1
2
5
10
3
4
legend
1. existing buildings in the estate
2. existing estate park and orchard
3. trail in forest
4. rabatten bos experience
5. forest meadow
6. historic stream
7. agriculture forest
8. vegetable garden
9. forest park
10. existing road towards the castle
400
200


FLR
2019
vision

7.

Discussion and conclusion

After experimenting FLR strategies and principles in Vorden cluster and the two estates, on different scales, reflection on the whole thesis throughout the whole accademic year is neccessary to be made.

This chapter clarifies if the research goal is achieved in the proposal and helps the author and readers to understand the role of design.

7.1. Discussion

In this thesis, the questions proposed have been answered below to show how to meet the research objective from this project.

+ How did historic deforestation affect the landscape through different levels?
Historic deforestation brings negative impacts not only on the ecological environment but also on the landscape quality. Forest area got demolished by historical human intervention, which caused weak soil functions and vulnerable hydrological environment. Apart from that, nature network gradually gets fragmented and more mono-functional agriculture field and meadow dominate the estate landscape, which also means the link between the present estate landscape and site's identity missing. In the estate landscape of Vorden cluster, insufficient water underground is still an urgent issue and the cultural-historical landscape is hardly recognizable and accessible to visitors.

+ What are the strategies and principles about forest landscape restoration to promote cultural-historical value and resilience to climate change in the estate landscape?
The proposed strategies are improving ecology quality, recognizable landscape, multifunctional land use, collaborative effort and sustainable development. Improving ecology quality, as well as recognizable landscape and multifunctional land use, is the main design strategy to achieve the design goal. Based on that, principles like silviculture and reinterpretation of the old and lost landscape elements, new structures for enhanced landscape quality, smart farms(agroforestry), intensified land use (agroforestry), afforestation and reforestation are proposed to construct a new estate landscape from aspects of ecology, landscape characteristics and agriculture.

+ How to apply principles to the study area of different geomorphology types and land use to address challenges of landscape characteristics and climate change?
This question is answered by the vision proposed for a new forest landscape in Vorden cluster, Baakse beek basin area as an example. The framework of FLR and a series of interventions from toolbox shows the process of being transformed from the current landscape. The relations between water circulation, historical landscape representation, agricultural activities and forest landscape restoration are explained to detail the vision at the regional scale. Moreover, 2 estates, De Wiersse and Het Medler, are the cases to elaborate these concepts for possibilities of the resilient cultural-historical landscape at the local scale.

+ What are the lessons learnt from applying design principles of forest landscape restoration from 3 aspects of ecology, landscape perception and agriculture to make a new forest landscape in the estate zone?
The research provides a new perspective to employ forest landscape restoration to culturalhistorical landscape for estate landscape's resilient development. A new estate landscape is proposed to function as an infrastructure to promote landscape quality from the ecological aspect and also societal aspect, which presents forest landscape restoration's adaptive capacities of addressing water issues and landscape quality issues. Also, the research also presents how to explore the potential values of the estate landscape through forest landscape restoration.

As for the methods and theory learnt from the research, site analysis through literature study on the body of knowledge of climate change, aquatic ecosystem and cultural heritage in Baakse beek basin

and forest landscape restoration is vital to understand the landscape as a process so that the diagnosis of the site could be more comprehensive. Mapping on the historical and current situation of the study area's landscape typology, ecology networks, land use and water system at different scales helps to understand the study area in-depth and to effectively show site's potentials after overlapping different maps.

Moreover, the research helps to reveal the role of design in research. The design provides a framework to elaborate selected output of research logically. It guides designers to focus on doing research on specific topics to achieve the goal of design. Also, it helps designers test, step back and find a restarting point to continue their research when research orientation is missing. Through testing and generating visions, a design can reveal and utilize potentials of study area. Moreover, people from different fields will have different perceptions towards a design so that more intriguing topics can be developed for further research.

7.2. Conclusion

The research of designing a resilient cultural-historical landscape through forest landscape restoration provides a new perspective of resilient development of the estate landscape in the Vorden cluster.

The proposal as presented here, forest landscape restoration for climate-adaptive estates in the Baakse Beek region, Gelderland, exemplifies how the theories and principles can be applied in the context of estate landscape in the eastern Netherlands. To achieve resilient landscape development, including aspects of ecology, landscape characteritics and agriculture, the historical role of the forest and its related contemporary and future opportunities for the estates are considered and integrated through multiscale landscape design.

This project hopes to calls for more attention to the various possibilities of estate landscape and values of the forest landscape restoration. And what FLR can offer is not only for the development of more resilient heritage estate landscapes, since it's not only about introducing trees on the land, but also about promoting an ecofriendly environment and people's well beings and revealing the ecological, societal and cultural-historical layers of the landscape in an adaptive way.

Again, what FLR can bring to us must be more than these, which deserves our further exploration.

Reference

Antrop, M. (2005). Why landscapes of the past are important for the future. Retrieved from Landscape and urban planning, 70(1-2), 21-34.

Angsana Boonyobhas. (2016). Retrieved from http://landezine.com/index.php/2016/07/metro-forest-bangkok-urban-reforestation-by-lab/

Bij12. (2017). Natuurtypen. Retrieved from: https://www.bij12.nl/onderwerpen/natuur-en-landschap/index-natuur-en-landschap/natuurtypen/

Bij12. (2017). A02.01 Botanisch waardevol grasland. Retrieved from: https://www.bij12.nl/onderwerpen/natuur-en-landschap/index-natuur-en-landschap/agrarische-natuurtypen/a02-agrarische-floragebieden/a02-01-botanisch-waardevol-grasland/

Brix, H. (1997). Do macrophytes play a role in constructed treatment wetlands? Water Science and Technology, 35 (5): 11-17.

Baks, A. J. (2002). Water indicator: ecological profiles of the water nature in the province of Gelderland. Pt. B. Stagnant waters.

Berezan, R. (2010). Edible Forest Gardens. Canadian Organic Grower, 7(4), 18-23.

Bloemers, J. H. F. (2010). The cultural landscape & heritage paradox: protection and development of the Dutch archaeological-historical landscape and its European dimension (Vol. 3). Amsterdam University Press.

Bhatt, S., Kala, S., & Kalisch, A. (2014). Systematisation: learning from experiences of community-based adaptation projects in India.

Bartlett, D., Laina, R., Petrović, N., Sperandio, G., Unrau, A., & Županić, M. (2018). Socio-Economic Factors Influencing Coppice Management in Europe. Unrau A, Becker R, Spinelli R, Lazdina D, Magagnotti N, Nicolescu VN, Buckley P, Bartlett D, Kofman P, 158-165.

Cosyns, E., Degezelle, T., Demeulenaere, E., & Hoffmann, M. (2001). Feeding ecology of Konik horses and donkeys in Belgian coastal dunes and its implications for nature management. In 8th Benelux congress of zoology (Vol. 131, No. s2, pp. 111-118). Koninklijke Belgische Vereniging voor Dierkunde.

Chazdon, R. L. (2008). Beyond deforestation: restoring forests and ecosystem services on degraded lands. Science, 320(5882), 1458-1460.

Chazdon, R. L., Brancalion, P. H., Laestadius, L., Bennett-Curry, A., Buckingham, K., Kumar, C., ... & Wilson, S. J. (2016). When is a forest a forest? Forest concepts and definitions in the era of forest and landscape restoration. Ambio, 45(5).

PROTEAK. (2014). Fresh Breeze Afforestation Project. Retrieved from: http://proteak.com/files/carbone/CarboneCapture.pdf

Garcia-Perez, A., Harrison, M., & Grant, B. (2011). Recirculating vertical flow constructed wetland for on-site sewage treatment: an approach for a sustainable ecosystem. Journal of Water and Environment Technology, 9(1), 39-46.

Gerrits, A. M. J. (2010). The Role of Interception in the Hydrological Cycle; TU Delft. Delft University of Technology, 5.

Groenewoudt, B. J. (2012). Versatile land, high versus Low: diverging developments in the Eastern Netherlands. In Proceedings of the Latvian Academy of Sciences (pp. 54-69).

Gerrits, A. M. J. (2010). The Role of Interception in the Hydrological Cycle; TU Delft. Delft University of Technology, 5.

GPFLR,(2020). What is Forest and Landscape Restoration (FLR)?.Retrieved from http://www.forestlandscaperestoration.org/what-forest-and-landscape-restoration-flr.

Hanson, C., Buckingham, K., DeWitt, S., & Laestadius, L. (2015). The restoration diagnostic. World Resources Institute (WRI). Washington DC, United States.

Koese, B., Schaminée, J., Sýkora, K., & Smits, N. (2011). Veldgids plantengemeenschappen van Nederland. entomologische berichten, 71, 1.

Li, Y. H., Zhu, J. N., Liu, Q. F., Liu, Y., Liu, M., Liu, L., & Zhang, Q. (2013). Comparison of the diversity of root-associated bacteria in Phragmites australis and Typha angustifolia L. in artificial wetlands. World Journal of Microbiology and Biotechnology, 29(8), 1499-1508.

Leuschner, C., & Ellenberg, H. (2017). Ecology of central european non-forest vegetation: coastal to alpine, natural to man-made habitats: Vegetation ecology of Central Europe (Vol. 2). Springer.

Leuschner, C., & Ellenberg, H. (2017). Ecology of Central European forests: vegetation ecology of Central Europe (Vol. 1). Springer.

Massop, H.Th.L., Gaast, J.W.J. van der. (2007) Reconstructie van de historische hydrologie. Alterra report 1466, Wageningen.

Morin, X., Fahse, L., Jactel, H., Scherer-Lorenzen, M., García-Valdés, R., & Bugmann, H. (2018).Long-term response of forest productivity to climate change is mostly driven by change in tree species composition. Scientific reports, 8(1), 5627

Nijhuis, S & Bobbink, I. (2012) Design-related research in landscape architecture. Retrieved from https://www.researchgate.net/publication/264814112_Design-related_research_in_landscape_architecture.

Nijhuis, S. (2013). Principles of landscape architecture. Farina, E & Nijhuis, S (eds.) Flowscapes: Exploring landscape infrastructures.

Nijhuis, S. (2016) Thinking with maps: Exploring landscape space, dynamic and material [PowerPoint slides].

Nijhuis, S. (2017). GIS-based landscape design research. A+ BE| Architecture And The Built Environment, (13), 1-338.

Prominski, M. (2005). Designing Landscapes as Evolutionary Systems. The Design Journal, vol. 8 no. 3, pp. 25-34.

Plan, N. F. B. A. (2012). NEW FOREST BIODIVERSITY ACTION PLAN.

Palombi, L., & Sessa, R. (2013). Climate-smart agriculture: sourcebook. Climate-smart agriculture: sourcebook.

PURproject. (2020). AGROFORESTRY AND REFORESTATION. https://www.purprojet.com/agroforestry-and-reforestation/

Seymour, F., & Busch, J. (2016). Why forests? Why now?: The science, economics, and politics of tropical forests and climate change. Brookings Institution Press.

Somya Bhatt., Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. (2019). Resilient rural livelihoods through eco-restoration and sustainable natural resources management. Retrieved from https://panorama.solutions/en/solution/resilient-rural-livelihoods-through-eco-restoration-and-sustainable-natural-resources

TEN CATE, M. A. R. I. A. N. N. E., & GÜSEWELL, S. (2003). Impact of mowing regime on species richness and biomass of a limestone hay meadow in Ireland. Bulletin of the Geobotanical Institute ETH, 69, 17-30.

Tooske Hofman. (2019). Wat is een helofytenfilter. Retrieved from https://vrijbuitersnest.nl/zelfvoorzienend/wat-is-een-helofytenfilter/

Vera, F. W. M. (2000). Grazing ecology and forest history. CABI publishing.

WallisDeVries, M. F., Vries, M. F. W., Bakker, J. P., Bakker, J. P., van Wieren, S. E., & Van Wieren, S. E. (Eds.). (1998). Grazing and conservation management (Vol. 11). Springer Science & Business Media.

Zinck, J. A. (2013). Geopedology, Elements of geomorphology for soil and geohazard studies. ITC Special Lecture Notes Series. ITC (Faculty of Geo-Information Science and Earth Observation), Enschede, The Netherlands.

THANK YOU

YANJIAO WANG/ 2020